

Mix it up!

Mixed-Ability Grouping in Math Instruction

Amanda Helsley

School of Education, Liberty University

Author Note

Amanda Helsley

I have no known conflict of interest to disclose.

Correspondence concerning this article should be addressed to Amanda Helsley

Email: ahhelsley@liberty.edu

ELCC ACTION RESEARCH CASE STUDY**I. Action Research Question**

What are the best teaching methods to improve instruction for small groups in math?

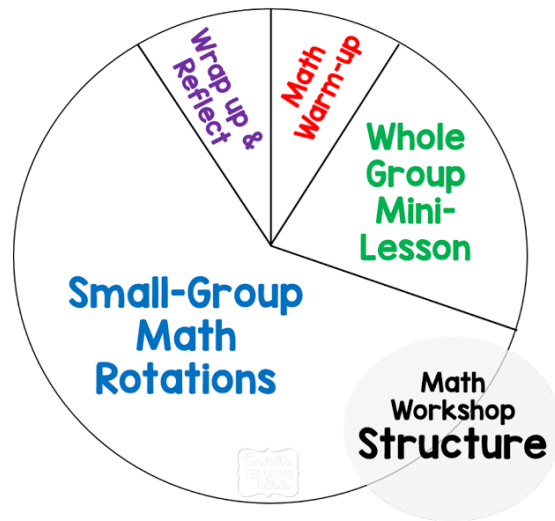
- The school administration approved the research.
- The research was conducted based on research best practices.
- No children were placed in harmful situations during this action research.

II. Evidence-Centered Research and Goal**Literature Review**

Teachers use many approaches for elementary mathematics instruction. In this literature review, three approaches will be described in detail so that the reader can decide which approach best fits their needs.

Math Workshop Model

The first approach to small-group mathematics instruction is the math workshop model. Historically, math instruction has been a teacher-centered endeavor, but over time it has evolved to a student-centered approach. The math workshop model is a “student-centered approach to teaching mathematics that creates a community of learners and allows students to take ownership of their learning” (Francis, 2020, p.1). This model features utilizes four different stations of learning pictured in the graph below:



Math Workshop Structure (Tunstall, 2015).

The class begins with a warm-up, or “activator.” They then move into a short, five to fifteen-minute mini-lesson on the presented concept. From there, the students work in small group rotations to develop mastery of the presented concept. The stations can vary according to the needs of the lesson, but often include manipulatives, digital work, and group work with the teacher. The last component of the structure gives students time to reflect on their work and look ahead.

One thing that makes this model of math instruction unique is the concept of the mini-lesson. The teacher presents one aspect of the math concept in the whole-group lesson but then goes into more detail with small groups at the teacher’s table. “Mini-lessons have one key idea you want to introduce and practice in a meaningful hands-on way” (Tunstall, 2015). The more intensive part of the lesson is taught in small groups, making it easier for the teacher to target instruction to the students in a particular group.

Mixed-Ability Grouping

The next concept that was researched was mixed-ability grouping. Historically, teachers group students according to academic ability levels, keeping all students on the same level in the same group.

This is also called homogenous grouping. “Grouping students by ability and tracking have been practices in public schools for more than a century... this type of grouping strategy creates classes separated with low achievers, average achievers, and high achievers” (Watkins, 2014, p.1). Research suggests that grouping students in this way puts them in a fixed mindset regarding academic achievement (Watkins, 2014). In the current educational climate, a growth mindset is the desired state of mind for students and staff, which conflicts with the traditional ability grouping style.

Unlike traditional grouping, mixed-ability grouping does not require students to be on the same academic level. It is collaborative and creates opportunities for students of multiple ability levels to work together to master new concepts and solve real-world problems. While there is still research being conducted on the effects of mixed-ability grouping in math instruction, the research available suggests a positive impact on student academic achievement, self-esteem, and ability to work collaboratively.

Concrete-Representational-Abstract (CRA) Approach

“CRA is an intervention for mathematics instruction that research suggests can enhance the mathematics performance of students in a classroom. It is a three-stage learning process where students learn through physical manipulation of concrete objects, followed by learning through pictorial representations of the concrete manipulations, and ending with solving problems using abstract notation” (Pennsylvania Training and Technical Assistance Network, 2020). CRA is a commonly used approach to teaching math in small-group and whole-group mathematics instruction. In a study of fifth-grade students receiving math interventions, those presented with the information using the CRA approach made significantly more progress than students who did not experience the same instruction (Flores et al., 2018). Students were also able to demonstrate improved problem-solving skills. “Students marked number lines and showed work related to fraction computation processes, rather than only

writing their answers (Flores et al., 2018, p. 210). As a small-group instruction tool, it is valuable to students needing more significant math intervention.

References

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Strategic SMART Goal

SMART Goal	Learning Standard from Candidate's State Department of Education	Website Link to State Department Learning Standards
<p>By the end of February, students in Mrs. Foggi's fourth-grade class will show measurable progress in mathematics by participating in mixed-ability grouping and instruction. If the percentage of students answering a question correctly is 50% or below, the score will increase by 20% on the post-test. Questions with more than 50% of students answering correctly will increase by 40% or to 100% correct answers.</p>	<p>4.10 The student will</p> <ul style="list-style-type: none"> a. Identify and describe points, lines, line segments, rays, and angles, including endpoints and vertices; and b. Identify and describe intersecting, parallel, and perpendicular lines. <p>4.11 The student will identify, describe, compare, and contrast plane and solid figures</p>	<p>https://www.doe.virginia.gov/teaching-learning-assessment/instruction/mathematics/standards-of-learning-for-mathematics</p>

	<p>according to their characteristics (number of angles, vertices, edges, and the number and shape of faces) using concrete models and pictorial representations.</p> <p>4.12 The student will classify quadrilaterals as parallelograms, rectangles, squares, rhombi, and/or trapezoids.</p>	
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III. Strategy Proposal

VOLUNTEER'S NAME	Diane Foggi
TOPIC	Math Small Groups

<p>BACKGROUND INFORMATION</p> <p>RELATED TO YOUR VOLUNTEER</p> <p>TEACHER'S TEACHING EXPERIENCE</p>	<p>Diane is in her second year of teaching 4th grade. Before teaching, she worked as a long-term substitute and a regular substitute teacher for four years. She is considered a “career switcher,” but her degree is in education.</p>
<p>RATIONALE FOR THE CASE STUDY</p>	<p>Diane has little experience with math small groups and is concerned about differentiating appropriately for all her students.</p> <p>Content-specific small groups provide extension activities to students who already understand the topics and build foundational skills for students struggling with those topics. Diane has participated in all county-offered professional development around differentiating for math groups but still feels unsure about successful implementation.</p>
<p>RESEARCH QUESTION</p>	<p>What are the best teaching methods to improve differentiation for small groups in math?</p>
<p>STATE LEARNING STANDARDS</p>	<p>At any given time, math small groups utilize many different Virginia SOLs. However, they are currently working on patterns. Below are the corresponding 4th Grade Standards for patterns:</p> <p>VA SOL 4.15 The student will identify, describe, create, and extend patterns found in objects, pictures, numbers, and tables.</p> <p>VA SOL 4.16 The student will recognize and demonstrate the meaning of equality in an equation.</p>

Date & Time of Scheduled Observations
Observation 1: 2/16/23- 9:40 AM
Observation 2: 2/21/23- 10:00 AM
Observation 3: 2/27/23- 10:00 AM

IV. Strategy Implementation

Observations	Journal notes from each observation
Observation #1 (2/16/23)	<p>Question up on the board- Identify two names for the shape below (quadrilateral, trapezoid)</p> <p>This was the most incorrectly answered question on the pre-test</p> <p>Use work from the previous day to answer</p> <p>Thumbs up and thumbs down for understanding</p> <p>2nd question- multiple choice</p> <p>Read question carefully- which statement about the statement above is true?</p> <p>Thank you for the thumbs up</p>

Observations	Journal notes from each observation
	<p>(students use whiteboard to write their answer down)</p> <p>Review of perpendicular and parallel</p> <p>3rd question- matching</p> <p>Match statement with the shape</p> <p>Reference work from yesterday</p> <p>*students seem like they are more knowledgeable of the vocabulary</p> <p>Students created flashcards and did a worksheet yesterday</p> <p>Math groups displayed on the board</p> <p>Zones of learning for mild, hot, and spicy</p> <p>*reference the slide in zones of learning</p> <p>Review of zones of learning and activities under each category</p> <p>Students break out into their groups and decide on an activity, groups called up to teacher for progress check</p> <p>Asks comprehension questions based on learning goals- what is a 4-sided polygon?</p>

Observations	Journal notes from each observation
	<p>Students working in groups- some groups completing the must-do activities, and other groups working on the mild or hot categories</p> <p>Most students are collaborating within their groups to complete the work, and are deciding on what to do next after they complete their must-dos</p> <p>Small group understanding check</p> <ul style="list-style-type: none"> - Draw a right angle - True or false questions - Venn diagram with rectangle and rhombus o Which shapes go where? o Why do they go there? <p>Group 2</p> <p>Group 9</p> <p>Group 5</p>
Observation #2 (2/21/23)	<p>Observation #2</p> <p>10:00-10:47</p>

Observations	Journal notes from each observation
	<p>Worked on polygons worksheet due to teacher meeting</p> <p>Students worked silently for 45 minutes! Some touched base with groups before working quietly.</p> <p>They all completed their assigned work and were given choices for their independent work, ALL STUDENTS WERE ON TASK!</p> <p>10:47</p> <p>Go over study sheet that students just completed</p> <p>#1</p> <p>#2- Ayush, correct answer and explain why others were incorrect</p> <p>#3- Shrinika, Nethan, both answered correctly</p> <p>#4- Luke, correct answer, all students agreed</p> <p>Why not b or d? Ananya</p> <p>#5- all class answer</p> <p>Why not lines? Brandon</p> <p>Why not rays? Shrinika</p>

Observations	Journal notes from each observation
	<p>Why not points?</p> <p>#6- Tommy, correct</p> <p>#7- Sam, correct</p> <p>How can you study for quiz tomorrow?</p> <p>Ayush; Sahej; Shrinika; Sam; Nethan</p> <p><i>What are the effects of mixed-ability on their progress?</i></p>
Observation #3 (2/27/23)	<p>Observation 3</p> <p>10:20-10:40 AM</p> <p>Last day before 3D shapes quiz</p> <p>Calling small groups up for check-ins, other groups will be working on zones of learning</p> <p>It is voice and choice, so you will make the choice to come see me if you need help. If you know those things you can do the hot, mild, and spicy work</p>

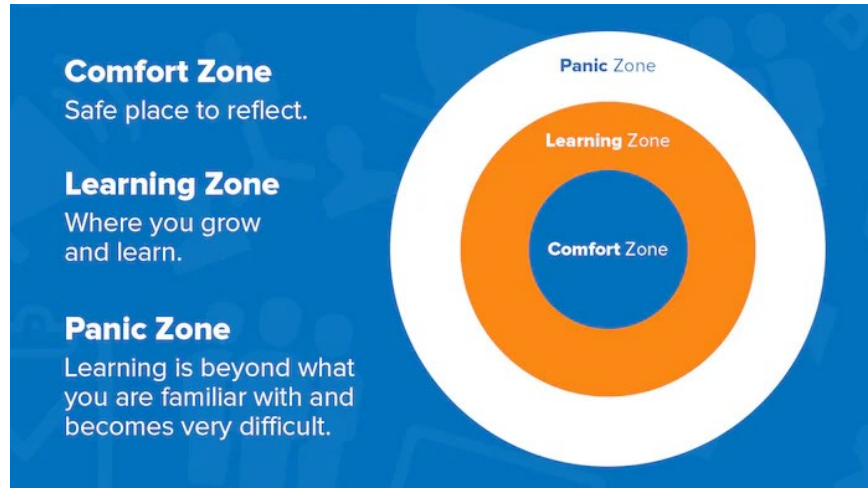
Observations	Journal notes from each observation
	<p>There's still a lot of work at the spicy and hot sections, which means students are spending too much time in the mild section. Challenge yourself today!</p> <p>Questions or comments or concerns about the work today?</p> <p>Released for small group instruction</p> <p>Two students immediately came up to the teacher table asking for help and pulled up chairs</p> <p>Groups @ 10:25</p> <ul style="list-style-type: none"> 1- Spicy 4.11 quick check 2- Hot- worksheets 3- Spicy- 4.11 quick check 4- Spicy- Characteristics of 3D shapes 5- Teacher table 6- Teacher table 7- Teacher table 8- Spicy 4.11 Quick Check

Observations	Journal notes from each observation
	<p>9- Spicy- Characteristics of 3D shapes</p> <p>Students at the teacher table answering questions with whiteboards and markers</p> <p>Review questions based on the upcoming quiz</p> <p>@10:36, all students have finished at the teacher table and are working in their groups</p>

V. Observation Cycle Criteria

- **Pre-observation Conference (2/2/23)**

Mrs. Foggi is very excited about embarking on this endeavor. After reviewing each approach presented in the literature review, she chose mixed-ability grouping as the approach she wanted to try implementing for small-group math instruction. We did extensive research into how and why it worked and came up with some strategies for how she could implement it going into her next math unit on lines, rays, and angles. We settled on a graphic found in one of the articles online that references the “Zones of Learning”, and decided to use that as a framework to guide instruction for small groups.



The Zones of Learning. <https://www.mindtools.com/a0bop9z/the-learning-zone-model>

Since Mrs. Foggi is familiar with the learning levels of all of her students, she asked me to put her students into small groups to eliminate any biases. I came up with nine groups of 3-4 students each. She compiled a set of learning activities for each learning zone and organized the lesson materials into a Google Slides presentation. She then set up a procedure with students accessing learning materials online via Schoology or SOLPass, as well as paper copies of activities at each level. After the initial whole-group lesson, small groups would report to the teacher's table for comprehension checks and collaborative problem-solving opportunities.

Mrs. Foggi shared the pre-test data for her current unit, and we used that data to create a SMART goal for this study. By the end of February, students in Mrs. Foggi's fourth-grade class will show measurable progress in mathematics by participating in mixed-ability grouping and instruction. If the percentage of students answering a question correctly is 50% or below, the score will increase by 20% on the post-test. Questions with more than 50% of students answering correctly will increase by 40% or to 100% correct answers. Pre- and post-tests are created by another 4th-grade teacher on the team based on past SOL assessments and current standards. All 4th-grade classrooms use the same 5-question assessment.

- **Post-observation Conferences**

Conference	Summary of Progress
<p>Post-Observation #1 (2/17/23)</p>	<p>For our first post-observation, I asked Mrs. Foggi what changes she has noticed in her class that might result from the mixed-ability grouping strategy. She reported that students are collaborating and engaging with their learning more, not just in math but in other subjects as well. She commented on how mixed-ability grouping has more students working with each other than wouldn't normally under normal circumstances. She reported that the "must-do" work that groups should complete before moving onto learning zones gave her a really good baseline and served to guide instruction with small groups at the teacher's table. When asked what she might change or do differently going forward, she wanted to make more activities available for the middle learning zone. She also expressed frustration that there aren't more opportunities in instruction to involve real-world learning experiences. Looking ahead, students have wrapped up their lines, rays, and angles unit and taken the post-test. Mrs. Foggi reports that all students did significantly better on the post-test, and demonstrated a clear understanding of the content.</p>
<p>Post-Observation #2 (2/22/23)</p>	<p>The teacher ended up in a meeting the morning of the observation, and the substitute had the class working on independent work for math when I arrived. I reported to the teacher that the students did a wonderful job of staying on task and working quietly. They also checked in with their</p>

Conference	Summary of Progress
	<p>groups before starting their work, and some groups sat together while they worked. Mrs. Foggi reported that they are currently working on the quadrilaterals unit, which is challenging for some students. She shared the pre-test data with me, and the goal for the research study remains unchanged.</p>
<p>Post-Observation #3 (3/7/23)</p>	<p>At this observation, students have completed the unit on quadrilaterals, and are working towards completing the unit on 3D shapes. This is a shorter unit and does not require as much teaching time before the post-assessment. Mrs. Foggi commented on how she is now using mixed-ability grouping in social studies as well, because the effects on their learning have been so positive. During the observation, I moved around the classroom and checked in with each group to find out what they were working on, and asked them questions about the material. Each group could explain what they were working on and what learning zone they were in. Many groups and students from other groups were working at the teacher's table at the beginning of math. However, when I did a second check-in later, most had returned to their groups and were working collaboratively.</p> <p>Mrs. Foggi shared that she observed students taking what they learned from the teacher's table back to their groups, making significant connections by reteaching the other group members what they had</p>

Conference	Summary of Progress
	learned. This is a challenging skill for some of her students and she was very pleased to see them taking this step!

Data Analysis

For each unit of study, a 5-question assessment is given before and after instruction.

This assessment is used across the grade level and serves as a baseline for further instruction.

The questions for each assessment are based on questions from previous state tests, and items taken directly from the curriculum. The data was analyzed based on the percentage of students who answered each question correctly. Over the course of this study, three units were taught with pre-and post-assessments given for each one. Below is a table containing data from each unit showing the percentage of the class that answered correctly on the corresponding test item:

	Lines, Rays, and Angles		Quadrilaterals		3D Shapes	
Question #	Pre-assessment	Post-assessment	Pre-assessment	Post-assessment	Pre-assessment	Post-assessment
1	75%	78%	54%	93%	70%	100%
2	27%	88%	87%	100%	100%	100%
3	52%	100%	45%	90%	98%	98%
4	72%	100%	87%	81%	98%	97%
5	52%	84%	52%	100%	61%	89%

Looking at the data, in most instances, students' scores improved on the post-assessment. Further, the two units that were taught after the implementation of mixed-ability grouping (quadrilaterals and 3D shapes) had significantly higher post-assessment scores. This shows that utilizing the mixed-ability grouping approach to small-group math instruction had a positive impact on student achievement in mathematics.

Conclusion

There were some limitations to this study, including time constraints and the number of students participating. With a smaller window of time to conduct the study, there were fewer opportunities to come in more often and observe for extended lengths of time. We also faced unanticipated scheduling changes, meetings, and illnesses of staff and students that inhibited the ability to complete aspects of the study as timely as possible.

Based on the assessment data, students demonstrated a better understanding of mathematics concepts when they learned through mixed-ability grouping. However, there were other indicators of success not included in the data. Students worked with others in their class that they wouldn't work with under normal circumstances. Students who struggled to work collaboratively were able to find their voices and improve their problem-solving skills. The class community became stronger as students continued to help each other and work together to learn new concepts. Lower-ability students learned from their peers, and higher-ability students gained a more thorough understanding of the content by teaching it to other students.

Based on this study, more research should be conducted on the effects of mixed-ability grouping on student achievement. There is a myriad of information about the positive and negative effects of homogenous grouping. Still, there needs to be more research done on the implementation and effects of heterogeneous grouping. Further research into extended lengths of time with multiple levels of mixed-ability grouping would be beneficial to understand the long-term effectiveness of this method.

Dispositions

Disposition	How did you promote the disposition in your interactions with the novice teacher and students?
Trust	<p>When beginning this study and throughout the duration, I reminded the cooperating teacher that there was no right or wrong answer to what we were researching. If it worked the way we were hoping, that would be great, but if it didn't, that wasn't a bad thing. We worked collaboratively and openly through the process and built a positive rapport.</p> <p>With the students, I have taught most of them at various points over the previous years, and have built positive relationships with them. This helped to keep their trust when I came and observed the class. They felt comfortable with me in the background and could continue with their work uninterrupted.</p>
Equity	<p>Using the mixed-ability grouping approach, we created a level playing field for all students to have an equal opportunity to participate in collaborative groups. Equity was also promoted during observations and post-observation meetings through discourse and dialogue.</p>
Fairness	<p>I promoted fairness in this study first by reaching out across the school community for volunteers willing to participate in this research study. From there, I was able to continually promote fairness by preventing my biases and preconceptions about small-group instruction from influencing the choices that my cooperating teacher made as we conducted the study.</p>
Respect	<p>All interactions between students and teachers were respectful and professional. During observations, I maintained respect when spending time as a guest in the teacher's classroom. I ensured that my observation and notetaking did not intrude on or interrupt the learning and kept interactions with students brief during that time.</p>

VI. Collaboratively Developed Professional Development Plan**ELCC ACTION RESEARCH PROFESSIONAL DEVELOPMENT PLAN**

Teacher Name: ___Diane Foggi_____ School Division Level: _Elementary___

1. At the final meeting, Mrs. Foggi and I agreed that this was a meaningful endeavor. We enjoyed finding a new way for her students to work collaboratively and enhance her small-group math instruction. The students have formed meaningful connections with each other and the content being taught.

2. Commendations (Two) from the teacher's involvement in the action research.

Mrs. Foggi effectively implemented mixed-ability grouping into her math instruction, and the improvement in her students is apparent. Mrs. Foggi also effectively used the information gained from the pre-test for each unit to guide her choices for each zone of learning, making the options more authentic to the level of ability required.

3. What one improvement (recommendation) needs to take place? Write as a SMART goal.

Mrs. Foggi expressed a desire to increase the level of accountability for her students concerning their independent choice of work in each learning zone. Her SMART goal is written with that in mind:

SMART Goal: By the end of the 2022-2023 School year, Diane will pursue professional learning focused on mixed-ability grouping and the Zones of Learning to implement stronger methods of accountability for her students' work.

4. Action Steps: provide 3-5 activities the teacher must accomplish to meet the SMART goal.

Action Steps (Activities)	Due Date	Who will assess progress/completion?	Resources Needed
Research and select PD offerings related to mixed-ability grouping and Zones of Learning.	March 31 st , 2023	Lead Grade-Level Teacher	List of available PD
Participate in selected PD and reflect with a colleague about how the experiences could help meet your SMART goal.	May 15 th , 2023	Lead Grade-Level Teacher	Documentation of completed PD Reflection notes from the grade-level teacher
Implement at least two strategies related to mixed-ability	June 5 th , 2023	Building Supervisor	

grouping and Zones of Learning in small-group math instruction.			
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If the due dates are longer than one week in the future, it is prudent to schedule mid-range goals to ensure progress toward final due dates. What must be accomplished by what date for each Action Step Activity? Activity 1 ___ 3/15/23 ___ Activity 2 ___ 5/1/23 ___ Activity 3 ___ 5/31/23 ___

5. Post-conference

The post-conference meeting will be conducted on June 9th, 2023, and facilitated by the researcher, building supervisor, and teacher. It will take place in the conference room. During the meeting, we will review the completed action steps, and reflect on the observation and planning process. We will create a plan for the 2023-2024 school year.

6. Connection to National Standards (Learning Forward Standards for Professional Learning, 2022)

- *Curriculum, Assessment, and Instruction- Professional learning results in equitable and excellent outcomes for all students when educators prioritize high-quality curriculum and instructional materials for students, assess student learning, and understand curriculum and implement through instruction.*
- *Evidence- Professional learning results in equitable and excellent outcomes for all students when educators create expectations and build capacity for use of evidence, leverage evidence, data, and research from multiple sources to plan educator learning, and measure and report the impact of professional learning.*

- *Learning Designs- Professional learning results in equitable and excellent outcomes for all students when educators set relevant and contextualized learning goals, ground their work in research and theories about learning, and implement evidence-based learning designs.*