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Administering and Implementing the Singapore Mathematics Curriculum at a Learning Center

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COLLEGE OF EDUCATION

This is to certify that the doctoral study by

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has been found to be complete and satisfactory in all respects,
and that any and all revisions required by
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Doctoral Study Submitted in Fulfillment

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Abstract

A learning center in the southeastern part of the United States used the Singapore mathematics curriculum (SMC) to support student learning of a wide range of mathematics skills. However, a study had yet to be conducted to gain an understanding about the administration and implementation of the program. This case study was conceptually based on constructivist pedagogical theory, where learning is constructed between the teacher and students. The research questions explored how the learning center staff administered and implemented the SMC. Data for this study were collected through multiple in-depth interviews and observations of 2 educators at the learning center. These data were analyzed through typological and inductive analyses in order to discover the underlying meaning of the data. The typologies for this study were bar modeling, textbooks, workbooks, teacher edition, activities, and games. The findings that were derived from these analyses focused on 10 themes, which became the basis of a professional development training project. These themes focused on bar modeling, manipulatives, and stages of learning: concrete, pictorial, and abstract, place value, number bonds, visualization, mastery, and games. The project will support positive social change by increasing educators' insight into how to administer and implement the SMC in order to improve student mathematics achievement.

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Section 1: The Problem

This study improved understanding about the administration and implementation of the Singapore mathematics curriculum (SMC) at a select learning center in the southeastern part of the United States. Originally, the study proposed was a program evaluation. When it became apparent that sufficient data to conduct a program evaluation were not available, in consultation with my project study committee, I changed the research design to a case study. This case study examined different aspects of the SMC to determine how to administrate and implement SMC in a learning center.

Researchers stated that implementation of the SMC should result in a passing rate increase from 40% and 50% to 90% in 4 years (Garelick, 2006). Therefore, students should be improving their mathematical skills using the SMC. Throughout this section of the study, I discuss the problem, rationale, evidence of the problem, definitions, significance of the research, research questions, and implications.

Definition of the Problem

A select learning center in the southeastern region of the United States implemented a program called SMC to support the improvement of mathematics skills of a wide range of students. To help improve achievement in the classroom and increase standardized test scores, school systems typically implement successful programs to bring scores to an acceptable level to reflect positive achievement (Naz, Tatlah, & Abida, 2011). However, there was a lack of understanding about how the administration and implementation of SMC program was at the learning center. Therefore, this case study

focused on gaining an understanding about the administration and implementation of SMC at the learning center.

Rationale

The revised plan for this study was to explore the administration and implementation of the SMC in a select learning center in the southeastern region of the United States. The administrator for the learning center (personal communication, November 14, 2012), commented that exploring how the program was administered and implemented would be helpful in assisting teachers in their instruction. As a result, I planned to explore how the learning center staff administered the program how an experienced teacher implemented the SMC at the learning center to instruct students.

The learning center staff used SMC to support and improve students' mathematical skills, and the teachers knew the program extremely well, as noted by the administrator for the learning center (personal communication, January 10, 2013). From gathered research (Ee & Seng, 2008; Leinwand & Ginsburg, 2007; Toh, 2007), three factors became apparent as critical in improving students' mathematics achievement: classroom setting, teaching styles, and teacher preparation. The purpose of the study was to gain an understanding about how to administer and implement the SMC program at the learning center.

Definitions

Professional learning communities (PLCs): Teachers and administrators getting together to learn a new skill, technique, and/or curriculum (Fang, 2010).

Singapore mathematics curriculum (SMC): A curriculum developed and used in Singapore to teach mathematical skills. The curriculum uses different strategies (i.e. number bonds, bar modeling) in place of traditional techniques to teach skills in mathematics (Leinwand & Ginsburg, 2007).

Significance

The significance of conducting a case study of SMC in one learning center in the southeastern part of the United States was to explore the administration and implementation of SMC. Studying the administration and implementation of the curriculum assisted in understanding the importance of using the curriculum to the fullest. The learning center staff members were able to conduct meetings to discuss the results of the case study in an effort to assist teachers in improving the way they administer and implement SMC. In that way, teachers are able to administrate and implement SMC successfully.

Guiding/Research Question

The basic elements of this study had to be revised to fit the data collected. In alignment with the revised research problem and purpose, the following revised research questions were posed:

1. How do educators at a select learning center describe the administration and implementation of the SMC program?
2. How do educators at the learning center demonstrate the implementation of the SMC program?

Originally one broad, open-ended research question was posed in order to focus the study and at the same time remain open to what would emerge from the data (Bogden & Biklen, 2007). Sometimes a needed revision of the research questions fit better based on the data collected and analyzed (Stake, 1995).

Review of the Literature

This literature review focuses on different aspects of research and how the study correlates with the current research conducted in other districts. In this section I explain the curriculum used in Singapore and the United States that guided me in understanding possible factors to examine in the study. The focus of the study was to evaluate the usage of SMC in the classroom. The purpose of this literature review is to discuss research on SMC and its relation to this study. I will discuss SMC and the typologies I used based on the research of SMC.

Throughout this portion of the project study, I discuss the conceptual framework of ideas related to the central phenomenon of interest, SMC. I also discuss typologies that are important components of the SMC: bar modeling, teacher edition, textbooks, workbooks, games, and activities. These typologies were essential in using SMC to the fullest.

In conducting my search of journal articles for this literature review, I used a combination of databases (i.e. *Education Research Complete, ERIC, and Google Scholar*). Within the databases, I searched using various terms (i.e. *Singapore Math Curriculum, curriculum, mathematics, teacher preparations, teacher development, textbooks, bar modeling*, and *mathematic strategies*).

Conceptual Framework

The conceptual framework is the component of a project study that assists in explaining the design of a study (Galea, 2012). For this study, I used a constructivist conceptual framework approach to evaluate the usage of the SMC within the classroom. According to Creţu and Rogoz (2011), constructivist pedagogy used terms of structure, organization, and the results of the program to evaluate the curriculum. According to Shabani, Khatib, and Ebadi (2010), constructivist pedagogy scaffold the knowledge of the students. Piaget (2011) stated the importance of teaching toward a need and supporting student ability. Addressing the students' needs during instruction, allows students to gain knowledge to be successful in the classroom.

The Broader Problem

Student achievement measured by using various tools (i.e., *tests, quizzes, performance tasks, state tests*). Students' success in mathematics is important for their future (Hemmings, Grootenboer, & Kay, 2010). Hemmings, Grootenboer, and Kay (2010) stated that there is a relationship between mathematical success and career opportunities for students. If they are not successful in mathematics, students will be less successful in obtaining or being successful in a job (Hemmings et al., 2010).

In addition, Hemmings et al. (2010) found a connection between attitudes of students and their achievement in subject areas (i.e., *math, science, social studies, language arts*). According to Dash, De Kramer, O'Dwyer, Masters, and Russell (2012), the lack of student success in mathematics was a result of underdeveloped teachers. In most cases, the teachers did not have the knowledge to use the resources (Dash et al.,

2012). However, there are situations where the teachers do not have the resources or the support available to instruct the student to meet the needs in the area of mathematics (Dash et al., 2012). The lack of professional development is critical to the lack of students not increasing understanding in mathematics (Dash et al., 2012).

It is important that students understand mathematics so they can successfully learn about the fields of science, technology, engineering, and mathematics (STEM) subjects. STEM education focuses on specific academic areas, which leads to students majoring in specific majors in college (Zollman, 2011). STEM education is more in-depth than just language arts standards (i.e. *reading and writing*; Zollman, 2011). The purpose of STEM education is to give students the skills needed to be successful in specific areas (i.e. *science, technology, engineering, and mathematics*; Mann, Mann, Strutz, Ducan, & Yoon, 2011). According to Mann, Mann, Strutz, Ducan, and Yoon (2011), STEM education meets various learning abilities and skills of students in the classroom, and students are becoming more successful in academic areas. Therefore, this specialized program allows students to gain the knowledge to be successful in the future, especially in mathematics.

SMC

Since the 1990s, students in Singapore have had higher mathematical test scores than those in the United States (Central Intelligence Agency, 2010). Leinwand and Ginsburg (2007) focused on the development and unity of the SMC program and how students learned from the program. Leinwand and Ginsburg's research showed that the standards of mathematics in Singapore and the United States were not comparative.

According to Leinwand and Ginsburg, educators and administrators in the Unites States put equal value to all of the skills (i.e. *computation and problem-solving skills*), whereas educators from Singapore used a pentagon framework with problem-solving in the middle and the other skills surrounding it.

The five elements of Singapore curriculum include organizing framework, alignment, focus, multiple models, and rich problems (Leinwand & Ginsburg, 2007). The organizing framework focuses on the process in which the curriculum is designed with the teacher edition, games, student textbooks, and workbooks (Leinwand & Ginsburg, 2007). The alignment of the program is important to assure that the skills are grade level appropriate and developmentally appropriate for the students (Leinwand & Ginsburg, 2007). The focus is another key element to the curriculum. The information and instruction must be mainstream (i.e. *consistent among classrooms and grade level*) to achieve success in students' performance (Leinwand & Ginsburg, 2007). Multiple models allow the students to use similar models with different variations to meet the needs of various mathematical problems (i.e., *computation and word problems*; Leinwand & Ginsburg, 2007). The rich problems give students challenges in solving word problems at various task levels: homework, chapter test, unit test, or standardized tests (Leinwand & Ginsburg, 2007). All five elements work together to create the curriculum (Leinwand & Ginsburg, 2007).

SMC uses a different approach to teaching math skills than American math curriculum. SMC focuses on bar modeling, number bonds, and different ways to think about numbers or process in solving problems. However, most curricula in the United

States involve a more traditional process to solve word problems and computations. According to Hook, Bishop, and Hook (2007), teachers in the United States taught too many skills each year, which resulted in low comprehension of the skills. Students would read a word problem and determine the operation they would use through the phrasing of the problem. Then, students would complete the computation. Students learned to do word problems without drawing pictures, which makes completing word problem difficult for some students. Hoven and Garelick (2007) focused on the simplicity and complexity of SMC and the process of completing word problems. Learning the skills of mathematics assures student success in mathematics and begins in the younger grades (Hoven & Garelick, 2007).

According to Hoven and Garelick (2007), school officials have been implementing SMC into the classroom to increase standardized test scores. In addition, Naz, Taltah, and Abida (2011) stated that implementing a successful curriculum in a struggling district or school and the success rate will increase. SMC is not the cure-all program and will not solve all of the problems the United States has in the classroom (Hoven & Garelick, 2007). Educators in Singapore still use the conventional practice of drill and practice to obtain the basic knowledge needed to be successful in subject and standardized testing (Koh & Luke, 2009). However, Hui and Lau (2010) studied the policies and development of education for China, Hong Kong, Singapore, and Taiwan and found that Singapore's educational system centers on schools that focus on thinking skills, creativity in the classroom, and encouragement of the programs. In addition, Hui and Lau (2010) discovered that creativity in the Singapore classroom was indicated in

general skills, innovation, artistic skills, visual arts, performing arts, psycho-motor skills, psycho-social skills, and cultural heritage. Having multiple venues of learning allows the curriculum to reach more learning styles in the classroom, which could be a factor for U.S. schools to improve on in the classroom.

Textbooks play an important role in educating students in the classroom (Yang, Reys, & Wu, 2010). Yang, Reys, and Wu (2010) compared the textbooks from three different countries: Singapore, China, and the United States. Yang et al. (2010) discovered that Singapore textbooks ranked higher than the other textbooks from China and the United States in the way material presented and the applications/practice in the books to successfully educate children in mathematics. The textbooks are key tools for instruction (Fan & Zhu, 2007). Fan and Zhu (2007) researched the effectiveness of textbooks from three countries—Singapore, China, and the United States—and discovered that Singapore math textbooks gave students a plan on how to solve various mathematical problems. Singapore textbooks were more supportive in student learning than the other textbooks (Fan & Zhu, 2007). Hoven and Garelick (2007) discovered that one could open the textbook to any page and the bar model was demonstrated in some way.

Fan and Zhu (2007) expressed how the United States textbooks did not give various strategies in order to solve the problem. The lack of guidance in the United States textbooks does not reach support multiple learning styles. Jiang and Chua (2009) researched strategies for solving word problems from China and Singapore. The researchers stated that Singapore math textbooks had various levels of questions (i.e.

basic and challenging) to reach students at different levels and to challenge the individuals for success (Jiang & Chua, 2009). Having multiple levels of questions allows the students to complete the material that is appropriate for their learning ability and challenge those students with high ability in mathematics.

The Study's Contribution to the Literature

From the literature, the success of the SMC has been based on the full use of the curriculum (i.e. teacher edition, textbooks, workbooks, games, and activities; Hoven & Garelick, 2007). The current research aligned with most of the studies previously conducted because I wanted to evaluate the usage of the program in my district. In addition, researchers have employed various types of designs to evaluate the program, including program evaluations (Hoven & Garelick, 2007; Leinwand & Ginsburg, 2007; Toh, 2007; Yang et. al, 2010). My study will add to the research of the topic of SMC.

Typologies

Through the research, I determined to explore several key typologies throughout this study (i.e. *bar modeling, teacher edition, textbooks, workbooks, games, and activities*). In understanding the reason why a curriculum works in one country, and as well in another country, one must look at the key elements of the educational system and classroom setting to assure similarities are apparent. Ee and Seng (2008), who compared Western and Eastern societies and the effects on education, described classrooms in Singapore and United States and actions in both that led to behaviors in the classroom. The design of Singapore classrooms had the teacher being authoritative and the students being more submissive (Ee & Seng, 2008). The respect students gave to teachers was

great, highly practiced, and expected as part of their culture (Ee & Seng, 2008). According to Ee and Seng, Singapore's education system was extremely structured, mainly lecture-based, focused on memory, drill, practice, rankings, tests effort, virtue (i.e. a behavior that shows a high moral standard), and learning through rewards and punishment.

A teacher's style is a skill that can be beneficial or detrimental to a student's success. Leong and Chick (2008) stated that teachers have many responsibilities when they walk into the classroom. Teachers must balance their students' learning styles, ability levels, curriculum, objectives, classroom management, and completion of skills in a timely manner (Leong & Chick, 2008). Carson (2009) expressed the importance of teachers using all types of teaching styles in order to help students become successful in the classroom. Teachers are able to observe students' success through various means and adapt lesson plans accordingly (Atallah, Bryant, & Dada, 2010). In Cavey, Whitenanck, and Lovin's (2007) research, teachers found that a free exploration approach to understanding mathematical skills allowed the students to gain a deeper understanding of the material taught in the classroom. The free exploration is when the students are allowed to learn through experimental trial and error to learn how to use a mathematical strategy or skill. Cavey et al. found that having a learning-friendly environment (i.e. learning centers, freedom to use manipulatives to solve problems, and other resources for students to use) allowed students to be more active in their learning. Lau, Liem, & Nie (2008) reported a similar result regarding the level of learning based on the learning environment.

Teacher preparation is a vital part of a teacher's success with their students in the classroom. Jefferson (2009) emphasized that teachers need extensive training and practice to prepare them for a complex curriculum. Therefore, Jefferson's theory of extensive training applies to SMC, which is a complex curriculum. It is still important for teachers to be able to grasp the complex ideas and steps even when using a scriptlike form of a teacher edition. The underpreparation of a teacher puts the class at risk of not being successful learning the skills (Jefferson, 2009). Benner and Hatch (2009) expressed that teacher preparation goes beyond just the skill of teaching to understanding the students' needs and addressing those needs in the classroom. Morris (2007) stated the importance of learning the basics in order to have a clear understanding of the skills. If teachers have a good understanding, they are able to expand on the skills in lessons to enrich student learning.

In gaining a deeper understanding of curriculum, districts will group teachers together to explain and/or teach new or existing curriculum. Fang (2010) researched the effects of professional development called professional learning communities (PLCs). Fang worked with SMC teachers to close a gap in learning a new skill for the classroom. Toh (2007) explored the effects of placing mathematics teachers in a professional development setting specifically conducted in Singapore. The Singapore Ministry of Education is a system that thrives on giving teachers the support needed to be successful in the classroom by placing teachers in these professional development settings (Toh, 2007). However, professional development is only a start in the right direction (Leinwoad & Ginsburg, 2007). PLCs are gatherings for teachers to learn about a new skill or

curriculum (Fang, 2010). The research showed PLCs were effective in supporting teachers learning skills for positive results in the classroom (Fang, 2010). PLCs gave teachers the opportunity to renew their skills or gain a deeper understanding of the classroom material.

SMC uses a technique to help students throughout the process of completing word problems called bar modeling. Bar modeling is a specific technique used in SMC. Bar modeling is an important process students must learn in order to be successful with word problems in the future (Hoven & Garelick, 2007). Bar modeling is an eight-step process first introduced in third grade to break apart word problems to solve them more easily and clearly using either the part-whole or the comparative model. Students continue to use the bar modeling technique through fifth grade; however, the word problems become more difficult.

Implications

Through this study, the findings provided an outline for how to effectively administer and implement the SMC program at a learning center. Findings given to the stakeholders was in an effort to allow them to gain a deeper understanding as to how to best administer and implement the SMC program at the participating learning center. The study showed the importance of using the curriculum to its fullest in order to improve the curriculum and ultimately improve student outcomes in mathematics. The administration and implementation shown in the study was of the curriculum at the learning center.

In addition, the findings intended were to assist the mathematics coordinator in supporting the teachers at the learning center and other learning centers the mathematics

coordinator serves. As for teachers, the purpose of the study was to help them to understand the importance of following the curriculum in their use of SMC in the classroom. The project for this study was in the form of a professional development training based on this study's findings given to the stakeholders and participants at the subject learning center (See Appendix A).

Summary

In Section 1, I reviewed and supported the current study by examining the local problem, posing a research question, and reviewing the literature to explain different aspects of SMC and the United States mathematics curriculum, classroom settings, teaching style, and teacher development. The information explored above describes the background information and the basic ideas underlying this study. Based on the information discussed in this section, I formulated the actual design of the study as described in Section 2.

Section 2: The Methodology

The research design for this study began in the proposal stage as a program evaluation. However, when it became apparent that there were insufficient data available to complete such a study, the research design changed to an instrumental case study (Stake, 2005) in order to better understand how the SMC was being administered and implemented in a specific learning center. In Section 2, I discuss the research design, participants, data collection, and data analysis for this study.

Research Design and Approach

The research design for this qualitative research project was instrumental case study (Stake, 2005). The data collected and analyzed through this study allowed me to explore how an administrator was administering the SMC program and how a teacher was implementing the program. Using another qualitative design (i.e., *ethnography, grounded theory*) would not allow me to evaluate the implementation of a program as well. Ethnography focuses on societies and cultures related to the study (Patton, 2002). Grounded theory focuses on creating theory as the focus of the study (Patton, 2002). Both ethnography and grounded theory do not focus on a case study, which is the basis of my study.

Participants

The participants for this study came from a select learning center in the southeastern part of the United States. Originally, I wanted to interview the administrator and interview and observe five teachers using the SMC at the learning center. However, I was only able to interview and observe the administrator and one teacher. Given this

limitation in data collection, I met with my project study committee to determine how to reframe the study to align with the available data. The committee agreed with a plan to use the interview data obtained from the administrator to understand how to administer the SMC program at the learning center, as well as the data collected from observing this administrator, and to conduct a further in-depth interview and observations with the one teacher participant within the framework of a case study research design. As a result, I reframed the design of the study and conducted a further interview and observations of the teacher participant. I used the same interview questions (Appendix B) and observation protocol sheets (Appendix C) in the interviews and observations except for the second interview conducted with the teacher (Appendix D). The observation of the administrator was in a classroom setting. He was not only an administrator but a teacher as well.

To gain access to the participants, I obtained a letter of cooperation from the appropriate person at the learning center. I completed the required Walden University IRB application form and submitted it for review. Once the application was approved (approval number: 21013.07.10 15:02:00-05’00’), I began recruitment of participants. Once I had received the written consent of the participants, I began working with the participants to set up times for interviews and observations.

In order to recruit the participants, I asked the learning center staff to send the following materials to potential participants: a self-addressed, stamped envelope; a letter of invitation; consent forms for participants to sign if they were willing to participate in the study; and a blank, stamped envelope for the learning center to put these materials in.

I asked the appropriate person at the learning center to place the materials listed above in each regular mathematics teacher's and the math coordinator's work mailbox. This was the procedure regularly used at the learning center for sending materials such as these to staff. The letter given to the teacher and math coordinator asked them to consider signing the consent form, putting it in the envelope provided, and placing the signed consent form in the mail.

The consent form was created based on the template provided by Walden University's IRB office and contained the time for each data collection activity, including interview transcript verification, permission to audio record the interview, guarantee of confidentiality, and allowance for the participant to withdraw from the study at any time. The envelope that the teachers placed the signed consent form in was self-addressed to me. After the participants placed the signed consent form in the self-addressed envelope, they placed it in the mail. Once I received the signed consent forms, I contacted the participating administrator and teacher based on their preferences (i.e., phone or e-mail).

I was not currently working and I had not worked in the past at the learning center. Therefore, favoritism or bias was not an issue. I had taught SMC, and I had an understanding of the material. However, the study was focusing on understanding how an administrator was administering and a teacher implementing the SMC at a specific learning center.

To establish a researcher-participant working relationship, I met with the participants prior to any data collection to talk with them about the data collection process. In addition, I gave them the interview questions to allow them time to think

about their responses, but they were encouraged to give honest answers. During the meeting with the participants, I reassured them that all responses and observations would remain confidential. To protect the participants, all data were to be stored on my personal, password-protected computer for 5 years. The coded names of participants were in order to protect the confidentiality of the individuals, as well as the name of the learning center, for any publication resulting from the study.

Data Collection

For a case study, interviews, observations, and archival data were appropriate methods of data collection (Creswell, 2012). Therefore, I used two traditional forms of qualitative case study data collection: interviews and observations.

Interviews

The interviews of the administrator of the learning center and one teacher used the same questions. These interviews conducted were at a private location and at a time outside of instruction that was mutually agreed upon by the participants and me. I transcribed all of the recorded interviews. Each participant's interview transcript needed that participant to verify the accuracy and completeness (Creswell, 2012). The initial interviews of the administrator and teacher consisted of five questions, and the second interview of the teacher consisted of nine additional questions (See Appendix B.)

The purpose of teacher and administrator interviews was to gain a deeper understanding of how to administrate and implement SMC. The interviews took place in a private location away from distractions (i.e. conference room). Each interview took about 30 minutes and had scheduled the participants at their convenience (i.e. after

school). The interview times varied depending on when the learning sessions took place. I sent the participants the interview questions in advance so that they could make notes and have their answers prepared prior to the interview.

To assure the interview data were complete and accurate, I tape recorded the interviews and took notes during all interviews, transcribed the interviews, and then sent the interview transcripts to the participants to allow them the chance to add to, make changes, or discuss the transcript with me.

Observations

Observations conducted in the classrooms had no student involvement or reporting take place. I developed an observation protocol sheet (see Appendix C) in order to take field notes during the observations (Creswell, 2012) of both the teacher and the administrator in his capacity as a teacher. The observation protocol noted certain specific activities that I wanted to focus on during the observation. The observation protocol sheet was used to guide the collection of data from the teacher observations. The observations took place during the math block.

The observations focused on the usage of SMC in the classroom. I used the observation protocol sheet (see Appendix C), which was based on the work of Creswell (2012). The observation form allowed me to focus on specific teacher actions and make notes about these actions. The observations held were during the mathematics class time as set by the learning center's schedule. The teacher was observed three times and the administrator once in this study. During the observations, I focused on how the teachers used the SMC curriculum materials in the classroom. The observations were about 30-60

minutes each. This amount of time was about half of the length of the typical session at the center depending on the grade level. The 30-60-minute observation allowed me to see the beginning, middle, and end of the math lesson using the SMC.

As a third grade classroom teacher who used SMC for 3 years, I had a firsthand experience working with the SMC and seeing the effects in my classroom, particularly regarding students' standardized test scores and abilities. Therefore, this experience might have affected the data collection and analysis processes. However, I approached this case study with an open mind as to what I might learn about the administration and implementation of SMC in a select learning center. I also had other methods (i.e., *peer-debriefer and interview transcript verification*) in place to provide evidence of quality and trustworthiness with regard to data collection and analysis.

I have not taught at the learning center or with any of the teachers at the center. There was no prior relationship with the participants professionally and/or personally. In addition, at the time I conducted the study I was not working at the learning center.

Once IRB approved the study, I sent cover letters, consent forms, and a self-addressed envelope to every staff member of the learning center. The math coordinator distributed the materials to each staff member. Within a week, I receive two consent forms in the mail. I made contact with both participants to schedule a date and time for both the observation and interview. I conducted both the observations and interviews with in the next few days of receiving the consents in the mail. When I went to the location for the observation of the first participant, I gave the participant a copy of the consent form that she had sent me in the mail. Once given the consent, she allowed me to

come into her class to conduct my observation. In terms of recording the data from the observation, I used a copy of the observation protocol sheet. As I observed the class, I typed notes in the specific areas on the protocol sheet. The document was saved on my personal password-protected computer using the first initial, last initial, observation, and the date as a marker.

With the teacher participant, I conducted the initial interview right after the observation. I turned the recorder on to check if it was working. Then, I turned the recorder back on and began interview. I used the interview protocol sheet to conduct the interview. I went through each question. I did make a few notes as I conducted the interview. After the interview was finished, I saved the audio file on my personal, password-protected computer using the first initial, last initial, interview, and the date as a marker. Once at home, I listened to the interview and typed the transcript to be sent to the participant to verify that the transcript of the interview was accurate and complete.

With the administrator participant, I completed the observation and interview on two separate days. When I met with this participant, I gave him a copy of the consent form that I received in the mail, and he began his class. I used the observation protocol sheet to collect the notes of the observation and saved the data on my personal, password-protected computer using the first initial, last initial, observation, and the date as a marker. The following day I met the participant at a public location of his choice. I checked the recorder to be sure it was working correctly. Knowing the recorder was working correctly; I turned the recorder on and began to ask the questions on the interview protocol sheet. I made a few notes as we discussed the questions and saved the

audio file on my personal, password-protected computer using the first initial, last initial, interview, and the date as a marker. Later at home, I listened to the interview and typed the transcript and sent it to the participant to verify completeness and accuracy of the transcript of the interview.

A week and a half after handing out the material to the staff, I had not received any additional signed consent forms. I asked the math coordinator if he would send out a reminder e-mail that I had written. He sent the e-mail out to all staff members. After another week, I had not heard feedback from anyone. There was a request to the math coordinator if I could have contact information for the staff in order to contact them directly. He asked his staff if they would be okay with him giving me their contact information. There were no responses to that request. Therefore, my first chair, second chair, university research reviewer (URR), and I had a conference as to what the next step would be in the data collection process. We had decided that we would refocus my study as a case study rather than as a program evaluation. This meant that I would need to conduct additional interviews and observations with the existing participants. With the teacher participant's approval, my committee chair and I submitted a change to data collection form to IRB asking to add an additional interview with a participant review and two additional observations. I received the IRB approval to conduct the additional interview and observations and arranged the dates and times for each event.

At the first additional observation, I presented the participant with the new approved consent form for her to sign and gave her a copy of the signed consent form for her records. Throughout the second observation with this participant, notes were typed on

the Observation Protocol Sheet and saved on my personal password-protected computer using the first initial, last initial, observation, and the date as a marker. This process was the same for the third observation. The additional conducted interview used the additional questions approved by IRB, and the responses recorded on the second interview protocol sheet (Appendix D). The tested recorder was to assure it was working properly prior to the interview. I started the recorder and conducted the interview. Throughout the interview, notes were made and saved on my personal, password-protected computer using the first initial, last initial, interview, and the date as a marker. Once at home, I played and typed the recording into a transcript and then sent the transcript to the participant to review for accuracy. After reviewing, the participant returned the document with the corrections and clarifications.

Data Analysis

The interview and observation data collected for this study used the same methods to analyze. The data analyses methods used for this study were typological and inductive analyses (Hatch, 2002). The first type of analysis used was typological analysis to analyze the data based on the research results about ideas that were to be important to the success of the SMC program. The typologies described in detail in Section 1 were bar modeling, teaching style, teaching delivery, curriculum usage, and teacher training. In addition, the other analysis used was inductive analysis to explore additional themes that might emerge during the coding process. Both forms of analyses covered all the data collected in the study and formed the basis of the findings. I used no software programs to help with analyses of the data collected.

The use of a peer debriefer was to provide data analyses by another person to help minimize any biased analyses and to discover other themes emerging from the data collected. Since the peer debriefer reviewed the data collected with no original names, she did not need to sign a confidentiality agreement. A peer debriefer is an individual who assists in evaluating material to assure there is no bias in the interpretation of the data collected (Creswell & Miller, 2000). The peer debriefer needed to be an individual who was impartial to the study and could assure no misinterpretation of the data. The peer debriefer used in this study met these criteria. She was a retired principal who had working knowledge of the SMC program. She was not able to identify any of the participants because she did not work with nor was she acquainted with any of them. She had a specialist degree, was in education administration from 2002 through 2010, and was analyzing data for the school where she worked during her administration years.

In keeping track of the data collected for data analyses, a creation of a table was to categorize the information from interviews and observations into the different typologies. I used a color code system to code the data within the original documents and then transferred the data into the table under the correct typology. The data that did not fit into one of the categories went in a new column to create a new typology.

In terms of organization of the documents, I used a document label code to help me know when and whom I interviewed, such as *HRInterview/Observation7-16-13*. This helped me to organize the interviews and observations in chorological order. I kept the original and a coded copy.

Findings

The findings were the basis of the following themes, which created the professional development training on SMC. Ten themes emerged from analyses of the data that lend themselves to a three-day training with four modules each day. The sessions focus on these key elements: (a) model drawing; (b) stages of instruction: pictorial, concrete, and abstract; (c) mastery: (d) place value/bundling; (e) games; (f) manipulatives; (g) number bonds; (h) visualization; and (i) administration of SMC.

Model drawing. A portion of SMC used throughout the year at every grade level was model drawing. During one of the observations, the teacher actually stated the steps to solving word problem. She said, "These are the steps to modeling (a) read the problem, (b) give unit bars, (c) chunk the problem, (d) label the bars, (e) place the "?", how do you find the missing piece?, (f) solve, and (g) answer the question." Students can us these steps to assist in answering any word problem in any situation (i.e. *homework, chapter tests, and standardized tests*). When students get stuck on a problem, the modeling gives the students a plan in solving the problem.

Stages of instruction. When learning SMC, there are stages in the teaching process: concrete, pictorial, and abstract. Concrete is the first learning stage. When students are at the concrete stage, they use manipulatives to represent the numbers that are working with. The teacher participant stated, "You start in the lowest of grade levels and after the student can concretely add objects or subtract objects." They use this technique when adding, subtracting, multiplying, dividing, and even with fractions. In one of the observations, the teacher created shapes using paper for the student to actually

see a 3-d model of shape in order to literally count the sides and angles and to manipulate the shape.

The pictorial stage is when the teacher uses pictures to represent the items in a word problem. If the word problem is talking about teddy bears, flowers, or buttons, then the students actually draw out the teddy bears, flowers, or buttons to represent the numbers of the items to solve the problem. The teacher participant stated, "Then, you represent them [the manipulatives] pictorially, and eventually, you take away the pictures and go into unit bars." The importance of having an accurate representation in the pictorial stage is to establish a sound foundation to build upon. In one of the observations, the teacher had the students bar modeling using bars to have a pictorial representation of the numbers the students were using.

The last learning stage is the abstract stage. In the abstract stage, the students use just a unit bar to represent a number with no individual cubes within the bar. At this stage, students do not need a literal representation of the numbers. Therefore, they may have two or more unit bars, but the length determines the bigger or smaller number. The teacher participant stated, "You don't have it separated into 3 sections and 5 sections, but as a continuous bar or model as they call it." The visualization is more in the students head than the previous two stages of learning. Students are able to visualize the numbers of items and do not need the actual picture to represent the number. Instead, the students take a unit bar and divide it into the number of cubes to represent a specific number.

Mastery. With any curriculum, mastery is a key element in the curriculum being successful. SMC is no different and has a specific percentage in which they focus on

prior to moving to the next skill. With SMC, the mastery rate is 80% accuracy 80% of the time for SMC. Mastery of a skill is important before going to the next step. The teacher participant stated, “If independently they can do 80%, then I would call that mastery.” Therefore, it is important that every child has 80% accuracy working independently before moving even if the curriculum map says to move on.

Place value. Place value is where students being working with the value of numbers based on the location within a number. With SMC, students start of by understanding the basic numbers zero through nine. Then, they move to tens, hundreds, thousands, etc. The teacher participant stated, “So, you have ten separate items and you wrap them up together with a rubber band or something and say ‘here’s a ten.’” When students move to working with tens, they will take 10 pieces, whether it is sticks, pencils, or anything you can bundle, and count out 10 and then rubber band them together to show that the bundle makes a 10. In addition, students learn how to write numbers in standard form and decompose numbers. This is another skill that manipulatives are very helpful in gaining the concrete connection.

Games. SMC actually comes with games that relate to the skills the students are learning. However, any game can be adapted to the curriculum. Using games within the lessons helps the students to stay engaged into the work they are doing. Some examples of the various games used in addition to the SMC games are swat, double trouble, and build the biggest number. The teacher participant stated, “They [games] are just additional ways to practice the skills.” The games actually allow the students to be able to practice the skills with a fun activity. In one of the observations, the teacher used a point

system with the students to keep them engaged in working the mathematical problems. If the student had the right answer, they received three points. If they had the answer incorrect, they tried again. If they had the answer right the second time, they received one point. The student who had the most at the end of the lesson received a reward.

Manipulatives. Manipulatives relates back to the learning stages especially the concrete stage. To make concrete connection to the skills and materials taught, students need to use manipulatives so they can touch and feel the items in order to make the proper connections. The teacher participant stated, "they actually touch, feel, and internalize by experimenting with the real world what the numbers mean." Manipulatives can consist of abacus, place value discs, cubes and rods, 3-d models, 3-d shapes, quart and gallon jugs. Any item used as numbers is a manipulative. In one of the observations, the teacher and students used an abacus to help solve adding and subtracting word problems. She explained that using the abacus would help the students understand the numbers they were working with at the time.

Number bonds. This taught element of SMC starts in the earliest of grades. Number bonds show the relationship of how and what numbers are. A part-part-whole relationship prepares students with a strategy for adding and subtracting numbers in their heads. The teacher participant stated, "The idea is to help them recognize part-part-whole relationships in knowing 3 and 2 make 5 or 4 and 1 make 5 or 5 and 0 make 5." Later in SMC, the students will use the number bonds for mental math. For example, when adding 24 and 8, the student would think about the number bonds of eight which added to four makes an easy 10. Therefore, the student would take 24 + 6 =30 + 2+ 32. In one of the

observations, the teacher encouraged the students to use number bonds to solve the computations in their heads. For example: 135 + 97. The teacher wrote above the 97, 100 – 3. Then, she added the 100 + 135 equaling 235. Finally, she subtracted the 3 she added earlier from the previous sum of 235 (i.e. 235 – 3), which equaled 232.

Visualization. Visualization has a connection with the three learning stages. With being able to visualize numbers, students are able to show their understanding of the concepts of numbers especially when they are in the abstract stage. The teacher participant stated, "Done with fidelity…from the concrete to the pictorial to the abstract stages, then the students have had an opportunity to experience the numbers and their relationships so they can usually easily recall those experiences to create a visual image." The previous stages, pictorial and concrete, allows the students to have prior knowledge and experience in order to visualize problems in later years.

Administration. The administration of SMC is another key element to the profession development training. This module will be an add-on to the professional training for administrators. From the interview of the administrator participant, he expressed the importance of SMC to students. He expressed the implementation of the program and the variations between Singapore's version and America's version of the same curriculum. "They [Singapore books in America] are all books from Singapore… created by the ministry of education in terms of the sequencing and what is being covered at the grade level," explained the administrator participant. The packets that he makes for his teachers come from various resources and include "extra problems, challenging word problems, the express math books, [and] the problem solving strategies…[are] mixed in

there [the packets]," he explained. Therefore, the teachers are using different sources of SMC to teach SMC.

To assure evidence of quality of the data collected, I used triangulation and peer debriefing. The multiple methods used for data collection were: interviews and observations. With these two types of data collection, I was able to compare the interview transcripts to the observations to assure the accuracy and validity of the data. Using a peer debriefer I was able to reduce the effect of bias and allow for another set of eyes to view the data.

The Project as an Outcome

The findings of this study answer and support the research questions. The research questions were:

1. How do educators at a select learning center describe the administration and implementation of the SMC program?
2. How do educators at the learning center demonstrate the implementation of the SMC program?

The interviews of both participants answered the first research question. They described how the program began and adapted to American schools. "They are all books from Singapore. So they are all based on that same general curriculum created by the ministry of education" the administrator explained. The teacher participant expressed, "things like the monetary units…used in Singapore and changed those to dollars… took some of the odd fruits, such as durians and other things that we have not heard of here in America, and changed all that," said the teacher participant. She explained that publishers

added more color and pictures to the American versions of SMC. In addition, the participants discussed the importance of starting to introduce the SMC skills in the earliest of years and the process one should follow in teaching SMC in the classroom. The teacher participant expressed, "You start [bar modeling] in the lowest of grade levels and after the student can concretely add objects or subtract objects." Students learn the skills and how to apply the skills. The administrator said, "You still have to do it [computations]…you really have to apply it all. You have to be able to use it [the skills]." SMC continues to build throughout the year and grade levels. Students must learn and apply the skills to be successful with SMC.

The observations answered the second research question. In each of the observations, the teachers demonstrated the implementation and administration of the SMC. In the observations, I could see how the teachers were using the SMC. With bar modeling, the teacher expressed the steps to her students saying, "These are the steps to modeling (a) read the problem, (b) give unit bars, (c) chunk the problem, (d) label the bars, (e) place the "?", how do you find the missing piece?, (f) solve, and (g) answer the question." The teacher participants were showing how they go through different processes of various skills. During an observation, the administrator was asking a student about a particular shape. When the student was unsure, the administrator began to ask questions to help guide the student's thought process in order to solve answer the question. I was able to observe various grade levels and noted implementation was the same across grade levels and across skills. Both teachers used various strategies to assist their students in solve mathematical problems. At times, the teachers used concrete and

pictorial examples to build the foundation for the students to use with the abstract problems.

The project is a professional development training for teachers learning the key elements of SMC. These key elements formed the modules for complete understanding of SMC, and there are ten themes of the professional development training. On the first day of training, the training will consist of four modules: introduction to SMC, pictorial learning, concrete learning, and abstract learning. Learning these elements first will allow the trainer to use the stages of learning to teach the other modules. This procedure will support the learning of the material in addition to learning the process for teaching SMC to students. On the second day, the training will continue with building on the foundations from the day before. The second day of the training will consist of another four modules: visualization, manipulatives, number bonds, and visualization. The third day will consist of the last four modules: model-drawing, place value/bundling, games, mastery, and administration. Through the three days of training, teachers will have the opportunity to gain the foundation and build upon it to use SMC in the classroom to improve mathematics skills and understanding.

Conclusion

This section described the methodology portion of the study. The design of the study is a case study focusing on the use of SMC in the classroom. Throughout the section, I have depicted the process of gaining access to participants, selecting participants, the collection of data, data analysis, and limitations of the study. With conducting this study, I was able to explore the usage of SMC in the classroom.

Section 3: The Project

The findings of the study were the basis of the professional development training project. Through the data analyses, these themes emerged as the foundation for the professional development training. This will be a 3-day training program with four modules each day. The goal of the project is to assist educators in learning the foundations for administering and implementing of the SMC. The reason for choosing this project was based on the findings. In reviewing the themes, it appeared those themes lent themselves to becoming the basic modules for a professional development training.

Review of the Literature

With both sections of this literature review, I used various sources to obtain current and peer-reviewed articles. I used Education Research Complete, ERIC, and Google Scholar databases to search for my articles. The terms used pertained to the themes and professional development (i.e., *Model drawing, concrete learning, concrete understanding, learning stages, scaffolding, conceptual scaffolding, visualizing, place value, number bonds, games, mastery, stages of instruction, number bonds, math skills and number bonds, Singapore math number bonds, number patterns, administration of programs, administering programs, Singapore math, Singapore mathematics skills, Singapore math skills*, and *visualization*). These terms supported my research in providing articles related to my themes and project.

Literature to Support Themes

The themes revealed through the course of this study were the basis of the project, a professional development training. There were several findings that emerged from the

data collected: (a) model drawing; (b) stages of instruction; pictorial, concrete, and abstract; (c) mastery: (d) place value/bundling; (e) games; (f) manipulatives; (g) number bonds; (h) visualization; and (i) administration. Each had a definite role in education, which was supported by the literature.

Module drawing is a strategy that allows students to draw pictures to represent and solve word problems. Barmby, Harries, Higgins, and Suggate's (2009) research focused on the importance of module drawing in mathematics. According to Barmby et al., module drawing shows understanding of skills in mathematics and using symbols and systems assists in learning a strategy of understanding and solving mathematics problems. Watkins's (2008) research showed that drawing out situations helped students to make connections to what they were learning in the classroom.

The stages of instructions have three parts: concrete, pictorial, and abstract. When instructing, it is important for teachers to follow these stages to establish a sound foundation to build upon in the future. Hodge et al. (2011) studied the learning process based on learning through practice. Hodge et al. defined concrete and abstract stages of learning. Concrete learning is using hands-on activities and items to manipulate in understanding the topic (Hodge et al., 2011). Abstract learning is when students must think logically and rationally and use background knowledge to solve the problem set before them (Hodge et al., 2011). Askell-Williams, Lawson, and Skrzyplec (2012) viewed the stages of instruction as a valuable asset to student success. Askell-Williams et al. researched applying scaffold instruction using various thought process strategies. In addition, the data showed that having these strategies helped students to cope in social

situations as well (Askell-Williams et al., 2012.) Wu and Looi (2012) researched the academic environment created using scaffolding. Students with a scaffold instruction are more engaged, responsive, and receptive to learning and problem solving (Wu & Looi, 2012.) Eshach, Dor-Ziderman, and Arbel's (2011) study showed that teachers became experts in the topics addressed in the training. The teachers were more knowledgeable about situations than prior to the scaffold training (Eshach et al., 2011). Eshach et al. examined the use of scaffold instruction to train teachers in instruction. Each study has shown the importance of using stages of instruction or scaffolding in instruction for students to be successful in the future of their academic studies.

Mastery is a set parameter to ensure students have a strong understanding of the material learned in the classroom. Nijlen and Janssen (2011) researched the importance of students having mastery in all grade levels. Having levels set for students to achieve mastery per grade level assures the students are learning and maintaining skills throughout lessons and the year (Nijlen & Janssen, 2011). Mastery scores were quantitative numbers that showed true progress of students learning new skills (Nijlen & Janssen, 2011). Reddy et al. (2013) focused on the mastery level of the content being integrated in the classroom. Reddy et al. (2013) showed that gaining mastery of a skill was critical prior to moving to the next skill. Those who did not gain mastery of the skill struggled with new skills that built upon the original skill (Reddy et al., 2013). Subitnik, Edmiston, Cook, and Ross (2010) focused on starting a program that involved mastery as a key element for student success. Students with mastery skills are able to expand of topics to advance their learning environment (Subitnik et al., 2010.) In the two studies,

the data showed that students needed to gain mastery of a skill to be successful in future skills.

Place value is the one of the first steps in learning mathematical skills. A study conducted by Triantafillou and Potari (2010) focused on the importance of place value skills. According to Triantafillou and Potari, learning place value is an important skill to learn in order to be successful in working with numbers at any point in life. Bussi (2011) concurred and found through the study the importance of place value. Bussi focused on the place value at the elementary level. Place value is important for students to have a clear understanding because place value is the foundation to all number systems (Bussi, 2011). Place value is a key element that students learn in the early years, expand, and build upon throughout their education.

Games are an additional strategy to the learning process. Pauschenwein, Goldgruber, and Sfiri (2013) researched the value of games in learning new skills. According to Pauschenwein et al., the data showed that having a game-based environment enhanced the knowledge gained of a specific skill the students were learning in the classroom. Games help students to remain engaged and practice a skill to have a strong foundation to build upon (Pauschenwein et al., 2013). Kelle, Klemke, and Specht (2013) researched the effects of using games to learning skills that assist in life saving techniques. The research showed that the games, in various forms, improved students' ability to learn the skill (Kelle et al., 2013). However, games are only limited to the full experience of the skills and should be combined with other forms of learning (Kelle et al., 2013).

Using manipulatives helped to visualize mathematical skills. Akkan's (2012) research focused on the beliefs of using virtual or physical manipulatives. Throughout the study, Akkan revealed data that supported the use of manipulatives with mathematics in the classroom. According to Akkan, manipulatives, whether virtual or physical, support students in gaining a deeper understanding of the skills. Students are more successful when they are able to touch and manipulate items to represent a mathematical problem (Akkan, 2012). Siew and Abdullah (2013) researched the impact of using manipulatives to solve problems in a physics class. Siew and Abdullah discovered that the students using manipulatives were able to focus and understand the problems they were working on in class. Boggan, Harper, and Whitmire (2010) researched the effects of elementary students using manipulatives in mathematics. In addition, Boggan et al. described how manipulatives were even used during ancient times and tribes (i.e. *Chinese, Aztecs, and Mayan*). Kosko and Wilkins (2010) studied the correlation between the continuous use of manipulative and understanding of mathematical skills. Kosko and Wilkins stated that manipulatives are a great tool to assist students in solving abstract problems using something that is concrete. All four studies supported the use of manipulatives in the classroom and showed that students using manipulatives were more successful.

Number bonds is a foundation of SMC that assists students in understanding what makes a number and how numbers work together. Gross and Merchlinsky (2002) researched the implementation of SMC over a 1-year span. Gross and Merchlinsky described understanding number bonds as gaining a deeper knowledge for more challenging word-problems. Cavendish (2011) evaluated the effectiveness of the

instruction of SMC. With using number bonds and other techniques, the mathematics achievement test scores of students at the subject school increased significantly from the pretest to the posttest (Cavendish, 2011).

Visualization is an element needed in all aspects of SMC. Sidhu (2013) focused the research on visualization to help with problem-solving within an engineering course. Using technology to visualize a new skill proved to be beneficial to students being successful in their problem-solving skills (Sidhu, 2013). Sidhu found that visualization gave students the background knowledge to be more successful. Akoumiankis (2011) researched visualization as an element of knowing the material the student was learning. The study showed that visualizing allowed the students to problem-solve better by finding patterns and connections (Akoumiankis, 2011). In addition, Nguyen and Khoo (2010) studied the use of visualizing tools to assist students in learning engineering. With enhancing learning using various visualizing strategies (i.e., *videos*) students are more successful than learning using traditional strategies (Nguyen & Khoo, 2010). Therefore, visualizing gives students a stronger advantage of using their skills to solve mathematical problems.

Though administration is an add-on module, it is still an important part of using SMC in a learning center. Roberts and Sampson (2010) focused on the success of the administration of programs in schools. Roberts and Sampson found that administrators must be honest about the dealings of a program with students and staff in order to be successful. Luu (2010) studied the training of administrators to be successful. Luu discovered that administrators must understand the programs thoroughly to meets that

needs of those involved (i.e. *students, teachers*). Therefore, members of an administration need to understand the various aspects of a program to be successful.

Professional Development Training

The second part of this literature review looked at the professional development training. The focus of the training is to encourage teachers and administrators to implement and administer SMC. According to Wu and He (2009), professional development training is important for individuals to learn about a specific topic. Wu and He researched the paradigm shift in teacher pedagogy as a result of professional development training. The development of the training was encouraged by Guskey's (2002) evaluation of a professional development training. Guskey's evaluation has five levels: (a) participants' reactions, (b) participants' learning, (c) organization support and change, (d) participants' use of new knowledge and skills, and (e) student learning outcomes. Guskey stated that evaluation should be simple yet effective. .

The basis of the professional development was to create a PLC for those participating. Another expert in professional development is Hord (1997). Hord took a successful strategy used in the business world, PLCs, and brought it to the educational community with equal success. Hord suggested that PLCs are an avenue to allow school staff to share ideas and experiences and grow professionally. PLCs should be an on-going process in order to learn and improve various skills in different settings (Hord, 1997). Hord argued that working together to learn from each other created a sound environment for success.

Project Description

The project is three-day professional development training with 4 modules each day. The themes that emerged from the data analyses was the basis of the modules. Each theme is an important part of SMC in being effective in implementing and administering the program. These key elements are (a) model drawing; (b) stages of instruction: pictorial, concrete, and abstract; (c) mastery; (d) place value/bundling; (e) games; (f) manipulatives; (g) number bonds; (h) visualization; and (i) administration. Each module has information and an activity for the participants to try that makes a connection between the material of the training and the skills taught in the classroom. In addition, there will be an optional module for administrators interested in the administration portion of SMC.

For this professional development training, I will need a projector and screen (i.e. *data projector, SmartBoard, or Promethean Board*), a room with chairs and tables, manipulatives, pens/pencils, copies of the PowerPoint handout, examples of the workbooks and learning packets, and my computer with a PowerPoint presentation. Alterations to the presentation are possible, if one or more items are not available.

The subject learning center has various resources that would be beneficial to the professional training. They have manipulatives, a room with desks, workbooks, learning packets, and writing utensils. If the administrator of the learning center is willing to allow me to use these materials, I will have every item needed for the training. These materials (i.e. *manipulatives, workbooks, and learning packets*) will be a visual support to the participants.

There are potential barriers with any training. For this study, a possible barrier to offering this training at the participating learning center is that the institution could close. There is the additional possibility that no other learning center will not want to introduce a new curriculum despite the benefits of the SMC.

The implementation of the training could take place at any time of the year. However, the beginning of the school year would be best time to implement SMC in a school or district. Since the research conducted was in a learning center, the most logical timing would be at a new employee training. Holding the training at that time will reassure that all employees trained receive the same training; therefore, the presentation of SMC skills to students in the classroom will be similar.

The responsibilities of the participants (the teachers) will be to listen and actively participate in the training modules. Some modules will have actual activities for the participants to participate in order to gain a deeper understanding of the material. These activities will be transferable to the students of their classrooms. The goal for the training participants is to gain the knowledge and experience about using SMC effectively in the classroom.

Project Evaluation

The basis of the evaluation of the project was Guskey's (2002) five levels of professional development evaluations: (a) participants' reactions, (b) participants' learning, (c) organization support and change, (d) participants' use of new knowledge and skills, and (e) students learning outcomes. Each element insures a successful evaluation of a professional development.

Participants' reactions focus on the participants themselves and their thoughts on the program. Guskey (2002) suggested asking questions that allowed the participants to voice an opinion as to how they liked the program, was the information useful, and what the atmosphere was like. The information collected using a questionnaire at the final meeting of the training (Guskey, 2002). Then, the presenter can use the information to make changes for future presentations.

The next level is participants' learning, which is measuring whether the participants learned the desired information for the professional development. Presenters gather this by having various collection types (i.e. *paper-pencil activities, demonstrations, reflections, portfolios, simulations;* Guskey, 2002). The participants' learning stage allows the presenter to gage the knowledge learned by the participants in the training.

The third level is organization support and change. This stage looks at the professional development training as a whole in terms of how it was organized and supported by the information throughout the training (Guskey, 2002). Records, follow-up meetings, questionnaires, interviews, and portfolios are ways to evaluate the organization, support, and change stage of Guskey's (2002) program evaluation plan. This information tells the presenter the degree of "the organization's advocacy, support, accommodation, facilitation, and recognition" (Guskey, 2002, p. 48). The presenter is then able to enhance the organization and promote change.

The participants' use of new knowledge and skills is the fourth level. The participants have an opportunity to apply their newfound knowledge in this stage, which

is what the participant is measuring at this stage. Guskey (2002) suggested that the presenter uses questionnaires, specific interviews, reflections, portfolios, observations, audiotapes, and video tapes. Stage 4 allows the presenter to measure the depth of the participants' knowledge of the material (Guskey, 2002). Through a variety of measurements, the presenter has a better understanding of the knowledge gained and can fix the areas that are weak.

The last level is students' learning outcomes. This is an important part of professional development training evaluations. The level determines how the program affected the participants and others. In this stage, the presenter may even discover positive aspects not originally planned for the training (Guskey, 2002). This overview of the program uses similar measurements as in previous levels (i.e. *records, questionnaires, interviews, and portfolios*; Guskey, 2002). Guskey's fifth level focuses on the cognitive, affective and psychomotor outcomes and suggested to use these measurements to enhance the program and the positive effects of the training.

The overall evaluation goal for this project is that the participants learn the key elements of SMC and implement the skills in various situations. Using Guskey's (2002) levels of evaluation promotes the professional development training to be successful each presentation. If the participants are able to implement the skill, I will feel confident that the participants understand the material and how to use the skills correctly. The key stakeholders will be able to give insight with this as well.

Project Implications

With this project, the implication of social change is to change the outlook of educators at learning centers regarding implementing and administrating SMC. Through participation in the proposed professional development training, learning center administrators and teachers will have a better understanding of the administration and implementation of SMC. As a result, there will be a social change for students attending these learning centers and others around the United States to improve mathematical achievement.

Conclusion

This section describes the collection and analysis of the data collected for this study. The data lead itself to a perfect set of themes. The themes of the data then were geared to the form of a professional development. Throughout this section, I discussed the different themes and support each one with literature. In addition, the section discussed the professional development training that developed through the data analysis of the study.

Section 4: Reflections and Conclusions

When I started this program, I already knew what I wanted to research. The topic was very special because I used the curriculum every day in my classroom and heard so many great things about the program. I had heard that the curriculum increased mathematical scores on standardized tests. I was a little skeptical about the program but implemented it in my classroom to the fullest. Garelick (2006) showed that school in 40% and 50% passing rate increased to 90% within 4 years of implementing the program. However, I did not see the results that I had heard about. During my first year of teaching, I was working on my master's degree and had to choose a research topic between writing workshops or Singapore math. At the time, I decided to research writing workshops because I wanted to be a better writing teacher and knew very little about the writing program. However, the topic of SMC still lingered in my mind. Once I was finished with my master's degree, I immediately entered the doctoral program and knew exactly what I wanted to study. I really wanted to learn more about SMC to help the students where I lived to improve their math achievement. Though I may not have been able to work with them directly, I now have a study and project that will help others to understand the key elements of SMC and assist teachers and administrators with implementing and administering SMC.

Project Strengths

The project for this study has strength in that it is evidence based. The research findings supported each component of the project. The project includes each element of the SMC and demonstrates how to use each piece in the classroom. For those who have

heard of SMC but do not truly understand the curriculum itself, this project allows them to understand the importance of learning and delivering the material to students.

Project's Limitations

Limitations are a part of every study and project. This project is no different. One limitation of this project is that there are those who have learned about SMC and are skilled and experienced in the implementation and administration of the curriculum, and I am unsure if this project will be able to assist them in a deeper understanding of the curriculum. In addition, this project is limited to application at a learning center. Though the information gathered from the participants was rich, the findings do not apply to every situation. Replication of this study in different contexts is an area for further study to build a stronger professional development training. However, this project was designed to include the basic elements of the SMC, and no matter what the setting those key elements, the activities, and the depth of knowledge are necessary for the successful implementation and administration of the SMC in any context.

Recommendations for Ways to Address Problems Differently

One way to address the problem differently would be to explore use of the SMC at two different educational settings. I could have looked at these factors and compared them between the different settings: (a) knowledge level of the teachers, (b) socioeconomic background of the students attending, and/or (c) the fidelity of the curriculum used. This type of study would result in a different approach to data collection and analysis. The findings might show (a) knowledge levels about the SMC were different among teachers and settings; (b) students at lower socioeconomic levels

performed on standardized mathematics tests at a lower level than their more affluent peers, and if one educational setting had more students coming from lower socioeconomic homes than the other school, this factor would impact the test results; or (c) the findings might demonstrate that the teachers in one educational setting are not using the curriculum as faithfully as the other setting. These are different possible ways to address the problem.

Scholarship

I learned that data without supported literature is just one part of the puzzle. The current literature that I read for this study assisted me in understanding how other research studies related to my study. The articles gave me insight about current research about the themes that I was findings from analysis of the data and allowed me to be more knowledgeable about how to apply the themes in the professional development training. Using current literature guided the research in a direction that resulted in being able to successfully assist educators in learning material that is useful for their professional growth related to the administration and implementation of the SMC. I have learned that this process is a very important step in the writing up of the findings and the project. In addition, reading other current research began to give me other ideas related to my research that I could study later.

Project Development and Evaluation

I really enjoyed developing the project and the evaluation for this study. I have always enjoyed creating lessons and ideas for students to learn in a fun and exciting way. However, those lessons were on a smaller scale compared to this project. When I began

working on the project, I was a little unsure what specifically I wanted the project to look like. I knew that I would have 12 modules divided evenly between 3 days, but beyond that the contents of the project were vague. Once I started to develop the outline of the project, I began working on the PowerPoint included in Appendix A. Guskey's (2002) professional development training guideline was very informative and taught me the in-depth understanding of creating a professional development training. Between the two, I began to use my background knowledge and what I have learned in this doctoral program to formulate a professional development training on the implementation and administration of SMC.

Leadership and Change

This study and project were a learning experience. I have gained a deeper appreciation for those who develop trainings. There is a lot of hard work that goes into developing a successful training. In developing a training, the developer has to be an effective leader. Through my professional and educational experiences, I have learned that being an effective leader is more than making a decision. An effective leader is one that can make the right decision for the benefit of the people the leader serves. That leader needs to be someone who can change and adapt to each situation. I have learned that change is part of progress.

Analysis of Self as Scholar

I believe being a scholar means gaining knowledge about a topic and using the knowledge to grow professionally. I feel that this study has taught me about what literature is available in the field and how that literature supported analysis of the data

collected. If collected and analyzed systematically, then the literature should support those data. I have gained new knowledge on the topic through the literature reviewed and the research conducted. I have learned the importance of being scholarly in each step of my research. Specifically, I have learned the importance of writing in a scholarly manner. By being committed to becoming a scholar I became knowledgeable about the topic of SMC, and I became an expert in the field.

Analysis of Self as Practitioner

This doctoral research process has been a learning experience. The thing that I learned the most as a practitioner is perseverance. Though I completed an action research study for my master's degree, I had no idea about the magnitude of a doctoral study. When I began my research, I had been talking with a potential research site, which was a local school. Everything seemed to be going smoothly until a month before I was to apply for IRB approval. Then people at the research site decided to decline my research proposal. At that point, I needed to find a new site and revise my proposal to fit the new location, which was a learning center. Once I had the learning center administrator's letter of cooperation and received IRB approval from Walden University, I began data collection. With the roadblocks encountered, I never thought I would have any additional problems. However, I did not receive consent from the number of participants that I needed for my study to be sufficiently rigorous. Therefore, the people on my committee and I conferenced and decided to change the study from a program evaluation to a case study. With the change, I needed to revise the study again and receive further IRB approval from Walden University for the changes made. I learned a lot about not relying

on the possibilities but the hard facts. I learned that changes happen and how to adapt to those changes. I think the process has made me a better practitioner and I will be able to take what I have learned and put it into practice in future research studies.

Analysis of Self as Project Developer

I found that I enjoyed writing this project. I used the knowledge that I had learned throughout various endeavors to build the foundation of the professional development training. At first when I started to develop the professional development training, I was a little unsure as to whether the ideas in my head would come together in the right way to create a successful SMC training. As I began to write, I began to think of ideas. I would try the different ideas, leave them for a day, and then return to see which ideas I wanted to pursue. Through this process, I was able to gain insight and apply my knowledge in a rewarding way.

Overall Reflection on the Importance of the Work and What was Learned

There is an importance to the work conducted throughout my research, and I learned a great deal about the importance of each detail related to the study. From my research, I have learned that there has been research that supported an increase to students' mathematical standardized testing scores using SMC in the classroom setting. Through this study, I have learned the importance of every teacher knowing and understanding the details of the SMC and the benefits the curriculum brings to the students. The potential of the SMC to improve students' standardized mathematical scores has grown to be a passion for me, and I hope I have the opportunity to share the knowledge I have gained through this project study with others.

Implications, Applications, and Directions for Future Research

The project developed for this study has potential for additional research. By implementing and applying the professional development training in various educational settings, the project will be able to enhance students' learning about mathematics, as well as improve teachers and administrators' use of the SMC. I see this project as leading the way for me and others to build upon the foundation to create trainings of SMC.

For future research, I would like to explore the use of SMC at other learning centers as well as public school settings to increase my knowledge of the SMC and improve the professional development training that has developed for this project study. The professional development training activities could then be more specific for the setting the educators are working in order to be successful.

Conclusion

I have learned so much from this doctoral program and project study. I have learned about myself as a person and as a professional and have grown into a researcher and program developer. The thought of my work having an impact on social change is very humbling. I look forward to see what the future has to offer and the opportunities to conduct more studies that are successful and continue to promote social change.

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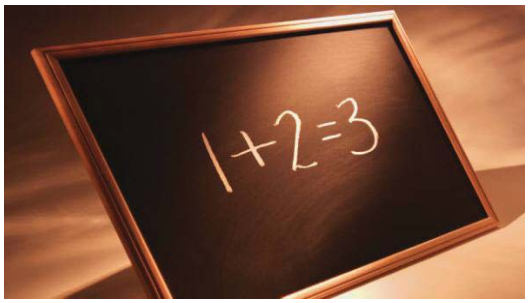
Appendix A: The Project



Introduction to Singapore Mathematics Curriculum (2003)

The Ministry of Education in Singapore created Singapore Mathematics Curriculum (2003). With Singapore ranking the top county for mathematics, the United States has implemented the program, with minimal changes, into schools throughout the United States with great success.

Overview of the Professional Development Training

The goal of this professional development training is to assist teachers and administrators in understanding, implementing, and administering Singapore Mathematics Curriculum (2003) into classrooms. The purpose of the training is to assist teachers and administrators in implementing and administrating SMC (2003) in a classroom setting. Through the training, the objective is to learn the key elements needed for SMC (2003). This training is for those individuals and/or learning centers who want to implement and administer SMC (2003) into their classrooms. In this training the participants will role play the activities, including the role of students. Students will not be involved in the role play activities.

Professional Development Training Created By:

Hannah Reaume

Schedule of the Professional Training

Day 1	9:00 am – 10:30 am	Module 1: Intro
	10:30 am – 10:45 am	Break
	10:45 am – 12:15 pm	Module 2: Model Drawing
	12:15 pm – 1:00 pm	Lunch Break
	1:00 pm – 2:30 pm	Module 3: Stages of Instruction
	2:30 pm – 2:45 pm	Break
	2:45pm – 4:15 pm	Module 4: Stages of Instruction Continue
Day 2	9:00 am – 10:30 am	Module 5: Mastery
	10:30 am – 10:45 am	Break
	10:45 am – 12:15 pm	Module 6: Place Value
	12:15 pm – 1:00 pm	Lunch Break
	1:00 pm – 2:30 pm	Module 7: Games
	2:30 pm – 2:45 pm	Break
	2:45pm – 4:15 pm	Module 8: Manipulatives
Day 3	9:00 am – 10:30 am	Module 9: Number Bonds
	10:30 am – 10:45 am	Break
	10:45 am – 12:15 pm	Module 10: Visualization
	12:15 pm – 1:00 pm	Lunch Break
	1:00 pm – 2:30 pm	Module 11: Administration
	2:30 pm – 2:45 pm	Break
	2:45pm – 4:15 pm	Module 12: Closing

Day 1 – Introduction and Training {9:00 am – 4:15 pm}

Objectives: To understand an overview of the training, to understand and demonstrate Model Drawing, and to understand and demonstrate Stages of Instruction

Materials: Sign-in Sheet, Pens/Pencils, Professional Development Training Notebooks, projector and screen, tables, chairs, a room, and a computer

Module 1: Introduction 9:00 am – 10:30 am

15 min – Sign-in and pass out materials

45 min – Self-Introduction and Program Introduction

30 min – Questions and Answers

Break 10:30 am – 10:45 am

Module 2: Model Drawing 10:45 am – 12:15 pm

30 min – Introduction of Model Drawing

10 min – Questions and Answers

20 min – Model Drawing Activity

30 min – Group Presentation

Lunch Break 12:15 pm – 1:00 pm

Module 3: Stages of Instruction 1:00 pm – 2:30 pm

45 min – Introduction of Stages of Instruction: Concrete and Pictorial Learning

15 min – Questions and Answers

30 min – Begin Stages of Instruction Activity

Break 2:30 pm – 2:45 pm

Module 4: Stages on Instruction Continue 2:45pm – 4:15 pm

10 min – Finish Stages of Instruction Activity

40 min – Group Presentation

20 min – Stages of Instruction: Abstract Learning

10 min – Questions and Answers

10 min – Discussion about Abstract Learning

Day 2 – Continuation of Training {9:00 am – 4:15 pm}

Objectives: To understand and demonstrate mastery, to understand and demonstrate place value, to understand and demonstrate games, and to understand and demonstrate manipulatives

Materials: Pens/Pencils, Professional Development Training Notebooks, projector and screen, tables, chairs, a room, and a computer

Module 5: Mastery 9:00 am – 10:30 am

30 min – Introduction of Mastery

10 min – Questions and Answers

20 min – Mastery Activity

30 min – Group Presentation

Break 10:30 am – 10:45 am

Module 6: Place Value 10:45 am – 12:15 pm

30 min – Introduction of Place Value

10 min – Questions and Answers

20 min – Place Value Activity

30 min – Group Presentation

Lunch Break 12:15 pm – 1:00 pm

Module 7: Games 1:00 pm – 2:30 pm

30 min – Introduction of Games

10 min – Questions and Answers

20 min – Games Activity

30 min – Group Presentation

Break 2:30 pm – 2:45 pm

Module 8: Manipulatives 2:45 pm – 4:15 pm

30 min – Introduction of Manipulatives

10 min – Questions and Answers

20 min – Manipulatives Activity

30 min – Group Presentation

Day 3 – Continuation of Training and Closing {9:00 am – 4:15 pm}

Objectives: To understand and demonstrate number bonds, to understand and demonstrate visualization, and to understand and demonstrate administration

Materials: Pens/Pencils, Professional Development Training Notebooks, projector and screen, tables, chairs, a room, and a computer

Module 9: Number Bonds 9:00 am – 10:30 am

30 min – Introduction of Number Bonds

10 min – Questions and Answers

20 min – Number Bonds Activity

30 min – Group Presentation

Break 10:30 am – 10:45 am

Module 10: Visualization 10:45 am – 12:15 pm

30 min – Introduction of Visualization

10 min – Questions and Answers

20 min – Visualization Activity

30 min – Group Presentation

Lunch Break 12:15 pm – 1:00 pm

Module 11: Administration 1:00 pm – 2:30 pm

30 min – Introduction of Administration

10 min – Questions and Answers

20 min – Administration Activity

30 min – Group Presentation

Break 2:30 pm – 2:45 pm

Module 12: Closing 2:45 pm – 4:15 pm

20 min – Reflections

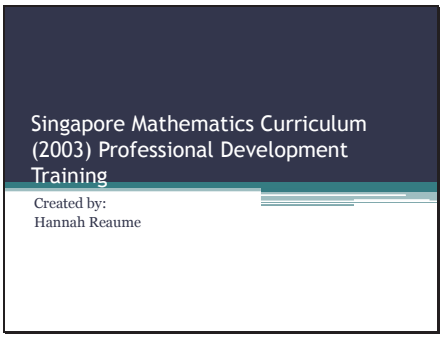
50 min – Presentation of Reflections

10 min – Evaluations

10 min – Closing Remarks

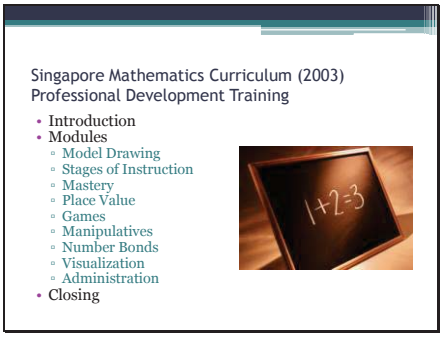
PowerPoint Presentation

Slide 1



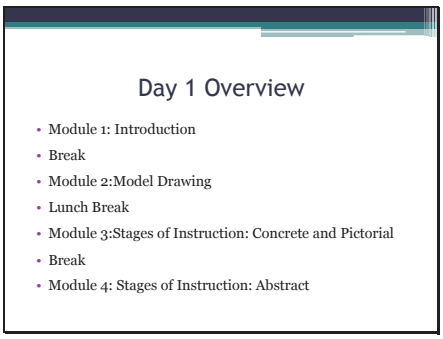
Introduce self and background. Describe how you came to Singapore Mathematics Curriculum.

Slide 2



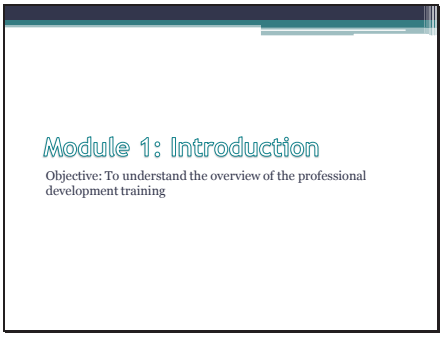
Read through the slide to give the participants an idea of the course.

Slide 3

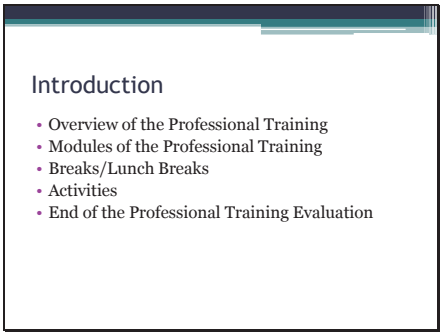


Read through the slide to give an overview for the day. I will go more in-depth about each as we go through.

Slide 4



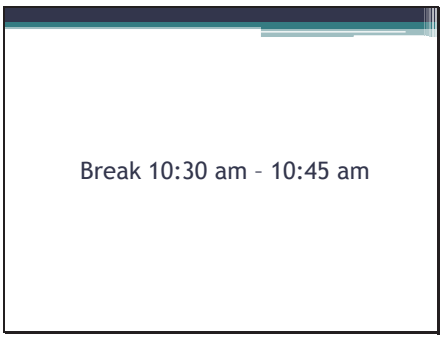
Slide 5



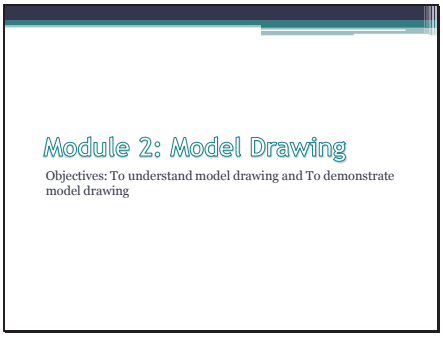
This portion of the training is to give you an understanding of the training and the various things that will be covered. The purpose of this training is to assist teachers implementing and administering SMC (2003). The training will have 12 module: Introduction, Model Drawing, Stages of

Instruction, Mastery, Place Value, Games, Manipulatives, Number Bonds, Visualization, Administration, and Closing. We will have breaks throughout the training. They will be 15 minutes long at 10:30 and 2:30. Lunch breaks are 45 minutes at 12:15. Feel free to go get lunch or eat lunch here. In each module, there will be activities that you will be asked to do. Please have fun with these, but really think about how to apply the material covered in the activity. At the end of the training, you will be asked to complete a professional training evaluation. The purpose is to help me grew the training and fix problem areas. At anytime throughout the training if you have a question, please feel free to ask. Are there any questions?

Slide 6

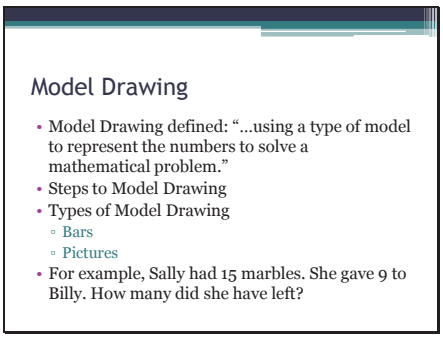


Slide 7



Welcome back. We are going to start with our next module: model drawing. The objective is to understand model drawing and demonstrate model drawing.

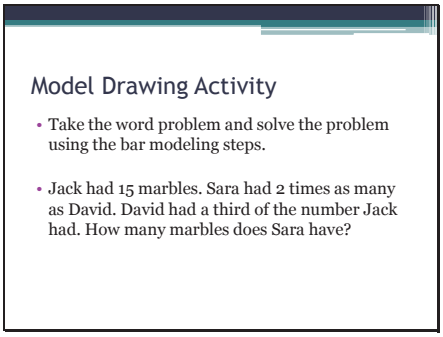
Slide 8



Model drawing is defined as using a type of model to represent the numbers to solve a mathematical problem. With SMC (2003), there are specific steps: (a) read the problem, (b) give unit bars, (c) chunk the problem, (d) label the bars, (e) place the "?", how do you find the missing piece?, (f) solve, and (g) answer the question. Each step is very important and must follow each step in this specific order.

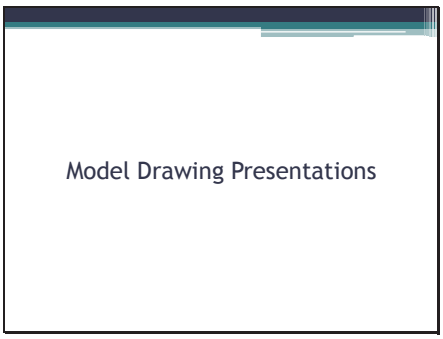
When it comes to the types of model drawing, there are two: bars and pictures. Pictures model drawing is used primarily in the younger grades. Bars are used in the older grade levels. The student actually draws a bar to represent a specific number. The bar models divide into two subcategories: comparative and part-whole. Here is an example. Now, this poster shows how I used picture modeling and the other shows how I used bar modeling.

Slide 9



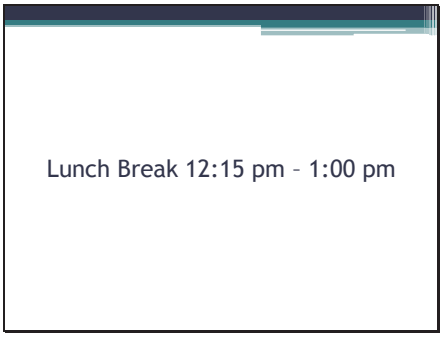
We are going to do an activity now. Work at your tables as a group. If you have any questions, please feel free to ask.

Slide 10

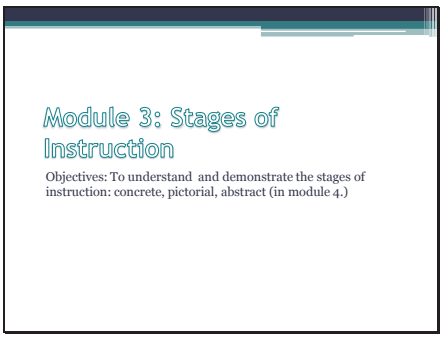


Allow each group to present their activity.

Slide 11

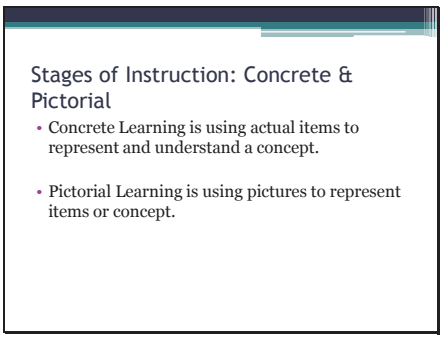


Slide 12



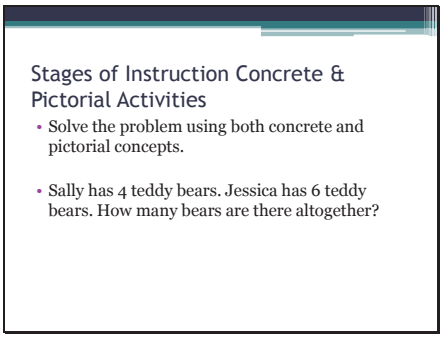
Module 3 is going to discuss the stages of instruction. The objective is to understand the stages of instruction, demonstrate the stages of instruction.

Slide 13



There are three stages of instruction: concrete, pictorial, and abstract. In this module, we will be discussing the first two learning stages: concrete and pictorial. Concrete learning is the foundation of learning. Students are using actual items of represent and understand numbers and various concepts. They are able to manipulate the items to grasp a clear understanding on the math problem they are working on at the time. The second learning stage is pictorial learning. This is when students convert to drawing pictures of the items on paper rather than having the physical item in their hands. The pictorial stage is transferrable to bar modeling, which we will discuss in a later module.

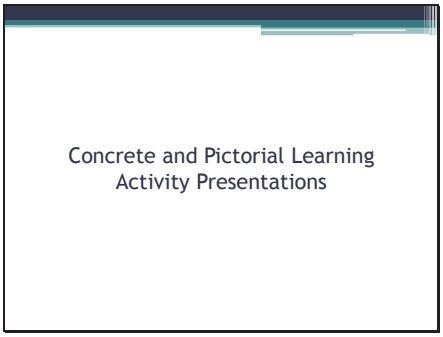
Slide 14



Now, we are going to do an activity. I want you to solve the problem using the two stages of instruction we have learned: concrete and pictorial. You have a poster board and some items on your table. Divide the poster into three sections: one concrete, one pictorial, and one abstract. The abstract section will be completed in a later module. You are going to use this word problem: “Sally has 4 teddy bears. Jessica has

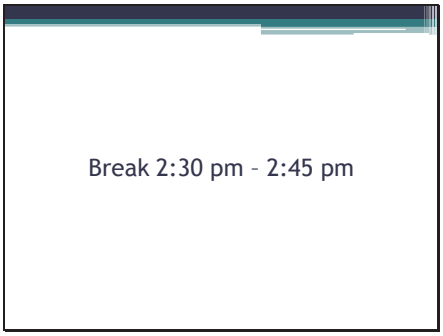
6 teddy bears. How many bears are there altogether?”

Slide 15

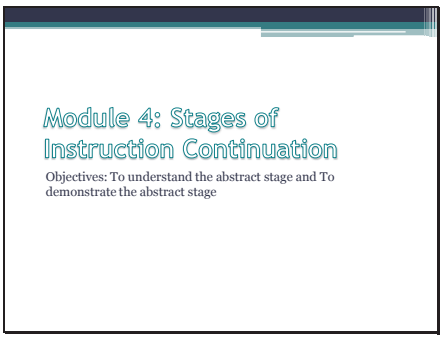


Participants present their posters.

Slide 16

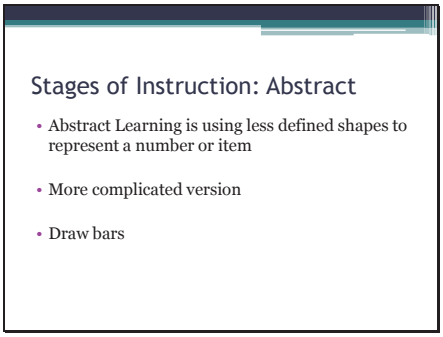


Slide 17



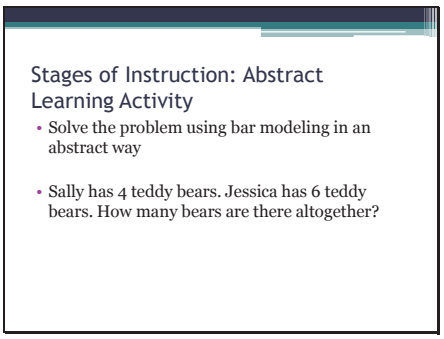
Module 4 is going to cover the last stage of instruction: abstract. The objective for this module is to understand and demonstrate the abstract stage of instruction.

Slide 18



With the stage of instruction: abstract, students are using more defined shapes to represent the numbers or items in a mathematical world problem. This transfer to a more advanced bar modeling technique that we will discuss in a later module. This stage is a more complicated for students to visualize the problem, but if they have been taught the other two stages well, they should transition well. If for any reason they are struggling with this concept, take a step back to the pictorial stage and if needed to the concrete stage. The abstract is a stage where the students will start to draw unit bars to represent the numbers in a word problem.

Slide 19

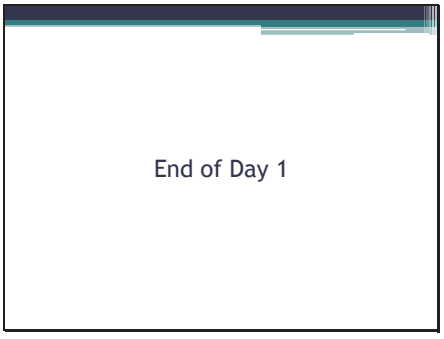


Now, we are going to start our activity. You are going to use the word problem: "Sally has 4 teddy bears. Jessica has 6 teddy bears. How many bears are there altogether?" This will be completed on the third section of your poster. This time you are going to use the abstract stage and draw unit bars.

Slide 20

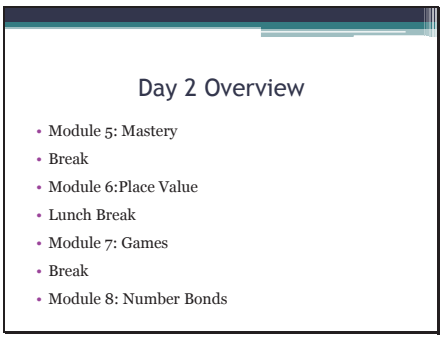
Participants present their posters.

Slide 21



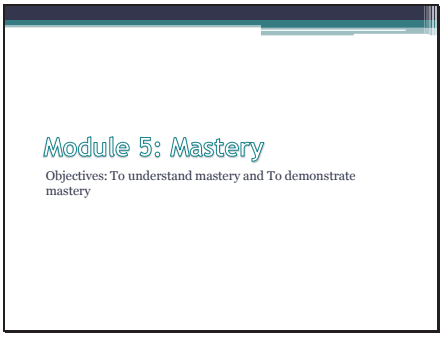
Thank you for a great first day. Does anyone have any questions about what we have covered thus far? Thank you again, and I will see you tomorrow!

Slide 22



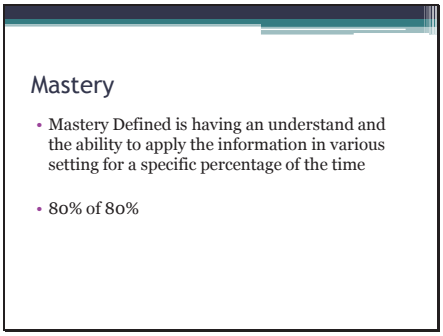
Good morning! We will have four modules that we are going to cover today: mastery, place value, games, and number bonds. We will follow the same schedule that we did yesterday taking breaks between each module and a lunch break in the middle.

Slide 23



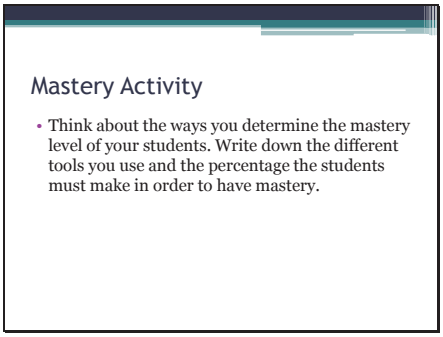
Mastery is module 5. The objective is to understand and demonstrate the concept of mastery.

Slide 24



Mastery is having the understanding of material and the ability to apply the material in various situations being successful a certain percentage of the time. With Singapore mathematics, mastery is considered 80% accuracy 80% of the time. The problems are more advanced therefore the percentage is lower than the typical 90% which is considered mastery in most curriculums.

Slide 25

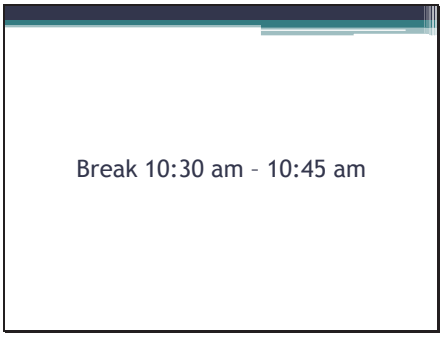


This activity is different compared to the others that we have been completed thus far. I want you to think about the ways you determine the mastery level of your students. Write down the different ways or tools that you use and the percentage that the students must make in order to have mastery of that skill. Look at each subject area. Is it different or the same across the board.

Slide 26

Participants discuss the various tools and the percentages of various subject areas.

Slide 27

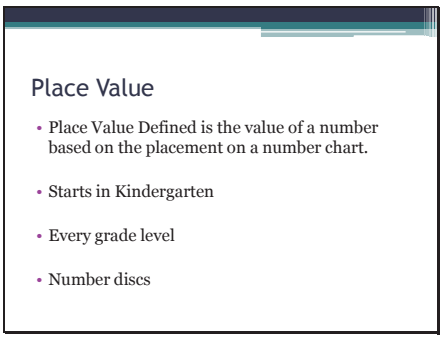


We are going to take a quick break.

Slide 28

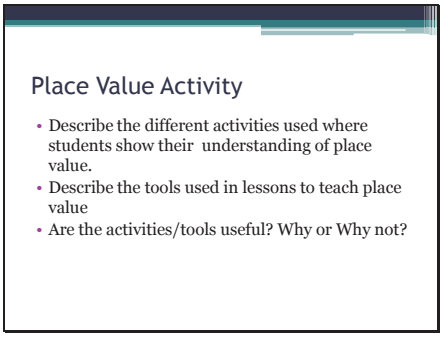
The next module that we are going to discuss is place value. The objective of this module is to understand and demonstrate Singapore's way of discussing place value.

Slide 29



Place value is the value of a number based on the placement on a number chart. Place value is introduced in kindergarten and is taught in every grade level. Singapore math uses colored number discs instead of the number rods. Number discs are used in a very similar way to number rods. Students are given the number discs and place value chart to work out addition and subtraction problems. When you borrow from the tens place, you trade the one "ten" for ten "ones". Then, all the ones are together. This works with every place value. With addition, you take ten "ones" and trade it for a ten and place in the tens place. So, it is very similar, but slightly different in the manipulatives being used.

Slide 30

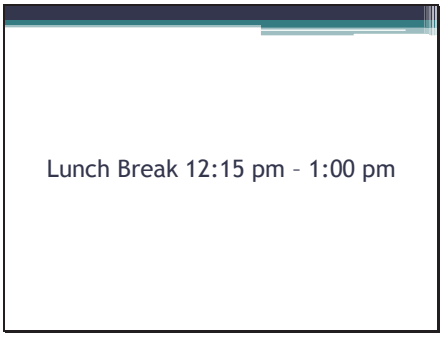


The activity that I want you to do is to describe the different activities used where students are sharing their understanding of place value, describe the tools used in lessons to teach place value. Then, think about the activities or tools that you use now and whether they are useful and decide why or why not.

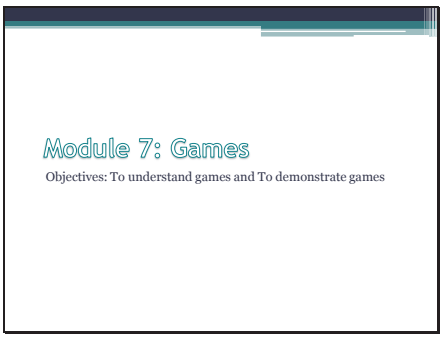
Slide 31

Participants will share their thoughts on place value.

Slide 32

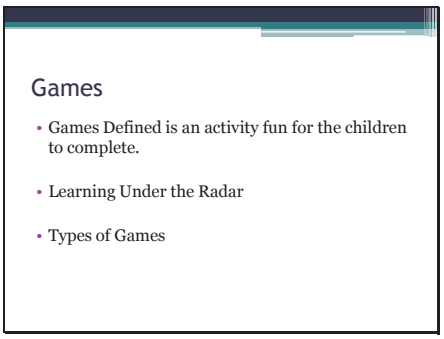


Slide 33



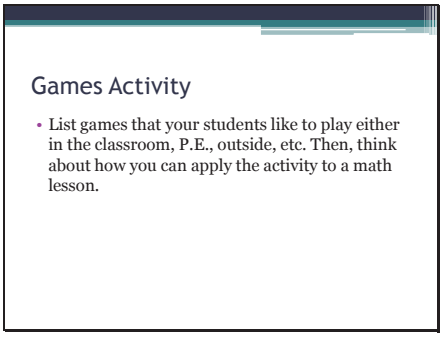
Games is our next module. Games are great way of supporting children in learning various skills. The objective of this module is to understand and demonstrate ways to implement games into learning.

Slide 34



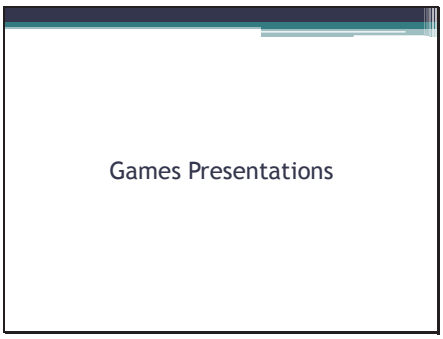
Games are fun activities for children to do. Kids love playing games, and they have fun playing games learning skills. Children will tend to not realize that they are learning while playing a game. They are just interested in winning the game. So, learning is more under the radar. There are many types of games that you can play: swat, double trouble, number cubes, etc. You can take mostly any game and rework them into a game that supports the skill being taught.

Slide 35



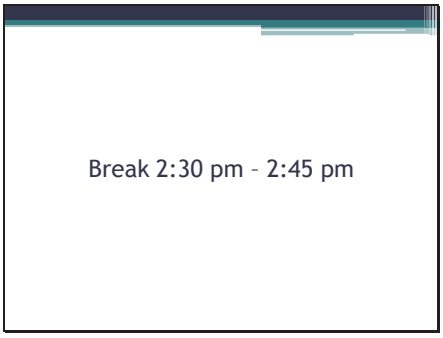
The activity for this module is to think about games. What games do your students love to play either in the classroom, P.E., outside, etc. and list them. Then, think about how you can apply some games to some various math lessons.

Slide 36

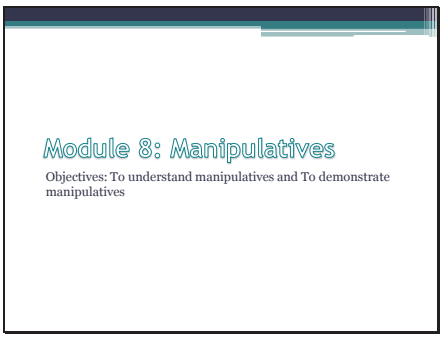


Participants sure your ideas with the games.

Slide 37

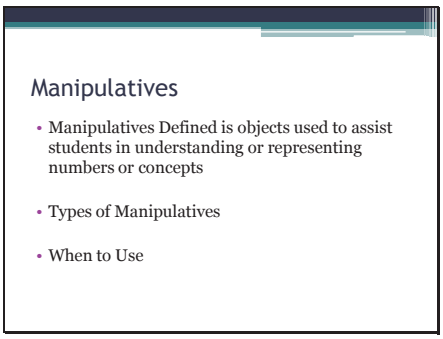


Slide 38



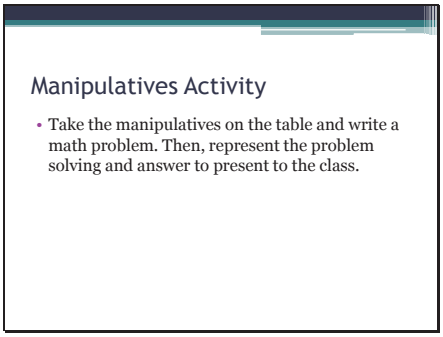
Our last module for today is module 8 on manipulatives. The objective is to understand and demonstrate the use of manipulatives.

Slide 39



Throughout this training, we have been using manipulatives. Manipulatives are objects used to assist students in understanding or representing numbers or concepts. Manipulatives are used at every grade level when learning a new concept or skill. Using manipulatives is most common in the concrete stage of instruction. There are many different types of manipulatives: marbles, straws, stuffed animals, etc. They can use anything and need to use to gain those concrete ideas.

Slide 40

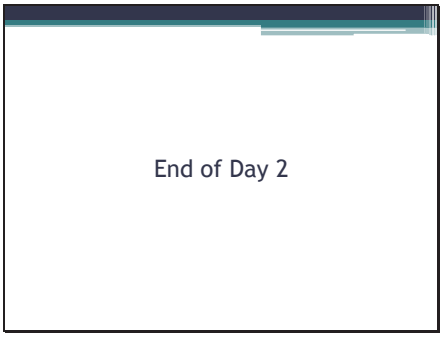


For this activity, I would like for you to take the manipulatives on the table and write a math problem. Then, represent the problem solving and answer the question. Then, you will present them to the class.

Slide 41

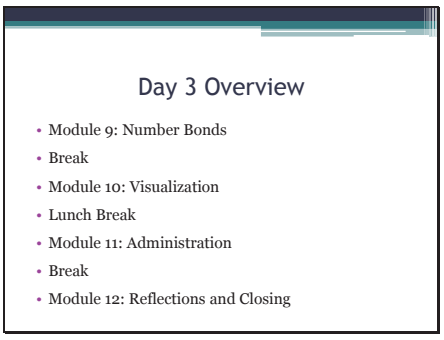
Participants share their math problems.

Slide 42



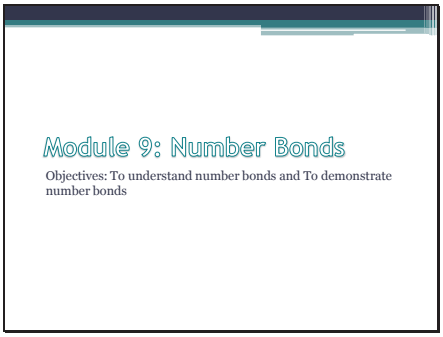
Thank you for a great second day. Does anyone have any questions about what we have covered thus far? Thank you again, and I will see you tomorrow!

Slide 43



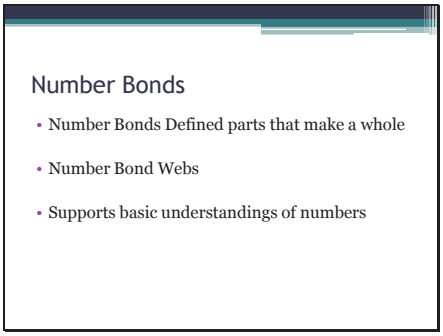
Good morning! We will have four modules that we are going to cover today: number bonds, visualization, administration, and reflections and closing. We will follow the same schedule that we did yesterday taking breaks between each module and a lunch break in the middle. In the last module, there will be an evaluation of the training for you to fill-out and return to me.

Slide 44



Our first module today in number bonds. The objective is to understand and demonstrate number bonds.

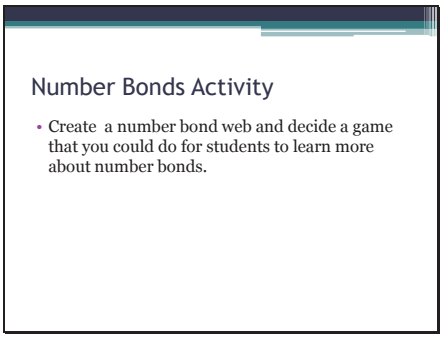
Slide 45



Number bonds is a combination of parts that make a whole. Six and four make ten. There can be any combination and the whole number can be broken down into two or more parts. For this, Singapore math recommends using number bonds webs to show the parts and the whole. In the younger grades, you will have a box on top with two boxes below. The top box and one of the lower

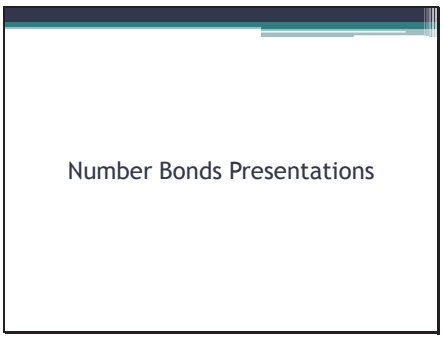
boxes can be filled in and the student must think about what the other part is to make the whole. Or you can fill in the bottom boxes and the students have to figure out the top box. This skill is great to support students understanding the basics of numbers and how they are made. Number bonds support mental math too.

Slide 46



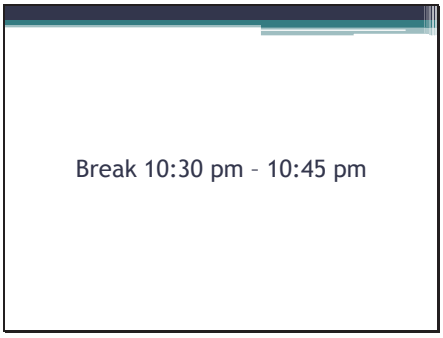
Now, I would like for you to create a number bond web and create a game that can be completed in the classroom to help with either concepts of numbers or mental math.

Slide 47



Participants share their ideas.

Slide 48



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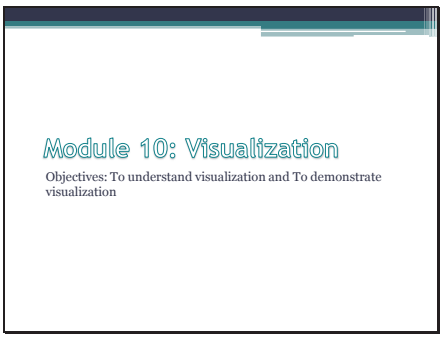
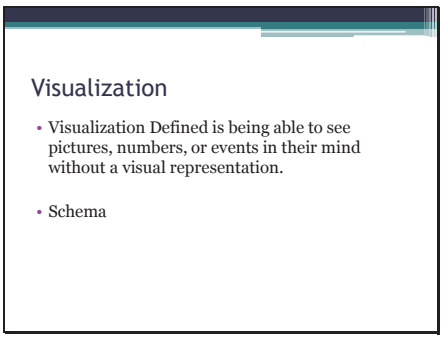


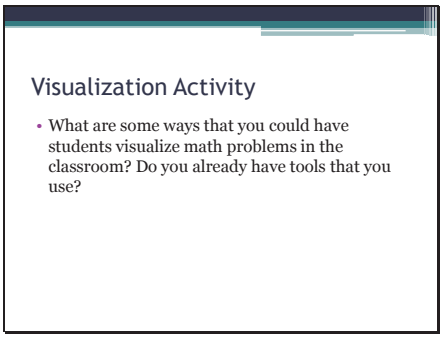
This module is visualization. The objective is understand and demonstrate visualization

Slide 50



Visualization is being able to see pictures, numbers, or events in the mind without a visual representation. Students build this skill in reading, but they need to build the skill in mathematics as well. This relates to the abstract stage of instruction. Students use schema to visualize known things in their head or fill in the gaps. If the students have had a strong concrete and pictorial learning experience that they should have the schema to visualize math problems.

Slide 51

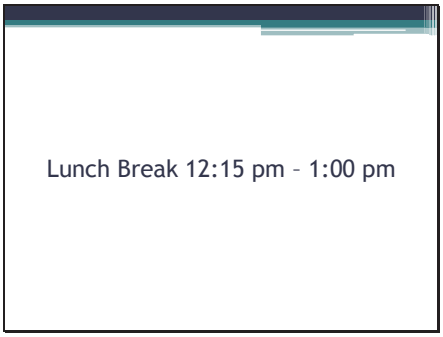


Think of ways that you can teach students to visualize math problems. Maybe you already have ways to teach the students how to visualize. Maybe you have an activity that could be integrated from another subject area. What tools do you have? Can you think of new ways and what would they be? Then, we will share those ideas.

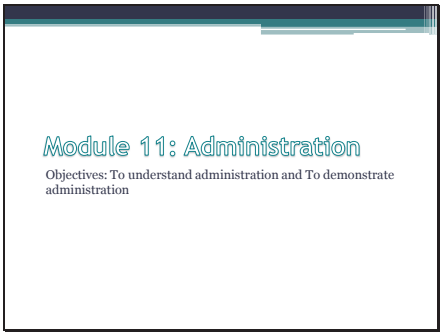
Slide 52

Participants share ideas.

Slide 53

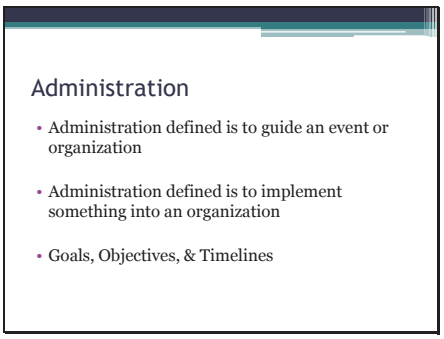


Slide 54



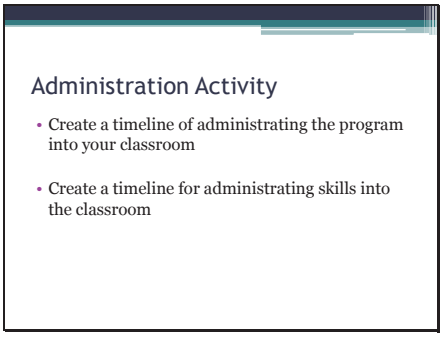
The next module is administration. The objectives in the understand and demonstrate administration.

Slide 55



Administration has more than one meaning. One is to guide an event or organization. The other is to implement or put something into place of an organization. Both can be applied to the implementation of Singapore math in the classroom or location. The important factors with both types of administration is to have set goals, objectives, and timelines for the implementation just as you would have with any lesson that you teach.

Slide 56

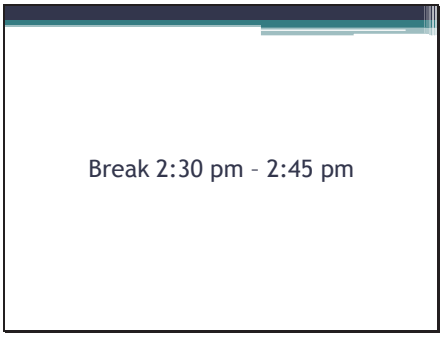


Think about administrating the program and the skills into the classroom. Come up with two timelines that you think would be appropriate for your students to implement the program into your classroom. Administrators can use the school instead of classrooms.

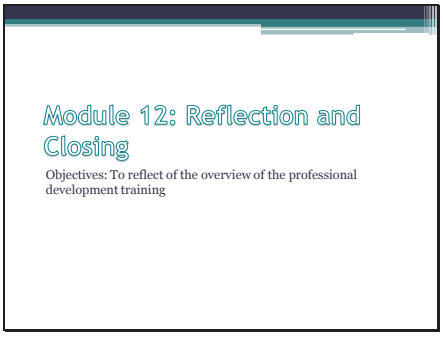
Slide 57

Participants will share their timelines.

Slide 58

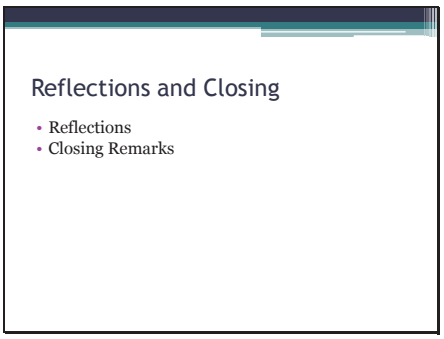


Slide 59



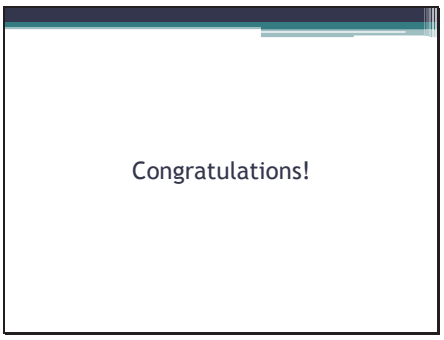
Well, we have reached our last module: reflection and closing. The objective for this module is to reflect on the overview of the professional development training.

Slide 60



I want to take a few moments to hear from each of you two things that you have learned from the training and how you plan to apply them in your classroom. Thank you for everyone sharing their thoughts. Are there any questions that you may have on any of the topics that were discussed? Next, we are going to complete the evaluation. Once you are finished with the evaluation, you are free to go, but before we start, I want thank you all for participating the in the training. I have enjoyed working with each and every one of you. Please respond honestly on the evaluation. This allows me to learn what you feel like you have learned, what could be better, and what was good. Thank you again!

Slide 61



Now, if you start the evaluations and turn them in before you leave. Thank you again!

Singapore Mathematics Curriculum Professional Development Training End-of-Session Evaluation

Please circle the rating that best describes your experience.

5 = Excellent, 4 = Great, 3 = Average, 2 = Fair, and 1 = Worst

1) **Participants' Reactions**
   a) Did you like it? 1 2 3 4 5
   b) Was your time well spent? 1 2 3 4 5
   c) Did the material make sense? 1 2 3 4 5
   d) Will it be useful? 1 2 3 4 5
   e) Was the leader knowledgeable and helpful? 1 2 3 4 5
   f) Were the refreshments fresh and tasty? 1 2 3 4 5
   g) Was the room the right temperature? 1 2 3 4 5
   h) Were the chairs comfortable? 1 2 3 4 5
2) **Participants' Learning**
   a) Did you acquire the intended knowledge and skills? 1 2 3 4 5
3) **Organization Support & Change**
   a) Was implementation advocated, facilitated, and supported? 1 2 3 4 5
   b) Was the support public and overt? 1 2 3 4 5
   c) Were problems addressed quickly and efficiently? 1 2 3 4 5
   d) Were sufficient resources made available? 1 2 3 4 5
   e) Were successes recognized and shared? 1 2 3 4 5
   f) What was the impact on the organization? 1 2 3 4 5

g) Did it affect the organization's climate and procedures? 1 2 3 4 5

4) Participants' Use of New Knowledge and Skills

a) Did you effectively apply the new knowledge and skills? 1 2 3 4 5

5) Student Learning Outcomes

a) What was the impact on students? 1 2 3 4 5

b) Did it affect student performance or achievement? 1 2 3 4 5

c) Did it influence students' physical or emotional wellbeing? 1 2 3 4 5

d) Are students more confident as learners? 1 2 3 4 5

e) Is student attendance improving? 1 2 3 4 5

f) Are dropouts decreasing? 1 2 3 4 5

6) Additional Notes: Please make any additional notes here. If something was great, you have a suggestion, or something did not work for you, please let me know. That way, I can improve the program to be the best. Thank you!

Appendix B: Interview Protocol Sheet

Interview Protocol Sheet for Interview 1

Project:

Time of Interview:

Date:

Place:

Interviewer:

Interviewee:

Position of Interviewee:

Consent Signed:

Recorder Working:

Questions:

1. What are your experiences with using the Singapore Mathematics curriculum?

2. How do you use the Singapore Math curriculum?

3. What factors in the curriculum are effective?

4. What factors in the curriculum are ineffective?

5. Do you have anything to add?

Interview Protocol Sheet for Interview 2

Project:

Time of Interview:

Date:

Place:

Interviewer:

Interviewee:

Position of Interviewee:

Consent Signed:

Recorder Working:

Questions:

1. What is your understanding of the basic principles of Singapore Math.
2. Please explain what you understand to be the differences between the Singapore Math workbooks and textbooks published for American schools and Singapore schools.
3. Please explain how you use regular model drawing.
4. Please explain what you mean by “teaching to mastery” with regard to the Singapore Math program.
5. Please explain what you mean by “place value.”
6. What games have you developed to support the Singapore Math program?
7. Please explain what you mean by “manipulatives.”
8. Please explain the purpose of number bonds in Singapore Math.
9. Please explain how Singapore Math processes provide a “great way to visualize math.”

Appendix C: Observation Protocol Sheet

Observation Protocol Sheet		
Teaching Style	Description	Interpretation
	Bar modeling	
Curriculum Usage	Description	Interpretation
	Teacher Edition Textbooks Workbooks Games Activities	

Appendix D: Second Interview Protocol Sheet

Interview Protocol for the second individual interview of one participant

Interview Protocol Sheet

Project: The Effectiveness of Singapore Mathematics

Time of Interview:

Date: 7/22/13

Place: Singapore Math

Interviewer: Hannah Reaume

Interviewee:

Position of Interviewee: Teacher

Consent Signed: Yes

Recorder Working: I tested and is working

3:32
I have transcribed the interview you participated in on May 11th. I have reviewed the transcript. Based on that review, I have some additional questions to ask.

1. What is your understanding of the basic principles of Singapore Math.

The main principle in Singapore Math is that you always introduce concepts on concrete material. Then, you move to pictorial and then move to abstract. And you don't move from one level to the next without feeling that the student has truly understood and comprehended what you are trying to teach.

And how do you gage that they are ready to move on?

Well, you give them multiple models. And if they can transfer from one model to the next, then you can be fairly certain that they understand the concept and didn't just memorized it from the first activity.

2. Please explain what you understand to be the differences between the Singapore Math workbooks and textbooks published for American schools and Singapore schools.

Originally, the biggest difference was some American publishing companies went through and changed the names from very Asian sounding names to American sounding

names. Then, they took things like the monetary units that were used in Singapore and changed those to dollars. They took some of the odd fruits, such as durians and other things that we have not heard of here in America, and changed all that. They did add a bit more color and put in a few more pictures, but the problems were mostly the same. Since that time, Hope Mifflin has worked on math and focus and it looks a little more American, and I think they put in a few extra topics that weren't in the Singapore Math Curriculum.

3. Please explain how you use regular model drawing.

Well, you use it in every grade level. You start in the lowest of grade levels and after the student can concretely add objects or subtract objects. Then, you represent them pictorially, and eventually, you take away the pictures and go into unit bars. The unit bar can then represent like 3 dolls or 3 trucks or 3 balls. Then, another unit bar could represent 5 dolls or 5 trucks or 5 balls. You don't have it separated into 3 sections and 5 sections, but as a continuous bar or model as they call it. When the children are able to conceptualize that then you can teach the different types of models, such as the addition model, subtraction model, comparison model, multiplication model, and so on and so forth. But model drawing solves about 80 to 85% of word problems. So, almost every problem, I first look to see if there is a model and if not, then there is some other way, such as make a list or another standard strategy that we use in our American school, but I always try to start with allowing them to model it. It works great and fabulous in fractions, decimals, percentages, all the things that our kids tend to struggle with. When you show it to them in a model, they just go 'wow, I see it!" And it is when they see it that they can internalize it. So, I use it in all aspects of problem solving.

It seems that the children really enjoy and grasp the bar modeling.

They do, because they are not lost out in space. They get what's going on, because the can truly see it and internalize it; whereas, sometimes I think when we are going through the algorithms without showing it. Yes, they will learn the rules, but then if they have to generalize to a different situation or if they get stuck, they can't remember the rules. They don't have a method for going back and figuring out. But if they have gotten comfortable using the modeling, they can always go back and model it and then figure it.

4. Please explain what you mean by "teaching to mastery" with regard to the Singapore Math program.

The Singapore Math program doesn't encourage you moving past a skill that a child might have some weaknesses in and hope that it might spiral back around in the curriculum. They believe that at each level to the degree of difficulty that is prescribed in that level that you teach and much sure the child understands that. They are well aware of the fact that all of the skills build on previous knowledge, and if the previous knowledge

isn't there, then they are going to fall apart with the later skills. So, even if the the curriculum map say it is time to move on, but a particular child isn't there yet, you need to keep working with that child not move them to the next topic or subject in math until they have the first one very, very strongly. And it may take a little more scaffolding. It may take more concrete material, munipulatives. It might take longer at the picture stage, but you have to keep working with that child until they have that knowledge before they move on.

I had found something in my research, if you don't mind me asking, that if a child scores 80% on a skill that it is considered mastery. Is that true from what you understand and have researched?

Yes, because the degree of difficulty may be a little bit hard, but the basic concept , if they can get 80% mastery 80% of the time you can show them a problem and they understand how to do it and they can describe it and talk about it and model it. Then there may be an occasional problems, 10 to 20%, that they are a little uncertain of and may need a little questioning to guide there thinking, but they eventually get through it. However, if independently they can do 80%, then I would call that mastery.

5. Please explain what you mean by "place value."

In American schools, I have noticed that we tend to have a little chapter at the front of the book on place value and we have the kids write the numbers in words and then standard form and expanded form, but we don't really work much with gaining a genuine understanding of the different places and there values. Also, understanding their relationships between that 10 ones truly makes a 1 ten. In Singapore math, they have you start off actually with bundling. So, you have ten separate items and you wrap them up together with a rubber band or something and say 'here's a ten.' We don't just show a tens rod to them that they may or may not see broken into the 10 pieces. So, it is truly a genuine understanding of the relationship between he places so that when they try and decompose numbers they can say 'oh, when I need to borrow a 10 that that is going to give me 10 ones and now I can use those ones with the ones I have to subtract the other amount. The same works true when they get to decimals. They really need to understand and be able to model and show their understanding that a tenth that it takes 10 tenths to make a whole. And they really need to understand, not only the place values, but the relationships between them in order to work with them comfortably.

6. What games have you developed to support the Singapore Math program?

I can't say the I personally have developed any of the games. They are all games that I have learned from other professionals throughout my career. But they are games that work and have been given in different curriculums as well. They are just adapted for the Singapore Math, such as we had 'Everyday Counts' math series for a while and there

were lots and lots of games that I took from there like: build the biggest number and double trouble. Early on when the children are just trying to get fluency with basic number facts to 10, you can play 'swat' where you put some numbers on the board and you call out a quick '3+4' and the first one to swat number 7 and you know they've got it. So, just for fluency. There is a game named double trouble where they roll the dice and that works really well with addition, subtraction or even multiplication skills. So, I just use all the games that you learn from different math teachers and throughout the curriculum can be adapted to Singapore Math. They are just additional ways to practice the skills.

7. Please explain what you mean by "manipulatives."

Manipulatives are generally something the kids can put up, touch, and hold. They can be used to represent numbers. It can be something as simple as counting discs or little bears or something like that. It could be an abacus, place value discs, cubes and rods, or hundreds squares. It could even be 3-d models of 3-d shapes. It could actually be scales, measuring liquids. You could bring in a quart jug or a gallon jug and a measuring cup. It is real life animate objects that you can touch and feel to describe numbers and their relationship.

Would that relate back to the movement between abstract and concrete and is that what builds that concrete knowledge?

Yes, they actually touch, feel, and internalize by experimenting with the real world what the numbers mean.

8. Please explain the purpose of number bonds in Singapore Math.

Kids learn number bonds at the earliest of ages. The idea is to help them recognize part-part-whole relationships in knowing 3 and 2 make 5 or 4 and 1 make 5 or 5 and 0 make 5. The reason they need to know those so that they can numbers apart/decompose numbers and rebuild them back again into something else. For example, if they wanted to add 18 and 5, it would be good to know that 5 can be broken into 2 and 3. So, then they can put the 2 with the 18 to make a 20 and then it is quick to add the 3 left over to make 23. Rather than to sit there counting on singularly from 18 (18, 19, 20…). It really helps when they can take number apart and helps with compensation strategies, speed strategies, but the idea is that numbers are made out of parts for the whole. That really helps with model drawing, with fractions, and with lots of other things. So, being able to take numbers apart and then put them back together again in groups that makes sense that are easy to add and subtract is the purpose of number bonds.

When do you start number bonds?

I start them with my kindergarten group. It is from the very get go and it is starting with manipulatives 5 little teddy bears out there. You put 4 in one group and 1 in another. Then, they can see that is 5. You do 3 and 2. You do 5 and 0. And you show them 'oh these are all the ways to make 5 and oh look I have 3, how many more do I need to make 5?' You talk about how 3 is part of the group and how many more do we need to make the whole group and you start to use that vocabulary and breaking number apart at the earliest of ages.

9. Please explain how Singapore Math processes provide a "great way to visualize math."

Well, if it is done with fidelity and truly done from the concrete to the pictorial to the abstract stages, then the students have had an opportunity to experience the numbers and their relationships so they can usually easily recall those experiences to create a visual image for themselves. I was trying to think of an example and I was thinking that it is like 'who would you rather have working on your car a mechanic that has actually touched each part of the car knows how they fit together and built a car or a mechanic that has only read about how to build a car and only seen pictures of the parts of the car. You really want the person who is touching your car someone who has touched and felt and fit together the parts. He is going to remember those experiences and be able to visualize and talk about it and be able to use that knowledge probably more so than the other person who has simply seen it on the page.

Is there anything that you want to expand on or add to?

Not specifically, but as questions arise please feel free to contact me. I think it is a fabulous way to teach, and I would love to see more teachers across America using these ideas. If they did, I think we would have more students so much further in math.

Curriculum Vitae

Hannah Colette Reaume

Professional Profile

Eager to instruct future teachers to be successful using research-based strategies to build a strong foundation in which the individual can grow as a teacher in the classroom instructing and classroom management.

Acquiring a Doctorate Degree in Education of Teacher Leadership, holds a Masters Degree in Early Childhood Education, Bachelors Degree in Arts of Early Childhood Education, and Associates Degree in Science.

Dedicated to enthusiastic and dynamic teaching as a means of creating and nurturing a lifelong love of knowledge in children.

Education, Honors, and Certifications

2010 – present	Doctorate of Education in Teacher Leadership Walden University Minneapolis, Minnesota
2009	Guest Speaker to an Introduction to Education Class Piedmont College, Dr. Gene Pease
1/2009 – 12/2009	Masters in Arts of Early Childhood Education Piedmont College Demorest, GA 30535 Graduated with a 4.0 GPA Capstone Research Presentation on Writing Workshop
2008 – 2009	Gifted Endorsement The endorsement allows me to teach gifted classes, sit on gifted selection committees, and test gifted students.
2006 – 2008	Bachelor of Arts in Early Childhood Education Piedmont College Demorest, GA 30525 Graduated Magna Cum Lude GPA of 3.86
2002 – 2006	Associates of Science Gainesville College Gainesville, GA 3050
1999 - 2000	Who's Who Among American High School Students

Key Qualifications

Currently working on Ed .D in Teacher Leadership
Holds a Master's Degree in Early Childhood Education
Certified in Elementary (K-5)
Gifted Endorsement

Want to help assist future teachers with obtaining the skills they will need to instruct and manage students in their own classrooms using a variety of strategies.

Employment

2013 – Present	Y.M.C.A Afterschool Program Site Director Supervisor Position: lead staff meetings, supervise staff, development of curriculum, implementing protocols and procedures Registration Team Safety Committee Developing and Leading a Development Team Created a 9 week Program for Afterschool Program Creating Curriculum Plan for Afterschool Program Creating Year long Curriculum for Sites for Afterschool Program
11/2012 – Present	Gainesville City School System Substitute Teacher Teach in all grade levels K-12
1/2013 – 5/2013	New Holland Elementary School 2nd Grade Long-term Substitute Taught all subject areas: Math, Reading, Writing, Science, Social Studies, Grammar, and Spelling Took on full teacher responsibility during that time: attended meetings, completed student evaluations, created lesson plans, planned with grade level, parent conferences Common Core GPS Standards
12/2013	Gainesville City Middle School 7th Grade Long-term Substitute Taught 7th grade Social Studies Had a student teacher in the classroom at that time Differentiated instruction

2/2012 – 6/2012	Adventures in Missions Admissions Sales for Adventures Encounters Assisted individuals and groups to coordinate mission trips around the world, answer questions about various trips, conduct interviews for trips, and respond to requests by email and phone. Temporary Position
2010 – Present	Wauka Mountain Multiple Intelligences Academy 3rd Grade – Taught all subject area: Math, Reading, Writing, Science, Social Studies, Grammar, and Spelling Taught specialty class: Equestrian Skills Math Chair, Student Council Association (Teacher Leader), Gifted Committee
2008 – 2010	Chicopee Woods Elementary 3rd Grade – Taught all subject area: Math, Reading, Writing, Science, Social Studies, Grammar, and Spelling Math Club (Teacher Leader), Gifted Committee Attended Reading Workshop Session
1/2008 – 4/2008	Sardis Elementary 4th Grade – Student Teacher Taught all subject area: Math, Reading, Writing, Science, Social Studies, Grammar, and Spelling
8/2007 – 12/2007	Baldwin Elementary 3rd Grade – Practicum Taught all subject area: Math, Reading, Writing, Science, Social Studies, Grammar, and Spelling Attended Writing Workshop Training Sessions

Professional Affiliations

2008 – Present Professional Association of Georgia Educators (PAGE)
2006 – 2008 Student Professional Association of Georgia Educators (SPAGE)