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Examining Teaching Practices that Increase Student Mathematical Achievement

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Jonah Zimmerman

Abstract

The current data in the United States surrounding mathematics shows that there are issues that must be addressed with teaching and learning math in the K-12 setting. In the perfect world, all students would meet grade level expectations in math prior to moving to another grade; however, this is not what is taking place. Students are not meeting proficiency, and as a result teachers and students alike are not gaining confidence in teaching/learning mathematics. This project looks at the Math Workshop Model as being one alternative to the more traditional teaching practices that are used today in the ABC School District. Through a review of literature, this project identifies four components of an effective Math Workshop Model, specifically geared for elementary aged students. Furthermore, a continuous professional development plan is established with resources such as surveys, data tracking spreadsheets, formative assessments, a slideshow presentation, professional development calendars/outlooks, and documents that support the implementation of the Math Workshop Model.

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Chapter One: Introduction

Problem Statement

Mathematical achievement data in the United States (U.S.) reveals that elementary students are not meeting core grade-level requirements and that foundational math skills are not being understood (Ing et al., 2015). In contrast, Boaler (2015) writes that in an ideal world elementary aged students would meet grade-level expectations for their respective grades prior to moving on in their educational careers. A recent study of mathematical performance illustrates the problem by showing the U.S. ranking thirty-sixth out of the sixty-four developed countries, and when the high levels of spending are considered, the U.S. falls to the very bottom of the list (Boaler, 2015). It is a huge problem when the U.S. pours the greatest amount of money into educating its youth in mathematics, with an expectation that students should perform at the top levels of developed countries, only to find out that the U.S. is at the back of the pack and that students are not meeting grade-level expectations. Educators across the country need to get to the root cause of this problem to address the growing concern of mathematics education in the U.S.

Importance and Rationale of the Project

It is a necessity that all elementary-aged students in the U.S. receive a math education that will set them up to gain success with the standards provided in the common core. Furthermore, students must meet these learning standards early on so that they are not playing catch up throughout their middle and high school years (Boaler, 2015). It is every district's hope to set each of their students up for success post-graduation, but how are they setting students up for future achievement when children k-12 are not meeting

basic levels of proficiency in mathematics? Moreover, careers in mathematics are on the rise and present ample opportunity for advancement. Sheen (2017) writes about the importance of mathematics in the U.S. workforce and discusses the opportunities that await students after high school graduation. Mathematics, statistics, and several other mathematical-related fields are ranked among the top thirty highest paying major professions. Further, having proficient math skills is a common factor when finding success in most other top paying majors and, in addition to the benefits of good pay, individuals in math-related fields report higher levels of job satisfaction than other fields.

Due to these reasons, schools are feeling pressured to increase academic rigor while teaching to these standards. Districts need to provide data of their students, from state and national assessments that test these standards, to show certain levels of proficiency at each grade level; however, it is this math data that shows the alarming nature of math education in the U.S. Boaler (2015) presents the problem as being a foundational issue that must be addressed. Schools are failing their children as opposed to children failing in school.

If this problem is not addressed in an urgent fashion, then the U.S. and its education system will continue failing students at an alarming rate. The consequences of this continuing to happen stretch beyond a student receiving a poor grade in a math class, a poor level of proficiency compared to a peer, or a district that struggles to earn certain funds due to lower proficiency levels on state assessments or federal benchmarks. Mathematics is a key that has the ability to unlock a plethora of career options. Successes and happiness are often found within these career paths (Sheen, 2017). So, the true consequence of a U.S. education that fails students in mathematics is that it takes away the

full benefits of this key subject. In addition, it diminishes the potential that it has to unlock future successes in careers related to the field of mathematics.

Background of the Project

The concept of U.S. math education falling behind is nothing new to its educational system. Historically, a major reason for this problem is due to the structure of the math lessons being taught. Students are placed in elementary classrooms where they sit through twenty-to-thirty minute math lessons, all while watching the teacher demonstrate problem after problem of a certain concept. With this learning approach, little has changed from decades prior to the present day. Students from the 1980s through the present will recall that they would watch and copy down similar problems so that they could practice mathematics alongside the teacher and their classmates. As Boaler (2015) writes, "such classrooms quickly learn that thought is not required in math class and that the way to be successful is to watch the teachers carefully and copy what they do" (p. 40). Historically, this type of learning occurred in most classrooms for most subjects throughout the 19th and 20th centuries. However, other subjects have more quickly gravitated toward different approaches while mathematics slowly hangs on to aspects of this passive approach (Boaler, 2015).

In 1980, it was identified that the United States was falling behind other developed countries in terms of mathematical proficiency. The United States was failing its students at extremely high numbers, and with the competitiveness of the Cold War, it was alarming the nation that they were failing its youth (Boaler, 2015). In 1989, the National Council of Teachers of Mathematics (NCTM) issued a new curriculum that helped guide teachers to be

facilitators rather than lecturers. This set of curriculum standards also guided students to work in groups rather than individually; however, the public wanted the continuation of a more traditional approach instead of this new reform approach to mathematics (Boaler, 2015). Fast forward twenty years, and the U.S. enacted the common core math standards which continue a group/open dialogue approach to mathematics instead of a teacher lecture approach. These standards continue to have opponents who would like to see math head in a direction traditional in nature (Ginsberg et al., 2014).

Even though standards are set up to transition from this more traditional approach to a reformed approach, math scores continue to dip when compared to other countries. The National Assessment of Educational Progress (NAEP) math data goes back to 1990 (one year after the NCTM standards were enacted) and not once has the average national data shown its math scores to be performing at even an average proficiency level (National Assessment of Educational Progress, 2019). In other words, while there are some gains from this transition in standards, overall things are much of the same: the nation is falling behind in mathematics. Although the standards changed in 1989 and then again in 2009 to a more reformed, group/open dialogue approach, most people will still remember the vast majority of their math classes k-12 as learning in more of a traditional/passive method, one that teaches that math is about listening carefully to the teacher while learning in a whole-group format, memorizing the methods, and then applying the methods to problems.

The alarming condition of U.S. math trickles down to individual states, as would be expected. In Michigan, the Michigan Department of Education (MDE) publishes annual academic reports for the public to view. The most recent report, which included the Michigan Student Test of Educational Progress (MSTEP) testing data, shows dire

proficiency levels in mathematics as every age level, 3rd through 11th, was achieving below proficient levels in 2019-2020 (State of Michigan, 2021). Age groups like 4th, 7th, and 11th all digressed in terms of academic achievement, and 3rd graders achieved the highest of any grade with only 46% of students meeting proficiency standards (State of Michigan, 2021). Narrowing further, MSTEP testing data for the ABC School District (a pseudonym) demonstrates that only 35.3% of students in 3rd through 11th grade are proficient in terms of math (State of Michigan, 2021). With scores like these, it is going to be important for educators to lead the charge in changing the student perception of mathematics from a passive learning environment to a more active and engaged learning environment in order to help every student achieve proficiency in mathematics.

Statement of Purpose

The purpose of this project is to increase mathematical achievement in the ABC school district by restructuring the way that teachers teach mathematics in the elementary schools across the district. This new approach to math lessons in the ABC school district will take on the identity of a workshop model, similar to workshop models that are being enacted for reading and writing units of study. The vision is to move from a more traditional approach to teaching mathematics (whole group lessons with independent work) to a workshop approach (whole group lessons followed by targeted lessons and partner work components). However, this project will outline both the necessary components for a researched-based math workshop and it will also identify the needed professional development for current and incoming teachers of the ABC school district. Implementing a math workshop format will increase student mathematical achievement by providing teachers with a research-driven approach to teaching mathematical content. This

will help students feel more supported and comfortable when learning new concepts in math, which in turn provides them with the confidence needed to be successful not only in classroom lessons but on state and local assessments. It is these assessments that demonstrate a student's understanding of their learning, and it is these same assessments that have shown the urgency that is needed for a math workshop approach.

Objectives of the Project

The rollout and implementation of a math workshop model in ABC school district will take a few years in order to properly train staff and to provide proper materials for the workshop to be successful. Several key components were identified as being important when implementing a math workshop model (hereinafter "math workshop"): whole group lessons, formative assessment, small group, and partner exploration components. These components will be studied while completing the first objective of this project which is to establish a grade level math representative for each elementary grade level. This team will partake in the professional development (PD) of math workshop, with administrators across the district, prior to the rollout to the entire district teaching staff. From there, the second objective will be to train current and incoming teachers and install a new teacher training in the ABC school district that identifies the important components of math workshop and trains all ABC teachers in this format. Lastly, research shows that for math workshop to be successful, teachers need access to quality formative assessments. A final objective of this project is to provide teachers with examples of these research-based tools so that they can begin to enter into the work of creating quality assessments themselves. In order for this project to improve math achievement in ABC school district, it is a necessity that each of these objectives be met.

The first objective of this project is to create a math representative team for each grade level. This team will consist of two individuals that represent the entire grade level across the district. They will eventually lead PD for the entire grade level during district-wide half days. During the 2022-2023 school year, these individuals will be trained in math workshop and the components of the workshop as outlined in this project. They will be provided with district training surrounding this workshop and will be expected to participate in three full days of PD that the district provides them. This objective will ensure that the foundation is laid for a successful workshop rollout by identifying teacher leaders who are passionate about this work and who want to improve math-teaching practices. With this objective, the ABC school district can begin to build on the foundation with objectives two and three.

The second objective of this project is to provide current and incoming elementary school teachers with the necessary professional development to begin teaching math workshop in their own classrooms. Currently, ABC school district does not provide training in the current math curriculum and does not have any training that encompasses math workshop. This objective will be reached by providing all staff the opportunity to engage with one another and learn from the district math representatives identified in the first objective. Time for this professional development will be allotted at four district-wide half days throughout the 2023-2024 school year. In subsequent years (beginning in 2024-2025), new teachers will receive this training at new teacher orientation. This objective will help train the broader elementary teaching base and create a positive culture surrounding math workshop. It will ensure that all teachers have the necessary information to positively impact student learning in the area of mathematics.

The final objective of this project is to provide teachers with examples of the research-based tools (e.g., formative assessments, small group manipulatives, and small group talking points) that are needed when teaching math workshop. Common classroom manipulatives, which the district already provides teachers with, are often used in whole and small group workshop formats. These manipulatives will be identified to the teachers during the 2023-2024 trainings and surveys will be created to make sure that all teachers have access to these materials. If they do not, the district will make a supply purchase based on the survey results. Furthermore, a successful math workshop identifies common formative assessments for each lesson as being a necessity. Teachers will be trained in writing these assessments and will be provided time to write common district assessments at subsequent PD days throughout the 2023-2024 school year. These assessments will be housed on the Google Drive for each grade level. Doing this will develop consistency for teachers, students, and administrators. Furthermore, it will allow teachers to work together and share the load when creating these assessments and then give the district a more accurate picture of the successes and failures of the workshop approach.

Definition of Terms

Common Core – A set of educational standards set in the United States for k-12 students.

Formative Assessment - An assessment that provides teachers and students with immediate feedback, which in turn allows for adjustment of instructional practices (Phelan et al., 2011).

Foundational Math Skills - Basic concepts which form a foundation for students' success in math (Boaler, 2015).

Math Workshop Model - Incorporates a mix of whole group instruction, group/partner work, and common formative assessments (Thanheiser et al., 2014).

MSTEP – The Michigan Student Test of Education Progress is a statewide assessment that is given to 3rd through 12th grade students in the Spring of each school year.

Professional Development or PD – Trainings surrounding district curriculum and teaching practices that the district provides its teachers.

Scope of the Project

This project's scope conveys the importance that achievement in the area of mathematics needs to improve in the ABC school district. This project will address the need for improvement by reassessing teaching practices and training its teachers in a math workshop model. Furthermore, this project will put in place a PD structure that will not only train current staff in this research-based model, but also train new staff at new teacher orientations. Through this PD, staff will be provided a visual framework of math workshop, examples of formative assessments, training in writing formative assessments, a district manipulatives list, and a survey to ensure that all teachers have the necessary tools to implement a successful math workshop within their own classrooms. This project will not be a creation of a brand-new math workshop, rather it will be an implementation of a workshop that is research-based and has shown success in helping students grow in their math achievement.

With this project in mind, there are a few factors that are relevant which could keep the math workshop model from being a success when implemented in the ABC school district. First and foremost, the teachers must have an open mind about implementing

math workshop so that a positive surrounding culture can be established. Without this buy-in, math workshop will not be effective, in that the teachers teaching it will not believe in its relevance. Another barrier that needs to be considered is the district's budget for additional resources. To execute math workshop effectively, the district will need to establish which important manipulatives each teacher has and consequently provide additional resources if necessary. These resources include materials in a math toolkit like counters, tens frames, tens blocks, whiteboards, etc. This financial burden could hinder the immediate successes of math workshop within the district. Lastly, in order for this project to be launched, the district must find teachers who are passionate about this learning to lead the way and become grade-level math representatives. Administrators will also need to be leaders in that these individuals will be the first stop when the trainings begin. For math workshop to be successful, both grade level representatives and administrators will need to be invested in the workshop format being taught, set aside their valuable time to attend several trainings throughout the school year, and be well-versed when teaching math workshop to their respective grade levels.

Chapter Two: Literature Review

Introduction

Achievement data in mathematics, which has been collected in the United States (U.S.), shows that students at the elementary level are not meeting important grade-level requirements before entering the next grade (Ing et al., 2015). Data shows that elementary students in the U.S. are falling behind in mathematics early on in their education and are not catching up once they fall behind (Boaler, 2015). Educators must address the disconnect that is currently taking place in elementary classrooms as it relates to math teaching and learning. This chapter will begin to address this problem by reviewing literature that looks at an alternative teaching and learning method called the Math Workshop Model. The literature reviewed in this chapter demonstrates how to effectively implement math workshop by establishing the components of a workshop lesson. Furthermore, this chapter will clarify how this model has worked when used in other elementary settings. Following the introduction, this chapter will look into the theories and rationale for using the math workshop model in an elementary classroom. The research and evaluation portion of this review will be comprised of the following sub-headings: (1) Current teacher practices, (2) Math workshop overview, (3) Components of the math workshop model, (4) Effective professional development, (5) Benefits of math workshop, and (6) Limitations of the model. Finally, two sections titled "summary" and "conclusion" will reaffirm the overarching themes from this chapter and help lay the framework for why the math workshop model is necessary to be implemented in all elementary buildings within the ABC school district.

Theory/Rationale

Data shows that mathematics teaching and learning need to evolve. Specifically, in the elementary grades, educators and the community as a whole understand that students are not meeting grade-level requirements in mathematics (Carpenter et al., 2015). However, there is little effort to establish change within these educational settings. Mathematical content standards have changed over time, but teaching practices surrounding these standards have not had the same advancement (Polikoff, 2012). These practices are where the larger problem lies.

Math teachers at any level of schooling can be described as either traditionalists, constructivists, or a balance between the two. These two theories offer completely opposite views on how to best teach and learn mathematics. As Boaler (2015) describes, traditionalists are those teachers who believe that more traditional ways of teaching math are most effective for students to learn content. Teaching practices within the traditional theory emphasize that students should be learning math in their own seats while the teacher takes students through a set of identical math problems. This teaching occurs for twenty to thirty minutes by explicitly showing how to solve certain problems. Students in a traditional setting are glued to their seats and math books. Traditionalist views on teaching and learning can be characterized as a more passive teaching approach. This approach defines mathematics teaching and learning in America, and the recent data shows that it is highly ineffective (Boaler, 2015; Carpenter et al., 2015; Sharp et al., 2019). Elementary students learning in a traditional manner not only find it difficult to sit through these types of math lessons, but also have a hard time using math in real life situations.

The constructivist theory takes the opposite perspective when teaching math at the elementary level. Constructivists believe that learners can actively construct their own knowledge with a teacher helping to guide the student, instead of just passively taking information in (Sharp et al., 2019). This theory also looks at math as a subject that needs students to stay curious in order to remain successful. Boaler (2015) writes that constructivists separate themselves from traditionalists by contributing real world problems to class, limiting whole group lessons to ten to fifteen minutes, allowing students to ask and answer questions with their group of peers, and to constantly re-partner or re-group students in order to keep ideas flowing around a classroom. Chiatula (2015) says that this collaborative approach to math instruction helps offer many learning opportunities for students and keeps them engaged by keeping their curiosity high. The math workshop model is one of the instructional strategies that falls under a constructivist approach and looks to keep a student's curiosity in-tact throughout a math lesson. With this in mind, this project and the literature reviewed for this project will be looked at through a constructivist perspective rather than the lens of a traditionalist.

Research/Evaluation

Current Instructional Practices

There are many instructional practices that contribute to the low achievement scores in mathematics. While some are more important to address, they all contribute to the problem. Educators have identified one of these instructional practices as being that students are not taught the “why” behind math concepts. This leaves students feeling anxious due to not understanding why some math concepts work the way they do

(Stylianides & Stylianides, 2007). Furthermore, anxiety makes it more difficult for elementary students to teach the concept to their grade level peers. Studies show that transitioning into teaching is an important step for students to take in order for them to master content, so when students are feeling anxiety surrounding mathematics they are not as effective with mastering the content (Thanheiser et al., 2014).

An absence of quality formative assessments is a second teaching practice that contributes to low achievement scores (Phelan et al., 2011). Researchers have found that there are a couple of reasons why formative assessments are not being used effectively: low quality assessments and teacher limitations regarding the creation and administration of these assessments (Phelan et al., 2011). In other words, teachers have certain limitations such as time constraints, limited background writing effective assessments, and adhering to many other district initiatives, all of which cause low quality formative assessment (Phelan et al., 2011). As a result, teachers and students are not able to identify which concepts a student needs the most support in. Teachers are not able to make instructional decisions based on concrete formative assessment data if there is no formative assessment data being collected. This lack of awareness causes students to fall behind in math and is one of the reasons for low math achievement.

However, the most important instructional practice contributing to the low math achievement is that students are receiving primarily whole group instruction in mathematics instead of instruction tailored to their individual needs (Ing et al., 2015). This type of teaching style is not the preferred method to help students close the mathematical achievement gap and researchers have noticed that whole group math instruction does not allow for much differentiation of learning (Ing et al., 2015). According to Ing et al. (2015),

teachers who use whole group instruction are not correcting misconceptions as readily as a teacher who utilizes small group instruction. Whole group instruction does not allow students to learn from their mistakes prior to taking a standardized assessment.

Teachers not explicitly teaching the "why" behind math, excluding formative assessments from their lessons, and primarily teaching in whole group are common practices that are failing students in the elementary setting. These practices go hand-in-hand in the sense that if a teacher is using one of the practices, it is a good bet that the others are showing up on a regular basis in math lessons. A shift in these practices must occur in order to better meet the needs of elementary students in the area of mathematics.

Math Workshop Overview

In order to better meet the needs of all students and reach the desired state where all students achieve proficiency on math standardized assessments, instructional practices must be closely examined to identify where teachers can make a change. In an effort to make this instructional change, teachers need to be trained in the math workshop model. Sharp et al. (2019) characterizes the math workshop model as a rigorous, student-centered approach that helps foster a sense of curiosity among all learners. The workshop model helps to improve student performance on math achievement tests through the use of effective teaching practices.

Furthermore, the literature is clear that math workshop looks to provide students with time to both experience and observe mathematics in action (Sharp et al., 2019). But, some districts and teachers have shied away from implementing new teaching practices in math due to the financial concerns of adding such a "program." However, it is common

belief that the addition of math workshop to a district's curriculum is a cheap but highly effective option (Suh et al., 2021). One of the most important aspects of the model is that there is no new curriculum that needs to be purchased in order to effectively teach the model. Curriculum can be used and re-designed, lesson by lesson, to match a workshop model (Suh et al., 2021).

The math workshop model consists of four components that will be covered more in depth in the next sub-heading. These components are as follows: (1) whole group instruction, (2) formative assessment, (3) small group instruction, and (4) individual / partner exploration time. It is imperative that when a district, such as the ABC school district, begins to use their curriculum with the math workshop format, that these components be met when teaching each math lesson. Without one of the components the others fail to be as effective (Sharp et al., 2019).

Components of the Math Workshop Model

The first component to show up when teaching a lesson within the math workshop model is a brief whole group instructional period. The goal of this period is to not only attach the lesson to what was previously accomplished, but to start with explicit instruction of the concept being taught (Sharp et al., 2019). When connecting a current lesson to pervious lessons, students begin to realize that concepts taught remain relevant after the conclusion of a lesson. Minetola (2014) shares that this connection helps spark the curiosity of students while also setting up a roadmap for the math lesson. Furthermore, the connection should not stop there. An effective connection also focuses on how the concept being taught can relate to a student's life. Doing this not only keeps the curiosity high, but

also continues to help a student see the relevancy in math. Sharp et al. (2019) writes that while still in whole group, the teacher can now teach a concept with students watching from their seats. This portion of the lesson looks like a traditionalist's view of teaching mathematics with one crucial difference: the length of the whole group lesson. The connection must be limited to one to two minutes, while the remaining explicit instruction taught in whole group is no more than ten minutes. It is during this time that a teacher can focus on teaching the steps to solving problems, strategies for successful math solutions, common misconceptions that he/she sees from year to year, etc. (Soloman et al., 2019).

Following the ten-to-fifteen-minute whole group teaching, instructional practices must now shift into gauging where students are at. Both Thunder (2016) and Turner (2016) write that this will be accomplished in math workshop by providing students with a brief formative assessment that determines student learning from the whole group instructional period. The purpose of including daily formative assessments in mathematics is so that students see how they are learning each day instead of waiting for a summative assessment to show them if they are understanding a certain concept or not. Oftentimes, summative assessments can be too late in showing someone, whether a student or a teacher, how someone is doing with their mathematics learning (Woods, 2022). Furthermore, the formative assessment component may be the most important aspect of math workshop because it not only shows students their understanding, but the formative assessment also gives the teacher a glimpse on how a student is doing and it guides the teacher in making important instructional decisions for the remainder of the workshop lesson components.

Phelan et al. (2011) found that students demonstrated improved understanding of mathematical principles following the administration of common formative assessments (CFA) within the math workshop approach. Teachers were able to administer a quick one to two question CFA and get immediate feedback on the effectiveness of their own teaching strategies. This helped teachers change their teaching strategies to help meet the needs of individual students throughout a math lesson and it often created a more individualized/small group approach for the remainder of the learning. In addition, the added focus on formative assessments showed students where they were performing and helped give them measurable goals when thinking of what they can improve upon each day.

While whole group instruction followed by assessing student learning using a CFA is important for the success of math workshop, oftentimes it is what a teacher does with this information that makes a difference in teaching and learning. Literature is clear that students benefit from being re-grouped into small groups depending on the information from the CFA data that the teacher can gather (Sharp et al., 2019; Ing et al., 2015). This small group, or sometimes individualized approach, is solely based on the misconceptions or strengths that the teacher identifies in the CFA data. A teacher can help individualize the approach through these small groups, rather than continuing a lesson in a whole group format (Sharp et al., 2019).

The observational study conducted by Ing et al. (2015) identified that when providing small group instruction to elementary aged students, the strongest practices that promoted growth between the pre and post tests were when teachers understood both the cognitive and socio-culture aspects of instructing a small group. The specific strategies that

relate to student success was teacher prompting student engagement and thinking throughout a small group lesson. This strategy relates to the cognitive aspect of a small math group. On the other hand, a strategy that helps meet the socio-culture need is for teachers to support and promote students engaging in mathematical discussion with one another.

Furthermore, Jacob et al. (2020) recognized when teachers provided small group instruction in this study, students gained valuable time with the teacher and were not able to sit back without participating in the math lesson. In addition, Phelan et al. (2011) demonstrates that after the administration of formative assessments students can be placed into small groups based on their individual needs. The students were able to get small group support for areas that they showed that they needed support in. Teachers were able to further identify which students needed extra support due to the small group format and were able to give that extra support on a lesson-by-lesson basis because of the small group component.

The final component of math workshop is individual / partner exploration. Sharp et al. (2019) write that this exploration period is characterized as time for students to dive deeper into their specific concept that was learned during that lesson by working independently or with a partner on different mathematical problems. Oftentimes, this component of the workshop model is not the last one to occur as it can be intertwined with the small-group component to keep the entire class engaged while the teacher is working with one specific group of students. Common problems / tasks that can be provided by the teacher during this individual exploration time can be implementing the district provided curriculum math journal or math pages, a district purchased online math program, a

teacher provided problem that engages the students further, or a critique of reasoning. Ing et al. (2015) characterize the critique of reasoning as the most important addition to partner exploration as it is one where students discuss solutions to a problem and explain their reasoning behind their work. This allows students to really evaluate their strategies and engage in the strategies of their peers.

Effective Professional Development

Chen et al. (2014) writes that an effective professional development (PD) plan will instill confidence in its teachers. Furthermore, PD is not just about increasing knowledge because knowledge in and of itself will not ensure a successful PD plan. A shift in practice from current teaching practices to the math workshop model will not take place unless effective PD is conducted within the ABC school district. The literature reviewed demonstrates the importance of continuous PD that not only gives teachers the confidence to use math workshop, but also teaches them more than just knowledge (Chen et al., 2014; Chiatula, 2015; Feldman et al., 2020; Gee & Whatley, 2016; Ginsberg et al., 2014; Minetola et al., 2014; Powell, 2012; Sharp, 2019; Suh et al., 2021; Turner et al., 2016).

Having a clear focus and vision is the number one indicator for success with a PD plan. This direct focus needs to be on best math workshop practices and not just shoveling knowledge at teachers (Ginsberg et al., 2014). Once a clear vision is provided, the path is clear to begin providing teachers with mathematical knowledge that is important for them to know. This knowledge will change at each grade level, but research shows that teachers need to be aware of what they are teaching and the scope and sequence of their lessons.

Setting up time to establish knowledge surrounding the mathematical academic standards will help ensure PD success (Chiatula, 2015; Feldman et al., 2020).

Additionally, PD in the content area of mathematics is most successful when districts or universities take a lesson study approach. This approach looks at other teachers who are teaching a successful workshop model. Lesson study is oftentimes used in PD by providing videotaped lessons or transcripts of lessons to the teachers who are engaged in its learning (Chen et al., 2014; Chiatula, 2015; Gee & Whatley, 2016; Suh et al., 2021). Finally, a successful PD needs to allow for actual field experience. This means that teachers need to be able to work on their craft over the course of a PD plan. It is important for districts to continuously come back to math workshop over the course of a few years to check-in and allow teachers to collaborate surrounding this learning. Teachers, like students, need to try, fail, and have time to learn from their mistakes (Chiatula, 2015; Ginsberg et al., 2014; Turner et al., 2016).

Benefits of Math Workshop

Through researching the math workshop model, it is clear that when the model is applied with fidelity that student achievement is positively impacted. Several studies show quantifiable increases in student mathematical achievement when a few, or all, of the math workshop components are enacted in an elementary classroom (Boaler, 2015; Carpenter et al., 2015; Gee & Whatley, 2016; Ing et al., 2015; Jacob et al., 2020; Lewis & Weixler, 2019; Melhuish et al., 2020; Sharp et al., 2019). Students benefit while learning within the workshop model by remaining curious and engaged through differentiated learning. They learn misconceptions that are occurring and strategies for how to fix these mistakes.

Furthermore, students and student thinking are readily available from student to student. This allows for students to partner up, work together, and demonstrate effective strategies to each other (Boaler, 2015; Carpenter et al., 2015; Gee & Whatley, 2016; Sharp et al., 2019). The benefits stretch beyond student benefits, as teachers reap the rewards of teaching within the workshop model. Studies provide proof that the workshop model allows teachers to better understand where students are learning and make changes within a workshop lesson. Teachers see the improved achievement scores and gain a confidence that they have never had when teaching mathematics (Boaler, 2015; Sharp et al., 2019).

Limitations of the Model

The research establishes that the math workshop model is an effective approach to increasing student success in elementary mathematics. This approach is one that helps students gain confidence in math; however, there are limitations to the model (Boaler, 2015; Chiatula, 2015; Gee & Whatley, 2016; Sharp et al., 2019). A school district's approach to PD and the role that it plays in establishing a successful math workshop may be a limitation when looking at the research. Chiatula (2015) and Gee and Whatley (2016) concluded that the best approach to PD is to provide teachers with a lesson study. These studies showed that the districts that did not provide a lesson study approach did not have as effective student outcomes following the PD cycle. The second limitation that is evident in several studies is that districts must be consistent and implement math workshop with fidelity. In doing so, math workshop is an effective model; however, it can quickly change to a more traditional approach if teachers do not implement all components of the model and identify the most important components of this model. Both an effective PD plan and

implementation with fidelity go hand-in-hand, so if one is missing it is probable that the other is too (Boaler, 2015; Sharp et al., 2019).

Summary

Achievement data shows that current approaches to teaching and learning math are not effective. Standardized testing scores show that mathematics education in the U.S. is struggling to keep pace with other developed nations (Boaler, 2015). As the content standards surrounding mathematics have changed over time in an effort to remedy this issue, the problem of low student achievement still remains. School districts now have to shift their focus and begin looking at teaching practices to identify where the true problem is occurring. A traditional perspective on teaching mathematics is one that focuses on the teacher providing his/her students with knowledge, teaching primarily in whole group, and hoping that students memorize concepts along the way. This perspective is still used today when teaching elementary students; however, it is this perspective that contributes to low math achievement (Boaler, 2015; Feldman et al., 2020; Polikoff, 2012). The research supports shifting from this traditional perspective of teaching math towards a constructivist perspective where students actively construct their own knowledge with a teacher helping to guide the student along the way. Constructivists keep students engaged by limiting whole group lessons, while maximizing real world problems and small group, partner work, and formative assessments (Boaler, 2015; Sharp et al., 2019).

Current traditional practices like whole group math instruction, not teaching the "why" behind mathematics, and lack of quality formative assessments have plagued math teaching/learning (Sharp et al., 2019; Boaler, 2015). It is important for districts to leave

these practices in the past and move towards constructivist practices such as the math workshop model. This model is a student-centered approach that keeps curiosity alive in students. Furthermore, studies conducted involving math workshop show increased improvement on math achievement tests compared to students learning from a traditional teaching style. The four balanced components (whole-group instruction, formative assessment, small-group engagement, and individual exploration time) help to not only explicitly teach math content to students, but also show the teacher where misconceptions are taking place (Sharp et al., 2019). Along the way, students remain engaged in lessons due to the differentiated nature of the lesson instruction and students gain confidence in mathematics as their curiosity soars.

The Math Workshop Model is an effective way to increase student achievement in math; however, districts like ABC public must establish a PD plan that will successfully implement the workshop model. Research shows that a PD plan needs to be continuous and give teachers the confidence to use the workshop model. A clear focus and vision established by the district is a top indicator for PD success (Chen et al., 2014; Chiatula, 2015; Feldman et al., 2020; Gee & Whatley, 2016; Ginsberg et al., 2014; Minetola et al., 2014; Powell, 2012; Sharp, 2019; Stipek, 2013; Suh et al., 2021; Turner et al., 2016). Further, it is imperative that teachers have a strong content knowledge for what they will be teaching and understand the scope and sequence of the lessons (Chiatula, 2015; Feldman et al., 2020). Studies show that with PD targeting math workshop, having a clear vision and strong content knowledge are only part of the PD plan. A lesson study approach provides videotaped lessons or transcripts of lessons to teachers who are engaged in PD (Chen et al., 2014; Chiatula, 2015; Gee & Whatley, 2016; Suh et al., 2021). This approach

has proven to be effective to teachers learning to implement math workshop, and it must be used when providing PD training to the ABC school district.

Conclusions

These studies conducted by Boaler, Carpenter et al., Gee & Whatley, Ing et al., Jacob et al., Lewis & Weixler, Melhuish et al., and Sharp et al. provide the distinct components of the math workshop model. Furthermore, these studies show evidence that this model elicits student growth based on increased formative assessment data. Many teachers currently teach in a traditional style and are not effectively engaging their students in mathematics, so PD training in math workshop must be the next step to move from this traditional approach to a constructive approach.

Math workshop places a greater focus on four components of a lesson instead of only teaching in whole group. The explicit instruction, usually taught in whole group, is a much shorter part of the math workshop model. This is time for teachers to engage their students and quickly teach them strategies to solve the content that they are working on for a lesson. Formative assessments must be readily available and use each day so that teachers can identify student successes and/or mistakes. Doing this helps teachers move toward small group instruction. This component, while teamed with effective teacher strategies, will become an effective tool for teachers and will drive students further in their learning. The final component, individual or partner exploration, allows students to actively learn and discuss math concepts with each other. These discussions show students other ways to solve problems and help create confidence in an elementary classroom.

For the ABC school district to move toward implementing the Math Workshop Model, they will need an effective PD plan put in place that teaches the important components to math workshop. The project created in Chapter Three will put a plan in place for math workshop to be used by teachers in ABC schools. This plan will demonstrate the components of math workshop and outline the implementation of workshop PD. Furthermore, the project described in Chapter Three will demonstrate how to collect and use formative assessment data to group students, and teaching strategies that promote and support active student engagement once in small groups. By moving toward the math workshop approach, ABC school district can ensure that students feel confident in math and that student achievement improves.

Chapter Three: Project Description

Introduction

Low achievement scores on standardized math assessments make it clear that there are issues surrounding the current teaching/learning practices being used in elementary schools. These low scores also exist in the ABC Public School District with the majority of students not meeting grade level expectations before moving to the next grade. Research supports the implementation of The Math Workshop Model as one solution for this problem. The goal of this project is to position the ABC School District for success in mathematics by implementing a professional development plan that introduces teachers to The Math Workshop Model within the district's elementary schools. Chapter Three will be organized into the following headings: (1) Project Components, (2) Project Evaluation, (3) Project Conclusions, and (4) Plans for Implementation. Throughout each of these headings, the appendixes will be referenced as a means to establish the components of this entire project. The appendixes include (A) District Assessment and Tracking System, (B) Student Workshop Survey, (C) Teacher Workshop Survey, (D) Math Representative Team Survey, (E) Math Resources Survey, (F) Common Core State Standards, (G) Math Workshop Diagram, (H) Formative Assessments K-5, (I) Professional Development Calendars, (J) Workshop Professional Development Slideshow, and (K) Sample Teacher Script.

Project Components

Increasing student achievement in mathematics through a shift in teaching practices is a difficult process that does not just happen all at once. It is important to consider not only the content teachers will teach, but the process they will use to teach it. For example,

Sharp et al. (2019) identified the importance of teachers understanding the components of the math workshop model, but equally as important are the resources needed for teaching workshop, training incoming staff, setting up a continuous professional development (PD) plan, and tracking the data that surrounds math workshop. These factors create a successful project; furthermore, these factors establish success with the math workshop model. When creating and implementing this project, it is important to craft resources that consider each of these factors.

The first part of this project establishes leadership/representative teams. Teachers in the ABC District who demonstrate math instruction as one of their passions are encouraged to complete the math representative survey (see Appendix D). This survey will be used to find two math representatives from each grade level who will first learn about math workshop and eventually teach math workshop to the remainder of the grade level teachers as according to the PD plan (see Appendix I). Gee and Whatley (2016) assert that an important aspect of successful professional development is to get teachers engaged in leading the PD. Doing this allows for teachers to take ownership of the program and helps other teachers to see how it can actually play out within an elementary classroom. Establishing these teams is one of the most important components that cannot go overlooked. It is recommended that a district conducts interviews of candidates who fill out the math representative team survey (see Appendix D) and compensates the individuals who are selected based on the given district's contractual language for merit pay. This will help attract teachers to the team and reward them for their work on the team.

The next component of this project sets up a PD plan that will be used by the ABC School District (see Appendix I). This overview shows a calendar for 2023-2024 PD and it

describes what will be learned at each session. The goal of an effective PD plan is to have it led by teacher representatives and to make it continuous (Gee & Whatley, 2016; Turner et al., 2016). This project does just that by laying out an entire PD plan that continues past a single school year. Furthermore, Gee and Whatley (2016) describe the importance of training new staff in the curriculum that is already being taught within a given district. This project includes new teacher trainings which are listed in Appendix I. This would train new staff in the math workshop approach each year.

Part of this effective PD plan (see Appendix I) is to provide the grade-level representatives with quality resources to help them teach the workshop model to the rest of their grade-level teams. Appendices F, G, and J will help these representatives navigate the PD sessions. This project includes links to the Common Core State Standards in mathematics so that teachers can access these standards when identifying what it is that their students need to learn throughout a given year (see Appendix F). Furthermore, a math workshop diagram has been created to give teachers a glimpse at the vision of what the workshop will look like on any given day (see Appendix G). It is evident that establishing a vision and clear focus is how effective PD begins (Minetola et al., 2014). The Workshop PD slideshow is one last resource that can help this PD plan flourish (see Appendix J). Presenting this slideshow will help all teachers understand the steps that the district is taking to improve outcomes for its elementary math students.

A separate section of this project is establishing the components within the math workshop model. This is first met by providing teachers with the necessary resources to teach each component. The Math Resources Survey (see Appendix E) takes inventory of what each elementary teacher has in terms of math resources. Taking this survey will show

the district where needs are and it will allow the district to meet these needs prior to the launch of the workshop. Once teachers have resources to teach math in the workshop model, it is time for them to understand the components of the workshop model. An overview of these components is found in Appendix G; however, a more in-depth look into these components exists in the PD slideshow (see Appendix J) and formative assessments K-5 (see Appendix H). Each of these resources looks at how math workshop is broken down as identified in Chapter Two. In addition, examples of formative assessments are provided (see Appendix H) so that teachers can have examples to work from when creating a formative assessment bank. Providing these formative assessments is the most important way for teachers to gain an understanding of where their students are learning and what the next steps must be (Phelan et al., 2011).

The final component that is addressed in this project is establishing a means to evaluate the workshop as a whole. This evaluation starts in Appendix C with a teacher survey. The teacher survey on Google Forms allows for teachers to express to the district their own views of math workshop. As the PD calendar shows (see Appendix I), teachers will take this survey before the 2023-2024 school year and then again after the conclusion of the year. Doing this allows for the district to hear from its teachers about their own perceptions. This self-assessment also gives teachers a sense of voice and ownership in the PD process which is important when considering teacher buy-in (Gee & Whatley, 2016).

Students who attend the ABC School District will also complete a self-assessment survey (see Appendix B). This survey is broken into two grade-level chunks of K-1 and 2-5, and it will be administered by teachers two times during the year (see Appendix I). Similar to how teachers want to feel included in the process, the district needs to get buy-in from

students. Also, the district can gauge how the student base feels about math at the start and after the conclusion of the 2023-2024 school year. Taking these surveys and collecting the data from them will allow the district to see if perceptions surrounding math have improved (Boaler, 2015).

During the teaching of every math lesson, a formative assessment like the ones provided in Appendix H will be given to students. These formative assessments are tools that can help teachers constantly evaluate how lessons are going and show if students are meeting grade-level standards as identified in Appendix F. Furthermore, teachers can gain valuable data from these assessments and provide students with more individualized learning within the small group component of math workshop (see Appendix G and I).

Finally, the overall goal of this project is to improve learning outcomes for students in the ABC School District. One way to achieve this goal is to demonstrate improved achievement scores on district and state/national standardized assessments. ABC Schools must have a means to take in and track this data so that the district can see if progress is being made. This project creates a district assessment and tracking system that tracks pre- and post- assessment data from all nine mathematics units that K-5 students work through (see Appendix A). Further, this spreadsheet tracks NWEA Fall, Winter, and Spring scores. All of this data will show if a student is making considerable progress throughout the year, and it can be paired with MSTEP data at the conclusion of the year to see if students are closing gaps and meeting grade-level requirements. When engaging with a PD plan like the one created in this project, it is important that the plan includes a way to track data so that the workshop model can be evaluated for its effectiveness across the entire district (Gee & Whatley, 2016; Phelan et al., 2011).

Project Evaluation

In an effort to evaluate the effectiveness of the Math Workshop Model within the ABC School District, data from district math assessments as well as state/national assessments (MSTEP and NWEA) must be tracked with intentionality. This project establishes Appendix A which is a data tracking spreadsheet for pre- and post- assessments for each math unit. Furthermore, this spreadsheet tracks each students Fall, Winter, and Spring scores on the NWEA so that teachers and administrators have a one stop shop for all of the district math data. Whereas the ABC District will use the spreadsheet identified in Appendix A, other districts may create other means for tracking assessment data. The important factor for evaluating the effectiveness of math workshop is that something is put in place to identify if students are making true progress to help them meet grade level expectations.

Phelan et al. (2011) write of the importance of tracking all assessment data as a means to evaluate an effective math workshop program. This assessment data includes district, state, and national assessments as described above, but it also includes survey data that can be collected by the district. Appendices B and C establish district surveys that will go out to students and teachers at the beginning of the year, prior to math workshop being implemented. Following one year of math workshop, these same individuals will receive the same surveys to see if the culture surrounding math instruction has changed within the district. This will help evaluate how effective math workshop has been in changing perspectives and beliefs on how to best teach and learn mathematics in an elementary classroom.

One final way to evaluate the effectiveness of this math workshop project within the ABC School District is for teachers to use the formative assessment examples found in Appendix H. All elementary teachers are able to see a student grow from the start of a lesson to the conclusion of a lesson by using these formative assessments. Furthermore, the formative assessment bank that the district creates during the professional development overview (see Appendix I) helps to supply teachers with the necessary assessments to teach math workshop. Students' growth within a lesson (or lack thereof) can be an effective evaluative indicator for workshop success.

Project Conclusions

Test scores show that students are not understanding and applying mathematical concepts that they are learning in elementary school. These standardized scores show that less students are meeting proficiency in the academic standards than five years ago. This downward trend in proficiency achievement has educators and parents worried that there is a problem with the way schools in the United States (U.S.) are teaching/learning mathematics. With this problem placed at the forefront of math education, the need for districts to implement strategies to improve achievement scores has increased. School districts like the ABC Public School District must enact The Math Workshop Model in order to improve teaching strategies, and ultimately improve the learning outcomes for students.

The research outlined in Chapter Two demonstrates the benefits of using The Math Workshop Model in elementary classrooms as it provides students more individualized supports rather than whole group instructional practices (Jacob et al., 2020). The consistent formative assessments provided in the workshop approach help teachers continually evaluate a student's performance, and it allows the students to do the same.

Transitioning into small group work as a means to reteach concepts and providing students the opportunity to explore each mathematical concept during the exploration period helps create a sense of curiosity around math. It provides students not only with the knowledge needed to be successful but also the confidence in each concept needed to improve achievement (Phelan et al., 2011). However, in order to implement such a plan, a continuous professional development plan that focuses on lesson study must be provided to every elementary teacher (Suh et al., 2021). Such an implementation is not easy, but it is within reach when the right action plan is in place.

Following this research is a big task but a necessary one for the ABC School District. Systems must be put in place that support an effective math workshop rollout. This includes a continuous professional development plan that puts a focus on math teaching and learning. The overall goal must be to increase achievement of all students so that they are meeting grade-level standards prior to moving to the next grade. If this project is implemented properly, students can reap the rewards on increased achievement, and teachers will find their students to be more engaged in their own learning within the workshop model.

Plans for Implementation

The purpose of this project is to provide the ABC School District with a professional development outline and several resources that will help enable a successful math workshop rollout. Furthermore, this project has the ability to be adapted to any district wanting to implement the workshop model. All of this has been created in an effort to help students meet proficiency in mathematical standards before moving to the next grade level.

However, an effective implementation must have everyone heading towards the same goal. It is imperative that district administrators and the board of education use the research provided in Chapter Two and understand the background of the problem in Chapter One. With this, implementing math workshop can begin if all stakeholders have a clear understanding of where math instruction currently stands and the vision for the future.

Once leaders within the district have this understanding, it is important to establish a plan to train and develop staff within the district (see Appendix I). The professional development (PD) outlook found in Appendix I can be used directly with the ABC School District but can also be changed to meet the PD needs of any district. The first step after developing a PD plan is to identify teacher leaders that have the same passions and visions for math instruction. This can be done by administering the math representative team survey found in Appendix D. The math representative team will consist of two teacher leaders from each grade level that will not only represent the grade level, but eventually teach the other teachers at that grade level the components of an effective math workshop.

After the professional development planning and choosing a representative team of teachers, it is important that data is collected before the implementation of math workshop. Appendixes B (student survey), C (teacher survey), and E (resource identification survey) will help the district collect the necessary data to see the culture surrounding math education prior to implementing the workshop model, and it will guide the district in purchasing the necessary resources for a successful workshop. These surveys will be emailed to the entire elementary teaching staff at the dates listed in the professional development plan (see Appendix I).

After the surveys and initial data is collected, teachers will work through the professional development plan during the 2023-2024 school year (see Appendix I). Teachers will first identify the standards that are necessary for their students to learn (see Appendix F) and then move into understanding the components of an effective workshop (see Appendices G, H, and J). All of this information will be introduced to the teachers at the first three PD dates and the representatives will be leading these PD sessions. Included in these sessions will be dissecting the data collections system as identified in Appendix A. It is important to evaluate the effectiveness of the math workshop model within the ABC School District, so this appendix will help with that evaluation. Teachers will include data from each unit assessment and from state and national assessments like the MSTEP or NWEA.

As teachers move through the 2023-2024 school year, they will have time provided to them to create formative assessments to use during the current school year and for future years. This is an important step, as it establishes a place for teachers (including incoming staff) to find formative assessments that match each standard. Teachers will have the opportunity to pull from this assessment bank for each of their math workshop lessons in an effort to gauge how students are doing and to help aide in creating small groups.

Lastly, teachers will conclude the school year by administering and completing the same surveys listed in Appendixes B and C. This is one last self-assessment that will provide data to the ABC School District on the effectiveness of changing the culture surrounding math instruction. The school district will also be able to see assessment data as recorded by each teacher (see Appendix A). These three data tracking pieces are every bit as important toward a successful implementation as the others. The district must notice

positive change in student outcomes in order to identify the success or failures of this workshop. It is recommended that the district re-evaluates its practices after one year and conducts further research into effective practices of both continuous PD and math workshop. Furthermore, it is recommended that districts use this project and its resources in a way that best fits their needs, yet keeps the components of math workshop and successful PD intact.

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Appendix A

District Assessment Tracking Spreadsheet (Pre-test / Post-test)

Created by Jonah Zimmerman

The district assessment tracking spreadsheet is created in google spreadsheets. Each grade level can enter data into the sheet to track student progress throughout the year. An example of this spreadsheet is shown below.

LAST NAME	FIRST NAME	Everyday Mathematics Unit																		NWEA Scores		
		Pre U1	Post U1	Pre U2	Post U2	Pre U3	Post U3	Pre U4	Post U4	Pre U5	Post U5	Pre U6	Post U6	Pre U7	Post U7	Pre U8	Post U8	Pre U9	Post U9	Fall	Winter	Spring
Teacher Name																						
Student 1																						
Student 2																						
Student 3																						
Student 4																						
Student 5																						
Student 6																						
Student 7																						
Student 8																						
Student 9																						
Student 10																						
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Student 11																						
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Student 13																						
Student 14																						
Student 15																						
Student 16																						
Student 17																						
Student 18																						

Appendix B

Student Pre- & Post- Workshop Survey

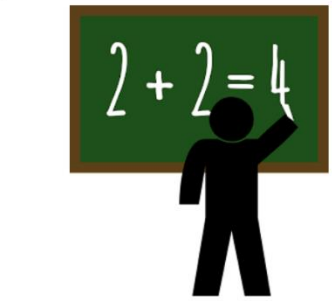
Created by Jonah Zimmerman

Student Survey Grades K-1

Student Survey: Math Workshop

This survey will be given to students K-1st at the beginning of the 2023-2024 school year before receiving instruction within the math workshop model. This same survey will then be administered at the end of the year for K-1st students after learning within the math workshop model.

What do you like most?

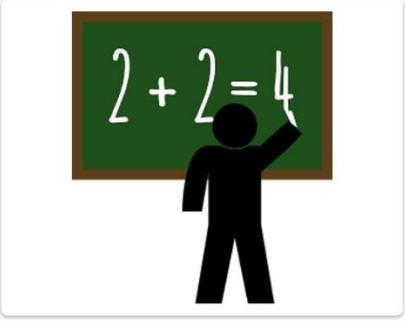


○ Math

○ Reading

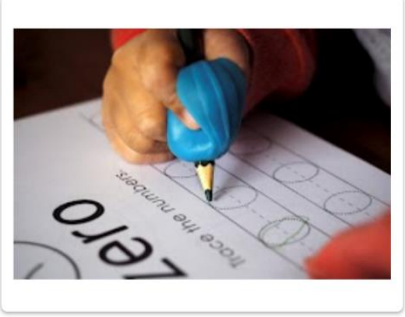
○ Writing

What are you best at?



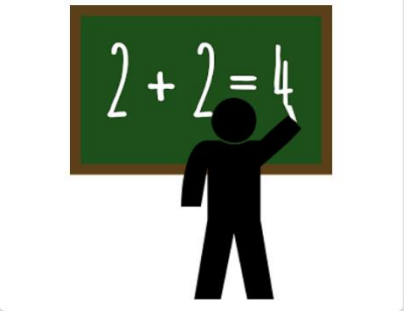
Math

Reading



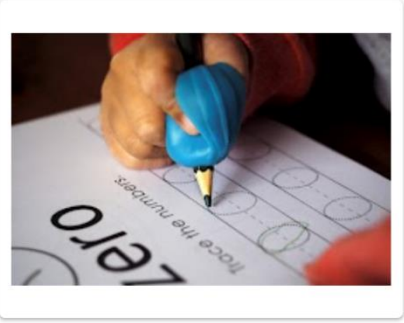
Writing

I'm most nervous during



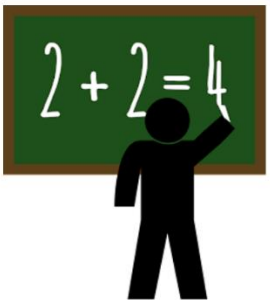
Math

Reading



Writing

I am most bored during



Math

Reading

Writing

Student Survey Grades 2-5

I've invited you to fill out a form:

Student Survey: Math Workshop

This survey will be given to students 2nd-5th at the beginning of the 2023-2024 school year before receiving instruction within the math workshop model. This same survey will then be administered at the end of the year for 2nd-5th students after learning within the math workshop model.

Which of these subjects do you like the most in school?

- ○ Math
- ○ Reading
- ○ Writing

Which of these subjects do you feel most confident in?

- ○ Math
- ○ Reading
- ○ Writing

Which of these subjects makes you feel the most nervous?

- ○ Math
- ○ Reading
- ○ Writing

Which of these subjects is the most boring?

- ○ Math
- ○ Reading
- ○ Writing

What do you like most about math class?

What do you like least about math class?

Check all that apply: How do you learn math the best?

- ☐ As a whole group with the teacher
- ☐ As a small group with the teacher
- ☐ One-on-one with the teacher
- ☐ By working with a partner

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Appendix C

Teacher Pre- & Post- Workshop Survey

Created by Jonah Zimmerman

Teacher Survey

Teacher Survey: Math Workshop

This survey will be given to all K-5 teachers at the beginning of the 2023-2024 school year before professional development within the math workshop model. This same survey will then be administered at the end of the year for the same teachers after professional development opportunities and following a year teaching within the math workshop model.

Which of these subjects do you like teaching most?

- ◯ Math
- ◯ Reading
- ◯ Writing

Which of these subjects do you feel least confident in teaching?

- ◯ Math
- ◯ Reading
- ◯ Writing

What do you like most about teaching math?

Your answer

Describe in one word your feelings towards math

Your answer

Write down what you perceive as an effective math lesson?

Your answer

Answer the following prompt: What does your math lesson look like from day-to-day?

Your answer

What do you like least about teaching math?

Your answer

What does 'math workshop' mean to you?

Your answer

Check all that apply: How is math taught the most effectively?

- [ ] As a whole group with the teacher
- [ ] As a small group with the teacher
- [ ] One-on-one with the teacher
- [ ] By having students work with a partner

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Appendix D

Math Representative Team Survey

Created by Jonah Zimmerman

Representative Team Survey

Math Grade Level Representative

Please answer the following questions to determine if you are a fit for our Grade Level Math Representatives.

Are you interested in joining our math representative team?

- (●) Yes!
- ( ) Maybe
- ( ) No

How would you describe math instruction?

- (●) As a passion of mine.
- ( ) As something that needs changed in our district.
- ( ) As a subject that needs curriculum change.
- ( ) As a subject that I am not as familiar with.

Are you okay with missing two-three days for PD trainings if you are selected as a math representative for your respective grade level.

- (●) Yes
- ( ) No
- ( ) Maybe

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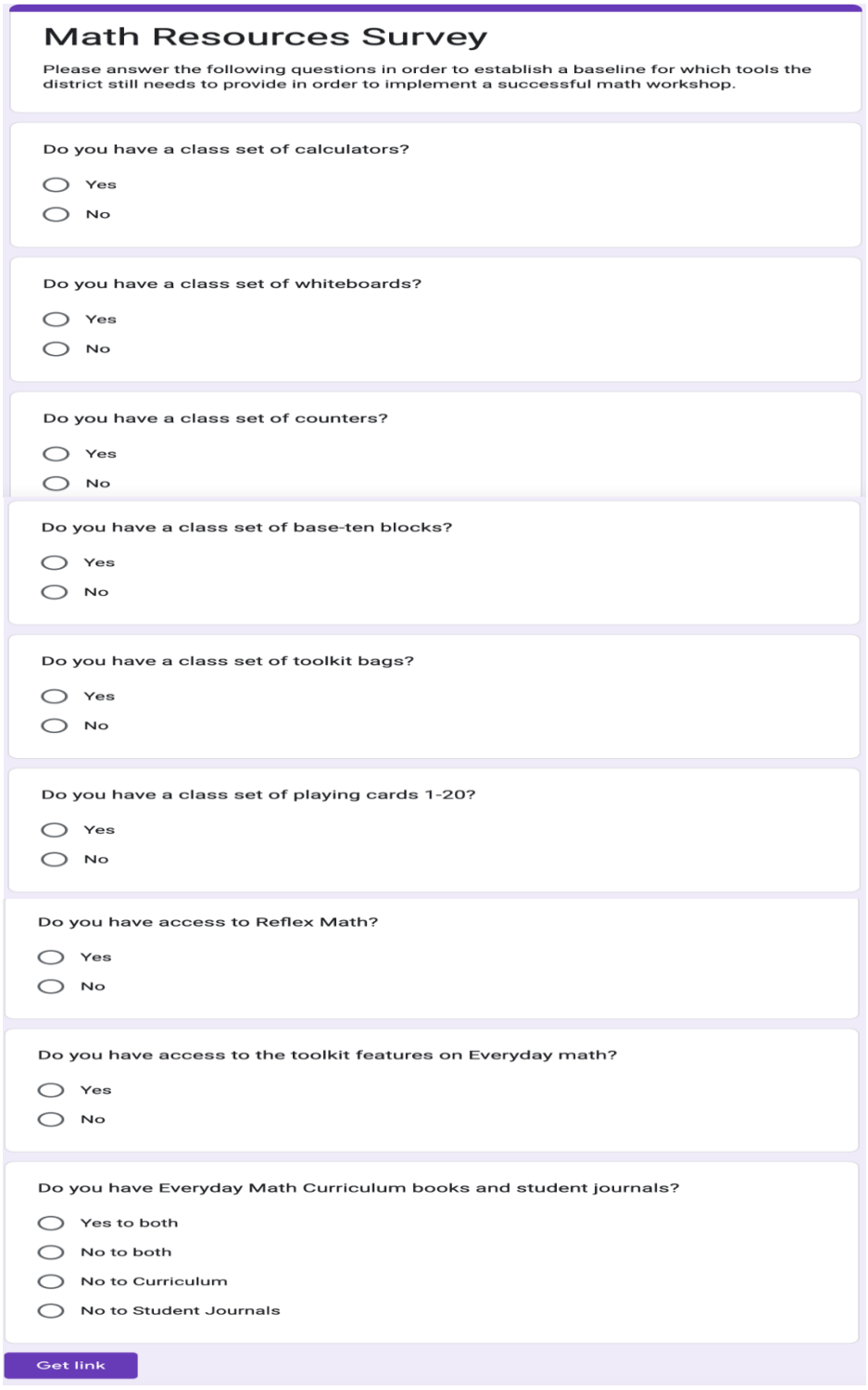
Appendix E

Math Resources Survey

Created by Jonah Zimmerman

Math Resources Survey



Math Resources Survey

Please answer the following questions in order to establish a baseline for which tools the district still needs to provide in order to implement a successful math workshop.

Do you have a class set of calculators?

- Yes
- No

Do you have a class set of whiteboards?

- Yes
- No

Do you have a class set of counters?

- Yes
- No

Do you have a class set of base-ten blocks?

- Yes
- No

Do you have a class set of toolkit bags?

- Yes
- No

Do you have a class set of playing cards 1-20?

- Yes
- No

Do you have access to Reflex Math?

- Yes
- No

Do you have access to the toolkit features on Everyday math?

- Yes
- No

Do you have Everyday Math Curriculum books and student journals?

- Yes to both
- No to both
- No to Curriculum
- No to Student Journals

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Appendix F

Common Core Math Standards k-5

For math workshop to be effective, a teacher must be well immersed in understanding the common core state standards for mathematics. These standards are linked here. Furthermore, a direct link to specific grade levels is also included below:

Kindergarten

First Grade

Second Grade

Third Grade

Fourth Grade

Fifth Grade

The following page demonstrates the importance of focusing on the mathematical standards set up in the common core. This is the home page for the common core standards and is the "home base" to find all academic standards for math k-12.

Mathematics Standards

DOWNLOAD THE STANDARDS PRINT THIS PAGE

For more than a decade, research studies of mathematics education in high-performing countries have concluded that mathematics education in the United States must become substantially more focused and coherent in order to improve mathematics achievement in this country. To deliver on this promise, the mathematics standards are designed to address the problem of a curriculum that is "a mile wide and an inch deep."

These new standards build on the best of high-quality math standards from states across the country. They also draw on the most important international models for mathematical practice, as well as research and input from numerous sources, including state departments of education, scholars, assessment developers, professional organizations, educators, parents and students, and members of the public.

The math standards provide clarity and specificity rather than broad general statements. They endeavor to follow the design envisioned by William Schmidt and Richard Houang (2002), by not only stressing conceptual understanding of key ideas, but also by continually returning to organizing principles such as place value and the laws of arithmetic to structure those ideas.

In addition, the "sequence of topics and performances" that is outlined in a body of math standards must respect what is already known about how students learn. As Confrey (2007) points out, developing "sequenced obstacles and challenges for students…absent the insights about meaning that derive from careful study of learning, would be unfortunate and unwise." Therefore, the development of the standards began with research-based learning progressions detailing what is known today about how students' mathematical knowledge, skill, and understanding develop over time. The knowledge and skills students need to be prepared for mathematics in college, career, and life are woven throughout the mathematics standards. They do not include separate Anchor Standards like those used in the ELA/literacy standards.

The Common Core concentrates on a clear set of math skills and concepts. Students will learn concepts in a more organized way both during the school year and across grades. The standards encourage students to solve real-world problems.

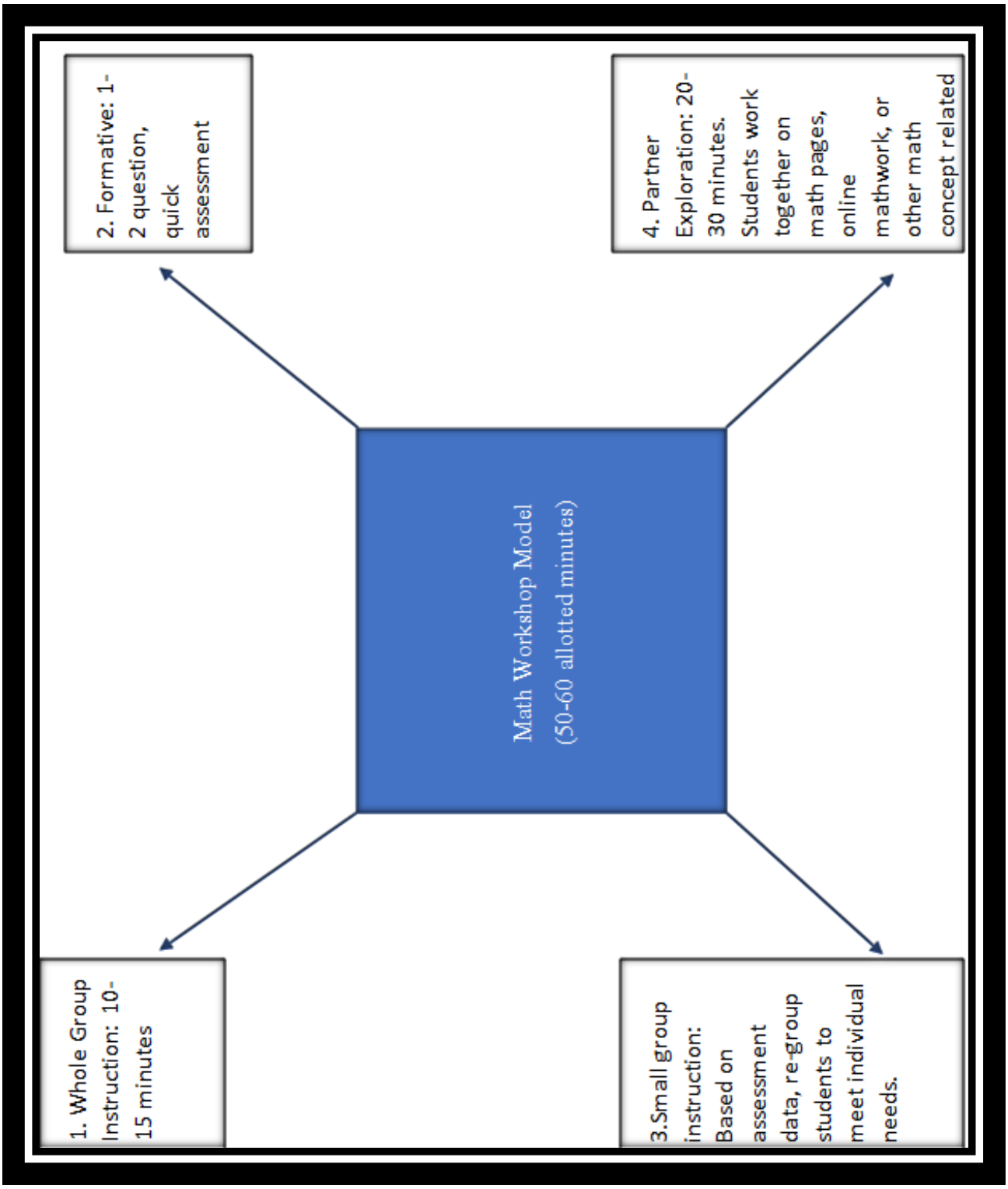
Understanding Mathematics

These standards define what students should understand and be able to do in their study of mathematics. But asking a student to understand something also means asking a teacher to assess whether the student has understood it. But what does mathematical understanding look like? One way for teachers to do that is to ask the student to justify, in a way that is appropriate to the student's mathematical maturity, why a particular mathematical statement is true or where a mathematical rule comes from. Mathematical understanding and procedural skill are equally important, and both are assessable using mathematical tasks of sufficient richness.

Appendix G

Math Workshop Components Diagram

Created by Jonah Zimmerman


Math Workshop Model
(50-60 allotted minutes)
1. Whole Group Instruction: 10-15 minutes
2. Formative: 1-2 question, quick assessment
3.Small group instruction: Based on assessment data, re-group students to meet individual needs.
4. Partner Exploration: 20-30 minutes. Students work together on math pages, online mathwork, or other math concept related

Appendix H

Formative Assessment Examples: K-5

Created by Jonah Zimmerman

Kintergarten Formative Assessment Example

Standard Taught:

CCSS.MATH.CONTENT.K.CC.A.3

Write numbers from 0 to 20. Represent a number of objects with a written numeral 0-20 (with 0 representing a count of no objects).

1. How many bees are there?

____ bees

2. How many funny chickens are there?

____ funny chickens

First Grade Formative Assessment Example

Standard Taught:

CCSS.MATH.CONTENT.1.OA.D.7

Understand the meaning of the equal sign, and determine if equations involving addition and subtraction are true or false. For example, which of the following equations are true and which are false? 6 = 6, 7 = 8 - 1, 5 + 2 = 2 + 5, 4 + 1 = 5 + 2.

1. Circle which equation is true.

6 = 6

7 = 8

5=9

2+3=6

2. Cross off the equal sign for equations that are false.

5+1=6

1+1=2

3=5

1+4=6

Second Grade Formative Assessment Example

Standard Taught:

CCSS.MATH.CONTENT.2.NBT.A.1

Understand that the three digits of a three-digit number represent amounts of hundreds, tens, and ones; e.g., 706 equals 7 hundreds, 0 tens, and 6 ones. Understand the following as special cases:

1. 526

___hundreds

___tens

___ones

2. 317

___hundreds

___tens

___ones

3. 702

___hundreds

___tens

___ones

Third Grade Formative Assessment Example

Standard Taught:

CCSS.MATH.CONTENT.3.NBT.A.1

Use place value understanding to round whole numbers to the nearest 10 or 100.

1. What is 77 rounded to the nearest 10?

   _____

2. What is 25 rounded to the nearest 10?

   _____

3. What is 61 rounded to the nearest 10?

   _____

Third Grade Formative Assessment Example (Continued)

Standard Taught:

CCSS.MATH.CONTENT.3.NBT.A.1

Use place value understanding to round whole numbers to the nearest 10 or 100.

1. What is 77 rounded to the nearest 100?

   _____

2. What is 131 rounded to the nearest 100?

   _____

3. What is 389 rounded to the nearest 100?

   _____

Fourth Grade Formative Assessment Example

Standard Taught:

CCSS.MATH.CONTENT.4.NBT.B.4

Fluently add and subtract multi-digit whole numbers using the standard algorithm.

1.) Add

89	136	237	611
+ 56	+ 34	+ 315	+ 389

2.) Subtract

45	73	168	431
- 7	- 26	- 103	- 97

Fifth Grade Formative Assessment Example

Standard Taught:

CCSS.MATH.CONTENT.5.OA.A.1

Use parentheses, brackets, or braces in numerical expressions, and evaluate expressions with these symbols.

1. Make each equation true using parentheses.

17 + 13 – 2 = 2

12 x 5 + 5 = 120

175 – 25 x 2 = 300

2. Create your own equation and enter parentheses. Make sure that it is a true equation.

Appendix I

Professional Development Calendars

Created by Jonah Zimmerman

2022 – 2023 Professional Development Calendar

January

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
15	16	17	18	19	20	21
22	23	24	25	26	27	28

Feb/March

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
	FEB 27	28	MARCH 1	2	3	4
5	6	7	8	9	10	11

April / May / June

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
	APRIL 10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30	MAY 1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	31	JUNE 1	2	3
4	5	6	7	8	9	

COLOR KEY

	Grade Level Representative Survey Deadline
	Grade Level Representatives Chosen / Potential Interview Dates
	Math Workshop Representative Team PD / Training

2023 – 2024 Professional Development Calendar

August / September

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
	AUGUST 7	8 NTO	9 NTO	10	11	12
13	14	15 PD OTH	16 PD OTH	17 Staff MTG	18	19
20	21 ½ Day MW	22 ½ Day MW	23 ½ Day MW	24 ½ Day	25 NS	26
27	28	29	30	31	SEPTEMBER 1 ½ Day	2
3	4 NS	5 NWEA Fall	6 NWEA Fall	7 NWEA Fall	8 NWEA Fall	9
10	11 NWEA Fall	12 NWEA Fall	13 NWEA Fall	14 NWEA Fall	15 ½ Day MW	16 Data Input
17	18	19	20	21 Staff MTG	22	23
24	25	26	27	28	29 PRE SURV	30

October

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20 ½ Day MW	21
22	23	24	25	26 Staff MTG	27	28
29	30	31				

November / December

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
			NOVEMBER 1	2	3	4
5	6	7	8	9	10 NS PD OTH	11
12	13	14	15	16 Staff MTG	17	18
19	20	21	22	23	24	25
26	27	28	29	30	DECEMBER 1	2
3	4	5	6	7	8	9
10	11	12	13	14 Staff MTG	15 Units 1-4	16

January

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
	1	2	3	4	5	6
7	8	9	10	11	12 Staff MTG	13
14	15	16	17	18	19	20
21	22 NWEA Win	23 NWEA Win	24 NWEA Win	25 NWEA Win	26 NWEA Win	27
28	29 NWEA Win	30 NWEA Win	31 NWEA Win			

February

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
				1 NWEA Win	2 ½ Day PD OTH	3 Data Input
4	5	6	7	8	9	10
11	12	13	14	15 Staff MTG	16	17
18	19	20	21	22	23	24
25	26	27	28	29		

March

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15 ½ Day MW	16
17	18	19	20	21 Staff MTG	22	23
24	25	26	27	28	29	30

April / May / June

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
	APRIL 8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	MAY 1	2	3 ½ Day PD OTH	4

5	6 NWEA SPR	7 NWEA SPR	8 NWEA SPR	9 ½ Day PD OTH	10 NWEA SPR	11
12	13 NWEA SPR	14 NWEA SPR	15 NWEA SPR	16 NWEA SPR	17 NWEA SPR	18 Data Input
19	20	21	22	23	24	25
26	27	28	29	30	31 Units 5-9	JUNE 1
2	3 POST SURV	4 POST SURV	5 POST SURV	6 POST SURV	7 POST SURV	8

COLOR KEY

	Other PD/Staff Meeting Dates
	Math Workshop PD.
	New Teacher Orientation
	Student and Teacher Surveys Completed.
	NWEA math window (Enter Scores into District Assessment Tracker).
	NWEA math scores must be entered in (Fall, Winter, and Spring).
	District math units 1-4 completed. Pre and Post assessments must be entered by this day.
	District math units 5-9 completed. Pre and Post assessments must be entered by this day.

2022-2024 Math Workshop PD Overview

Friday, April 21st 2023			
Staff	8:00-11:00	11:00-12:00	12:00-3:00
Math Workshop Grade Level Representatives	Introduction to Math Workshop. Vision. Discuss component diagram as an overview.	Lunch	Show Math Workshop Powerpoint & discussions.

Friday, May 12th 2023			
Staff	8:00-11:00	11:00-12:00	12:00-3:00
Math Workshop Grade Level Representatives	Workshop data tracking (NWEA, District, formative assessments).	Lunch	Survey data tracking (pre & post survey's given to GL Reps & discussed).

Thursday, May 25th 2023			
Staff	8:00-11:00	11:00-12:00	12:00-3:00
Math Workshop Grade Level Representatives	Creation of GL google drive for math workshop.	Lunch	Creation of GL appropriate PPT. Begin to add items into google drive folder.

Monday, August 21st 2023			
Staff	8:00-11:00	11:00-12:00	12:00-3:00
Elementary Staff	Teaching	Lunch	Introduction to Math Workshop. Vision. Discuss

			component diagram as an overview. Have PD outlook printed in color.

Tuesday, August 22nd 2023			
Staff	8:00-11:00	11:00-12:00	12:00-3:00
Elementary Staff	Teaching	Lunch	Show Math Workshop Powerpoints & discuss the components of math workshop.

Wednesday, August 23rd 2023			
Staff	8:00-11:00	11:00-12:00	12:00-3:00
Elementary Staff	Teaching	Lunch	Data and survey tracking. Teacher scripts & videos of workshop in action.

Friday, September 15th 2023			
Staff	8:00-11:00	11:00-12:00	12:00-3:00
Elementary Staff	Teaching	Lunch	District tracking for NWEA & district assessments. Modeling a math workshop lesson with GL reps as

			teachers and El. Staff as students.

Friday, October 20th 2023			
Staff	8:00-11:00	11:00-12:00	12:00-3:00
Elementary Staff	Teaching	Lunch	Data noticings. Student noticings. Begin to create formative assessment bank. Use standards landing page to identify learning goals.

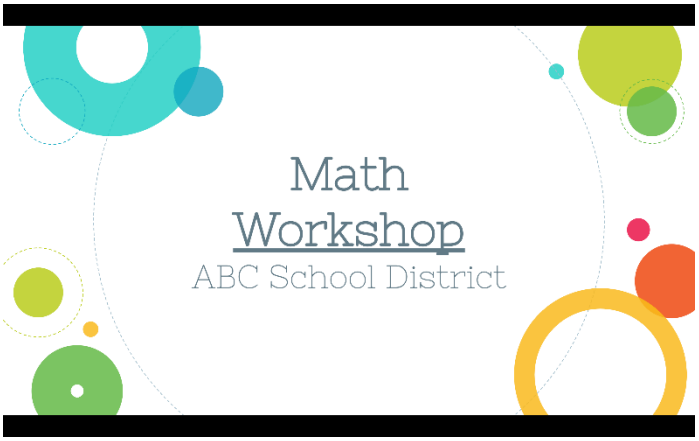
Friday, March 15th 2024			
Staff	8:00-11:00	11:00-12:00	12:00-3:00
Elementary Staff	Teaching	Lunch	Creation of common formative assessments. Place in math workshop drive.

Appendix J

Professional Development Powerpoint Presentation

Created by Jonah Zimmerman

Slide 1:



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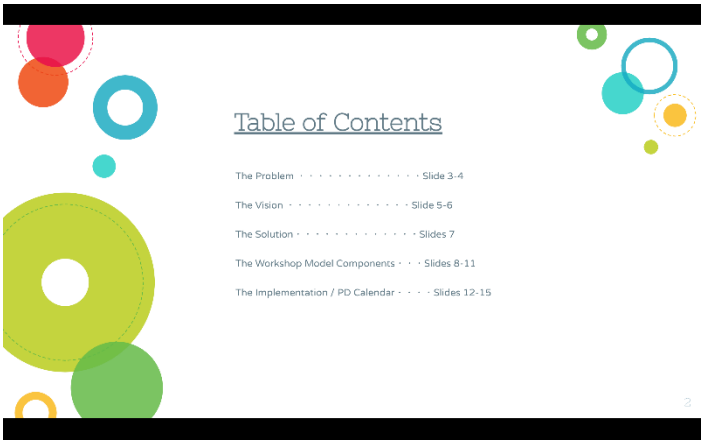

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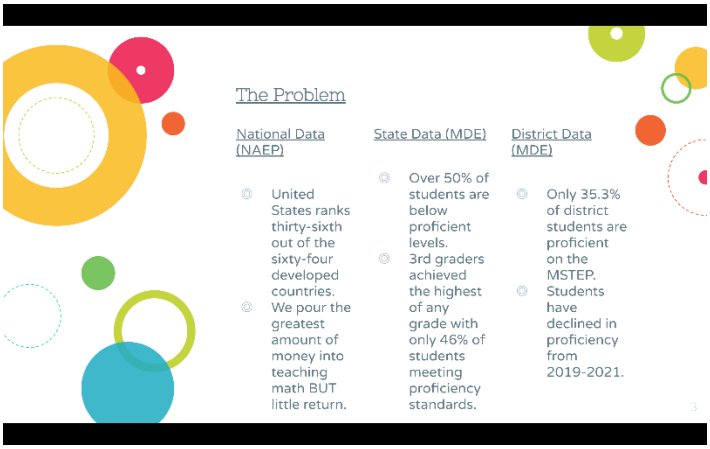

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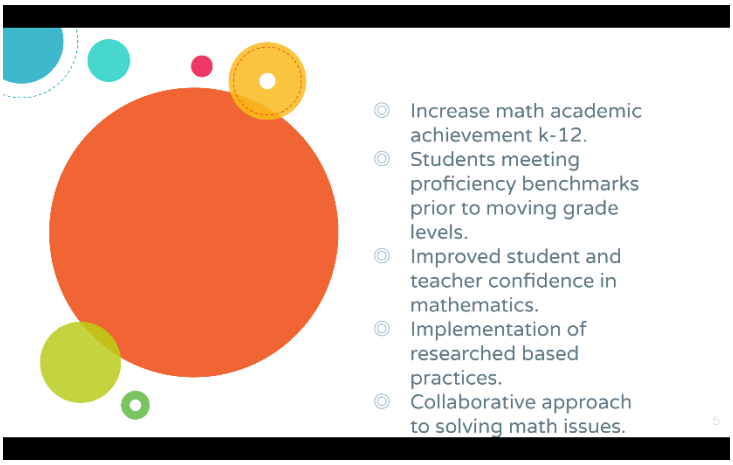

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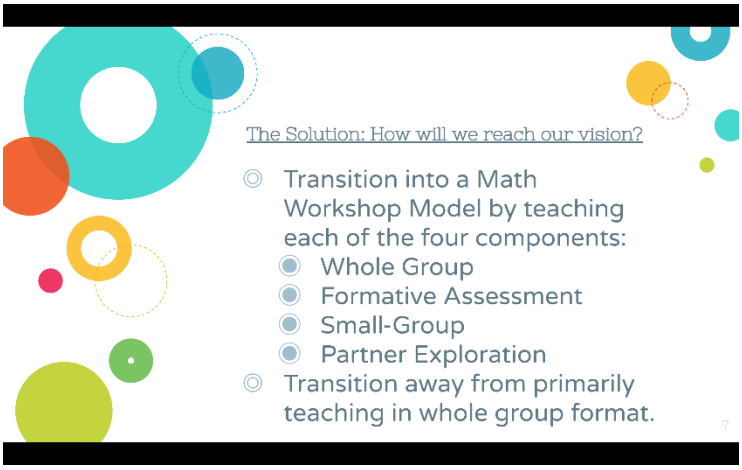

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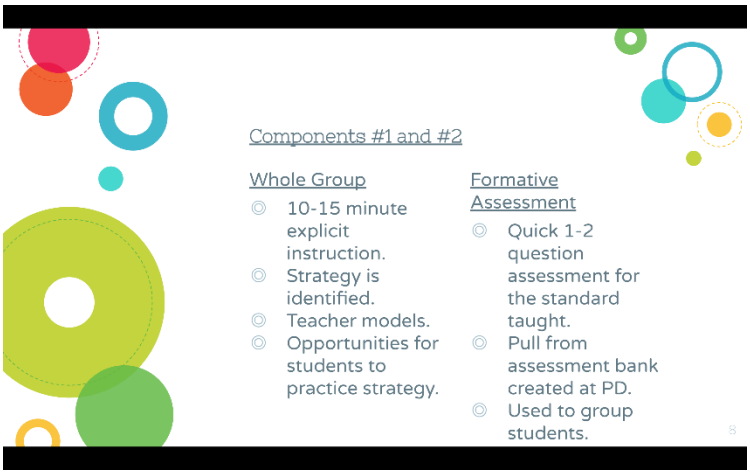

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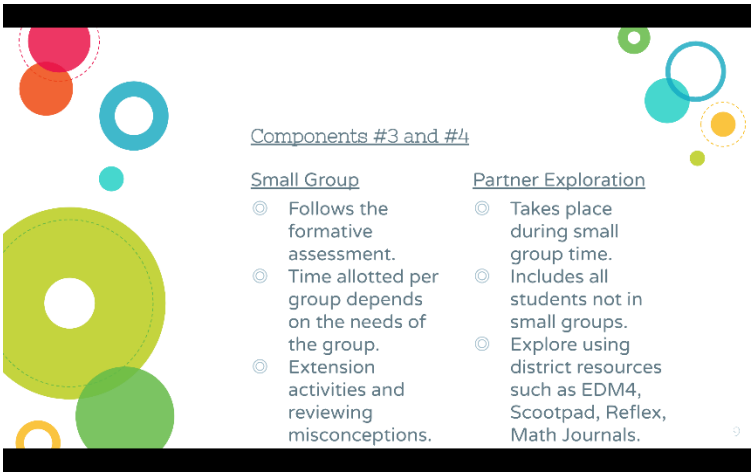

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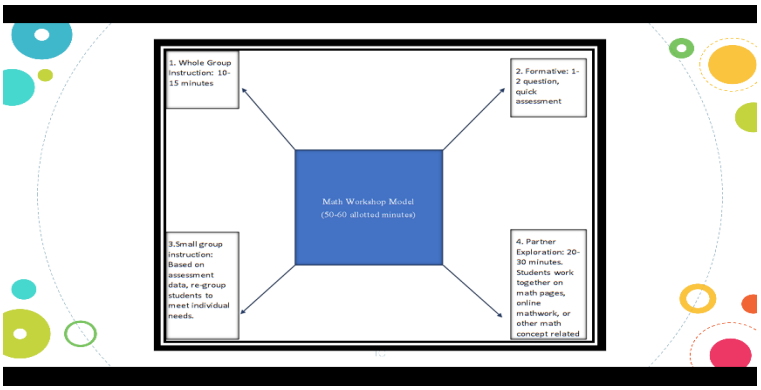

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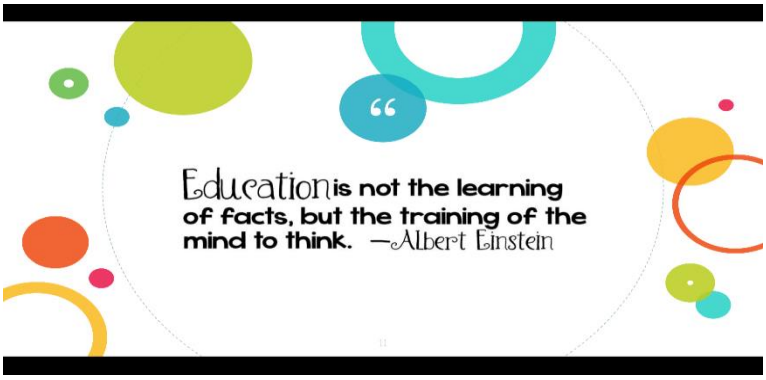

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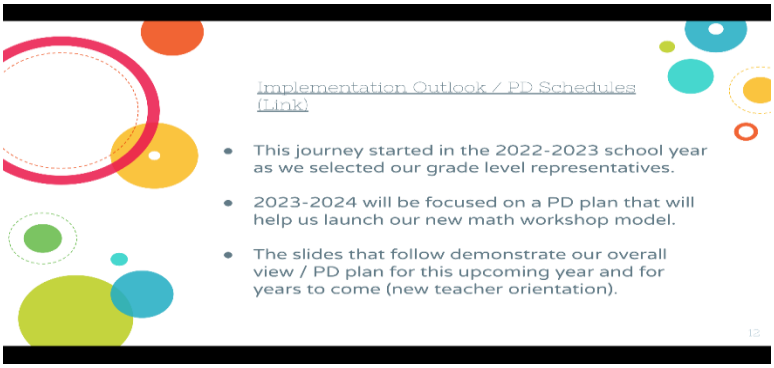

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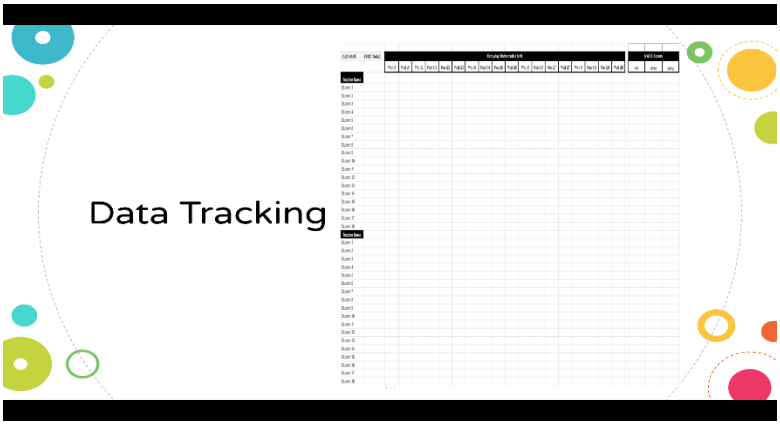

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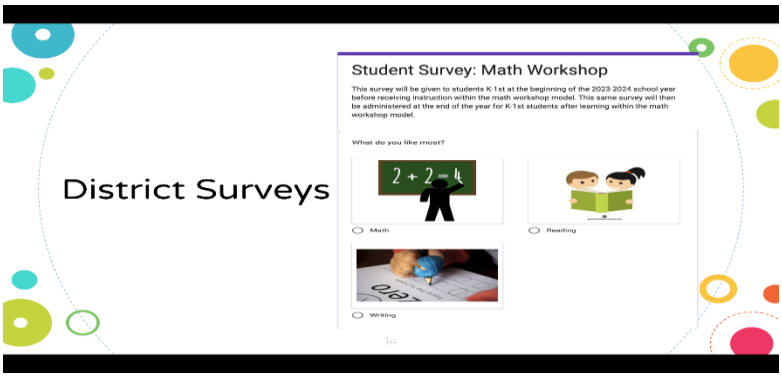

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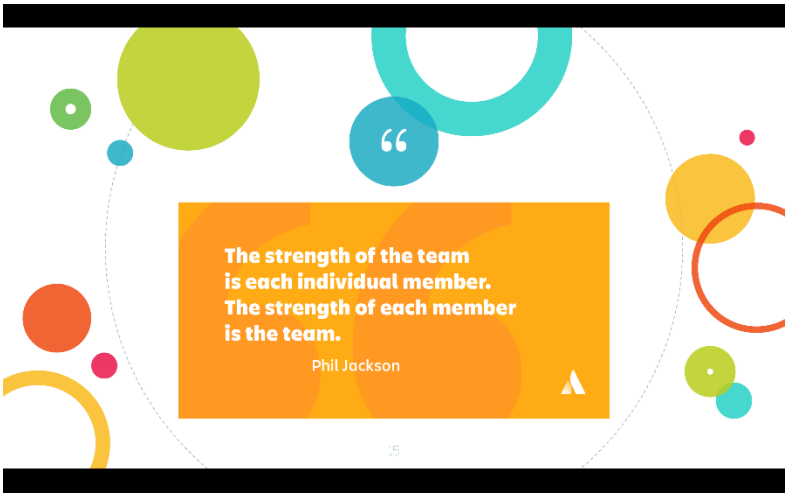

Appendix K

Sample Teacher Script: 3rd Grade Math Workshop Lesson

Created by Jonah Zimmerman

Component #1: Whole Group Lesson

"Here we go third grade mathematicians! Yesterday, we learned all about representing multiplication number sentences with pictures. We tried to represent the number sentence 4x5=20 with four circles and five in each circle. For our warmup, let us try to complete a few of these types of problems to get our brains ready for today!"

"Great job on those warmup activities! I can really tell that you are ready for our new learning today. Today, we will be adding to our math toolbox by representing multiplication number sentences by drawing an array. An array is a picture of dots that represents the numbers in an array. I will show you a multiplication number sentence like 4x5=20 and I will first show you the steps to using and solving a problem with an array. It is your job to watch as I demonstrate, because in a few short moments you will be showing me what you know.

-2 or 3 teacher led problems showing math number sentences and array representations.

Component #2: Formative Assessment

"Now that we have had a quick learning experience with creating arrays that represent multiplication problems, I would like to see what you know and have learned so far! I have a short assessment that I would like you to complete on your own. It is important that I see your thinking so that I can get you into a group that will help you grow as best as possible. You may end up in a similar group as yesterday, or it may be completely different. Once you are done with your assessment I will look them over quickly and form my groups. You will be working independently on your multiplication scrolls once you are done with the assessment. I will let you know what the directions are for partner exploration and for my groups once everyone is done. You may begin!"

Component #4: Partner Exploration

"Class, before we split up into small-group instruction for today, I want to commend you for your hard work on your assessment. I can now see exactly how you are understanding our lesson from today. Also, before you get into your groups, I just want to let you know what you will be doing when you are waiting for our mini lesson together. Today, you will be working on _____ with your partner. This work will help you with the concept that we have learned today, and it will help move your learning forward. Do not forget that teams work together by discussing the problem and working ideas with each other. A good team does not just give each other answers, but they focus on bouncing ideas off each other and correcting any mistakes by coaching each other just like a sports coach would do to an athlete."

"Now it is time for you to explore mathematics with your partner. Be on your way and listen for your name to be called for small groups. You may begin."

Component #3: Small-Group Instruction

"Samantha, Tommy, Caleb, Diane, and Matthew, can I please have you at our small-group space. Please remember to bring your white-boards, markers, and erasers to our rug so that we can learn from our strengths and our mistakes today in small-groups."

"Today, I looked over your assessment and I noticed that each of you had some commonalities from these assessments. I decided to have you in a group since you had similar strengths and similar mistakes so that we can all grow as mathematicians. I noticed that when we were writing arrays for the multiplication number sentence 5x4=20 we all added one extra column...."

"Thank you for learning with me today in small groups! I look forward to seeing you tomorrow. Now before you return to your explorations, please remember to be respectful for the other groups that will be with me. They have been respectful for our learning, so we will continue to do the same for them. It is time for you to explore! I am going to gather my next group of mathematicians."

Appendix L

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GRAND VALLEY STATE UNIVERSITY

EDL 693 Data Form

NAME: Jonah Zimmerman

MAJOR:

__X__Educational Leadership _____ School Counseling

_____ Special Education Admin. _____ College Student Affairs Leadership

TITLE: Examining Teaching Practices that Increase Student Mathematical Achievement

PAPER TYPE: Project

SEM/YR COMPLETED: Winter 2022

Using key words or phrases, choose several ERIC descriptors (5 - 7 minimum) to describe the contents of your project. ERIC descriptors can be found online at http://eric.ed.gov/?ti=all

1. Educational Process: Classroom Perspectives.
2. Curriculum Organization
3. Educational Process: School Perspectives
4. Learning and Perception
5. Mathematics
6. Research and Theory
7. Students,Teachers,School Personnel
8. Subjects of Instruction