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Mathematics Teaching Practices Professional Development

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Project Abstract

Implementation of the new common core state standards in mathematics and research surrounding the skills 21st century students need to be successful has demanded a shift in how mathematics is taught. Teachers are life-long learners and require effective professional development in order to help them better their teaching practices to meet the needs of 21st century students. This project provides a curriculum for a professional development workshop to support mathematics teachers in learning best teaching practices. The curriculum was created by reviewing relevant literature about both teaching practices as well as effective professional developments, attending professional developments myself, and collaborating with staff at my school site. Included in the curriculum are two seven-hour workshop activities, a commitment to change, and a feedback survey.

Keywords: collaboration, high school, mathematics, professional development, workshop, teaching practices, 21st century
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Chapter One: Statement of Problem

In this chapter I will be introducing the purpose of this project, the key areas of literature that has informed my decisions, as well as the steps I will take to create this project.

Background

Education has been evolving to meet the needs of our culture and societal needs. In the United States our society is going under a major change, which can be seen as the change in workforces that exists; for example, the decline in the automotive industry, the raise in the computer science industry. We have reached a time to make changes to the topics and skills that educators are teaching students. Sir Ken Robinson (2010) explains this need clearly in his Ted talk Changing Education Paradigms. Robinson states that “the current system was designed and conceived and structured for a different age,” the age of the enlightenment and industrial revolution. Society no longer requires obedient, rule following, factory line workers, instead we are in need of creative, collaborators, and problem solvers.

John Dewey’s philosophy of progressivism address the concern “of forming a democratic education, in which today’s students and tomorrow’s citizens, will be able to learn to communicate with their social environment, to raise questions and to think correctly, so as to work with their peers, in order to make serious decisions and to be aware of the consequences of their actions, through self-control and acquired self-criticism,” (Dewey, 2009) more clearly stated education needs to address students ability to collaborate, think critically, creatively, and be able to problem solve. It seems there have been minor changes to the educational system in attempts to meet the needs of our current societal and cultural needs. In the recent past standards have been set nationwide for all high school graduates to meet in order to be successful and “ready” for their future.
According to the Common Core State Standards Initiative in 2009, “state school chiefs and governors…[began] develop[ing] the Common Core State Standards” in attempt to “provide a clear and consistent framework for educators” (p.1). In math education one shift provided by these standards is a move toward justification and reasoning, replacing the ability to perform arithmetic and memorize algorithms. This is one minor step towards Dewey’s philosophy of progressivism encouraging students to think critically and understand why and how to find solutions (2009). With that said educators are still in need of more, a framework has been provided but how do we shift our classrooms to foster and develop creativity, collaboration, and problem solving?

**Purpose of Project**

Many educators understand and fully believe in the need to change what and how we teach youth in the United States, but some teachers are unaware of how to make these changes within their own classrooms. This project will address the need presented by Sir Ken Robinson (2010) structuring education different to meet the needs of the present by integrating strategies that stem from Dewey’s progressivism that are specific to mathematics education. This project presents a teacher professional development workshop enabling and motivating high school mathematics educators to implement teaching strategies that develop the necessary skills for students to be successful in their future (2009). Teachers will be learning strategies from current day math education from sources, such as the National Council of Teachers of Mathematics, to develop classrooms full of creativity, collaboration, and problem solving.

**Literature Preview**

The literature review for this secondary math professional development covers three themes: Effective Professional Development, Effective Lesson Planning, and Teaching
Strategies during Instruction. The first theme, effective professional development, provides researched based decision in order to make this workshop guide meaningful to the participants (Boston Consulting Group, 2014). Secondly, effective lesson planning, encourages and structures educators in “mak[ing] an effort to actively envision how students might mathematically approach the instructional task” (Smith & Stein, 2016, p 8). The third theme is teaching strategies during instruction introduces specific strategies for high school mathematics teachers to promote collaboration and creative problem solving within their students such as accountability quizzes, multiple ability treatments, and participation feedback (Cohen, E. 2014).

**Methodology Preview**

The methodology for this two-day secondary math professional development was done with the McTighe and Wiggins (2011) backward planning process. The first part was to identify the desired results, identify evidence of learning, and then planning the learning activities (McTighe & Wiggins, 2011). This included conducting research in the form of a literature review. The key interactive components of the professional development included: norm check, standing points, reflection, and learning centers.

**Significance of Project**

The significance of this math professional development workshop is the benefit it can provide for the educators and their students. The educators targeted by this workshop are secondary mathematics teachers who have an ongoing desire to better their teaching practices and value collaborating with other educators. The educators can benefit by entering the workshop with an open mind and value the ideas and contributions of other participants. School districts like Escondido Union High School District have been working tirelessly to educate their mathematics educators with ongoing professional development to better the practices across the
district. This workshop’s purpose is to allow educators in any district, who have the desire to learn, the opportunity to similar effective and engaging professional development. These educators’ students will benefit by receiving better first-time instruction which includes an emphasis on specific skill set that will empower them in the new wave of 21st century careers.

Chapter One Summary

Many math educators agree with the importance of developing their teaching strategies to meet the needs of students entering the new 21st century workforce but do not know how to teach skills such as collaboration, creative problem solving, and creating classrooms with student centered discussions. The design of this secondary mathematics professional development can address this problem. The professional development models how educators can more effectively and efficiently lesson plan for tasks that are group worthy, implement teacher moves during instruction that will amplify the quality of collaboration a creative problem solving, and allow teachers to transition to a facilitator of learning and students led discussion rather than the presenter of knowledge. The next part of this chapter provides definitions for the key terms used in this project. Chapter two provides a review of the literature that informs the design of this professional development.

Definitions

This section provides definitions for the key terms that are used in this curriculum project.

21st Century Careers

Careers that will require employees to use a different set of skills including but not limited to; innovation, collaboration, creativity, effective communication, and problem solving.

Centers
Learning centers where learners are provided different activities to engage in as small groups. In this the learner is able to receive more specific instruction, or exposure, to the topic they are most interested in.

**Complex Instruction**

Complex instruction is a pedagogy that includes many teaching strategies that focus on students working in groups as well as building every student’s belief in their ability to do math. Some of the strategies that are often used in conjunction with complex instruction are multiple abilities treatment, assigning competence, and participation feedback.

**Collaboration**

The term collaboration refers to individual’s ability to work together as a team instead of a group of individuals.

**Group Worthy Tasks**

A group worthy task is one that requires the input of every group member in order to be successful. These are not just individuals working on their own task, but a group of people working collaboratively on a specific task.

**Norm Checks**

An activity aimed to normalize a room of potential strangers to commit to a specific set of expectations for interaction.

**Reflection**

When referring to reflection in the project, it is an individual reflection of a learner with the expectation that you are working towards a professional goal.

**Talking Points**
The term talking points refers to a specific protocol aimed to create a safe environment when discussing topics that are potentially more personal. Through using the talking points protocol every participant will have equal opportunities to speak.

**Student led Discussions**

In comparison with teacher led discussions, student led discussions are when the teacher removes their voice from a whole class discussion and allows, and requires, the students to generate a discussion about learning.

**Teaching Strategies**

Purposeful and intentional actions, physical placement in space, visible instructions, types of questions, reinforce students’ ideas, etc., teachers perform during their instruction.

**Summaries**

In reference to lesson planning, or the different parts of instruction, this term refers to the time after students have been given the time to explore and research the mathematical topic at hand. During summaries the goal is to solidify students understanding of the essential mathematical standard, how instructors orchestrate this happens is a variety of ways.

**Workshop**

A form of professional development that is structured so that participants are collaborating with each other and actively researching and working towards a specific professional goal.
Chapter Two: Literature Review

This literature review is to identify how to organize and implement an effective teacher professional development workshop that is adaptable to the participants so that teachers gain the most value. This workshop will consist of intensive professional development centered around teaching and implementation strategies for high school mathematics teachers to incorporate student collaboration, creativity, and problem-solving skills needed for future citizens. The first theme is Effective Professional Development which discusses different types of professional developments, tailored to educators, and which will lead to the highest rate of success. After identifying the structure for the professional development workshop, the following themes are the main focuses of the workshop that consists of; Effective Lesson Planning and Teaching Strategies during Instruction.

Effective Professional Development

Teachers are continuously being asked to change their pedagogy, or update their curriculum, or their students’ needs change, or most recently in mathematics education a change in standards, all of these demand effective teachers to continue learning their trade. A variety of profession require ongoing development of their skill, in education professional development opportunities are one of the most common vehicles for increasing in-service teacher quality (Sowder, 2007). With that said, not all professional developments are perceived as effective. Gates (2004) states that only

29% of teachers are highly satisfied with current professional development offerings,

34% of teachers think professional development has improved, and large majorities of
teachers do not believe that professional development is helping them prepare for the changing nature of their jobs. (p. 3)

Currently educators have a wide variety of experiences with professional development including; courses, conferences, lesson observations, coaching, intensive summer sessions, self-guided professional development, workshops, and professional learning community. In order to promote and develop an effective professional development program many factors need to be addressed to avoid resistance from teachers and ensure the most positive change.

According to a research study done in 2014 by Boston Consulting Group (BCG), which was funded by the Bill & Melinda Gates Foundation, teachers describe the ideal professional learning experience as: relevant, interactive, delivered by someone who understands my experience, sustained over time, and treats teachers like professionals. The Kentucky Department of Education in July 2003 provided a guide to promote quality professional development, which they found:

- A focus upon instruction and student performance;
- Peer review, collegiality, and collaboration in plan development;
- Flexibility, experimentation, and risk taking, rather than prescribed lockstep behaviors or punishment for failures;
- Group decision making about: content, format, timing, implementation specifics, evaluation, and other dimensions of professional development;
- Realistic time estimates for changes in practice. Participants need sufficient time to be able to learn, plan for, and try out new skill approaches. They need to reflect on their
success with helpful coaches; revise, retry, and learn more; and get ongoing support for their efforts;

- Participants have time to work on professional development and assimilate new learning;
- Participants sharing and building upon their own experiences and perspectives, and acknowledging the personal concerns involved in making significant changes (p. 3)

are crucial to effective professional development. The following paragraphs describe how this project addresses these needs within the developed high school mathematics workshop.

With this list in mind the developed workshop will require each participant to contribute to the content by participating in a protocol designed to sort out themes the participants are interested in. The intent of this workshop is to be as tailored to the participants as possible while being a stand-alone guide allowing any educator to be the facilitator. There will be some flexibility in the timing of the workshop even though there are suggested time lines provided in the guide. Lastly participants in this workshop will be taken through a commitment to change during day 2 of the workshop, this suggests making plans with another participant but allows full autonomy in timing, evaluation, and format depending on what each individual deems productive.

The main goal of this workshop is to allow participants to have time to learn, reflect, build upon each other’s experiences, and plan for change together. Majority of the time spent in this workshop will be dedicated to participants developing further understanding of specific topics through collaborative learning, as well as developing a presentation of their learning. Starting as one large group quickly the workshop will break into 3 smaller groups, in order to
better produce meaningful conversation, then again will break into groups of no more than three allowing individuals to take ownership of their own interests and goals for the workshop.

**Purpose**

It is imperative that participants understand and agree with the purpose of the professional development. Wilson and Berne (1999) claim that professional development should consider what teachers should learn as well as how best to accomplish this goal (p. 201). And the educators should choose to participate because they are invested in the purpose and should not be mandated to participate.

**Collaboration**

Collaboration has the potential to increase the productivity and quality of any learning experience as such this Workshop to Develop Teaching Skills for High School Mathematics Classrooms will utilize collaboration for a majority of the workshop time. Unfortunately, even though teachers understand the value of collaborating with colleagues they often have more experiences with failed attempts at collaborating. Boston Consulting Group, formed by Bill and Melinda Gates, used a focus group to answer the question “Which images represent your current experience and the ideal state of collaborative professional development?” which in summary teachers describe their current experience as “lack of engagement”, “poor use of time”, and “poorly planned/executed” which their ideal is described as “energizing”, “supportive”, and “hands-on//scenario-based” (Boston Consulting Group, 2014, p. 9). According to the Boston Consulting Group teachers believe that in-school collaboration can be improved by having a structured agenda and objectives, mutual accountability for those who participate so that
everyone is invested in the work, and protocols for giving and receiving feedback. These same teachers feel that collaboration helped them with planning specific lessons, developing teacher skills and content, and aligning curriculum and expectations (Gates, 2014, p. 10). “Teachers also suggest that the ideal professional learning experience should focus less on presentations and lectures and more on opportunities to apply learning through demonstrations or modeling and practice” (Gates, 2014, p.4).

**Effective Lesson Planning**

High school mathematics teachers are to facilitate learning everyday which requires choosing a task, or problem, for students to engage with, planning how to launch and facilitate learning, and how to orchestrate discussions of what students are learning. All of this planning must take place prior to the lessons enactment in order for the best result. In fact, in order to lesson plan effectively McTighe & Wiggins (2012) states you must use backwards planning in which you follow specific a sequence of, identifying a specific end goal, identify how to evaluate if that goal has been achieved, and lastly identify specific activities to reach the goal (2005). Planning in this way will increase the ability for students to reach each learning target or long-term goal. Backwards planning was implemented for this professional development where the end goal was identified; mathematics teachers improving their ability to use specific strategies in their classrooms to increase the amount of problem solving, creativity and critical thinking. Secondly, it was decided that presentations given by each participant as well as a commitment to change activity would serve as a way to evaluate and measure the success of reaching the end goal. Lastly activities were planned for participant to engage in throughout the 2 days of the
professional development that will allow each participant to reach the end goal, such as reading articles, reflecting, watching videos.

While mathematics lessons may use a different format than other subjects it is critical to include specific criteria into your lesson planning such as the cognitive demand of the task students will engage in and the discussion and questioning strategies you will implore during the enactment of the lesson. The following will explore these topics in further depth.

**Cognitive Demand**

In order to foster problem solving in mathematics students the level of cognitive demand must be appropriately challenging. Stein (2016) cites the Professional Standards for Teaching Mathematics (NCTM, 1991) which states that:

opportunities for student learning are not created simply by putting students into groups, by placing manipulatives in front of them, or by handing them a calculator [instead] it is the level and kind of thinking in which students engage that determines what they will

Even when a “high-level task [is] introduced in the classroom, many teachers have difficulty maintaining the cognitive demand of those tasks as students engage with them” (Stein, Grover, & Henningsen 1996). There are characteristics that teachers can incorporate in their lessons such as, open-ended questions, multiple opportunities to show understanding, both group interdependence and individual accountability, and multiple entry points and solution paths that encourages genuine problem solving and collaboration.
In order to remain focused on developing students to enter 21st century careers it is also imperative that teachers are selecting group-worthy tasks. According to Lotan (2003) group-worthy tasks are those that include open-ended and complex problem solving, multiple entry points as well as multiple opportunities to show competency, and require positive interdependence and individual accountability. Along with developing tasks for students that combine all these different characteristics there are teacher moves that will also help students develop collaboration skills, problems solving skills and creativity. One key effective lesson planning is the use of group worthy tasks as well as discussion and questioning strategies.

**Group Worthy Tasks**

Developing skills such as problem solving, collaboration, and creativity requires a different set of skills than what mathematics teachers previously possessed. Lotan describes one of these skills which is engaging students in open-ended group work in comparison to routine tasks (2003). When presenting a group with an open-ended the teacher is allowing students to show competence in multiple ways, while also building interdependence as well as individual accountability.

**The Right Questions**

Teachers have developed many ways to ask students questions in order to implement accountability or as formative assessments, such as using popsicle sticks, calling on raised hands, randomly calling any student. Wiliam presents a new outlook on asking questions, for example having a no hands up classroom, asking a variety of types of questions, having all students respond to questions, and most importantly to plan questions (2014).
Discussion Strategy

In many lesson plan structures, there exists a whole class discussion portion but “creating discussion-based opportunities for student learning will require learning on part of many teachers” (Smith & Stein 2015, p.1). In the National Council of Teachers of Mathematics, NCTM, publication *5 Practices for Orchestrating Productive Mathematics Discussions* Margaret Smith and Mary Stein explore strategies that will increase the productivity and deepen the engagement of students in complex problems, or tasks. Smith and Stein have presented a discussion framework with five specific strategies they labeled; anticipate, monitor, select, sequence, connect.

**Anticipate to Craft Questions.** The only one of these five practices that relates to effective lesson planning is the anticipate in which the teacher determines the goal for students when working through a problem, or task.

When teachers plan lessons, they generally plan, in considerable detail, the kinds of activities in which they will engage the students, the learning intentions of the lesson, and a number of other features. It’s far less common for teachers to plan the questions they will use to determine whether the instruction has succeeded. (Wiliam, 2011, p.19)

When teacher start planning, they will need to “make an effort to actively envision how students might mathematically approach the instructional task” which can be difficult to do (Smith & Stein, 2015, p.8). This practice is essential in crafting questions and prompts to encourage students to think deeper about the task and to guide them to the ultimate goal the teacher has in mind for the specific task.
Monitor. In this new role as a facilitator of learning teachers need to monitor students’ questions, explanations and responses around their mathematical thinking. The purpose of this is for teachers to make decisions about what students’ strategies are shared during whole class discussions (Smith & Stein, 2015). While this portion is titled monitor it is important that teachers are doing more than just watching and listening, they should “also ask questions that will make students’ thinking visible, help students clarify their thinking” along with making sure all students are engaged in the task and not going in an unproductive direction (Smith & Stein, 2015, p.10).

Select. Selecting is where the teacher needs to implore their expertise in the subject area and knowledge of their students to decide which student or groups of students will share out their strategies and/or solutions. This is also a place where the teacher can use their knowledge to help raise student’s status in the classroom as mathematicians.

Sequence. Sequencing is where the teacher needs to implore their expertise in the subject area and knowledge of their students to help formulate a story to help all their students build up their mathematical understanding. Smith and Stein (2001) state that, “by making a purposeful choice about the order in which students’ work is shared, teachers can maximize the chances of achieving their mathematical goals for the discussion” (p. 11-12).

Connect. This last practice is when the teacher can step back in and solidify and draw connections between the different student ideas and solutions.

Teaching Strategies During Instruction
In 1979 Elizabeth Cohen, a former professor of education and sociology at Stanford, founded the program for "Complex Instruction," an educational pedagogy that applied sociological theory to promote equity in the classroom spent years researching and becoming familiar with group work in education, in other words, the ability to collaborate with one another. Cohen’s complex instruction includes strategies effective for developing both intellectual and social learning goals whilst in groups, which includes skills such as creative problem solving and increasing effective and clear communication (Cohen, 2014). Students who think hard about problems and then communicate their thinking are going to experience a deeper level of understanding, complex instruction argues that placing students in visibly random groups of no more than four students will increase the likelihood of this occurring.

An important reason for using random grouping is the teacher is implicitly communicating that all students are capable of working together as well as helping to eliminate the issue of status in the mathematics classroom. Cohen (2014) defines status characteristic as “an agreed-upon social ranking where everyone feels it is better to have a high rank than a low rank” (p. 28). This occurs everywhere in society and is imperative for students learning that if they are deemed low-status that the teacher is actively working to raise their status in everyone’s eyes. In addition, many high school mathematics students have a deep-rooted belief in what it means to be a good mathematician, usually including attributes such as speed in problem solving, answer getting, quick computation the list goes on. Complex instruction intentionally addresses the need to breakdown their usual false belief and replace with the many ways of thinking mathematically, such as recognizing patterns, making connections between different representations, perseverance, asking genuine questions.
Complex Instruction has a developed strategy known as status treatment to highlight all the different mathematical abilities and bring light to when students are using these abilities. As a teacher it is imperative to understand when to intervene with students and when to allow groups to exist in productive struggle. Teachers understanding how to use questioning strategies will highlight specific students, push groups forward together, and encourage all students to participate (Wiliam, 2011). This has the intent of shifting thinking away from the narrow belief about what skills are needed in order to be a successful mathematician to include a wide variety of abilities that students display that attribute to their success in mathematics. It is essential that teachers define abilities that are viewed by all students as necessary and to explain that no one person is good at all these skills, but everyone is good with at least one. This multiple ability treatment is most successful when students are engaging in a task that requires many different abilities in order to find the solution.

There have already been steps made to help teachers more successfully instill problem solving, collaboration, and creativity in their students. One of said steps are the mathematical habits of mind, Cuoco, Goldenberg, and Mark (1996) believe that students will be using, understanding, and making mathematics that doesn’t yet exists, this is much more important than specific mathematical results that have generally always been taught. The importance of a group-worthy task presents itself as a way to allow student to develop these skills. When students have group-worthy tasks along with the space from teachers to work through these tasks with their group without interruptions is when students are able to flourish in productive struggle (Lotan, 2003). Similarly, Conrad Wolfram believes mathematics education needs to change because students need to be prepared for a different future than what exists now (2010). Students should
have more practice at creating, describing, inventing, conjecturing, tinkering, visualizing, experimenting, the list could go on, with mathematics.

Summary of Chapter Two

By combining the best practices in modern day mathematics education with what our future citizens will need to be successful in moving our society further teacher will be more confident and effective in their careers. High school mathematics educators who are ready for this shift in their teaching practices may often need further professional development on these ideals, as such this project will provide a teacher professional development workshop to address that very issue.
Chapter Three: Methodology

This chapter on methodology will address the background, design of a two-day professional development guide, the target audience, instruments used to design this professional development as well as activities included in the professional development, and lastly the procedure intended for use of the professional development.

Background

The history of education in the United States demonstrates its ability to change and meet the needs of our society. Now in the 21st century students need to learn differently in order to be successful and continue to move in our society, while simultaneously moving our society forward. The careers that our current students will hold require the ability to work collaboratively, persevere, think creatively, and problem solve more so than ever before. The purpose of this project, which will be presented through the lens of high school mathematics education, is to ensure teachers have the skills and support to incorporate teaching strategies that allow students to develop collaboration, problem solving and creativity within the classroom. With the release of the common core standards came what are known as the standards for mathematical practice, these mathematical practices are the first sign of putting value on these skill sets for mathematics students. According to the common core state standards initiative, these standards “describe varieties of expertise that mathematics educators at all levels should seek to develop in their students.”(corestandards.org) In teacher preparation courses future mathematics educators and being exposed to more recent mathematics education research from groups like NCTM, National Council of Teachers of Mathematics, which hold high value in teaching students’ skills such as collaboration, perseverance, creativity, and problem solving.
What is still required in mathematics education is specific teacher professional development to address how to teach these skills effectively in a mathematics course while still allowing students to work on the required mathematics standards, for teachers who have not had access to these ideas previously in their career. This chapter will address the design of a two-day professional development guide, the target audience it is designed for, instruments used to design the guide, and finally the implementation of this guide.

**Design**

This professional development was designed for secondary mathematics teachers who have self-identified as wanting more support with moving their teaching practices forward. This is intended to be 14 hours and span across 2 days. These two days consist of collaboration among participants identifying areas of potential growth that will generate targeted groups to attend smaller centers. The second half of day one consists of centers where participants will be split up and focus in on a topic that is more meaningful for them. The second day will consist of presentations delivered by each participant as well as reflections. The objectives incorporated into this professional development are derived from the California teacher performance expectations and are as follows, participants will communicate effectively with peers and colleagues with the intent to support teachers and student learning (CA TPE Standard 6.4), participants will reflect on their own teaching practice and identifying a specific instructional focus to learn more about and improve (CA TPE Standard 6.1), participants will present their understanding of a specific instructional strategy ranging from planning, designing, implement and monitoring instruction in order to provide students access to the content (CA TPE Standard 4.4), and lastly participants will reflect and commit to implementing teaching practices that they feel strongly about (CA TPE Standard 6.1).
Participants

This workshop was designed for an individual with a background in teaching mathematics to act as the trainer. This includes but is not limited to: current and former mathematics teachers, math coaches, and administrators with a background in mathematics education. The intended participants in the professional development are high school mathematics teachers who have self-identified as desiring more support in bettering their teaching practices. While the resources and activities included in this specific guide are specific to the need of high school mathematics teachers, it could be adapted to work for all levels of mathematics education. The workshop was designed to support teachers in southern California, with a diverse population, specifically with English language learners. Many of the strategies presented are to help not only math development, but language development.

Instruments

The materials and instruments used in the creation of this teachers’ professional development workshop were resources and reference materials such as templates for lessons and activities.

Professional Development Structures

The National Council of Teachers of Mathematics offered many resources including activities that develop collaboration, creativity, problem solving, and perseverance. I was able to include as concrete examples to help teachers visualize lessons in their own classrooms.

Norm Checks. A critical part of the start of a professional development activity is a norm check. This allows participants to identify the purpose they choose to participate, behavior expectations, and goals. This not only helps set a foundation for the professional development,
but it also models what can be done with high school students to set expectations and gain buy-in to the learning.

**Reflection.** A key component to learning is to provide time for reflection. To identify what is being process, what was gained, what still needs work, and to develop a plan. This is in line with one of the mathematical habits of mind provided by NCTM which encourages students to practice metacognition.

**Pacing and Breaks.** Pacing is critical for maximize learning. Brain-based research suggests that to maximize learning and production is to provide breaks every 50-90 minutes. It is critical to provide breaks to allow the brain down time to make the connections for learning.

**Centers.** The use of centers is being used in this professional development to allow participants to learn relevant information according to their own personal interests. Research by Gates and Gates (2014) states that participants will find professional developments more meaningful if it is directly relevant.

**Online Resources and Materials**

For the purpose of organizing all the materials and information provided in this professional development workshop I used online resources to create a website with all the materials digitally, in a format that can also be printed out as hard copies.

**Procedures**

I have experienced knowing many mathematics teachers who have what is best for their students in mind, but at the same time are unsure of how to meet all their student needs. What these teachers require is help with the specifics of how-to bring skills such as collaboration and creativity to their classroom. I have attended many professional development opportunities as well as teacher professional developments, but what they lack is allowing teachers to leave with
not only a specific plan in place but also a method to remain accountable to these plans. For these reasons I researched which skills will be most essential for high school students to possess for their future as well as strategies for a trainer to instill accountability in their participants.

Within my review of literature my research covers many themes including skills needed for careers in the 21st century, how to structure and deliver an effective professional development, teaching strategies that enhance students’ abilities to practice and develop skills such as collaboration, problem solving, creativity, and perseverance. When designing the teacher professional development workshop first I had to decide how the professional development would run, then decided what would be the topics throughout the workshop that would be presented, finally decisions about how the specific information would be presented.

**Summary of Chapter Three**

The aim of this project is for any math teacher to be able to receive a more personalized and intensive form of support through a two-day workshop. Not only is this workshop intended on being delivered at the school site and district I am a part of, it has purposefully been designed so that other districts and math teachers may have access to implementing it. Chapter 4 includes materials required for this professional development, as well as links to google documents and slides.
Mathematics Teaching Practices Workshop

Developing Strategies to push your teaching further
Table of Contents for Workshop

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Day One of Workshop

This workshop is intended to take place in at any high school or district office as a professional development opportunity. The workshop is an opportunity for up to 30 mathematics educator who is looking to improving their teaching practices to collaborate and discuss with other educators looking to do the same.

**Standards:** California Teacher Performance Expectation (TPE)

6: Developing as a Professional Educator

6.4 Demonstrate how and when to involve other adults and to communicate effectively with peers and colleagues, families, and members of the larger school community to support teacher and student learning.

6.1 Reflect on their own teaching practice and level of subject matter and pedagogical knowledge to plan and implement instruction that can improve student learning.

**Objectives**

The objectives for the first day of this professional development include:

1. Participants will communicate effectively with peers and colleagues with the intent to support teachers and student learning (CA TPE Standard 6.4).

2. Participants will reflect on their own teaching practice and identifying a specific instructional focus to learn more about and improve (CA TPE Standard 6.1).

**Assessment**

Evidence of meeting these objectives include:

1. A co-created norms poster including how the group will interact during the workshop (CA TPE Standard 6.4).
2. A sticky note with one specific practice each participant will learn more about and reflect upon (CA TPE Standard 6.1).

**Day One Learning Activities**

During the first day of the workshop participants will engage in a variety of activities depending on the collective decision of the group. Day one of two will consist of 7 hours, including a 1-hour lunch break. These activities include,

1. Norms where participants create a set of norms on how to interact with each other planned to take 15 minutes,

2. Talking Points where participants focus on themes of interest in mathematics education planned to take 90 minutes.

3. Independent Reflections to process Talking Points planned to take 20 minutes.

4. Centers where participants choose a center activity they want to focus on. While at designated centers participants may be reading articles, watching videos, responding to predetermined prompts, conducting personal research, and creating a presentation of their learning planned to 4 hours.

**Materials**

1. Day One of Workshop Google Slide Retrieved from

   https://docs.google.com/presentation/d/1zjWk4DDF9e2KDgy4mUTop3RaUoWM70RwUmLYSU6yDp4/edit?usp=sharing

2. Teacher Moves During Instruction Google Slides Retrieved from

   (https://docs.google.com/presentation/d/1I-8vgR8olI491s0V9xBSickEMJp9qeF8LHOGEQs4sQs/edit?usp=sharing)
3. Effective Lesson Planning Collaboration with Colleagues Google Slides Retrieved from (https://docs.google.com/presentation/d/1PMG_fjTDW8nDea4H5YUvRSwl4E98txaQbgMn-l2iTTI/edit?usp=sharing)

4. Shift from Teaching to Facilitating Student Discussions Google Slides Retrieved from (https://docs.google.com/presentation/d/1JIPZ5hSJrl5gIgoxTzD3UJum9M0UnuP0EFT_snEXxKE/edit?usp=sharing)

5. Pen, pencils, erasers, scratch paper (about 5 per participant)

6. White board & markers, chalk board and chalk, or chart paper and pens to write out norms on.

7. Talking Point Handouts

8. Three separate spaces dedicated for participants to split up into centers (each of which need access to computer and projector and access to YouTube),

9. Center Materials: Digital access or hard copies of the following articles and internet access for videos.


h. Computer with presentation capability, internet access for google slides, videos, and articles.

i. Projector for computer images.

**Workshop Instructional Steps**

The activities for day one follow the sequence of activities on Day One of Workshop Google Slides. A copy of the Google Slideshow can be found using the link below. Included below is a workshop guide with an explanation of each slide and activity.

**Day One of Workshop Google Slideshow**

(https://docs.google.com/presentation/d/1zjWk4DDF9e2KDgy4mUTop3RaUoWM70RwUmLYSU6yDp4/edit?usp=sharing)

**Slide One: Introduction**
This is an introduction slide that is projected while participants are entering the workshop location. The slide reads, “Mathematics Teaching Practices Workshop - Developing Strategies to push your teaching further.”

**Slide Two: Facilitator**

This slide is a backdrop for the facilitator to introduce themselves and to provide reasoning for why this workshop and bettering our teaching practices is important. The slide reads, “Quick Introduction: Facilitator Background

Why is this workshop important?”

**Slide Three: Agenda**

This slide has the agenda for the first day of the workshop. It reads:

Agenda

Day 1

1. Norm Check (15 minutes)
2. Talking Points (90 minutes)
3. Independent Reflection (20 minutes)
4. Lunch BREAK----(1 hour)
5. Centers and Create Presentation (4 hours)

**Slide Four: Norm Check**

Slide four reads:

Directions:

1. Independently in your notebook, write down three norms that you value most.

2. Find 2-3 other people to share each of your norms with.

3. With the same 2-3 people decide on 3 norms to suggest to the whole group. Be prepared to share!
4. As a whole group, do we need to make changes, add, or delete any norms? (We must all agree on our norms for this workshop.)

This slide is for norms creating activity that each participant will contribute to, that consists of 4 steps. It is important to define how each person is expected to act and participate during our time together in order to maximize the amount of productivity and collaboration that occurs. During step 3 this activity the facilitator is responsible for writing a visible list of the agreed upon norms on a poster that will remain up during the entire workshop.

**Slide Five: Talking Points**

Slide five is a display of the “Talking Points” protocol that participants will follow in bring a common frame of reference for this workshop. This protocol is intended to be used with the following handout, titled Talking Points Handout.

Which follows as such:

In small groups of about 4 people per group.

**Directions—**

**Round 1:**
- One person reads a Talking Point
- Go around the group. Each person says whether they AGREE, DISAGREE, or are UNSURE about the statement AND WHY.
- The most important part of this is that there is NO COMMENT by anyone else in the group. Their job is to listen.
- After everyone has had their turn, proceed to round 2.

**Round 2**
- Go around the group again. Each person says whether they AGREE, DISAGREE, or are UNSURE about their own original statement OR about someone else’s statement they just heard AND SAY WHY.
- Again, there should be NO COMMENT from anyone else in the group while someone is speaking. After everyone has had their turn, proceed to round 3.

**Round 3**
- Go around the group one final time. Each person simply states whether they AGREE, DISAGREE, or are UNSURE about the original statement. The group takes a tally and moves on to the next Talking Point.
Talking Points Handout

<table>
<thead>
<tr>
<th>Statements</th>
<th>Agree/Disagree/Unsure</th>
</tr>
</thead>
<tbody>
<tr>
<td>It is important for students to talk to each other in order to gain deep understanding of mathematics.</td>
<td></td>
</tr>
<tr>
<td>Students can learn new things, but they can’t change how good they are at math.</td>
<td></td>
</tr>
<tr>
<td>As a teacher I can greatly affect the status of my students.</td>
<td></td>
</tr>
<tr>
<td>My role as a teacher is to show students how to do mathematics.</td>
<td></td>
</tr>
<tr>
<td>Arithmetic and algebraic manipulation are the most important aspect of mathematics education.</td>
<td></td>
</tr>
<tr>
<td>Collaboration with fellow teacher improves students understanding.</td>
<td></td>
</tr>
<tr>
<td>When I write out lesson plans and scripted questions, students understanding is increased.</td>
<td></td>
</tr>
<tr>
<td>The expectation of students should differ depending on whether they are preparing for college, workforce, or vocational school.</td>
<td></td>
</tr>
<tr>
<td>Student who complete tasks question and accurately understand the mathematical concepts.</td>
<td></td>
</tr>
<tr>
<td>Students who think hard and talk about mathematics will gain more understanding.</td>
<td></td>
</tr>
</tbody>
</table>
Slide Six: Reflection

Slide six reads as follows:

Independently in your notebook respond to the following prompts:

1. What are my students doing during class time?
2. What am I doing during class time?
3. How do my practices reflect what I believe about teaching mathematics?
4. What message do my actions communicate to students?

Think of ONE specific practice you are currently using in your classroom to reflect upon and write this on a sticky note.

The slide is a reflection activity for participants to process what was said during the Talking Points activity. Participants will be reflecting by writing on a piece of paper or notebook to specific prompts. After responding to the prompts above each participant will need to write one specific teaching practice that they would like to focus on during this workshop time.

Slide Seven: Break

This slide is a placeholder and reminder for a 1-hour break, it reads “Break for 1 Hour.”

During this break the facilitator is expected to create themes based on self-selected practices provided by participants on sticky notes.

Slide Eight: Centers

Slide eight displays the titles for each of the possible centers that participants may focus on. The facilitator should suggest centers for each participant, but participants may choose a different center if they want to. The intent is that each participant is receiving professional development aligned to their interests. In addition, this slide explains that the work at the centers is to be co-facilitated by the participants. The role of the facilitator is to provide assistance when
needed at the centers. The facilitator may find that stepping into centers periodically may be beneficial or clarifying the directions may be needed. The slide reads,

Centers

While at the centers, participants will co-facilitate following the instructions on the slides (Suggested times are provided on each slide)

Center A: Teacher Moves During Instruction
Center B: Effective Lesson Planning Collaboration with Colleagues
Center C: Shift from Teaching to Facilitating Student Discussions.

**Teacher Moves During Instruction Center**

The following slides are to be accompanied with the respective center. A copy of the Google Slideshow can be found using the link below.

Teacher Moves During Instruction Retrieved from
(https://docs.google.com/presentation/d/1I-8vgR8oll491s0V9xBSickEMJp9qeF8LHOGEQs4sQs/edit?usp=sharing)

**Slide One: Introduction**

This is an introduction slide that is projected while participants move to their intended center. The slide reads, “Mathematics Teaching Practices Workshop- Teacher Moves During Instruction.”

**Slide Two: Teacher Move Strategies**

Slide two states:

Three Specific Teaching Strategies that will be explored at this center: (Cohen, 2014)

1. Assigning Competence (Multiple Abilities Treatment)
2. Accountability Quizzes
3. Participation Feedback

This slide is the start of this center, it introduces the terms of three strategies that will be discussed. These strategies include: assigning competence, accountability quiz, and participation feedback.

**Slide Three: Assigning Competence**

Assigning competence is the focus of slide three, which includes a link to the YouTube Video, “Complex Instruction.” Second on the slide are directions for what participants should be thinking about and recording while watching the video. Lastly on the slide are directions for participants to have a conversation about their thoughts about the video.

1. Watch the video, Multiple Abilities Treatment and Assigning Competence found at [https://youtu.be/51WmR3hrnbQ](https://youtu.be/51WmR3hrnbQ) (Meyers, 2018)

2. While watching the video record your thinking.
   a. Notice the teacher moves while interacting with students.
   b. What did those teacher moves communicate to the students?
   c. What did the students do as a result of those teacher moves?

3. After the video allow 2 minutes for participants to finish recording their thoughts about the video.

4. One person start a conversation about the video and the above questions (allow all participants to share out their thoughts and reactions)

**Slide Four: Multiple Abilities Treatment**

Slide four provides an explanation of what a multiple abilities treatment is which is as follows,

What is a Multiple Abilities Treatment? (Cohen, 2014)

This is a strategy designed to promote all students engagement in a task.

Multiple abilities treatment is a way to combat the belief that some students have low status in a math classroom, and instead celebrate how all students are able to contribute positively to their group. In fact that they are needed in their group in order for the group to be successful.
The teacher would launch the lesson/task with this treatment and refer back to in throughout the explore phase, or at the summary of the lesson.

**Slide Five: How to Introduce Multiple Abilities Treatment**

Slide six describes the ideal way of introducing and implementing a multiple abilities treatment to a class of students.

How to Introduce Multiple Abilities Treatment in class:

- In order for your group to be successful today you will need….

(List specific abilities that students will need for the identified task)

- No one is good at all of these abilities but everyone is good and at least one of these.

**Slide Six: Possible Abilities**

This slide provides possible abilities the participants could use in their own classroom and asks that they try to add more abilities to this list. Using abilities’ that students’ value is imperative to the success of this teaching practice.
• What abilities could you add to this list?

<table>
<thead>
<tr>
<th>Analyze</th>
<th>Build</th>
<th>Classify/Categorize</th>
<th>Design</th>
<th>Estimate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Formulate</td>
<td>Generalize</td>
<td>Conjecture</td>
<td>Take Risks</td>
<td>Guess</td>
</tr>
<tr>
<td>Investigate</td>
<td>Persevere</td>
<td>Justify</td>
<td>Listen</td>
<td>Model</td>
</tr>
<tr>
<td>Number Sense</td>
<td>Organize</td>
<td>Recognize Patterns</td>
<td>Prove</td>
<td>Question</td>
</tr>
<tr>
<td>Represent</td>
<td>Substitute</td>
<td>Test/Check</td>
<td>Visualize</td>
<td>Wonder</td>
</tr>
<tr>
<td>Explain</td>
<td>Reason</td>
<td>Interpret Directions</td>
<td>Rephrase</td>
<td>Manipulation</td>
</tr>
</tbody>
</table>

• It is important that your students value the abilities as mathematically significant

Slide Seven: Participation Feedback

Slide seven reads,

Participation Feedback (Participation Quiz)

Potential new role for teachers during the explore phase, would be to implement an accountability quiz.

• This has the potential to assist the teacher communicate and assess what high-quality group work should look like.
• Expectations/norms/roles should be emphasized.
• Documentation must be public

Why use this strategy?

• By documenting publicly teachers can bring value to behaviors they want and possible mitigate perceived status.
This slide is information about a teacher strategy known as participation feedback, or participation quiz. Participants will read the quick introduction of this strategy and a motivation for why they might use this strategy. (Cohen, 2014)

Slide Eight: Participation Quiz 1

With slide eight participants will watch a short video describing how to use this in a classroom. Lastly participants are to reflect and discuss how they could use this in their own classroom.

Watch this short video, Participation Quiz found (https://youtu.be/IB2GSSSuMJE), at which explains how this works in a classroom (Milvidskaia, 2016):

Discuss: How/when could you implement this in your classroom, what would you emphasize with your students?

Slide Nine: Participation Quiz 2

Slide nine provides a brief introduction to what an accountability quiz and the intent behind using this strategy.

Accountability Quiz (Cohen, 2014)

- Unlike the previous two strategies, an accountability quiz is a strategy that will bring accountability that all students are engaged AND that students are understanding of the mathematics content.
- Accountability quizzes works best when you have a place midpoint in the students’ task where you want to check in with students before they move on.
  - For this strategy the teacher directs students to pause or raise their hand at a specific place in their task, this is when the teacher will check in with the group and randomly choose a student from the group to report out their understanding.
  - The intent is twofold: 1. To make sure everyone in the group has the same understanding and 2. The group is on the correct path towards completing the task.
Slide Ten: Accountability Quiz

During slide ten participants will read an article that includes more literature around the strategies presented in this center. Participants are to read this article independently followed by sharing out 2-3 thoughts each.

Slide ten reads,

Assessments that Promote Collaborative Learning

Please read the following article independently:

- Assessments That Promote Collaborative Learning by Maika Watanabe and Laura Evans

Note anything that stands out to you

Be prepared to share 2-3 thoughts about this article

Slide Eleven: Presentation Instructions

The last slide, slide eight, describes the expectation for presentations that participants will present either individually, in pairs, or a group of three. This slide also describes what is expected in between each presentation.

Presentations

Each participant will be responsible to create an Ignite style presentation on a specific topic of their choice.

- Ignite style means you must have 20 slides which will automatically advance after 5 seconds, so you get to the point fast.
- Each presentation will be 5 minutes long, with 5 minutes after dedicated to writing down questions and feedback while the next presenter is preparing. (These questions will be addressed later in the workshop.)

Make sure you discuss topics with people at your center to decrease the amount of crossover in presentations (the more unique of topics the more information everyone will be receiving).
Effective Lesson Planning Collaboration with Colleagues Center

The following slides are to be accompanied with the respective center. A copy of the Google Slideshow can be found using the link below.

Effective Lesson Planning - Collaborating with Colleagues Retrieved from

https://docs.google.com/presentation/d/1PMG_fjTDW8nDea4H5YUvRSwl4E98txaQbgMn-l2iTII/edit?usp=sharing

Slide One: Introduction

This is an introduction slide that is projected while participants move to their intended center. The slide reads, “Mathematics Teaching Practices Workshop- Effective Lesson Planning- Collaborating with Colleagues.”

Slide Two: Motivation for Collaborations and Lesson Planning

Slide two reads,

Why lesson plan?

With no more than two other people try to come up with at least 3 items for each of the following:

- Potential Negatives of Lesson Planning

- Payoff of Lesson Planning

This slide is intended to bring additional motivation to participants for the importance on collaborating with colleagues and lesson planning. This slide includes directions that state for participants to come up with at least 3 items for each of the following: potential negatives of lesson planning and the payoff of lesson planning.

Slide Three: Self Reflection
In slide three there is a link to the YouTube video “Conrad Wolfram: Teaching kids’ real math with computers,” and directions for participants to reflect and share their reflection with the group.

Why do we teach math?

1. Watch the following YouTube video: https://youtu.be/60OVlfAUPJg

(stop video at 4:49)

2. Take 5 minutes to individually write and reflect about what sticks out to you about this video.

3. One person start a conversation about the video and the above questions (allow all participants to share out their thoughts and reactions)

**Slide Four: Group Worthy Tasks Reading**

Slide four is a placeholder to signal participants to read the article “Group-Worthy Tasks” by Rachel Lotan.

1. Read article “Group-Worthy Tasks” by Rachel Lotan
   

Keep track of anything new that seems helpful in deciding or creating group worthy tasks.

**Slide Five: Group Worthy Tasks Activity Instructions**

Slide five reads,

Group Worthy Tasks Sorting Activity

1. With no more than 3 other people you will need to identify what type of task each of the following are.
   a. The activities are on the next slide
   b. Pull 2-3 activities from your current curriculum, or that you use in your classroom in addition to the tasks provided.

2. After which discuss when it would be appropriate and meaningful to use each task in your classrooms.
This slide informs participants of an activity they will complete along with the directions for them to follow. The activity is to take what they just read and learned from the previous slide and apply it in a sorting activity. In groups of no more than 3 participants will identify what type of task the following activities are as well as bring in activities they have done in their own classrooms.

**Slide Six: Group Worthy Tasks Activity Visuals**

Slide six provides 3 different visuals to use during the sorting activity, described in previous slide, by the participants.

**Slide Seven: Why use Group Worthy Tasks**

This slide provides participants will a list of why group worthy tasks are important to incorporate into their classroom. Participants are to note these reasons to think about them moving forward.

Why are group worthy tasks important?

- Students are more engaged, doesn’t feel like an assignment.
- Students will have something meaningful to talk about.
- A clear group worthy tasks allow students to be in control of their learning, in other words it removes the need for the teacher to keep the learning moving.

**Slide Eight: Why Lesson Plan?**

Slide eight includes suggested steps for lesson planning and explains the focus of this professional development will remain on the third step because of the potential limitations in the first two steps. Participants are to read this slide then move forward in the presentation. The slide reads,


Step 1: Identify end goal for students to achieve.

Step 2: Choose strategy to assess if students have reached this goal.
Step 3: Plan activities to build students understanding and ability so that they will reach the goal.

- Each of these steps can be very involved and specific depending on your site, so for this center we are focusing on step 3.

**Slide Nine: Productive Lesson Planning**

Slide nine reads,

Planning Teaching Strategies that Support Student Growth

- Launch with a puzzle, engaging task
- Use student presentations as a way to start, continue, and deepen understanding NOT as final or ending thinking
- Ask questions that go deeper into the concepts
- Establish routines that enable students to think hard and communicate

(Adapted from EUHSD professional Development)

Participants should reflect out loud and come to consensus about what each of these bullet points means, and how to incorporate all of these in your own practices.

This slide provides suggestions about productive lesson planning. Also included are directions for participants to reflect out loud about this slide.

**Slide Ten: 5 Practices for Orchestrating Productive Mathematics**

Slide ten reads,

Individually read Chapter 1 (pages 7-12) of this book

- Take notes as you see fit
- Be prepared to share out your big takeaways after about 15 minutes

Partner up (at most 3 people in a group) and share your big takeaways from this chapter.

This slide is for participants to read about specific strategies to plan for during instructions to help prepare their students for 21st century careers.

**Slide Eleven: Lesson Plan Format**
Slide ten and eleven provide a potential lesson plan format for participants to reflect
upon, discuss, change, improve.

Included on slide ten is,

- With your thinking now look at the following suggestion and reflect, discuss, change, improve.
- Could you commit to using a template like this, what would you be able to commit to?
  What is essential?

Mathematical Goal:

Anticipated student thinking:

Prepared Questions/Prompts:

**Slide Twelve: Lesson Plan Format**

Similar to slide ten, slide eleven is a continuation of the potential lesson plan format to
reflect on.

Included on slide eleven is,

Launch: (What puzzle will you use?)

Explore: (What discussions do you anticipate? What understanding will be presented to move
close conversation forward? What sequence will ideas be presented?)

Summarize: (What structure will be used to present understanding? What questions will be asked
to deepen understanding? What will I re-state in closing? How will connections be made
between ideas?)

National Council of Teachers of Mathematics developed the idea of Launch, Explore
Summarize.

**Slide Thirteen: Presentation Instructions**
Slide twelve describes the expectation for presentations that participants will present either individually, in pairs, or a group of three. This slide also describes what is expected in between each presentation.

This slide states,

Each participant will be responsible to create an Ignite style presentation on a specific topic of their choice.

- Ignite style means you must have 20 slides which will automatically advance after 5 seconds, so you get to the point fast.
- Each presentation will be 5 minutes long, with 5 minutes after dedicated to writing down questions and feedback while the next presenter is preparing. (These questions will be addressed later in the workshop.)

Make sure you discuss topics with people at your center to decrease the amount of crossover in presentations (the more unique of topics the more information everyone will be receiving).

**Shift from Teaching to Facilitating Student Discussions Center**

The following slides are to be accompanied with the respective center. A copy of the Google Slideshow can be found using the link below.

**Shift from Teaching to Facilitating Student Discussions Retrieved from**

https://docs.google.com/presentation/d/1JIPZ5hSJrl5gLgoxTzD3UJum9l0UnuP0EFT_snEXxKE/edit?usp=sharing

**Slide One: Introduction**

This is an introduction slide that is projected while participants move to their intended center. The slide reads, “Mathematics Teaching Practices Workshop - Shift from Teaching to Facilitating Student Discussions.”

**Slide Two: Self Evaluation**
This slide poses the question “what does teaching look like in your classroom?” including two opposing picture of what classrooms may look like. This slide asks participants to silently reflect before moving on in this center.

**Slide Three: Reflection**

Participants will follow the directions provided on slide three to reflect individually and then share their thinking about the information presented on the chart.

**BIG IDEA:**
Students need to think hard and interact in order to learn.

Reflect Individually (2 minutes):
- What stands out to you?
- What are your strengths?
- What do you want to improve?

Share your thoughts with a partner (or 3 if needed)

The table is as follows:

<table>
<thead>
<tr>
<th>DIMENSIONS</th>
<th>CORE FEATURES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nature of Classroom Tasks</td>
<td>Make mathematics problematic</td>
</tr>
<tr>
<td></td>
<td>Connect with where students are</td>
</tr>
<tr>
<td></td>
<td>Leave behind Something of Mathematical Value</td>
</tr>
<tr>
<td>Role of the Teacher</td>
<td>Select tasks with goals in mind</td>
</tr>
<tr>
<td></td>
<td>Share essential information</td>
</tr>
<tr>
<td></td>
<td>Establish classroom culture</td>
</tr>
<tr>
<td>Social Culture of the Classroom</td>
<td>Ideas and methods are values</td>
</tr>
<tr>
<td></td>
<td>Students choose and share their methods</td>
</tr>
<tr>
<td></td>
<td>Mistakes are learning sited for everyone</td>
</tr>
<tr>
<td></td>
<td>Correctness resides in mathematical argument</td>
</tr>
<tr>
<td>Mathematical Tools as Learning Supports</td>
<td>Meaning for tools must be constructed by each user</td>
</tr>
<tr>
<td></td>
<td>Used with purpose – to solve problems</td>
</tr>
<tr>
<td></td>
<td>Use for recording, communicating, and thinking</td>
</tr>
<tr>
<td>DIMENSIONS</td>
<td>CORE FEATURES</td>
</tr>
<tr>
<td>--------------------</td>
<td>------------------------------------</td>
</tr>
<tr>
<td>Equity and Accessibility</td>
<td>Tasks are accessible to all students</td>
</tr>
<tr>
<td></td>
<td>Every student is heard</td>
</tr>
<tr>
<td></td>
<td>Every student contributes</td>
</tr>
</tbody>
</table>

**Slide Four: Strategies**

Slide four suggests three different strategies that will be introduced in this center.

Strategies that we will explore:

- What is the teacher doing while students are working/discussing
- Group Roles
- Teacher Questions

**Slide Five: Suggestions**

Slide five reads,

- Carry Clip Board: Teacher should carry a clipboard (or digital equivalent) in order to write down and keep track of any questions or thoughts that students are sharing in order to address or highlight later in the summary phase.
  - Anything you are wanted to address in the moment write a note down about it and if the group doesn’t resolve the issue you can address this with them later or during the summary phase you can orchestrate other groups to uncover information to help the struggling group.
- Multiple Summaries: As the teacher you don’t have to wait until the end of the lesson to have groups share out their thinking
  - Doing this in the middle might help stuck groups without the teacher having to intervene
- Wait Time: Make sure as the teacher you are not dominating the airtime, one strategy to help manage this is to allow yourself to wait until students begin to talk. (Wait and they will talk)

This slide provides three suggestions for what teacher should be doing while their students are working on tasks. Each suggestion is accompanied with a brief explanation of why teacher might try these moves.

**Slide Six: Types of Group Roles**
Group roles is the topic of slide six in which two different types/styles of group roles is introduced, a brief summary of how to introduce group roles to students and a tip when implementing group roles.

Types of group roles:

1. Task based: Assigning students to do an action (ie grab materials, record work…)

2. Habit/interaction based: Assigning students to manage group interactions (ie student in charge of making sure each group member is include, a student in charge making sure each group member has the same understanding…)

How to introduce group roles: Roll out one group role at a time, use them when students see value in them, when rolling out group roles be intentional in explaining why we have these group roles and why they are important.

Reinforcing group role habits: You must keep referring to these roles or students will not follow through!

**Slide Seven: Brainstorm Group Roles**

Slide seven reads,

In a group of no more than 3:

Brainstorm 2-3 group roles that you want to implement in your classroom:

1. What is the roles responsibility?
2. How does the students know if they are being successful at that role?
3. How are you able to monitor this group role?
4. How will you introduce these group roles to students?

After 15 minutes: Share out your top 1-2 favorite group roles, why it is important and how you intend to introduce it to a class.

This slide has participants split up into groups no more than 3 and brainstorm group role ideas.

There are four different prompts to help guide their thinking in this brainstorming activity.

**Slide Eight: Reading about Questions**
Slide seven is a placeholder to signal participants to read the article “The Right Questions, The Right Way” by Dylan Wiliam. This slide also includes directions for participants to first reflect individually and then with peers.

The slide is as follows,

Teacher Questions

1. Read excerpt from article “The Right Questions, The Right Way” by Dylan Wiliam
   http://www.ascd.org/publications/educational-leadership/mar14/vol71/num06/The-Right-Questions,-The-Right-Way.aspx
2. Individual Reflection
   a. Initial Reaction
   b. Respond to Prompts
3. Discuss your reflection with up to 4 people

As a group create a bank of questions that you will commit to using in your classroom.

Slide Nine: Presentation Instructions

Slide eight describes the expectation for presentations that participants will present either individually, in pairs, or a group of three. This slide also describes what is expected in between each presentation.

Each participant will be responsible to create an Ignite style presentation on a specific topic of their choice.

- Ignite style means you must have 20 slides which will automatically advance after 5 seconds, so you get to the point fast.
- Each presentation will be 5 minutes long, with 5 minutes after dedicated to writing down questions and feedback while the next presenter is preparing. (These questions will be addressed later in the workshop.)

Make sure you discuss topics with people at your center to decrease the amount of crossover in presentations (the more unique of topics the more information everyone will be receiving).
Day Two of Workshop

Standards: California Teacher Performance Expectation (TPE)

4: Planning Instruction and Designing Learning Experiences for All Students

4.4 Plan, design, implement and monitor instruction, making effective use of instructional time to maximize learning opportunities and provide access to the curriculum for all students by removing barriers and providing access through instructional strategies that include:

- Appropriate use of instructional technology, including assistive technology;
- Applying principles of UDL and MTSS;
- Use of developmentally, linguistically, and culturally appropriate learning activities, instructional materials, and resources for all students, including the full range of English learners;
- Appropriate modifications for students with disabilities in the general education classroom;
- Opportunities for students to support each other in learning; and
- Use of community resources and services as applicable.

Standards: California Teacher Performance Expectation (TPE)

6: Developing as a Professional Educator

6.1 Reflect on their own teaching practice and level of subject matter and pedagogical knowledge to plan and implement instruction that can improve student learning.

Objectives

The objectives of the second day of the professional development include:

1. Participants will present their understanding of a specific instructional strategy ranging from planning, designing, implement and monitoring instruction in order to provide students access to the content (CA TPE Standard 4.4).
2. Participants will reflect and commit to implementing teaching practices that they feel strongly about (CA TPE Standard 6.1).

Assessment

Evidence of meeting these objectives include:

1. Each participant will create a twenty-slide presentation that will be shared with each participant attending the workshop including the new knowledge regarding a specific self-identified instructional strategy (CA TPE Standard 4.4).

2. The facilitator will collect a copy of each participant's commitment to change including their plan to follow up with a peer (CA TPE Standard 6.1).

Learning Activities

Day two of two will consist of 7 hours, including a 1-hour break. The learning activities for day two include:

1. Create Presentations with teams planned to be 2 hours

2. Break planned to be 1 hour

3. Presentations planned to be 10 minutes per presentation: Each participant present their learning in pairs or group of three to the entire group, in between each presentation participants write down questions and feedback to then address after all the presentations.

4. Questions planned to be 30 minutes: Participants have time to question and clarify the different strategies presented.

5. Commitment to Change planned to be 10 minutes: Participants engage in a commitment to change activity.
6. Feedback planned to be 10 minutes: Participants asked to provide feedback about the workshop as a whole.

**Materials**

The materials needed for day two includes:

1. Computer with projector capability for electronic presentations,
2. Pen, pencils, erasers, scratch paper (about 5 per participant).

A copy of the Google Slideshow can be found using the link below. Included in this workshop guide is an explanation of each slide and activity.

Day Two of Workshop Google Slideshow Retrieved from

[https://docs.google.com/presentation/d/12c7Oo9m8Xqa1voOENGvxSIU1sgTY2bm2yMU_rLLjtgc/edit?usp=sharing](https://docs.google.com/presentation/d/12c7Oo9m8Xqa1voOENGvxSIU1sgTY2bm2yMU_rLLjtgc/edit?usp=sharing)

**Slide One: Introduction**

This is an introduction slide that is projected while participants are entering the workshop location. The slide reads, “Mathematics Teaching Practices Workshop- Developing Strategies to push your teaching further”

**Slide Two: Agenda**

This slide has the agenda for the second day of the workshop. It reads:

Agenda

Day 2

1. Create Presentations (2 hours)
2. Lunch BREAK (1 hour)
3. Presentations (10 minutes per presentation)
4. Questions (30 minutes)
5. Commitment to Change (10 minutes)
6. Feedback (10 minutes)
Slide Three: Presentations

Slide three describes the expectation for presentations that participants will present either individually, in pairs, or a group of three. This slide also describes what is expected in between each presentation.

Each participant will be responsible to create an Ignite style presentation on a specific topic of their choice.

- Ignite style means you must have 20 slides which will automatically advance after 5 seconds, so you get to the point fast.
- Each presentation will be 5 minutes long, with 5 minutes after dedicated to writing down questions and feedback while the next presenter is preparing. (These questions will be addressed later in the workshop.)

Make sure you discuss topics with people at your center to decrease the amount of crossover in presentations (the more unique of topics the more information everyone will be receiving).

Slide Four: Break

This slide is a placeholder and reminder for a 1-hour break, it reads “Break for 1 Hour.”

During this break the facilitator is responsible for collecting all the questions from participants in order to organize questions to make the next activity more meaningful.

Slide Five: Questions

Slide five reads,

Questions

Presentation Questions - Facilitator will read off questions for presenters/participants to answer/discuss.

Any other Questions - Time for any unanswered questions to be posed to whole group.
This slide is instructions for a semi-structured question and discussion activity. The facilitator will read out questions about the presentations that are provided by participants. The expectation is for anyone to discuss or respond to questions that are posed.

**Slide Six: Commitment to Change**

Slide six explains the process this professional development uses to ensure participants commit to making real change in their own teaching practices. Participants will follow the instructions provided on the slide, facilitator will circulate the room and offer any suggestions or advice on the importance of making a change after attending the professional development.

The text on the slide reads,

What are you going to commit to:
- Be as specific as possible, include a time frame
- Include why you are committing to change this practice
- How do you hope this change will affect your students

Plan to follow up with participant:
- Find a partner (or group of 3 if needed) exchange contact information (that you check often)
- Schedule a time right after each individual's commitment to change to check in
  - Check in must include:
    - Initial reaction of how the implementation went
    - What went well
    - What additional changes are you thinking
    - Could include pictures, videos, lesson plans, written explanations
  - You must respond to your partner with feedback which could include
    - Positive feedback
    - Wonderings along lines of what other small strategies they could try
    - Common themes/Connections to your classroom

**Slide Seven: Feedback**

This slide contains a link for a digital feedback form for each participant to complete. The feedback form includes three open ended questions. The aim of these questions is to receive
feedback from the participants in order to modify and improve this workshop to maintain its usefulness to those educators who attend.

Slide seven reads,

Please go the following form to provide feedback about this workshop: https://bit.ly/2WJKLDS

**Mathematics Teaching Practices Workshop Feedback**

Now that you have completed this workshop, it would be very helpful to hear from you about what you liked and what you disliked along with any suggestions or praises.

* Required

1. What was the most meaningful activity you participated in across these two days? What about it did you find helpful? *
   Your answer:

2. What changes would you suggest to any parts of this workshop? *
   Your answer:

3. How would you rate this professional development compared to others you have attended? *
   The worst I have attended 1 2 3 4 5 Far better than any I have attended

4. Explain your rating from the question above. *
   Your answer:
Chapter 5: Reflections and Recommendations

Creating a professional development workshop that is specifically designed to reach mathematics teachers has been very eye opening and rewarding. It was imperative to incorporate a format and method that teachers would appreciate and walk away feeling accomplished. Mathematics education is going through a large shift in what skills we are instilling in students and due to this there is currently not enough meaningful support offered to teachers. The hope is this professional development can stand for a base for districts across the country to encourage and foster collaboration, creativity, and problem solving in both teachers and students.

This final chapter will discuss lessons learned, plans for implementation, and suggestions for modifications.

Lessons Learned

Throughout all the different iterations of this professional development I have gone through a large learning process both as a student and a teacher. I learned lessons that fall under three different categories: motivation for professional development workshop, what teachers need, and math pedagogy.

Motivation for Professional Development Workshop

When setting out to start this curriculum I first envisioned creating a specific curriculum designed for one mathematics course that teachers could pick up and adapt and use if they wanted, but I realized that for me that addressed a different problem. The problem this workshop is one I have come across in the work I have been a part of at my school district, which is teachers need more time to explore and develop their skills: in effective lesson planning, creating engaging group worthy tasks, and developing teacher moves to facilitate student led discussions.
These are imperative for their students to develop their ability to collaborate, be creative, and problem solve which will be required of them post-secondary education (Robinson, 2010). So, it dawned on me, to create time and space for teachers to engage in these very skills focused around their teaching. I know plenty of teachers who are extremely interested in pushing their practices forward, the only issue is they are worrying about a variety of other aspects of their job and don’t feel they have the time or ability to focus in on their teaching practices.

**What Teachers Need**

Another lesson I learned during this experience is the same strategies teachers use to engage and help students build understanding are just as important when engaging teachers. I have my own experiences with professional developments, as well as the reactions to professional developments from colleagues which have helped to inform my decision making. It was eye opening reading the Boston Consulting Group (2014) review of effective professional developments with specific critiques from teachers and administration, that many of the strategies we use with students is what works best with educators as well. Teachers and administrators want to be engaged in problem solving and collaboration, they want to have ownership over their learning, and choice of what it is they are learning about (Boston Consulting Group, 2014). I have walked away from this process with a deeper appreciation and desire to create schools where students, teachers, staff, administration are all engaged in collaborative problem solving every day.

**Math Pedagogy**

Lastly, I learned numerous research-based math pedagogy to ensure students are being prepared for their future. I found that all these different strategies are centered around the goal of
having students thinking hard and communicating about their thinking with others. As a high school mathematics teacher, I understand how there are so many different aspects of teaching that can be focused on and improved all the time, it is necessary to focus on a few at a time, so not to get overwhelmed. Many people assume that if you put high school students into a group that students will be able to effectively and efficiently collaborate without any training, but what my research has shown me is the main role for teachers is to create a truly collaborative classroom. These strategies come from numerous authors for example choosing the correct tasks (Lotan, 2003), to questioning students (Wiliam, 2011), to listening and observing groups and students thinking (Smith & Stein, 2015), to validating all mathematical skills and more (Cohen, 2014).

I decided that these strategies would be highlighted in this professional development due to their ability to uncover the personal philosophies around teaching. I feel that all of these strategies, articles, and videos demonstrate and explain why these ideas are necessary for moving our mathematics teaching forward to meet the needs of our students who are undoubtedly entering into a workforce that will look different than has ever existed. This connection to why is imperative in a professional development for the participants to buy in and commit to making any sort of change, and to limit the amount of resistance (Boston Consulting Group, 2010). In order to encourage participants, in this professional development, to take ownership of their learning I wanted to have them present and share what their biggest take away from their center. In addition, the Ignite style presentation ensures that participants remain focused as they will be constricted to this specific format. Presenters will be limited in the number of slides they are allowed to have as well as the time they have to speak for each slide.
Plans for Implementation

With the professional development workshop created the next step is to inform teachers administration and district personnel of its existence and advertise this opportunity for teacher. My school district has started an annual tradition of having two days prior to the start of the school year dedicated for educators to attend teacher led sessions with a variety of topics. I see this as potential time to implement this entire workshop or a good starting place for an abbreviated version of this professional development to gain interest. We also have many mathematics professional development opportunities during the year, this workshop could take place during those days. In addition, this could be presented at a conference, or in a methods course, or adapted to be an online version so that any mathematics team could use this during common preparatory time. Another possible implementation for this professional development would be to split the days up more and incorporate into professional learning community time, which at my site occurs for one hour each Monday. In this case, the workshop could be repeated, and new topics and centers could be added depending on the goal of the professional learning community.

Suggestions for Modifications

Possible modifications that I suggest fall into two categories: professional development modification and content or grade level modification.

Professional Development Modifications

One potential modification to this professional development could be the time spent, although I strongly oppose shortening this workshop the way it is split up into two days could be adjusted. In order to keep the integrity of the workshop it needs to still have the priority of
allowing teachers to collaborate, problem solve, discuss, share ideas, and be creative together. (Boston Consulting Group, 2014). This workshop could also be modified so that each participant does each centers activity (Sowder, 2007) instead of choosing the one that is related to their area of focus, this would require more time dedicated to this workshop. The emphasis of this workshop is to get teachers in a space where they are able to explore and be exposed a variety of research-based teaching practices.

**Content or Grade Level Modifications**

While my area of expertise is in math, this workshop could be stripped down to the pure format and any grade level, or content area could insert the current research-based teaching practices they wish to explore and emphasize. One of the first activities, talking points protocol (Roskam, 2016), is to see what the participants are interested in so that they are able to spend their time learning about a practice they might try and not being prescribe a particular practice they may not have any interest in. To modify this activity to a different content area you would just need to replace the statements to be relevant to the practices you have centers set up for. The other modification that would need to occur is to provide articles, videos, and activities that allow participants to learn about the reasoning behind each practice and how to implement each practice (Boston Consulting Group, 2010).

**Conclusions**

The implementation of this professional development has the potential to shift the way teachers interact and collaborate at school sites, or districts. In doing so students will not only be receiving better instruction due to teachers learning about current research-based teaching practices but when teachers collaborate it sets an example for students to collaborate as well.
Which is a skill that every student will need in order to be successful when they graduate from any high school. In order for this workshop to be successful it is imperative that the teachers that participate are interested and not forced, as well as administrative and district support to allow the time and space for this professional development. This professional development has the potential to change the culture of a school site and district is implemented successfully.
References


