A Restructured Math Curriculum: A Case Study

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Abstract

In this paper, I explore the idea of restructuring math education so that my students can be more successful in higher level mathematics courses. I begin by analyzing previous solutions used to reduce the disparity in math achievement between different populations of students and discuss why these solutions do not work. I then review the role of standards and explore how to still have standards but reduce the "othering" caused by them. I propose that we change the way that we use standards, and that we should view standards as a benchmark rather than concepts that must be mastered by a certain time. In addition, I suggest that individualized learning could be a technique used to help students work at their own pace and used to reduce "othering" that occurs too often in math classrooms. I then propose a new way the mathematics curriculum should be structured starting in early grades. Lastly, I lay out a current day Algebra 2 curriculum that implements aspects of individualized learning.

Introduction

I am currently a fifth-year high school math teacher in New York City. Throughout my time teaching, one of my biggest challenges is creating lessons that are both aligned to the Algebra 2 standards and accessible to all my students. In this paper, I will propose a new curriculum that is based on an individualized approach, modifies the role of standards, and takes advantage of digital technology, and I will report on its performance.

A Brief Survey of my Schools

I have taught at two schools. In this section, I present the student demographics in these schools and offer insights into the performance of students in my math classes. Teaching these wonderful students is what inspired me to write this paper. Math is an extremely important subject that relates to all aspects of life. Specifically, math is a tool that can be used to help analyze and combat injustices that are occurring in our society (Flores, 2007). For this reason, it is important that all students get a quality math education. Later on, you will see that I actually try a new curriculum for a unit with these students that I describe below.

School 1

I taught at School 1 for the first four years of my career. This school has 324 students. According to the Department of Education (DOE), the student population at this school is 40% Black, 45% LatinX, 7% White, and 3% Asian. Twenty-one percent of the students are classified as students with disabilities, and nearly 70% of the students are facing economic hardships. Only 53% of the students have an attendance rate higher than 90%, which is about 25 percentage points lower than the state average. Having an attendance rate of lower than 90% means students

are missing at least two days of instruction per month. The school's average Algebra 1 Regents[1] score is 73. A score of 80 is considered college-ready according to The City University of New York. While the graduation rate for 2022 was 100%, only about 49% of the students were considered college persistent. (College persistence measures how many students complete their first year and return for their second year of college. Reasons why students may not persist include financial difficulties and not being prepared for the rigor of college level courses.)

While these statistics seem discouraging, there was a lot of joy in my class. A lot of the joy was due to my classroom being a supportive and safe environment. In addition, I personally saw a lot of students grow more and more confident with math throughout the year. I had students who would initially put their heads down and refuse to do any work, but by the end of the year they would willingly go up to the board to explain their answers. In addition, we had heated and spirited discussions about math concepts. Students were okay with giving the wrong answers, because they knew that trying was the most important part. It was really a wonderful environment. However, something that I struggled with a lot was helping my low-performance students while also pushing my high-performing students. I had some students who could solve complex equations (rational and radical equations) and others who had difficulty in adding and subtracting numbers. In the end, it would often feel as if I was not pushing any student to their full potential, which I feel is very important.

There are many reasons as to why I felt like I could not properly support all my students. The first is a lack of qualified teachers. Throughout my tenure, I was paired with co-teachers unfamiliar with the content. My first co-teacher was familiar with middle school math, but not

[1] The Algebra 1 Regents is a New York State standardized test. There is also an Algebra 2 Regents test as well as a Geometry Regents test. In order to graduate with a regent's diploma, you must pass at least one math regent's test. Usually, this is the Algebra 1 test.

high school math. My second co-teacher did not even have a math background. Thus, it was my responsibility to teach content to my co-teachers. Although we had dedicated planning periods, often I could not teach them, as we had to attend to other urgent matters, such as covering classes, meetings, etc. Because my co-teachers were not familiar with the content, we had difficulty differentiating the material up and down our struggling students. Further, working in small groups was difficult because sometimes my co-teacher did not know the content well enough to scaffold it for our low-performance learners or did not understand well enough to push our high-performing learners. Unfortunately, it was very difficult for me to work with both groups during the same lesson.

Another important reason was class size and lack of space/resources. My classes were around 34 students, which is extremely large. For classes like this, it would have been helpful to pull out groups in a separate classroom, but the school did not have the space to do so. So, the problem of a wide range of math ability was compounded by the lack of space or resources. I would say overall that my low performing students were not getting the support they needed to learn the material, and my high performing students were not getting the rigor they deserved to push them to their full potential.

School 2

I currently teach at School 2. This school has 327 students. The demographics of the student body is as follows: 51% Black, 43% LatinX, and 2% Asian. Twenty-six percent of the students are classified as students with disabilities, and nearly 85% of the students are facing economic hardship. The average Algebra 1 Regents school is 55. (For reference, a score of 80 is considered college-ready.) The graduation rate for 2022 was 90%; however, only 38% of the students were considered college persistent. At this school, only 29% of the students have an

attendance higher than 90%. Thus, 71% of the students miss more than two instructional days per month.

Similar to school 1, these statistics are not a perfect depiction of my actual classroom; however, I do struggle with supporting all my students and this is due to some of the same reasons as before. These reasons include difficulty in finding a common planning time with my co-teacher and lack of resources. A new complicating factor in this school is low attendance. Students often will not show up for weeks at a time, so when they do attend, they are far behind on the content. There are no good mechanisms for these students to catch up. As a result, it is quite difficult to plan lessons that are accessible to all students. Differentiation can also be difficult, because we are out of compliance with the number of students with disabilities (SWD) in each class. According to the DOE, the number of SWDs in a class cannot be more than 12 or 40% of the overall class size, whichever is smaller. In some of my classes, around 50-60% of the students are SWDs. This is not to say that their math ability is low; however, it is difficult to accommodate every learner's needs.

Factors Responsible for Inadequate Student Support

In the above review of my classrooms at two schools, I have identified several common reasons behind my inability to support all my students: (a) lack of resources (teachers, physical space, large classes, and time), (b) student population with a wide range of math skills, and (c) low attendance.

Due to the wide range of ability and the lack of resources available, we often do not get through all of the New York Next Generation Standards. Most of my students, for the reasons discussed above, require more time for many topics than what is expected by the standards. Therefore, we go through the topics at a slower pace than what the standards dictate. As a result,

I cannot cover all the Algebra 2 standards. I usually pick topics that the students find interesting in their day-to-day lives, such as exponential functions (because they relate to money) and probability (because it relates to games).

Because the students have not been taught the standards completely, they are at a disadvantage when taking the standardized tests. They could have made significant progress on topics covered in the class, but the test results do not validate the progress, discouraging them. Students usually already have a negative attitude coming into my class. During the school year, I see my students' confidence increase; however, taking the standardized test can be disheartening for them.

Objective in this Project

It is evident that the current math education system is not working for the students in the above two schools, and perhaps in many other schools in New York City and across the country. In this project, I outline a revised system that focuses on individualized/personalized curriculum, and attempts to minimize the negative effects of standards and to overcome the challenges created by lack of resources. The project will address the following questions:

- How can math education in these schools be restructured so that students are mastering the content necessary to succeed in higher level (high school and beyond) mathematics courses?
    - Could a personalized learning approach help?
- Is having standards that must be completed by the end of each grade beneficial or harmful for students? How can we reduce the "othering" (explained in the section *Role of Standards)* caused by the standards?

- What aspects of personalized/individualized learning can be implemented in a current day Algebra 2 curriculum and classroom?

The rest of this paper is organized as follows. I begin with a review of the disparities caused by the current math education system. I then discuss potential solutions to reduce the disparity and their effectiveness. This is followed by a description of the role of the standards and how it can lead to "othering." Next, I present the inspiration behind a different curriculum framework and then introduce the said curriculum framework. I have created a website for a sample unit based on the proposed curriculum framework. It is available at https://sites.google.com/view/karkiedmproject/home . I then reflect on the implementation of the sample unit. I conclude with implications of the new framework for other classrooms in similar situations.

Disparities Caused by the Current Math Education System

Many states have math standardized tests at specific grade levels. Due to these tests, teachers strictly follow the grade-level standards and curriculum regardless of whether the students have mastered previous content. The math standards are heavily built upon each other, so in order to be successful with the standards in high school, you must have a good grasp of the standards in elementary and middle school.

Unfortunately, there are huge disparities in mathematics education among different population groups. Research (Flores, 2007) shows that only 13% of students from poor families are at proficient or advanced levels of understanding math concepts. The numbers are especially low for African American and LatinX students; only 9% of African American and 3% of LatinX students are proficient in mathematics by eighth grade (Haycock, 2006). Therefore, the statistics clearly suggest that students from low-income backgrounds and Black and LatinX students are

not receiving the resources and support they need to have high achievement in math. While standardized tests are not a completely accurate representation of abilities, because of factors such as biases, the statistics are similar to those in the two schools I am familiar with. Flores (2007) reports that even among non-poor families, only 38% of students are at advanced levels of math. While this is higher than the number for poor families, there is significant room for improvement.

This disparity in math skills has lasting negative effects on these population groups. Students from these groups are much less likely to be put in college track courses, a decision which then has an effect on whether they attend college and which college they do attend (Flores, 2007; Rozen et al., 2018). In addition, these students are more likely to be enrolled in remedial classes in college, which costs money but does not earn the students any college credit (Keierbler, 2016; Roberts 2020). Therefore, these students essentially pay more money and fall behind on their degrees. Consequently, African American and LatinX students are underrepresented among STEM (Science, Technology, Engineering, and Math) graduates. According to a Pew Research Center Report (2021), Black students across bachelor's, master's and doctoral levels earned only 9% of the STEM degrees awarded in 2018. This is problematic because the cycle of lack of generational wealth is not broken. Jobs in the STEM fields are usually high paying, which can allow for financial freedom and provide for future generations (Fry et al., 2021).

There are multitudes of reasons for these disparities in math education (Flores, 2007; Persell, 2004). One reason is the teacher quality. Research has found that teacher quality is inequitably distributed among racial groups (Darling-Hammond, 2001; Esch et al., 2005; Wilkins et al., 2006). Black and LatinX students, on average, have lower quality teachers compared to

their white counterparts. Students in high-poverty areas are more likely to have inexperienced teachers. Such math teachers are unlikely to emphasize high-quality mathematics instruction. These students may be receiving A's for work that would probably receive B's and C's in affluent schools, which lowers the expectations of the teachers. In addition, the certification to become a teacher has changed due to teacher shortages. Requirements have become looser, which allows inexperienced people to become teachers; these teachers usually are placed in high poverty schools.

Another reason for the disparity is that the school funding is usually tied to the neighborhood. Thus, the schools in higher poverty areas are receiving less local and state money, causing shortage of resources (Flores, 2007).

Another big reason for the disparities in math education is minimum grading practices (Carifio & Carey, 2010). A popular minimum grading practice is to set the lowest score to 50%. (This is followed in both schools I have taught at.) Therefore, if a student receives a score of 20%, it goes into the gradebook as 50%. This practice essentially makes it harder for a student to fail a class. Another common minimum grading practice is to not assign zeros for missing assignments; in the gradebook, a zero is replaced by an "incomplete," a practice which does not affect students' grades. You then give students the opportunity to make up the work. The goal of these policies is to ensure the students' grades will not be extremely low, motivating the students to stay engaged. These policies relate to the idea that if students feel positive about school, they will be more engaged. However, critics (Frey 2005; Freiss 2008b; Lorence et al. 2002) believe that these policies are lowering expectations for math learning, inflating grades, and ultimately promoting the students to the next grade even if they have not mastered the standards.

Many researchers (Frey, 2005; Friess, 2008b; Lorence et al. 2002) believe that minimum grading policies are effectively propagating the practice of social promotion, which was ended in 1998 by the federal Department of Education. Social promotion (Carifio & Carey, 2010; Frey, 2005; Hacsi, 2002; Mahwinney, 2016; Martin, 2011; McGuinn, 2006; Tyack, 1974) is the idea that we should promote students to the next grade, rather than retaining them, even if they have not mastered the content, so that they stay with their age group.

The problems caused by minimum grading policies (and social promotion) get amplified in an education based on rigid standards and standardized testing. Students are being promoted to the next grade, even if they have not mastered the topics specified in the standards. Thus, the gap between what the students are expected to master according to the standards and what they actually have mastered keeps widening as they move to higher grades. Eventually, in high school, the students are tested with a standardized test. (In New York City, to get a Regents diploma, students must pass one of the standardized math tests.) If we push students to the next grade without considering their skills, how can we expect them to pass one of these tests?

Potential Solutions to Reduce the Disparity

So how do we reduce this disparity, that is, improve the math skills of all students in my class? If standards are so important and must be adhered to, the potential solutions are (a) to retain students who have not mastered the standards and (b) to have interventions for these students. (Interventions will be discussed later.) Both of these solutions have been researched (Jimerson et al., 2006; Martin, 2011; McCombs et al., 2010), and neither seems feasible for the schools we are concerned with.

Most research has found that grade retention, that is, the practice of holding a student back, is ineffective in raising student achievement. Martin (2011) found that this practice has a

negative relationship with academic self-concept and homework completion. He also found that this practice correlated with an increase in absences from school. When it comes to non-academic factors, he found that grade retention has a negative relationship with self-esteem. Other research has found that while some gains are made initially when retaining a student, these gains fade away and these same students tend to fall behind. Many researchers (Jimerson et al., 2006; Martin, 2011; McCombs et al., 2010) have also found that grade retention is the number one predictor of students dropping out of school. It is fair to say then that grade retention is not a solution to close the math achievement gap. It has way too many negative consequences.

Interventions are strategies that are "aimed at promoting the social and academic competence of students" (Jimerson et al., 2006, p. 90). Jimerson stresses that there is not one intervention that meets the needs of all students and that it is important to consider the specific needs of each student. Some interventions may include preschool intervention programs (Casto & Mastropieri, 1986; Zigler & Styfco, 2000), comprehensive programs to promote social and academic development (Sugai et al., 2002; Zin et al., 2004), summer school and after-school programs (Cooper et al., 2000), looping and multi-age classrooms (Goodson, 2020; May et al., 1995), school based mental health programs (Armbruster & Litchetman, 1999), parent involvement (Slavin & Madden, 2001), early reading programs (Slavin & Madden, 2001), effective instructional strategies and assessments (Barnett et al., 1996), and behavior and cognitive behavior modification strategies (Robinson et al., 1999). Research (Jimerson et al., 2006; Martin, 2011; McCombs et al., 2010) has found that retaining a student with interventions can be more effective than just retaining the student. However, some of these interventions may not always be feasible. For example, Jimerson et al. (2006) explains that to implement programs to promote social and academic development, there needs to be considerable training, personnel,

and resources. Urban schools that lack resources may not be able to implement those interventions. In addition, the implementation of these interventions is often outside the control of just one teacher. One needs the support of the administration and resources to start the interventions.

The Role of Standards

In theory, with standards, all students across the country, irrespective of their backgrounds, will be learning the same material in the same grade. However, this is rarely the case, as the statistics from the two schools I have taught confirms. Instead of standardizing education, rigid standards may increase the "othering" that is felt by students (Lesko, 2012; Mawhinney et al., 2016). "Othering" refers to a construction that students may feel if they do not achieve success "within the current social structures extant in schools" (Ladson-Billings, 1995, p. 467). The "othering" is often due to race, social class, ability, anything that relates to the "hierarchical structure that is defined as meritocracy" (Ladson-Billings, p. 467).

Current standards, both academic and non-academic, warp our view on what it means for a student to "develop." As Lesko (2012) mentions, "adults know what the correct and happy ending is…. Although youth themselves are expected to take each moment seriously, we, the adult audience, know that these things are relatively trivial." (Lesko, p. 113). In other words, as adults, we have gone through adolescence and know that not everyone develops at exactly the sometime. Yet we have created academic standards that students must achieve by at a certain time. In addition to warping our view on developing, standards reproduce the status quo and inequality rather than engaging students in the struggles against oppression (Sleeter & Stillman, 2005). Ravitch (1990) discusses that by focusing so much on standards, we are ignoring skills like focus the student's ability to think differently, pursue knowledge, work at their own pace etc.

As these researchers point out, focusing on standards has detrimental effects. Lesko (2012) mentions that students who are not meeting the standards, or are going past the standards, they may have difficulty accepting themselves. For example, if a student is developing at pace faster than the "norm," then this student may feel out of place or uncomfortable with themselves. If students are held to these rigid standards, and are all forced to do the same thing at the same time, how are they supposed to feel comfortable with themselves?

In addition, with the rigid standards structure, we are essentially saying that these standards constitute what is considered important knowledge. Though these standards may seem neutral, they are not (Giroux, 2003; Melmed, 2006). Often, standards come from the dominant culture, the group of people who fit in with the most powerful ideologies at the time (Lesko, 2012). This group of people in power create policies and practices that prevail these ideologies even if they are not neutral or culturally relevant to all students (Giroux, 2003; Oakes et al., 2018; Sleeter, 2004;). In other words, the standards are created from a great distance from the communities they are meant to serve (Oakes et al., 2018). By holding the students to standards that may not be relevant to them, we are making it difficult to respond to individual student's needs and strengths. In addition, we are implying that the dominant culture's knowledge is the only knowledge that is worthy. This can lead to teachers having a deficit mindset towards Black and LatinX students who do not master the standards in the time necessary. This leads to the status quo, dominant classes being at the top of the social order, being reproduced over and over again (Picower, 2011).

The combination of rigid standards and minimum grading policies also leads to othering. Mawhinney et al. (2016) interviewed two Black women who were both retained and socially promoted during their schooling experience. The women were aware that they were being passed

through without learning anything. Lauren, one of the women, said that she grew frustrated and started acting out because she realized she had not learned anything, but the material was getting more difficult. She mentioned that she was confused as to why she was continuing to pass, when she was not learning the material. She also believed that this had affected her adult life because she was not able to get certain jobs due to her low reading/writing ability. Shantel, the second woman, had a very similar experience. It is evident that both women felt "othered" through the behaviors they exhibited. The experiences of these women also show that social promotion, the idea of just promoting students to the next grade even when they have not mastered the standards, works only if standards are not rigid.

In math specifically, the effects of having to master standards within a certain time frame may create frustration for certain students. From my personal experience, students often have a negative attitude towards math at the beginning of the year; however, once they see that it is do-able, their mindset tends to change, and they are much more engaged during class. Retaining a student or pushing a student through continues the frustration that students feel. If retained, they feel uncomfortable being with students who are younger than them. If they are pushed through, they still feel frustrated because they are expected to learn harder content without having mastered the previous material.

Under this situation, we have to ask the question, are these standards too rigid? What if we viewed standards not as absolute, but as a roadmap? In this roadmap situation, standards are used as a guideline for where students should be at, rather than something that must be completed by a specific time. If we let students work at their own pace, we can use the roadmap of standards to track the progress of the students. We can also use the suggested standards to determine what supports students need. If a student is falling behind, they may need some sort of

intervention, such as re-teaching, one-on-one help, or be paired with a student who understands the material. I believe that students would find more success if standards were viewed this way. For example, a student who only needs a week to learn the multiplication table could spend that week and then move on. If a student needs to spend a month on the same multiplication table, they are given the extra time and then they move on. In my opinion, this new arrangement is better than if everyone spend the same two weeks on one topic. In this arrangement, when the latter student reaches Algebra 2, they will not struggle as much on solving equations for which they need to know their multiplication table. I currently have students who struggle with equation solving because they were not given the time they needed to learn their multiplication table and other basics.

This idea is very similar to benchmark assessments, which provide summative data on student learning (Herman et al., 2010; Odden, 2009). Benchmark assessments provide more detail on student performance and can provide information throughout the school year rather than at the end. By knowing this information, the teacher can make adjustments.

With the structure of the school that I have taught at or currently teach at, benchmarking would currently not be possible or useful. This is because of several reasons. One being that students are expected to take a summative exam that tests them on all the standards. With this expectation, benchmarking would not make much sense, because in the end, all students need to finish learning the curriculum. If you had to slow down the curriculum for some students, these specific students would not cover all the standards. In addition, there would not be much to adjust in the classroom using the benchmark data. As stated before, there is often a restriction of space, knowledge, and resources that do not allow for much personalization or differentiation. So even if some students were not growing as much as hoped, there may not be enough resources to

support the student. In what I propose, the Next Generation math standards should be used as a benchmark of where students should be at/what they should be accomplishing, and if students are not there, interventions must be created to help them. In addition, summative exams would be de-emphasized, and they would not be used as a graduation requirement or a reason to pass or fail a student. By allowing students to work at their own pace, by creating personalized interventions for them, and by not having an expectation to complete a summative exam at the end, we are able to really focus on the students and ensure they get the support they need, which can lead to a decrease in othering.

Inspiration for a Proposed Curriculum

Since the current math education system is not effective in improving the math skills of students in my classes (and in similar classes elsewhere), especially with low-performing students, I propose a completely restructured system to better support the students.

Basic Framework

The inspiration for ideas proposed here came from the structure at The Citizen School Project in Brazil (Bartlett et al., 2021; Fischman & Gandin, 2016; Gandin & Apple, 2002). The school was started by Paulo Freire, who strongly believed that education needed to be democratic. According to Freire, a democratic education was one that got rid of oppressive structural powers and exposed injustices in society (Bartlett et al., 2021). He believed that if education was more democratic and there was a shared vision between the educators, parents, and students, students may be more engaged in school overall.

What I found most interesting about this school was how it was structured: instead of grades (like 1st and 2nd grade), it had cycles. The cycles were a conscious decision so that the structure of the math education did not perpetuate failure, dropouts, feelings of otherings, etc. In

this structure, each cycle lasted three years. The school created several mechanisms to ensure that students did not fail, including interventions such as progression groups in which students got close attention. With all these intentional interventions, the goal was to ensure that the students got the necessary support and succeeded. The curriculum was self-paced and highly personalized. The school was essentially removing the idea of failing. The removal of "failing" was important for these educators because often when a student fails, the student is blamed, even though it is usually not the student's fault[2].

The Citizen School Project promotes individualized (personalized), self-regulated learning. It essentially adopts the idea of benchmarking for designing the curriculum. In the context of education, benchmarking is the idea that you evaluate students' performance in a subject against the standard and use this information to innovate forward. So, the role of standards in the curriculum is significantly different from their role in the current education system.

Standards are no longer the absolute measure of competency in the subject matter; instead, they are now seen as a roadmap or suggestion, used primarily for guidance. Students should be able to work at their own pace; and the standards (roadmap) should be used to monitor their progress. The benchmarking with the standards also allows the teacher to determine what kind of support a student may need.

It should be emphasized that a curriculum restructured in this way does not call for getting rid of standards. There needs to be some conception of goals in order for an education program to be planned and improved (Tyler, 2009). While students may not be working at the

[2] After the success of the initial school, several other schools of this kind were opened in Brazil. Most of the students in these schools were from low-income backgrounds.

same pace, all students should be learning the same topics overall. Without some sort of standards, it is possible that inequity may increase if there is no consensus of what topics should be covered.

In order for the standards to be effective, however, they need to be taught in a culturally relevant way. This could mean showing students how the standards relate to their lives (for example, building wealth, investing money, playing games, playing sports, addressing environment racism problems) (Ladson-Billings; 1995; Snider and Hart, 2001). It could also mean teaching the content in a way that promotes student engagement and creates a positive and affirming environment. Teaching techniques could include having cyphers, having students work in groups, and using call and response (Love, 2015; Petchauer, 2009). A culturally relevant teaching approach combined with the benchmarking process helps in reducing othering and improves the chance of success.

The restructured math system would also involve new ideas for assessments. Unit assessments, like unit tests and quizzes, will still exist; however, with individualized learning, students will be taking them at different times. The national and standardized tests should be used to assess student growth rather than the mastery of specific standards. Such tests already exist. An example is the Northwest Evaluation Association Measures of Academic Progress (NWEA MAP) test (https://www.nwea.org/map-growth/). According to its website, the test is an adaptive achievement and growth test. It creates a personalized assessment for each student, precisely measuring the progress and growth. It provides the teacher with essential information about what a student knows and what they are ready to learn. The test tracks growth over multiple years. This test is ideal for the restructured curriculum. My personal experience is that, because of the large number of tests students must take during the year (Regents, SAT, NWEA

MAP Growth, to name a few), we rush through this test and brush it off. In fact, giving the test is often frustrating, because it takes away two instructional days, reducing the time available to teach. As an education system, we should value growth and ensure that all our students are learning and improving throughout the year. To help meet this goal, growth assessments should have high priority and be given multiple times every year. The results of these assessments, in addition to measuring student progress, should be used to help determine what supports students may need in the classroom. I recommend that the number of other standardized assessments be reduced, and that emphasis be placed on the growth assessments.

Role of Technology

The implementation of personalized learning can greatly benefit from the recent advances in computer/digital technology (Palaigeorgiou & Papadopoulou, 2019). Interactive learning videos have now become popular, especially during the pandemic. There is a wide range of what is considered an interactive learning video. Some components that can be implemented in videos are navigating a non-linear path, have additional links to access additional information, adding annotations, collaborating with students, and having motions (Sauli et al., 2018). For example, an interactive video can be direct instruction with checks for understanding embedded. Another example is an exploration lesson in which students graph functions and discuss what changes they see. With these videos, students can control their own speed, watch parts again, and pause the videos to check for understanding, and have links to go more in depth into a topic. In addition, by using the interactive videos, the students may feel less embarrassed and anxious when learning new content. This is an important social-emotional benefit that can reduce "othering." Many students that I have taught have had a previous negative experience with learning mathematics and at times feel embarrassed to ask questions especially when other peers

around them are understanding the content. By using videos, these students can really take their time understanding the material in a more private way. In addition, researchers believe that interactive videos could be very helpful with self-regulating, playing a crucial role in personalized learning.

The benefits of interactive videos have also been reinforced in a study by Palaigeorgiou & Papadopoulou (2019). In interviews, students said they liked that they could work at their own pace and liked that they could talk and exchange opinions with their partner while going through the lesson. Teachers noticed that students were focusing more and students who were usually indifferent seemed more engaged. Though these students were in elementary school, they had extremely good self-control, self-discipline, and learning autonomy.

To use the videos effectively, the students must be taught to be self-learners and self-disciplined. This teaching will be part of the curriculum in the initial school years.

Here it should be mentioned that such videos are already available, for example, at Khan Academy. However, I found that these videos were not suitable for my students. There are several reasons: (a) These videos are generic in nature; they do not take into account what skills my students have mastered and what they are still struggling with. (b) The videos are usually not interactive enough for my students. (c) Content may not be culturally relevant to my students. (d) The teaching style in the video may be different from the style of the teacher. The videos I make can be customized to meet the needs of my students, and I have control over the relevancy of the content.

Highlights of the Curriculum

Here are the highlights of my proposed curriculum:

- Uses the concept of benchmarking to identify the needs of the students and develop supports.
- Changes the role of standards. Standards are seen as a roadmap rather than a group of concepts that must be mastered by a certain period.
- Standards must be taught in a culturally relevant manner.
- Emphasizes personalized learning, allowing students to work at their own pace.
- Emphasizes growth assessment and eliminates end of year summative assessments.
- Makes heavy use of interactive videos as a tool for students to be self-paced.
- Reduces "othering" felt in the math classroom.

Proposed Math Curriculum Framework

In this section I will discuss the rationale, content overview, organization, assessments, and interventions needed for a proposed curriculum framework specifically developed to respond to the concerns relating to my students. It implements aspects mentioned above to address the othering that often occurs in mathematics as well as math disparities that exist for students that I teach. The objective is to increase the number of students who are successful in higher-level mathematics.

Rationale and Philosophy

This curriculum framework is based on the idea that students develop at different paces and are allowed to follow separate, individualized tracks. The framework involves deliberate steps to minimize the feeling of othering, which is caused by forcing all students to follow the same track. The curriculum uses benchmarking to track student's growth and their needs.

The structure still follows the Next Generation NY Math standards; however, the standards are used as a roadmap rather than mandatory concepts students must know by a certain

time. When students enter first grade, they take a diagnostic exam to help the teacher understand where all the students are at. Based on the diagnostic exam, teachers can put students in groups and give them a starting point in the curriculum.

Technology plays an important role, as students in groups will watch interactive videos on the concepts they are learning. Some videos may be a replacement for direct instruction while other videos may cover an interactive graphing activity. Other technological tools such as jamboard, padlet, desmos, etc. are used for collaboration and for getting a deeper understanding of the material. The beauty of technology is that it allows creativity in the preparation and delivery of content.

Students complete the lessons in groups. Teachers use formative assessments to tailor the curriculum to the needs and the strengths of the students, and to give them the support needed to understand the concepts. For example, if a teacher notices from the exit slip that a specific student is not understanding a concept, the teacher can pull the student into a small group the next day. Throughout the year, students will also participate in growth assessments that can show how much progress they are making throughout the year. Teachers can also use this information to tailor the curriculum. For example, if a student is not making much progress, this is evidence that the teacher needs to switch things up for the student. By using this framework, students are given the time they need to master basic mathematics concepts. This will eventually allow them to be more successful with higher level mathematics.

Goals

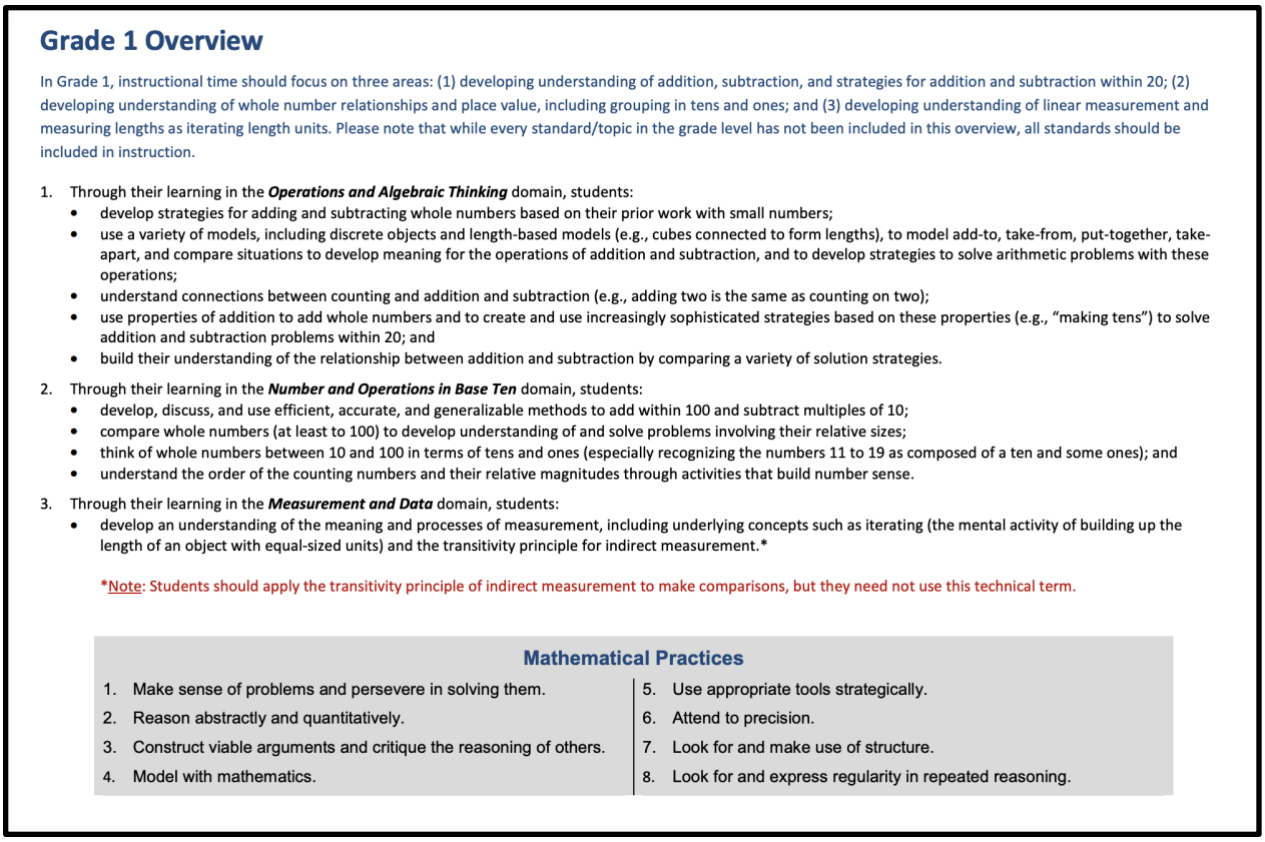
Students will continue to learn and master the NY Next Generation Math Standards. To reduce othering, teachers should take a culturally relevant approach to these standards that is appropriate for the students being taught. As a result, students should not only master the

concepts but also relate concepts to their own lives and understand their importance. While not every single NY Next Generation Math Standard may be culturally relevant to your group of students, the standards can still be taught in a culturally relevant way. (Examples include call and response, discussions, group projects, movement, etc.) In addition, conversations can be had of what types of jobs certain standards would be relevant in.

By allowing students to work at their own pace, students will be given the time they need to master basic mathematical concepts. This, in turn, will hopefully help these students be more successful with higher-level mathematics (high school and beyond). Generally, the curriculum hopes that students will feel more confident in their math ability and therefore reduce the "othering" that is often experienced in math education.

Content Overview

As stated above, the curriculum will use the NY Next Generation Math Standards (http://www.nysed.gov/curriculum-instruction/new-york-state-next-generation-mathematics-learning-standards) to track the progress of the students and to develop interventions. For reference, the standards for 1st grade are given in *Figure 1*. In the new curriculum, the message is not that the students must master these standards, but rather, this is the *suggested* place a student should be at the end of 1st grade. Here is an example of how to use the standards. Assume a class in which most of the students have mastered how to add within 100, but one student has spent over two months on this topic. You (the teacher) are worried that if the student keeps going at the same pace, they will only get through half of the standards. In this situation, it would be appropriate for the teacher to have a meeting with the student and the student's guardian to discuss the student's progress. In this meeting, the teacher would also discuss potential interventions to help the student progress faster. The interventions could include the parent



Grade 1 Overview

In Grade 1, instructional time should focus on three areas: (1) developing understanding of addition, subtraction, and strategies for addition and subtraction within 20; (2) developing understanding of whole number relationships and place value, including grouping in tens and ones; and (3) developing understanding of linear measurement and measuring lengths as iterating length units. Please note that while every standard/topic in the grade level has not been included in this overview, all standards should be included in instruction.

1. Through their learning in the ***Operations and Algebraic Thinking*** domain, students:
   - develop strategies for adding and subtracting whole numbers based on their prior work with small numbers;
   - use a variety of models, including discrete objects and length-based models (e.g., cubes connected to form lengths), to model add-to, take-from, put-together, take-apart, and compare situations to develop meaning for the operations of addition and subtraction, and to develop strategies to solve arithmetic problems with these operations;
   - understand connections between counting and addition and subtraction (e.g., adding two is the same as counting on two);
   - use properties of addition to add whole numbers and to create and use increasingly sophisticated strategies based on these properties (e.g., "making tens") to solve addition and subtraction problems within 20; and
   - build their understanding of the relationship between addition and subtraction by comparing a variety of solution strategies.
2. Through their learning in the ***Number and Operations in Base Ten*** domain, students:
   - develop, discuss, and use efficient, accurate, and generalizable methods to add within 100 and subtract multiples of 10;
   - compare whole numbers (at least to 100) to develop understanding of and solve problems involving their relative sizes;
   - think of whole numbers between 10 and 100 in terms of tens and ones (especially recognizing the numbers 11 to 19 as composed of a ten and some ones); and
   - understand the order of the counting numbers and their relative magnitudes through activities that build number sense.
3. Through their learning in the ***Measurement and Data*** domain, students:
   - develop an understanding of the meaning and processes of measurement, including underlying concepts such as iterating (the mental activity of building up the length of an object with equal-sized units) and the transitivity principle for indirect measurement.*

*Note: Students should apply the transitivity principle of indirect measurement to make comparisons, but they need not use this technical term.

Mathematical Practices

1. Make sense of problems and persevere in solving them.	5. Use appropriate tools strategically.
2. Reason abstractly and quantitatively.	6. Attend to precision.
3. Construct viable arguments and critique the reasoning of others.	7. Look for and make use of structure.
4. Model with mathematics.	8. Look for and express regularity in repeated reasoning.

Figure 1: Grade 1 Overview of Math Standards in New York

working with the student at home, the student working with more manipulatives in a small group with the teacher during class, the student working with a service provider one-on-one sometime during the school day, or pairing the student with another student who is progressing at a faster rate. The guardian, teacher, and student would try the agreed interventions. The teacher would monitor the progress and, if needed, tweak the interventions.

This is different from how the classrooms that I have taught in typically work. Since students are not working at their own pace, you often do not have a situation in which a student has spent way longer than expected on a topic. There are times when I have a multi-day topic, and I notice that after one day some students are further along the topic than others. When this is the case, I try to differentiate the materials to the best of my ability. For example, I have tried

having three levels on the second day of a concept. Each level is at a different stage of learning the concept and the students are doing slightly different things in class. This has proved successful; however, after the designated few days, we move on to the next topic whether or not every single student has understood the material. In addition, we rarely meet with parents or service providers often enough where we talk about specific math topics. So while we do have in place some support for a struggling student, it is not enough to help the student catch up.

The above example clarifies the role of standards. Standards are still needed, because, without standards, there is no general route for students to follow. Further, while all students develop differently and work at different paces, standards help contextualize extreme situations.

In addition, the standards can help students visualize the concepts they must understand to reach a certain goal. For example, consider a student in the 11th grade who has the intention of going to college, but has not yet mastered the standards for the 10th grade. The student could conference with the math teacher and the math teacher could present the standards necessary for the student to not have to do remedial math during college. This would include standards up to pre-calculus. Interventions, like the ones mentioned previously, could be created to help the student get to all these topics. This may motivate the student as they now see a concrete goal.

Organization: Guidance for Teachers

The following section gives guidance to teachers about the general structure of the classroom, how the classroom should be set up, and skills that students need.

General Structure

Despite moving away from the traditional curriculum, this modified curriculum would still be implemented in a traditional classroom, with teachers playing an important role. But, unlike in the current structure, each day, students will be assigned to specific groups and work on

a specific concept or lesson. In addition, the students will use different resources, depending on their group or topic: Some may use an interactive video, and some may be taught by a teacher.

The lesson structure depends on the topic. For example, some lessons may have three components: a video of a mini lesson, collaborative practice, and an exit slip. After students finish the mini lesson and practice, they will complete the exit slip and turn it in to the teacher. Another type of lesson may be an interactive activity where students are graphing different functions. Other lessons may be more exploratory where they explore the key parts of an equation or function. If students complete the lesson early, they can move on to the next lesson or an extension activity. After class, teachers should review the exit slips and other data and then create a plan for the next class. This plan would include groupings and the corresponding topics.

The teacher will use the standards to monitor the progress of students, to determine if interventions are needed, and to develop interventions. The interventions may include small group instruction, one-on-one instruction, or even summer school. (These will be further discussed in *Interventions and Groupings*.) In the next grade, students would continue from the last topic of the previous year. This structure would continue through the rest of their math education.

Classroom Setup

Because of the flexibility of this curriculum, what is happening in the classroom may vary from day to day. (This is in contrast to the current classroom, where the structure is more or less fixed.) Teachers must be prepared for students to be working on different lessons at the same time.

For example, some lessons may be exploratory, requiring students to use manipulatives. Other lessons may have students watch an interactive video on laptops. If a lesson does not need

a mini lesson, students may be working on a worksheet. Another lesson may include a gallery walk in which students put their comments on anchor charts. These anchor charts would stay up for multiple days until all students have completed the lesson. All these different lessons may be simultaneous since students are working at their own pace.

This arrangement may feel messy for a teacher who is used to a traditional classroom; but this flexibility is a key element of the proposed curriculum and recognizes that students are following individualized tracks.

While this curriculum requires (or even encourages) a flexible classroom structure, it would be beneficial to always have a small-group space. Small groups should be pulled almost everyday. This will be further explored in the section *Interventions and Groupings*.

Skills that Students Need

For this structure to succeed, there are some skills that students need to master. There are different ways to teach these skills, depending on what skills if being focused on.

With students learning different topics at the same time, much of the traditional classroom management that teachers and students are used to may not necessarily work. For example, teachers often use cold calling or warm calling to keep students engaged in the lesson. With students working on different topics, this would not be feasible for the whole group. In addition, teachers often use redirection prompts to help students stay on task. If teachers are focusing on a small group of students, they will not be able to walk around the room to redirect all students. For the classroom to be successful without these traditional management tools, the students need to be self-disciplined and must have good self-control. These skills do not need to be taught explicitly; the students will learn them by virtue of this new structure.

However, the students will need to be taught technology skills, including how to use a laptop/tablet, troubleshoot a laptop/tablet, and use the selected learning platforms (google classroom, canvas, desmos, etc.) These skills are not directly related to mathematics and can be taught as singular lessons. (These skills provide benefits beyond the classroom. That they will be taught and emphasized is an important side benefit of the proposed curriculum.)

The proposed curriculum expects the students to be familiar with the lesson structure. For this, they will need skills like lesson tracking, ability to understand the structure of a lesson, and figuring out what group they are in. These are skills that students will learn as they go through the lessons.

These skills need to be taught and emphasized from the beginning, and they should be reinforced periodically. It is best to teach and discuss these skills for the entire class as a group.

Assessment

The following section will review the assessment rationale and give examples of types of assessment for this curriculum framework.

Assessment in this structure is mainly used to provide data/guidance on how to move forward with each student. Since students are not expected to learn a specific set of standards by the end of each year, summative assessments are de-emphasized, while formative assessments and growth assessments are emphasized.

Summative assessments are typically given at the end of the unit, after a string of concepts, or at the end of a year. They assess how much of the expected content the student has mastered. Many schools and states have major end-of-year summative assessments. For example, NYC schools have Regents exams for specific topics. In order to graduate with a Regents diploma, students must pass at least one math Regents exam, usually the Algebra 1 test. If

students do not pass the Algebra 1 regents, they are usually sent to summer school or they are placed in a repeater class the next year. Summative assessments like the Algebra 1 Regents test would not be part of the new curriculum. Given that students are working at their own pace and are not being expected to master a specific set of standards, it does not make sense to have these high stake tests that determine if you repeat a class or move to the next grade. All students would move to the next grade and continue where they left off.

However, the new curriculum will continue to use the unit tests, which are useful for deciding how a student should proceed through the curriculum. If a student passes a unit test, they can move onto the next concept. If not, depending on the performance on the test, the student can review specific material or receive an appropriate intervention.

In addition to the unit tests, students should work on real-world tasks relating to the content of the unit. As stated before, though we are still using the same standards, the standards should be taught in a culturally relevant manner. It is imperative that students understand how the content is applicable to their real life. From personal experience, I usually do not have enough time to relate every single concept to a real-life scenario. However, with this curriculum there is no set number of concepts that need to be learned by a certain time, so more real-life applications can be explored. In addition, interactive videos can help students explore their own interest within a math topic.

Formative assessments monitor student learning and provide feedback to students. Some commonly used formative assessments are exit slips, fist to five (students put up 5 fingers if they feel confident about the material or a fist if they do not understand the material), teacher observations, independent practice, interactive video response, and self-reflection. In the new math structure, exit slips are the most consistent and valuable formative assessment. At the end

of each lesson, all students must turn in exit slips. The exit slips will help the teacher understand how each student is progressing. The teacher can see the student's misconceptions, concept mastery, and whether the student is ready to move on to the next topic. Another important formative assessment is self-reflection, which allows the students to voice whether they need more practice with a concept or if they feel good about it. These formative assessments help the teacher in creating groups for the next class.

Growth assessments are usually given multiple times throughout the year to monitor student's growth over time, that is, to understand student mastery/struggles. Currently, the NWEA MAP test is a very popular growth test nationally. The math MAP growth test is given to students three times a year: at the beginning, middle, and end of the year. Currently, the results of this growth test are not taken seriously (at a school level).

However, in this modified structure, the growth assessments are the most important assessment. Since students are working at their own pace, these tests help the teacher in tracking the student growth throughout the year. The growth assessment at the end of the year helps in deciding the starting point for the next year. These tests will also help teachers and administrators in determining supports or interventions. Since the growth assessments are crucial for the success of the modified structure, they should be given high priority. If teachers and students feel testing fatigue, certain summative assessments could be eliminated.

Interventions and Groupings

As stated above, the results of assessments provide guidance for creating interventions. Although the interventions will depend on the type of learners in your classroom, here are some general examples. One intervention that is crucial for the success of the new structure and should be common to all classrooms is a small group intervention. There are many ways a teacher can

decide on the small group. The teacher can decide to grab a group of students who are significantly behind to help them catch up or grab a group of students who are significantly ahead to do an extension lesson, or grab a mix of students who have small misconceptions that need to be pointed out. This small group should change often, if not daily, based on the needs of the classroom. The small group can also serve a check-in with the students.

Currently small groups usually consist of low-performing students. This is because there is an expectation for students to all be at similar paces to finish the standards by the end of the school year. To keep the low-performing students on pace, they often need to be in a small group to get some guidance. It is very rare that I work with another small group of students. There are very few times in the school year where I pull the high-performing students in a small group to work on an extension lesson. In general this scheme for forming small groups is not ideal because low-performing students are not being given the time they actually need to process the information and high-performing students are not always being pushed to their full potential.

Depending on the availability of resources and the schedule of the school, another recommended intervention is having one-on-one time with the teacher to work on material. This could be a pull out during the day or even before or after school. Another intervention could be summer school, where classes would be structured the same way as during the regular school year. The summer school would give the student more time to go through the lessons and concepts.

Summer school is often considered the last resort for trying to make up credits. At the school that I currently teach at, summer school uses an online platform where students go through different modules related to the subject. In this online platform, there are no videos or resources explaining the content, only practice questions and assessments. This is obviously not

a productive use of a student's time, and they often are not gaining much knowledge. By structuring summer school the same way as class, students can continue their learning.

Along with creating interventions, the teacher should also group students who will work together for the day. To create the groups, the teacher should use the data from the formative assessments, such as exit slips. But how this data is used is up to the teacher. The most basic grouping is probably placing students who are working on the same lesson together. But there are other possibilities. For example, a teacher can group students who have misconceptions about a topic from the previous lesson with students who have understood that topic. The idea is to allow one set of students to learn from the other set. Some students might find this setting more attractive than going to the teacher. Teachers can also use the exit slips to determine the mix of students in the group. Another example of this grouping is peer-to-peer tutoring, in which a student who is quite behind the roadmap of standards is paired with a student who is ahead of the roadmap. Research has shown (Walker, 2006) that students can learn a lot from each other and that, at times, this mode of learning/teaching can be more effective than a teacher teaching the students.

Since students are currently expected to work at the same pace, there is not much urgency for creating groupings. I personally tend to change groupings every unit. While these groupings can be strategic, they stay the same for multiple weeks. At times, if a student has been absent or is late, I will ask a student who has mastered the material to help them. However, changing groups daily is not part of the routine.

As one can see there is a lot of flexibility with how groups can be created. Changing the groups often will allow students to collaborate and to learn from each other. In addition, this arrangement will keep students engaged, because each day will look slightly different. Also, it

will create a culture of understanding that everyone has different strengths and weaknesses, which is beneficial to students learning to be respectful towards each other. To form appropriate groups, the teachers must have time to review the exit slips. This is important in order for the groups to be successful.

Trigonometry: Sample Unit for Algebra 2

Restructuring how math education works with the students that I have taught requires groups of people to agree and requires a lot of time. While that may seem disheartening, I would argue that many aspects of the proposed structure can be implemented in a classroom setting today. While it is true that, in a present-day classroom, teachers are expected to teach the standards associated with the course, and students are expected to master the standards by the end of the year, we can still implement aspects of personalized learning, incorporate interactive videos, and promote self-paced learning.

I have created an Algebra 2 sample unit on Trigonometry that implements all these aspects. While the curriculum is still constrained by the standards, students are allowed to work at their own pace so that they truly understand the concepts. The curriculum which is based on this rationale can be found on the following website.
(https://sites.google.com/view/karkiedmproject/home)

There are a few lessons that I would like to emphasize as I believe they encompass the values of this curriculum well. Lesson 1 is a great example of how different lessons can have different structures. In Lesson 1, students are at times watching a video and at other times using Desmos to discuss what exactly is a periodic function and not a periodic function. Lesson 3 and Lesson 16 show how the material can be taught in a culturally relevant way. Lesson 3 has a part where students look at google maps and determine what is the shortest way to get to a specific

destination. Lesson 16 has students explore how sine and cosine waves relate to music and sound. Lessons 7, 8, and 9 are great examples of how interactive videos can be helpful in replacing direct instruction. These three lessons have a lot of explicit modeling. However, they all relate to one standard, so students can work at their own pace through them. In addition, for Lessons 7 and 8 I have given additional model videos for students who may be struggling. It is completely optional to watch. All the lessons with videos have questions that pop up to keep the student engaged and to gather data on their understanding of the material.

The website has separate sections for educators and for students. The section for educators includes an overview of the unit and the materials needed for each lesson. Each lesson is linked to a Google Drive folder, which contains the resources for the lesson. The section for students is where they would go to everyday. Students click on the lesson for the day and there are links to each component of the lesson. Not every component is done on the computer. The website indicates when the student must get a worksheet from the front of the room.

Another benefit about this curriculum is that much of the videos and materials can be used the next year. Obviously with a different set of students, you will have different needs. However, the core concepts may not change much. You may need to include more (or less) additional videos, or you may want practice questions; however, I believe, many of the videos can be used again. So while the amount of work may be significant during the first year, the workload will decrease in subsequent years.

Reflections from Implementing the Unit in the Classroom

I implemented the sample unit in two of my Algebra 2 sections. I used the observations in these two classes to tweak and refine the curriculum. What I have presented above is the revised version. In this section, I am presenting my reflections on four aspects of the curriculum: the

ability for students to work at their own pace, status of the students who were absent, students' engagement with the videos, and the groupings.

Student Ability to Work at Own Pace

A key aspect of the proposed curriculum is that it allows the students to work at their own pace. This aspect relies on interactive videos. Some of the videos were direct instruction. Other videos were an exploratory lesson where they had to graph specific functions and observe what happened. I observed that many students found the videos helpful. Here are the specifics related to one student. This student usually needs more time to process the material presented in the class. This has been noted by many of his teachers on his Individualized Educational Plan (IEP), a legal document created for students with disabilities. In general, he tends to be very quiet in class and will usually not ask for help but at the sametime will not complete the work by himself. To support this student in our current classroom, either my co-teacher or I usually go through a few of the practice problems with him before he fully grasps the concept. I observed that the use of videos allowed him to grasp the materials himself, without any intervention by the teachers. He specifically took advantage of the pause and rewind feature of videos. He was able to work more independently during the practice, and he commented that he liked watching the videos, rather than having me model in front of the whole class. This was the most positive comment I had heard from him all year with regards to my class. When it came to the final assessment, I noticed that he was a lot more confident in the material and he passed the unit test, which is usually not the case.

I also have a handful of students who have a strong grasp of mathematical concepts and need less time to complete lessons. They also found the videos useful, because they were able to proceed to the next lesson instead of waiting for the next class. In the traditional class, I usually

ask these students to work on an extension. Although they complete it, they perceive it as extra work, a penalty for finishing the standard lesson early. With the availability of the video for the next lesson, these students no longer work on the extension; instead, they move on to the next lesson. Their thinking changes: By finishing ahead, they move ahead, instead of getting penalized. Thus, the proposed curriculum was successful in allowing the students to work at their own pace.

Status of Absent Students

I currently model in front of the whole class. In this practice, the absent students do not have access to the subject matter covered, and they cannot catch up on their own. By making the videos available in the new curriculum, I was hoping that absent students would be inclined to complete some of the work at home. The students had all the tools to complete the work, as everything was posted on Google Classroom, and the practice was given out in packets, to be done on paper. Contrary to my expectations, the findings were mixed. Some students, if they missed a day, did complete the next lesson at home. However, most of my students did not take up that opportunity.

I did observe, however, that the videos were beneficial for students who came late. Along with the low attendance rate, I usually have many students come late to my morning periods. To give a sense, when the bell rings, I often have only 4 out of 25 students present. As I do not like to waste instruction time, I still teach my lesson. However, it can be frustrating to have to re-teach the concept multiple times throughout the period. It is something that my co-teacher and I have struggled with this year a lot. By having the videos, students who came late were still able to learn the content, and I did not have to leave what I was doing in order to help the latecomers.

Here, I should note that the use of videos in the classroom was a new concept, and that I had not emphasized their use in catching up. I wonder if more students would have completed work at home if the role of videos had been explained and emphasized from the beginning of the school year. In the unit that I implemented with the two sections, we had two buffer days, so if students only missed 1 or 2 days, they were still on track to finish on time. However, if students missed more than 2 days, and did not complete the work at home, it became quite complicated for them to catch up. At one point, my co-teacher and I had to split up a large group of students who were behind and gave them abbreviated versions of two lessons so they would not be as behind. In a way, this is an example of intentional grouping; however, the purpose of a small group should not always be to help students who are behind. Perhaps the results would have been different if the videos were introduced from the beginning and their use for catching up was emphasized.

Student Engagement with Videos

After observing the implementation of the sample unit, I realized that I could have prepared more effective videos. As stated above, some students really benefited from the videos. But some students vocalized that they liked me modeling in the front better, because they were more engaged in the material. My initial videos were screen recorded from my iPad and uploaded to Google classroom. In these videos, it was hard to implement things that usually keep the students engaged, like calling on students, checking for understandings, etc. However, after reflecting on the unit, I realized these aspects are necessary and important. In the sample unit linked above, I have used interactive videos, which incorporate the feedback from the students. For creating these videos, I used EdPuzzle (https://edpuzzle.com/) . By using Edpuzzle, I was able to incorporate questions into the videos where students have to pause and think and then

type their answer. I think this type of interaction will help students stay more engaged and test their understanding of the content throughout the mini lesson, rather than waiting until the practice. The videos I created for the sample unit are similar to videos you may see on Khan Academy (https://www.khanacademy.org/). While research on the effectiveness of Khan Academy is still new, researchers (Light & Pierson, 2014; Murphy et al., 2014; Weeraratne & Chin, 2018) have found positive effects such as increased engagement and increased achievement when videos from Khan Academy are used in high school classrooms in a way that they do not replace the teacher (just like in the sample unit).

Another change that I made to the curriculum after observing the implementation in my classroom was the creation of groups for watching the videos. When I first implemented this curriculum, I had students watching the videos independently. This worked for some students; however, I could tell that other students were disengaged. The signs included behavior like putting their head down. Also, at times, students would watch the video and then when they got to the practice, they would call over a teacher and say that they did not understand the topic. I realized I could promote engagement by asking a small group (2 or 3 students) to watch the videos together, encouraging them to talk to each other and discuss the material when they had to answer the questions. I believe this group activity will help students grasp the material faster and will keep more students engaged.

Groupings

The last aspect I want to reflect on is the groupings. For each class, my co-teacher and I would decide which group of students to work with. We would write the groups on cardstock and then reconfigure the room as needed. Unfortunately, as mentioned before, most of these times, this group comprised students who were significantly behind due to absences. However,

there were occasional exceptions. For one lesson, *rotation diagrams and trig ratios*, I decided that it would be better for me to model the concept in person, because students in the past have found it difficult to grasp. I wanted to be able to check-in with students during the mini lesson to make sure they were understanding it. So whenever students were at that lesson, they were my small group for the day, which they knew by the cardstock, and instead of watching the video, they would work with me. This arrangement worked well, because I could clarify the specific misconceptions of the students in the small group. For example, some students were struggling with drawing the original diagram, while others were struggling with labeling hypotenuse, opposite, and adjacent. I was able to give them specific strategies to help them. This personalized instruction would not have been possible, if, instead of the small group, I had to work with the whole class.

Summary

I saw benefits from this personalized approach. Throughout the unit I asked for feedback through exit slips and through conversations. Students appreciated being able to work at their own pace. I also found it advantageous to work with small groups of students at a time, so that I could specifically address their misconceptions. However, there were certain aspects of the implementation that could have been more effective. These included having students watch the videos in groups, creating more effective and engaging videos, and creating an expectation (in fact, encouraging) that this work can be done outside the classroom as well.

Implications for Other Classrooms in Similar Situations

Overall, the implementation of this curriculum had some positive impacts on my students. Students were able to work at their own pace; they were able to use interactive videos to their advantage; they were able to still learn the content even if they were late; and I was able

to give more individualized support to students. While this curriculum was created and implemented for my specific students, there are many schools in New York City and across that country that are dealing with similar issues as me. These schools will most likely benefit from a curriculum structure like the one proposed. Research must be done to see what the effect of would be using a curriculum like this from the beginning of a student's education.

Concluding Remarks

It is evident that many of my students are not being pushed to their full potential, this includes both high-performing and low-performing students. I believe this is because these students are being forced to go through one uniform pathway instead of being given the time they need to develop and learn at the pace that works best for them. For low-performing students, this hinders their ability to be successful in higher level math which eliminates many future opportunities for these students. I call for a restructuring of math education, specifically focusing on how we view standards. Instead of standards having to be mastered at a certain time, standards should be viewed as a roadmap and benchmark. Students should be allowed to work at their own pace, and teachers should compare the student's progress with the benchmark standards to determine what sort of interventions a student may need to stay on track. The curriculum would use technology and grouping as tools to allow students to work at their own pace and to keep students engaged. While it is unlikely that the structure of math education will completely change, there are aspects of this benchmark curriculum that can be implemented in classrooms today. This curriculum will help all learners be pushed to their full potential.

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