Effect of Math Workshop on Number Sense and Relationships

Amy Baumert

University of Nebraska – Omaha

What is Math Workshop?

Students in any classroom differ in many ways. They enter the classroom with a range of differences including readiness, interests, and learning profiles. Addressing the learning needs of students is not an easy task, but accounting for these needs is crucial for supporting students as they continually work toward succeeding and learning. Math Workshop allows students of different developmental levels to construct knowledge appropriate to their abilities. According to a 2010 research study by Slavin, Lake, and Groff, "differentiated instruction is the most effective teaching strategy to improve student achievement" (Benders & Craft, 2016, p. 2). The implementation of the Math Workshop model is a student-centered environment where personalized learning is key. Math Workshop is a framework that allows students to learn new concepts each day, practice math strategies in various ways, and reflect on learning.

The structure of Math Workshop is similar to that of the writing workshop, consisting of a mini lesson, an activity period, and reflection (Heuser, 2000). Students participate in a 10 minute whole-class mini lesson during which new math content is introduced. The mini lesson is one of two very brief times when all students are working on the same activity. Within the mini lesson, the teacher extends previous learning, models particular skills, generates questions, or introduces new strategies. Teaching a brief whole-class lesson is new material for some students and review for others (Kobelin, 2009). After the mini lesson, students then break into small groups for an extended work session in which they practice the new math skills taught that day, build their problem solving skills by solving performance tasks, get hands-on math practice,

use technology to practice math skills, and receive differentiated instruction from the teacher. As one small group meets with the teacher, the other students are actively engaged in math stations. The teacher meets with each small group for 15 minutes. "Small grouping in mathematics is a data-driven intervention that matches a student's readiness level for learning with the appropriate instructional strategy, delivering the right content at the right pace. Grouping is an ongoing intervention process where a student's assignment to a particular ability group can change based on performance of improved competency and skill development" (Benders & Craft, 2016, p. 2). During this phase of Math Workshop, students are seen talking to the teacher, each other, or working independently. The teacher is almost always actively engaged either with one student or a small group of students. The room is noisy and the students are active in mathematics (Baker & Harter, 2015). During the last 5 minutes of Math Workshop, the teacher provides a whole-class closure (ie: partner share out). Closure gives students the opportunity to reflect on what they did and learned from the math lesson of that day verbally or in writing (Heuser, 2000).

Why is Math Workshop Effective?

Children that are in the same grade level may require different degrees and types of intervention at different times in their school career, or for different aspects of the mathematics curriculum (Benders & Craft, 2016). One challenge facing educators today is meeting the needs of individual learners. Many math educators are still delivering math instruction in a one-size fit all model. Classrooms are filled with varying abilities ranging from learning styles to academic readiness. Math Workshop promotes differentiated

mathematics instruction which "is a powerful way to potentially increase students learning and is a strategy supported by several researchers" (Huebner, 2010; Murray, 2007; Newton, 2013; Sammons, 2010; Taylor-Cox, 2013 as cited in Benders & Craft, 2016, p. 2). It is difficult to meet the needs of all students at their level during whole-class instruction, but small groups in Math Workshop allow time for students to get needed instruction. Math Workshop offers grouping based on students' academic needs as determined by formative, summative, and/or diagnostic testing (Benders & Craft, 2016). Small groups that are established by different forms of assessment are more effective than ability grouping because "students are assessed frequently for growth and reassigned to different groups based on assessment" (Tieso, 2002, p. 5). Math Workshop provides students an opportunity to learn at their level and proceed to higher levels of achievement. "Student achievement growth should improve by getting the support they need" (Benders & Craft, 2016, p. 3).

Differentiating instruction through Math Workshop can be incredibly complicated and challenging for the teacher, but it is undoubtedly best practice (Kobelin, 2009). As Molly Edick, current third grade teacher and former math interventionist identified, "as more teaching suggestions continue to develop on effective math instruction, educators must continue to adjust the curriculum and improve practice to help all children succeed and value mathematics" (personal communication, December 20, 2017). Math Workshop forces educators to adapt, change, experiment, and innovate in an effort to provide a program differentiated to meet the needs of all students. "The philosophy behind the Math Workshop is founded on research and theory that support diverse learners'

understanding of math" (Heuser, 2000, p. 35). According to research, students who participate in Math Workshop are actively involved in math, encouraged to construct their own knowledge, benefit from choice, and receive time to reflect on and communicate their understanding (Heuser, 2000). Math Workshop promotes these things through small group work. In fact, in a research study conducted by Anne Dopkins Stright and Lauren H. Supplee, it was found that students were significantly less likely to attend to instructions, seek help, and talk about their thinking during teacher-directed instruction than during small group or seat work (Stright & Supplee, 2002). Such research provides insight into the benefits of implementing Math Workshop as the model actively engages students in math. "Students may perceive teacher-directed instruction as an inactive time in the classroom. They may wait until they are given assignments to complete during seat work or small groups to attend to the instructions carefully" (Stright & Supplee, 2002, p. 9). To avoid student inactivity during math instruction, differentiated groups in Math Workshop allows students to independently solve problems, pacing themselves and working either with or without manipulatives while other students work with the support of the teacher at the teacher's pace.

Choice is a key element for differentiating instruction (Kobelin, 2009, p. 20). For students to be actively involved in math, they must make choices about the materials and methods they will use. In order for students to construct their own knowledge at their own developmental readiness and experiences, they must choose work that is more or less challenging. Choice allows each student to take on an appropriately challenging task and requires that they take responsibility for their own learning (Baker & Harter, 2015).

Students benefit from choice, both as a motivator and as a mechanism to ensure that students are working at an optimal level of understanding and development (Heuser, 2000).

Importance of Number Sense and Relationships

Number sense and relationships are essential mathematical concepts in all grade levels. Understanding mathematics is important in daily life, so helping children develop number sense is recognized as an important mission of mathematics education (Yang & Wu, 2010). There are a couple of reasons to highlight the importance of teaching and learning number sense. First, number sense is a way of thinking that often represents flexibility, inventiveness, efficiency, and reasonableness. Another reason is that number sense is a concept of quantities, numbers, operations, and their relationships, which should be efficiently and flexibly applied to daily life situations. According to authors, Yang and Wu, several research studies have demonstrated that children in elementary and middle-grade levels are lacking number sense due to traditional mathematical teaching (2010). Students who lack a strong number sense will have trouble developing the foundation needed for even simple arithmetic, let alone more complex mathematics.

It is argued that "learning mathematics with understanding is essential" and that research shows "the alliance of factual knowledge, procedural proficiency, and conceptual understanding makes all three components usable in powerful ways" (Smith, M. & Smith, S., 2006, p. 2). It is essential for students to make sense of what numbers mean, understand their relationship to one another, be able to perform mental math, understand symbolic representations, and use those numbers in real world situations. To

progress in mathematics, students must possess both the knowledge of procedures and the concepts behind those procedures (Ferguson, Mink, & Witzel, 2012, p. 90). Children sometimes complete a procedure without understanding why or how it works. They just follow the procedure that they are asked to do. In addition, a curricular emphasis on memorizing facts also has an impact on children's lack of understanding. Some students possess algorithmic skill, but do demonstrate mathematical knowledge of specific concepts (Smith, M. & Smith, S., 2006, p. 2). However, if children understand the procedures and the concepts behind them, they are more likely to successfully progress to more complex concepts in mathematics.

The importance of number sense cannot be overemphasized. Knowledge of number sense is a reliable and powerful predictor of mathematics achievement. "The most valid means of predicting mathematics difficulties in young children involves some of the basic principles of number sense" (Ferguson, Mink, & Witzel, 2012, p. 90). The findings of Yang and Wu's study demonstrated that children's number sense can be effectively promoted through the inclusion of number sense activities and real-life situations (2010, p. 390). There is a great need for educators to help young children make connections from numeral to number and to understand the value of numbers. Concrete experiences, teaching proficiency, and connecting language to math are all ways to help children improve their number sense (Ferguson, Mink, & Witzel, 2012). However, it is important to develop and try more techniques.

Conclusion

The implementation of the Math Workshop model will include a focused mini lesson, guided group instruction, cooperative practice, and independent practice. As mentioned by Molly Edick, "some students will not move around as much as others as they may need additional support during Math Workshop. The most important part is that each student is in a small group at their appropriate instructional level" (personal communication, December, 20, 2017). Through formal observations and daily coursework, some students will demonstrate they are in need of extra guidance and re-teaching while other students will need supplemental opportunities to practice math concepts and skills. There will also be students who are ready to be challenged further. Small group instruction reaches all students at their level of development and takes them to the next level. The implementation of small groups enables teachers to differentiate instruction from the struggling students to the students having difficulty with just one skill or concept, to those who are advancing quickly through the material and need new challenges (Benders & Craft, 2016).

Math Workshop allows opportunities for the teacher to observe the various needs of each math learner. The traditional classroom now encompasses a range of mixed abilities among students – some struggling to meet grade level standards to those performing above grade level (Benders & Craft, 2016). Each student is a unique individual whose learning style and attitudes may reveal his or her strengths and challenges. Differentiated instruction gives the teacher an opportunity to observe and assess each individual student based on their individual needs. Taking time to listen to each student and to observe them in the classroom setting during math instruction both

serve as valuable tools in assessing their individual learning styles and attitudes. Though it may be challenging to plan and implement the Math Workshop model, the work of teaching in ways that bring all students to meet the ambitious expectations set for them is worth it.

References

Baker, K., & Harter, M. E. (2015). A living metaphor of differentiation: a meta-ethnography of cognitively guided instruction in the elementary classroom. *Journal of Mathematics Education at Teachers College*, *6*(2), 27-39.

Benders, D. S., & Craft, T. (2016). The effect of flexible small groups on math achievement in first grade. *Networks*, *18*(1), 1-9.

Edick, M. (2017, December 20). Personal Interview.

Ferguson, C. J., Mink, D. V., & Witzel, B. S. (2012). Strategies for helping preschool through grade 3 children develop math skills. *YC: Young Children*, *67*(3), 89-94.

Heuser, D. (2000). Reworking the workshop for math and science. *Educational Leadership, 58*(1), 34-37.

Huebner, T. A. (2010). Meeting students where they are: What research says about differentiated instruction. *Educational Leadership*, *67*(5), 79-81.

Kobelin, M. (2009). Multi-age made me do it: a teacher tackles differentiation in math instruction. *Schools: Studies in Education*, *6*(1), 10-22.

Murray, M. (2007). *The differentiated math classroom*. Portsmouth, NH: Heinemann.

Newton, N. (2013). *Guided math in action: building each student's mathematical proficiency with small-group instruction.* New York, NY: Routledge.

Sammons, L. (2010). *Guided math: A framework for mathematics instruction*. Huntington Beach, CA: Shell Education Publishers.

Smith, M. E., & Smith, S. Z. (2006). Assessing elementary understanding of multiplication concepts. *School Science & Mathematics, 106*(3), 140-149.

Stright, A. D., & Supplee, L. H. (2002). Children's self-regulatory behaviors during teacher-directed, seat work, and small-group instructional contexts. *Journal of Educational Research*, *95*(4), 235-244.

Taylor-Cox, J. (2013). Differentiating mathematics instruction so everyone learns. In *Glencoe Math White Pages*. Retrieved from Glencoe Math database https://s3.amazonaws.com/ecommerce-prod.mheducation.com/unitas/school/explore/sites/glencoe-math/research/glencoe-math-differentiating-mathematics-instruction-so-everyone-learns.pdf

Tieso, C. L. (2002). The effects of grouping and curricular practices on intermediate students' math achievement. *National Research Center on the Gifted and Talented*. Retrieved from ERIC database.

Yang, D., & Wu, W. (2010). The study of number sense: Realistic activities integrated into third-grade math classes in Taiwan. *Journal of Educational Research*, *103*(6), 379-392.