Overcoming Barriers in Excellence in STEM Education Through Looping

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Introduction

In order to prepare students for a workforce that will ensure innovative progress in the 21st century, we must provide purposeful instruction and opportunities to develop problem solving skills through well-defined STEM programs in K-12 districts. STEM education must be appropriate for their age level and development; the students must be involved in learning the knowledge of STEM disciplines and be able to apply that knowledge (Bybee, 2013) Kennedy and Odell (2014) states, “All students must be a part of the STEM vision, and all teachers must be provided with the proper professional development opportunities preparing them to guide all their students toward acquiring STEM literacy.”

Research shows that not only do strong relationships between teachers and students affect the culture of a school but also affects student learning (Raider-Roth, 2005). When a teacher instructs the same group of students over two or more school years, this practice is referred to as “looping”. Spending multiple years together in the classroom allows more time for teachers and students to build relationships that positively affect student learning. I have explored how looping courses can benefit both teachers and students and therefore serve as a vehicle for overcoming barriers in implementing excellent STEM education.

In addition to building student relationships, I’ve found looping to be beneficial in understanding content, focusing instructional time, and having a firm overall understanding of curriculum across several grade levels. Other research has found positive effects in social/emotional welfare of students particularly at younger grade levels.

Background

I started my career 8 years ago at the middle school in the same district teaching 8th grade and Algebra for accelerated students. This was the inaugural year for Common Core Learning Standards (CCLS) in grades kindergarten through 8th grade in math and ELA. At the end of the year I was recruited to move to the high school to fill a vacancy. Implementation of the CCLS would phase in each year so my background in the 8th grade standards and curriculum would prove useful in the vertical alignment.

This also meant I would have several of the same students in my Algebra and PreAlgebra classes. Fast-forward to the following year, I pick up Algebra II for two years through Common Core implementation, having several former students in class. My rise through the ranks finally landed me in teaching Calculus and Precalculus in my fifth year of teaching with students in previous years composing approximately 70% of my caseload of my upper level students (I also had some sections of Algebra filling my day). For a couple years several of my PreCalculus and Calculus students had been in my class for three years. One student was in my class four out of five sequential years. To say we were close was an understatement. I knew their background and they knew my routine. We knew each others' quirks, senses of humor, and learning/teaching styles. All the makings for a relationship founded on mutual respect.

Vertical Alignment

Understanding the vertical alignment from middle school through high school has allowed me to create a PreCalculus course that not only prepares students for my Calculus course but also fills in gaps in the Common Core Learning Standards. I have a firm knowledge of which concepts have a strong focus and which need more attention which allows me to better understand the needs of my students and aid in curriculum development. Because PreCalculus doesn't conclude with a state assessment and the Common Core Learning Standards are merely a guide per New York State Education Department (2013), the course inherently has the autonomy to include multiple topics for advanced study that don't pertain to calculus but enhance an overall high school curriculum like matrices, further study into topics in Algebra I, Geometry, and Algebra II for deeper understanding like trigonometry and functions, and/or truly Pre-calculus topics such as limits and conics. As the only teacher of calculus in my district, I've developed a curriculum that focuses on a deeper look into the study of functions and trigonometry while also including topics in calculus such as limits and the unit circle so that the students are most prepared for studying calculus either in my Calculus class or in their post-high school experience hence making the content intentional and enriching.

Focus of Instructional Time

Most research of looping is done at the primary levels but looping is practiced across all grade levels and disciplines. One of the incentives of looping is the increase in instructional time that comes from not needing the usual transitional time for teachers and students to acquaint themselves with each other both in classroom routines and through teacher knowledge of student skill sets. In the second year of the loop, I'm able to start the year with instruction in calculus topics without much need for precalculus

review or acclimating students to my own unique methods and algorithms for doing menial yet necessary tasks such as combining fractions and factoring. Time is saved through student familiarity of classroom procedures and routines. Some research shows additional time saved through looping is a month of instruction/learning time during the second year of the loop (Cistone and Shneyderman, 2004). This saved time can then be used for enrichment, projects, or deeper looks into content- all things teachers often state they do not have time to integrate.

When surveyed anonymously about the benefits of having the same teacher for both Precalculus and Calculus students responded:

> "You know exactly where you left off in your previous year so there's no question about any of it. You build off of the things you learned the year before and the teaching style doesn't change from one year to the next"
>
> "We don't have to get used to a new teacher and we already know how you (the teacher) teach and solve problems"
>
> "You (the teacher) know what you have taught us and it is the same style"
>
> "Having a teacher who already knows who you are and how you work as far as learning goes"

Social/Emotional Welfare

Preadolescence and adolescence is innately a very tumultuous phase in human development. Research shows that looping allows more time for students to form relationships and facilitate the development of social skills. Looping can alleviate anxiety when moving from one level to the next and improves student confidence (Cistone and Shneyderman, 2004). Driving this back to STEM, mathematics education has many stigmas attached such as math anxiety, therefore, being able to reduce other factors causing growing pains is beneficial to students.

Knowing that I will have students for two years, I have to keep my students interested in learning high levels of mathematics. To keep healthy numbers in my program, I have a vested interest to keep math anxiety and any stigmas of inaptitude of learning math out of my classroom. This often requires me to be my students' biggest cheerleader while also keeping my standards high and level of rigor up. Although it

varies year to year my retention of students in my loop is almost 100% with most cases of getting out of the loop are a result of scheduling conflicts or lack of need for the Calculus course. Granted I am the only teacher of the courses so any student who requires them for college has only one option, but I'm confident my students do not choose to not take Calculus based on their social/emotional needs not being met with me as their instructor. Two student testimonies:

> "I have created a connection with the teacher and she knows my strengths and weaknesses coming into Calculus."

> "Your teacher already knows how you work and can that can aid in helping students understand the work better, allowing for an almost personalized teaching style based on what works"

Looking ahead to next year, when students were asked what they will look forward to in Calculus that will be a result of having the same teacher for a sequential year one student replied:

> "Having a teacher who already knows who you are and how you work as far as learning goes"

One caveat to be mindful of in creating a successful looping practice is that not all teachers are fit for it. For best results I believe teachers who build great relationships with students and portray an exemplary passion for STEM are the best candidates. Afterall, how can we ask our students to be interested in STEM if we are not constantly STEM's biggest advocate?

Looping Toolkit

The barriers to providing excellent STEM programs in school districts most often include lack of time and money making a looping practice as a piece of an overall successful program beneficial as it is essentially free. With a pool of viable candidates for the practice, i.e. teachers with reputations of having excellent respect and rapport with students and a paramount command of content standards across several grade levels, the last component is a master schedule conducive to implementing the practice.

At the elementary levels, looping can easily be done with the buy-in from two teachers willing to essentially trade places to complete a loop. At the secondary level, setting up a master schedule conducive to looping can take more finesse which would

require support from the building principal and perseverance from the guidance counselor(s) who create(s) the master schedule.

Conclusion

To provide students with the skills to be college and career ready while also promoting good citizenship is the foundation of public education. Providing students with the best instruction provided by the most excellent faculty is every school's agenda and creating purposeful and intentional opportunities in STEM enhance the education system for our future. Students with a solid foundation in STEM education are the future for innovation and progress. Many barriers exist that inhibit schools from providing an excellent STEM education. With time and money (or lack thereof) being at the forefront of the list of barriers, schools look to find economical and logistical solutions to providing enriching opportunities in STEM. This is why implementing a looping practice among teachers with nurturing classroom culture and climate is worth investigating. Saving time while building exemplary relationships with students through looping practices can be a building block for an overall excellent STEM program at a cost that all districts can afford.

Works Cited

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