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Implementing the Math Workshop Approach: An Examination of Perspectives among Elementary, Middle, and High School Teachers

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Improving student performance in mathematics is reinforced through the use of effective teaching practices. One such practice, the math workshop approach, is a rigorous, student-centered way to teach mathematics that fosters inquiry among the community of learners. The purpose of the present study was to explore the perspectives of mathematics teachers who implemented the math workshop approach in their classrooms. Using a concurrent mixed methods research design, an electronic questionnaire was administered among four elementary teachers, two middle school teachers, and two high school teachers who had several years of teaching experiences. Quantitative and qualitative data were collected and analyzed separately to examine congruence with reported perspectives. Quantitative data were tabulated and reported with frequencies and percentages. Qualitative data were analyzed with descriptive analysis techniques to identify themes. Findings revealed that participants recognized the math workshop approach as an effective teaching practice to improve teaching and learning in mathematics. These findings pointed to implications for teacher preparation programs and professional learning efforts among math professionals employed within school districts. Limitations and future areas of study were also discussed.

Keywords: math workshop approach, mathematics instruction, mathematics teachers, teaching, learning, teachers

INTRODUCTION

Teachers and their teaching practices are the single-most influential variable on student learning (Glasser, 1998; Hattie, 2009, 2012; Hattie & Yates, 2014; Stronge, 2007; Tucker & Stronge, 2005). Mathematics teachers must be well-prepared teaching professionals (Hiebert, Morris, & Glass, 2003) who are skilled with both content and

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pedagogy (Darling-Hammond, 2000; Hurst, 2017). For over 60 years, improving student performance in mathematics has been a priority among educational stakeholders (Greenes, 2013). Efforts to improve teaching and learning in mathematics have sought to enhance student achievement among diverse learners in all grade levels through (a) the identification of effective classroom practices (Blazar, 2015; Gilbert et al., 2014; Hegedus, Tapper, & Dalton, 2016; Martínez, Stecher, & Borko, 2009); (b) engagement in comprehensive school reform initiatives (Choi, Meisenheimer, McCart, & Sailor, 2017; Gross, Booker, & Goldhaber, 2009; Krupa & Confrey, 2017; Mac Iver & Mac Iver, 2009); and (c) implementation of successful models of professional learning for teachers (Kutaka et al., 2017; Parise & Spillane, 2010; Polly et al., 2015; Tabernik & Williams, 2010). Despite these myriad of efforts, recent reports have revealed that student performance in mathematics continues to lag (Organisation for Economic Co-operation and Development, 2016; Provasnik et al., 2016; The Nation's Report Card, 2015).

Empirical studies have suggested correlations between high school mathematics performance and future academic success (Cortes, Goodman, & Nomi, 2015; Long, Conger, & Iatarola, 2012), as well as future earning potential (Joensen, & Nielsen, 2009; Rose & Betts, 2004). However, low enrollments in advanced high school mathematics courses, especially among students who are racially diverse and live in poverty, leave a large number of high school graduates underprepared for college-level mathematics (Hilgoe, Brinkley, Hattingh, & Bernhardt, 2016; McCormick & Lucas, 2011). Additionally, students have been exposed to a great deal of "drill-and-kill" and "show-and-tell" mathematics instruction throughout their K-12 school experiences, which potentially hinders opportunities to learn about mathematics from effective teachers (Hattie, Fisher, & Frey, 2017, p. 3).

Recently, the National Council of Teachers of Mathematics (NCTM, 2014) reinforced the powerful influence that teachers and their teaching practices have on student learning with mathematics. They recommended eight research-based Mathematics Teaching Practices that should underpin every lesson:

1. Establish mathematics goals to focus learning.
2. Implement tasks that promote reasoning and problem solving.
3. Use and connect mathematical representations.
4. Facilitate meaningful mathematical discourse.
5. Pose purposeful questions.
6. Build procedural fluency from conceptual understanding.
7. Support productive struggle in learning mathematics.
8. Elicit and use evidence of student thinking.

In thinking about how mathematics instruction has been traditionally approached, the NCTM's Mathematics Teaching Practices necessitates a significant paradigm shift among mathematics teachers. No longer will prescribed, scripted, teacher-centered lessons suffice (Hattie et al., 2017). Hattie et al. emphasized that mathematics instruction should be "punctuated with collaborative learning opportunities, rich discussions about mathematical concepts, excitement over persisting through complex problem solving, and the application of ideas to situations and problems that matter (pp. 14-15).

The mathematics teaching community must embrace a model of instruction that is rigorous, student-centered, and fosters inquiry among students who act within a community of mathematicians, such as the math workshop approach (Hoffer, 2012; Newton, 2016; Wedekind, 2011). The math workshop approach provides mathematics teachers with the necessary framework to implement rigorous, student-centered, and inquiry-based instruction among a community of mathematicians. Although the math workshop approach appears to present a promising model of instruction, there was an extreme paucity of available literature at the time of the present study. Along with a small number of practitioner-oriented texts (i.e., Hoffer, 2012; Newton, 2016; Wedekind, 2011), only one empirical study was located, which explored the different ways in which elementary teachers implemented the math workshop approach to improve student performance with mathematics (Ashley, 2016). The present study sought to extend these findings and address an underrepresented area of literature by examining the perspectives of experienced elementary, middle, and high school teachers who implement the math workshop approach in their classrooms. Specifically, the following research question was explored: How do elementary, middle, and high school math teachers plan and implement the math workshop approach in their classrooms?

REVIEW OF LITERATURE

The math workshop approach transforms classrooms into mathematical communities of learners who engage in meaningful tasks within a math-rich learning environment (Newton, 2016). The math workshop approach is a social constructivist approach teaching approach because students develop conceptual understandings in mathematics by completing inquiry-based tasks in small groups (Dewey, 1933; Vygotsky, 1978) using dialogue and reflection (Bruner, 1961). In order to maximize the learning potential among all students, mathematics teachers design and facilitate small group tasks that "invite individuals to construct and negotiate deep conceptual understanding, as well as develop fluency with numbers" (Hoffer, 2012, p. 2).

The math workshop approach consists of four components that provide a framework of instruction for mathematics teachers (Hoffer, 2012; Newton, 2016; Wedekind, 2011). First, the teacher introduces the lesson with an opening. The opening is usually only a few minutes and should stimulate mathematical thinking among students. Next, the mathematics teacher delivers a mini-lesson. A mini-lesson is a shortened lesson that provides explicit instruction with a specific mathematics concept or skill that students will encounter during work time. During work time, students work in pairs or small groups to complete inquiry-based tasks. As students work collaboratively, the teacher confers with students to listen, understand their mathematical thought processes, and identify ways to advance their learning. If the teacher notices that several students require additional support, they may employ differentiation strategies, such as invitational groups, to address these needs. The final component of math workshop is the closure, where students come back together as a whole group to share and reflect upon their understandings from work time.

METHOD

Context

The present study was conducted in a public school district located in the Southern United States. At the time of the present study, this school district was engaged in professional learning efforts to train and provide ongoing support with the math workshop approach among approximately 70 teachers from all grade levels. These efforts had been in place since 2014, and these teachers had voluntarily committed to implement the math workshop approach in their classrooms. The two school district math curriculum specialists (i.e., the second and third co-authors of this research report) provided ongoing support for teachers who were implementing the math workshop approach in their classrooms. These support features included coordinating book studies related to math workshop, supporting attendance at state- and national-level math workshop trainings, inviting speakers to conduct math workshop training at the district-level, and organizing classroom lab observations of master teachers who implement math workshop effectively.

Participants

All teachers in the school district who implemented the math workshop approach were invited to participate in the present study via email. Eight classroom teachers who had several years of teaching experiences responded to our email invitation and provided consent to participate. As shown in Table 1, participants included four elementary teachers, two middle school teachers, and two high school teachers. In order to ensure anonymity and confidentiality, pseudonyms were used for each participant and school site.

Table 1
Study Participants Who Implemented the Math Workshop Approach

	School Campus	Grade Level	Years of Experience
Teacher 1	Elementary School #1	2nd Grade	10 Years
Teacher 2	Elementary School #2	3rd Grade	25 Years
Teacher 3	Elementary School #3	4th Grade	16 Years
Teacher 4	Elementary School #4	5th Grade	10 Years
Teacher 5	Middle School #1	6th Grade	8 Years
Teacher 6	Middle School #2	8th Grade	20 Years
Teacher 7	High School #1	Algebra I	15 Years
Teacher 8	High School #2	Algebra II	19 Years

Research Design

A concurrent mixed methods research design was employed to achieve the purpose of the present study (Teddlie & Tashakkori, 2009). It was determined that this design was most appropriate because narrative and numerical data would provide a more balanced understanding of how elementary, middle, and high school mathematics teachers implement the math workshop approach in their classrooms. Quantitative and qualitative data were collected simultaneously and then compared during analyses to examine congruence with reported perspectives.

Data Collection Procedures

The present study took place during the 2016-2017 school year. In early September, each participant was emailed an electronic Google Form questionnaire (see Appendix). The questionnaire consisted of five sections and collected quantitative data regarding the math workshop approach via six closed-ended statements and qualitative data via 10 open-ended questions. Once participants received the questionnaire, they were given four weeks to complete and submit their responses.

Data Analysis

Once data were collected, quantitative data were analyzed first. Responses were tabulated for each closed-ended statement and reported distributions with frequencies and percentages (Christensen, Johnson, & Turner, 2014). Next, qualitative data from the questionnaire were analyzed using descriptive analysis techniques (Elliott & Timulak, 2005). Three independent reviews were conducted to analyze and code qualitative data (Corbin & Strauss, 1990). First, open coding was used to label concepts present in the data. Next, axial coding was used to confirm the accuracy of codes and group similar codes into themes. Finally, codes within each theme were reviewed to identify the presence of subthemes. The research team communicated frequently during data analyses through face-to-face meetings and email exchanges. Periodic member checks were also conducted to discuss data and interpretations

FINDINGS

All eight participants completed the questionnaire. Below, a summary of quantitative findings was presented, followed by a summary of qualitative findings.

Quantitative Findings

On the first section of the questionnaire, participants used a scale of 1-10 to indicate the degree to which they perceived that the math workshop structure was evident in their classrooms (i.e., 1 = low level, 10 = high level). Findings showed that all participants perceived a moderate to high level of math workshop structure within their classrooms [5: n = 1(12.5%); 6: n = 3(37.5%); 8: n = 3(37.5%); 10: n = 1(12.5%)].

On the second section of the questionnaire, participants used a 5-point Likert scale to indicate their perspectives regarding two components of the math workshop framework: the mini-lesson and work time. With respect to the mini-lesson, participants indicated their perceived level of agreement with seven possible purposes for a mini-lesson. As shown in Table 2, seven participants selected either Agree or Strongly Agree for six of these purposes. In contrast, three participants selected Disagree for providing students with directions. With respect to work time, participants used a 5-point Likert scale to indicate their perspectives regarding preferred grouping arrangement for inquiry-based tasks. Findings revealed that five participants had no preferences for a specific grouping arrangement and reported that they used all grouping arrangements. Two participants reported a preference for collaborative group work, and one participant reported a preference for paired work.

Table 2
Purpose of a Mini-Lesson during Math Workshop Approach

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Model Thinking	--	1 (12.5%)	--	2 (25.0%)	5 (62.5%)*
Prepare for Work Time	--	--	--	4 (50.0%)*	4 (50.0%)*
Provide Directions	--	3 (37.5%)*	2 (25.0%)	1 (12.5%)	2 (25.0%)
Think Aloud	--	1 (12.5%)	--	1 (12.5%)	6 (75.0%)*
Focus on Specific Purpose	--	1 (12.5%)	--	3 (37.5%)*	4 (50.0%)*
Adhere to Time Allotment	--	2 (25.0%)	2 (25.0%)	3 (37.5%)*	1 (12.5%)
Review Specific Strategies	1 (12.5%)	1 (12.5%)	1 (12.5%)	2 (25.0%)	3 (37.5%)*

*Indicates the majority of responses

On the third section of the questionnaire, participants used a 3-point Likert scale to specify the frequency of their use of conferring and invitational groups during work time. As shown in Table 3, seven participants specified that they Always use conferring during work time. In contrast, two participants specified that they Sometimes use invitational groups, while six participants indicated Never.

Table 3
Use of Conferring and Invitational Groups during Work Time

	Never	Sometimes	Always
Use of Conferring	--	1 (12.5%)	7 (87.5%)
Use of Invitational Groups	6 (75.0%)	2 (25.0%)	--

On the fourth section of the questionnaire, participants used a 5-point Likert scale to indicate their perceived level of agreement for each of the following features of the math workshop approach: Student Thinking, Communication, Struggle, Collaboration, Deep Understanding of Content, and Student Ownership of Learning. Overwhelmingly, seven participants selected Strongly Agree for all but one feature, Student Ownership of Learning. Only one participant selected Agree for this feature of the math workshop approach.

Qualitative Findings

On the fifth section of the questionnaire, participants provided rich, descriptive responses to each of the open-ended questions, which resulted in a total of 2,750 words. Qualitative data analyses produced the following three themes: Community of Learners, Teacher Support, and Math Workshop Framework. Within the theme Math Workshop Framework, three sub-themes emerged: Planning, Closure, and Work Time. A description of each theme and sub-theme are presented below in order from least to greatest, along with supportive statements.

Community of Learners

There were 11 descriptive statements within the theme Community of Learners. Participants emphasized the importance of establishing this “culture in the classroom from Day 1” and engaging in efforts throughout the school year to “help the community grow.” According to participants, a community of learners:

- creates a support system (". . . everyone becomes supportive of each other in the classroom. Students are not afraid to share and learn from others' mistakes and failures, which benefit everyone's growth in math. The students start to help each other when they see another student struggling.");
- fosters a safe learning environment where mistakes and struggle are seen as valuable opportunities to learn ("We are ALL learners and benefit from struggling with a problem and persevering until we are satisfied we have found an acceptable solution. Students and teachers learn a lot more when there is discussion about how to solve problems differently—having to defend one's answer helps clarify thinking for everyone. Students do not learn individually, they learn as a community."); and
- relies upon active learning and collaborative interactions to promote ownership with learning among students ("Students need to be the ones who are collaborating; they need to know how to collaborate with one another in a nice manner, and how to react to someone who is speaking with them.").

One participant shared that building a community of learners during math workshop was challenging because she had "students who become frustrated and cried." However, this participant persisted with her efforts to build the classroom community and described how she overcame this challenge: "I give students support, prompts as needed, and time. I reassure them through my demeanor and verbal encouragement."

Teacher Support

There were 23 descriptive statements within the theme Teacher Support. While implementing math workshop, participants indicated that they promote a student-centered learning environment by coaching, modeling, and "facilitating their [students'] math talk" during work time. According to one participant, "I'm really just a support person for them. I let my students take the lead." Three participants specified the following as ways in which they supported student learning:

> "I coach them by asking a lot of questions. Even if they ask me a question, I will ask them a question back to help them go further into the problem without me answering it for them."
>
> "I go around to each partner group and see where they are on the problem. If they are really stuck to where they have not progressed in quite a while, I will give needed prompts. If the whole class is struggling with understanding what is asked, I will bring them back together and give what is needed. I never give the answer. If a partner group is really, really close, I will sometimes pair them up with someone who has gotten it."
>
> "I make sure everyone is participating and that not just one person is taking the lead. I model a lot about how group communication and work should be going. I also have a math talk poster hanging up that they can use as sentence starters. As this is happening I walk around, sit, and listen to groups. I usually don't speak—I just sit and listen!"

One participant pointed out that their role during the math workshop approach was different from their role during traditional math instruction. She stated, “It is no longer the monkey effect where students basically repeat what I did during the lesson.”

Math Workshop Framework

There were a total of 39 descriptive statements within the theme Math Workshop Framework. Descriptive statements within this theme were further categorized into three sub-themes: Planning, Closure and Work Time. These three sub-themes are presented below in order from least to greatest.

- Planning: Participants made five descriptive statements regarding how they plan for math workshop. One participant explained that she used backward design to plan instruction. Additionally, five participants disclosed that they aligned instruction with state standards and adapted activities based upon students’ needs.
- Closure: Participants made 17 descriptive statements regarding the closure component of the math workshop framework. Participants named several ways in which they close a math workshop lesson, such as exit tickets, reflective math journal entries, think-pair-share activities, whole class debriefings, short quizzes, and surveys. Participants also conveyed that closure was “very valuable” for both students and the teacher. For students, closure helps students “cement their new learning” and “lets them know if they are staying on track with the topic and understanding everything they need to know.” For teachers, closure serves as an informal assessment tool that provides information “to determine if the lesson was successful and if students understand the objective.”
- Work time: The majority of descriptive statements within this theme were categorized within the sub-theme Work Time (n = 20). Participants viewed this aspect of the math workshop framework as a critical time to engage students in differentiated, discovery activities designed “to promote deeper thinking.” One participant provided an authentic example of how she differentiated a work time activity:

  > “I have many different tasks they [students] can work on. For example, the expanded notation activity. Students are given a number with the same number written in expanded notation, which are cut into pieces. Some numbers would have every piece of the expanded notation cut up, and others would have it cut into chunks. Students are still doing the same activity, but it is just on different levels.”

Six participants also expressed the importance of collaboration and communication during work time so that students “hear other students’ ideas” and “learn that it’s okay to change their thinking.” One participant encouraged collaboration and communication among her students by them with “questions printed on a piece of cardstock” and “sentence stems they keep in their math journals.”

DISCUSSION AND CONCLUSION

Findings from the present study have revealed interesting insights regarding how eight elementary, middle, and high school teachers implement the math workshop approach in their classrooms. Each of these teachers had several years of teaching experiences, thereby ensuring that their perspectives were reported through the lenses of knowledgeable, seasoned professionals. Moreover, each of these teachers had voluntarily participated in their school district's math workshop initiative, which reflects their commitment to continuous professional learning and openness to implement new teaching approaches in their classrooms (Guskey, 2002).

After analyzing the quantitative and qualitative data, it became evident that the teachers in the present study recognized that the math workshop approach was an effective teaching practice to improve teaching and learning in mathematics. Each teacher reported that they routinely implemented the math workshop approach in their classrooms and observed tremendous benefits associated with providing students with "time to experience, not just to observe" math (Hoffer, 2016, para. 6). Unlike traditional "show-and-tell" math instruction (Hattie et al., 2017, p. 3), the teachers in the present study affirmed that the math workshop approach provided them with a framework necessary to establish a mathematical community of learners who collaborate, communicate, and engage with challenging tasks (Hoffer, 2012). Through the math workshop approach, Hoffer asserted that students are "doing the most work," which means they "are doing the most learning" (p. 5). With this in mind, data analyses showed that the ways in which the teachers in the present study implemented math workshop in their classrooms aligned seamlessly with the NCTM's (2014) Mathematics Teaching Practices.

These findings have important implications for teacher quality among teacher preparation programs and school districts. Much literature has expounded on the importance of teachers who are knowledgeable in the content they teach (e.g., Darling-Hammond, 2000; Hill, Rowan, & Ball, 2005; Hurst, 2017), as well as how to teach this content to others (e.g., Darling-Hammond, 2000; Hurst, 2017). Thus, programs that prepare and train teachers must ensure that their program requirements, such as respective curricula, learning activities, and field experiences, prepare future teachers mathematically and pedagogically (Hiebert et al., 2003).

Findings from the present study have also pointed to the importance of continuous professional learning efforts within school districts. Unfortunately, many people, including practicing mathematics teachers, possess fixed mindsets that inhibit mathematical potential among themselves, as well as others (Boaler, 2016). However, school districts can implement ongoing professional learning activities that develop growth mindsets among their teaching professionals so that they may in turn nurture growth mindsets among their students. Teachers who possess growth mindsets are empowered to move away from ineffective, traditional approaches to mathematics instruction and establish productive and supportive classroom environments that encourage mathematics learning among all students through the math workshop approach.

Although reported findings achieved the purpose for the present study, there was one unavoidable limitation regarding sample size. Since this research was conducted among a small number of participants, there were limitations with generalizability of findings. It is recommended that additional studies be conducted to explore further the perspectives of elementary, middle, and high school teachers who implement the math workshop approach. These studies should invite teachers from across all grade levels and who have varying levels of teaching experience to participate. In addition to a more comprehensive study with a larger number of participants, future studies might also explore school district-level initiatives of math workshop implementation. By doing so, school districts have an opportunity to monitor the effectiveness of their continuous professional learning efforts, identify possible areas needing improvement, and explore possible correlations with teachers who implement the math workshop approach and student achievement.

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Appendix

Google Form Questionnaire Regarding the Math Workshop Approach

Quantitative Questions	Qualitative Questions
Section 1: *Select one rating.* To what degree is the math workshop structure evident in your classroom? Low Level 1 2 3 4 5 6 7 8 9 10 High Level	**Section 5** 1. Describe the importance of having a community of learners in your classroom. 2. How do you facilitate a community of learners during math instruction?
Section 2: *Select one rating for each of the following. (i.e., Strongly Disagree, Disagree, Neutral, Agree, Strongly Agree)* The purpose of a mini-lesson is to: Model thinking to understand content Prepare students for work time Provide directions Think aloud about content Focus on specific purpose Adhere to a specific time allotment Review specific strategies or practices Math workshop helps promote: Student Thinking Communication Struggle Collaboration Deep Understanding of Content Student Ownership of Learning	3. What guides your choice of student activities? 4. How do you differentiate for students? 5. How do you coach your students? 6. What do you see as valuable with the use of closure? 7. What are specific ways that you conduct closure? 8. What is your role as the teacher during work time?
Section 3: *Select one response.* During work time, what is your preferred grouping arrangement? Independent work Paired work Collaborative/group work No one preference, use all arrangements	9. On average, how many problems are students given to work during work time? 10. How do you respond to students' needs during work time?
Section 4: *Select one rating for each of the following.(i.e., Always, Sometimes, Never)* How often do you use invitational groups to offer support during work time? How often do you confer with students during work time?	