Using the What-How-Who Structure to Plan an Equitable Mathematics Lesson

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Abstract

This article describes how a first-grade teacher used the What-How-Who structure to plan a series of mathematical tasks focused on fairness and equity in a real-world situation. The teacher used Shel Silverstein's "Band-Aids" poem as a catalyst to plan mathematical activities that would prompt students' analysis of skin-toned bandages as they organize, represent, and interpret data.

Discussion And Reflection Enhancement (DARE) Pre-Reading Questions

1. How would you plan a primary mathematics lesson that addresses fairness and equity?
2. How can stories and poems get students to explore fairness and equity?
3. How can students view mathematics as a tool to investigate real world issues?

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Using the What-How-Who Structure to Plan an Equitable Mathematics Lesson

Kelley Buchheister, Christa Jackson, and Cynthia E. Taylor

The **What-How-Who** structure provides teachers a lens to plan, facilitate, and evaluate mathematical investigations that not only value contributions of each and every student, but also provide opportunities for students to engage in mathematical tasks focused on fairness and equity. Children's literature may serve as a catalyst in designing these mathematical investigations because it has the potential to facilitate connections between mathematical ideas and students' experiences, even out of school (Moyer, 2000; van den Heuvel-Panhuizen & Elia, 2012). Literature, such as stories or poems, may help primary students see the relevance of mathematical content and investigate social issues that exist in today's society (Flevares & Schiff, 2014; Moyer, 2000). The **What-How-Who** used as a planning structure provides an impetus for teachers to consider **what** tasks will provide opportunities for students to explore ideas, engage in reasoning and problem solving, and have multiple entry points for all learners while simultaneously meeting the mathematical goal of the lesson. After attention is given to tasks, teachers should consider **how** to structure the activities in the lesson to foster rich mathematical discourse and provide opportunities to engage each and every student in rigorous tasks. Furthermore, teachers should attend to **who** contributes to the mathematical storyline and **who**se voice is shared as a valuable part of the conversation; thus promoting an environment in which all learners have the opportunity to see themselves as thinkers and doers of mathematics. In this article, we describe how a first-grade teacher, Mr. Elliott (pseudonym), applied the **What-How-Who** structure (Buchheister, Jackson & Taylor, 2019) for the first time to plan a series of lessons that address the state mathematics standard for organizing, representing, and interpreting data, while simultaneously using children's literature as a foundation to provide students an opportunity to investigate fairness and equity.

The WHAT-HOW-WHO Structure

Using the **What-How-Who** structure in planning mathematics lessons, Mr. Elliott focused on **what** tasks can be explored through children's literature, **how** to structure the tasks to initiate conversations around equity and fairness, and **who**se voice is heard in the mathematical discussions.

What

When integrating literature into mathematics instruction, **what** stories teachers select and **what** tasks emerge from the storyline contribute to opportunities that promote deep mathematical reasoning. Teachers can select from three categories of literature that provide a foundation for mathematical activities: content-explicit, content-implicit, and content-invisible (Columba, Kim, & Moe, 2009). Content-explicit literature includes an intentional focus on mathematical ideas, such as counting or shapes, with little to no storyline or character development. Authors of these stories intentionally highlight mathematics in the writing, and these books are often selected for the purpose of learning specific mathematical concepts. In contrast, content-implicit literature weaves mathematical ideas into the context of an intriguing storyline that could stand on its own; whereas content-invisible literature represents books or poems in which the author has not intentionally emphasized mathematical content.

Mr. Elliott purposefully selected Shel Silverstein's "Band-Aids" poem (Silverstein, 1974, p. 140) because he viewed the content-implicit storyline as a context for organizing and interpreting data.

BAND-AIDS

I have a Band-Aid on my finger,
One on my knee, and one on my nose,
One on my heel, and two on my shoulder,
Three on my elbow, and nine on my toes.
Two on my wrist, and one on my ankle,
One on my chin, and one on my thigh,
Four on my belly, and five on my bottom,
One on my forehead, and one on my eye.
One on my neck, and in case I might need 'em
I have a box full of thirty-five more.
But oh! I do think it's sort of a pity
I don't have a cut or a sore!

Additionally, Mr. Elliott explained how the poem could provide a segue for investigations related to fairness and race. He noted his school district and class was comprised of primarily white, middle-class families, and he wanted to expose his students to situations that they may not have encountered.

> I think that the biggest issues for people in my community is honestly the lack of exposure to diversity, and I want to do this lesson as a way to think about social justice math lessons. I remember how the teacher in the [Chao & Jones (2016)] article got Pre-K kids to think about race, which I think can be hard for kids to discuss" (Mr. Elliott, 2019).

He further explained how the Pre-K article reminded him that children see race in the people and images they encounter each day. However, Mr. Elliott also recognized how racial bias was pervasive in products like bras, underwear, crayons, and bandages that claimed to reflect "peoples' skin tones," and described how selecting Shel Silverstein's poem pushed him to investigate more about race and skin-tone bandages. Mr. Elliott shared excerpts from articles he found about a 45-year-old man named Dominique Apollon who described his experience of using skin-tone bandages for the first time:

> "As a black person, I'm not used to seeing products geared to me in national online retailers. The default is typically some type of Caucasian skin tone" (Chen, 2019).
>
> "This felt like belonging. Like feeling valued. Sadness for my younger self and millions of kids of color, esp[ecially] black kids. [Bandages were] like a reminder of countless spaces where my skin is still not welcomed" (Brito, 2019).
>
> "I just started feeling sad that I'd spent my entire life — 45 years — perhaps without ever having experienced that before. It's impossible to say, but how might I have felt if I'd had that experience of care as a kid. It's a product that said to me, 'We see you. You're valued.'" (Chen, 2019).

Mr. Elliott wanted to ensure each of his students, especially his students of color, felt a sense of belonging as they engaged in problem solving tasks. It was at this juncture that Mr. Elliott wanted to rehumanize his mathematics teaching by planning a lesson on fairness and equity that focused on skin-toned bandages. Mr. Elliott expressed that he wanted every learner in his class to think critically and reflect on who is or who is not being privileged in our society—even subtly through the availability of skin-toned bandages. In other words, Mr. Elliott wanted to create opportunities for his students to question how society positions people who are non-white and consider how to examine these issues mathematically, which in turn can spark curiosity within his students that could potentially lead to change.

Because there are no mathematical questions within the "Band-Aids" poem, Mr. Elliott needed to create high quality tasks that would incorporate multiple solutions or entry points, require high levels of cognitive demand, and encourage connections among mathematical ideas (Breyfogle & Williams, 2008). He planned a variety of activities that would encourage his students to analyze relations among the given information and provide space for students to pose questions and demonstrate deep mathematical reasoning. For example, Mr. Elliott planned to have his students create visual representations of how they would sort the data from the poem (e.g., tally chart for where the bandages were placed on the body). In addition, he planned questions that simultaneously focused on the mathematical content and his intended goal of equity and fairness such as:

- *Why do we have different color bandages?*
- *How do companies decide the number of each size, shape, and color of bandages to put in each box?*
- *Does every student in our class have an opportunity to choose bandages that match their skin color?*

Now that he was satisfied with **what** tasks he would use for his problem solving activities, Mr. Elliott could plan **how** to structure the tasks into a cohesive sequence of activities.

How

Mr. Elliott considered **how** he could best sequence the activities that would use data analysis to develop students' mathematical reasoning and promote classroom discussions around equity and fairness. He wanted to integrate multiple modes of presentation, engagement, and expression (Buchheister, Jackson, &

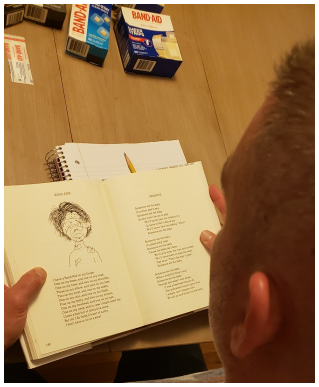
Taylor, 2017; Rose & Meyer, 2000) in the lesson sequence as the students explored different features of the bandages: size, shape, and color. To build the background for the powerful discussions he wanted to generate, Mr. Elliott structured the bandage exploration over three days (see Table 1).

Across the series of lessons, Mr. Elliott thoughtfully considered how he could organize the activities in order to stimulate his students' curiosity, promote problem solving, analyze anticipated strategies, emphasize key concepts, compare strategies or representations, and evaluate students' mathematical thinking.

For each lesson, Mr. Elliott planned to foster his students' problem solving strategies and facilitate mathematical discourse by following the launch, explore, summarize lesson structure (Lappan et al., 2014; NC2ML, 2017). For example, Mr. Elliott planned to use notice and wonder tasks as a springboard to collect and organize data about the locations of the bandages in the poem, as well as a mechanism to generate questions that would prompt discussion about equity and fairness. As he thought through the problem solving tasks, Mr. Elliott anticipated how his first graders would respond to the activities and planned specific questions (see Table 1) that would extend and support his students' thinking as they investigated the

Table 1

Sequence of Activities Exploring Equity and Fairness Through Data

	Lesson Launch	**Problem Solving Exploration**	**Summary of Big Ideas**
Day 1	Read "Band-Aids" poem.  Ask, *What do you notice about Shel Silverstein's poem, "Band-Aids"? What are you wondering (e.g., how many bandages are on the child's head? How many bandages were used all together? Are there more bandages on his head or feet?)?*	Give each table a two-column chart, construction paper, and a box of bandages to create their object graphs and tally charts. Students use observations from the launch to create an object graph and tally chart to visually represent where the bandages are placed on the character in the poem.	Compare the visual representations of the data and look at the distribution of the bandages in the object graphs and tally charts. After students share representations where bandages were located on the child in the poem, have students make observations about the types of bandages in the object graphs. Ask, *Did each table use the same kind of bandage for their object graph? Are all bandages the same? What is different about the bandages? Are they all the same size? Are all bandages the same color? Why do we have different color bandages?*

	Lesson Launch	Problem Solving Exploration	Summary of Big Ideas
Day 2	Look at the picture of your store's bandage aisle.  *What do you notice about the bandage boxes? What are you wondering?*	These (examples below) are pictures of the bandage boxes from the same store. *How can we sort the pictures of the bandage boxes? (Note: Cut out pictures of bandage boxes and make them into cards).*  Have students work with partners to sort the pictures in at least two ways. Partners use the picture cards to create an object graph that represents one way they sorted the boxes.	Students share graphs, and discuss how their graphs represent their sorting categories. Ask, *What do you notice about the size, shape, and color of the bandages in the boxes? Why do you think there are different sizes, shapes, and colors? How do companies decide the number of each size, shape, and color of bandages to put in each box?* Sequence the discussion to end with the following observation (if no student group notices the color of the bandages, have a graph ready to discuss the following prompts): *Why do you think there are different colors of bandages? Does every student in our class have an opportunity to choose bandages that match their skin color? Do you think every student in our city has an opportunity to choose bandages that match their skin color? Why do you think this is important?*
Day 3	Examine a variety pack of bandages and discuss how the box contains various sizes, shapes, and colors of bandages. 	Students work with a partner to create a box of 35 assorted (sizes, color, and/or shape) bandages. Ask questions that prompt students to explain why they included the various bandages in their box (e.g., *Why did you include [these] bandages but not [these]?*).	Students share the box they created. Then ask, *What box would you buy? Why would you buy this assorted box? How do we know we are getting the same number of bandages? Does everyone have an opportunity to choose a bandage that matches the color of their skin if they bought this (hold up a box) box of bandages?*

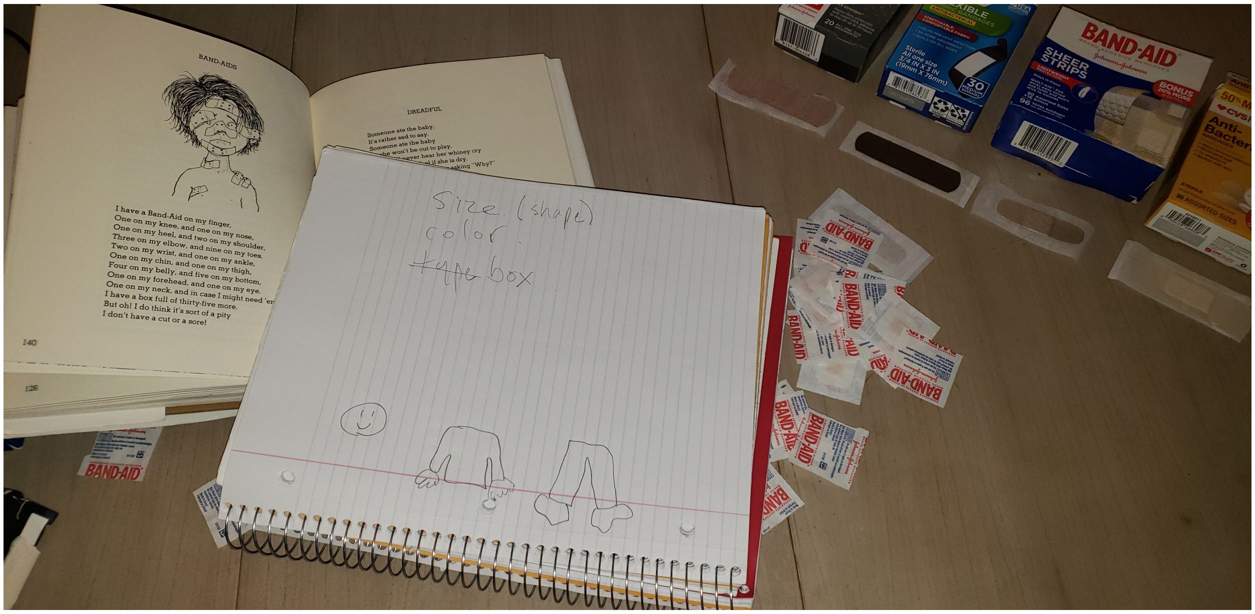
mathematical concepts in the exploration. For example, when he considered how students would sort pictures of the bandage boxes from the store aisle and represent the data, he anticipated students would sort the bandages by size, shape, color, and box (See Figure 1). Mr. Elliott intended to use the summary as an opportunity to have the students share their mathematical thinking and reasoning. Therefore, he purposefully planned how he would sequence the students' sharing and use their discussions of the data to engage in critical conversations around equity and fairness—specifically emphasizing skin-toned bandages. Now that he was satisfied with **what** tasks he would use to engage his students in integrated investigations of mathematics and equity, and **how** he had planned the structure and sequence of the tasks, he began thinking about the most integral component of the lesson—**who**se voice would be heard.

Who

To truly define equitable instruction, it is vital teachers attend to **who**se voice is heard, **who**se contributions are recognized, **who** is encouraged to contribute to the mathematical discussion, and **who** has opportunities to make meaningful connections to the mathematical experience. Before being introduced to the **What-How-Who** structure, Mr. Elliott had never fully considered

Figure 1

Categories Mr. Elliott Anticipated His Students Would Use to Sort Bandages



how to plan participatory methods in his mathematics lessons. In fact, he stated,

> Sometimes, actually most of the time, I'm trying to get my students to STOP talking. And, I have a cup of name sticks—little popsicle sticks with their numbers on it—and I use those to make sure I call on different kids each time. But, *now* [emphasis added] I'm thinking there's more to planning these lessons.

After reflecting on the **What-How-Who** structure, Mr. Elliott now realized he needed to plan intentional strategies that would not only stimulate his first graders' participation in a variety of ways, but also recognize the contributions of each and every student in the class. Mr. Elliott reviewed his activities and considered ways he could incorporate novel participatory structures in each part of the lesson sequence so each student could enter the mathematical conversations. As he planned to create a risk-free classroom environment where each student had an opportunity to contribute to the mathematical discussion, Mr. Elliott explained how he planned to value his students' mathematical reasoning—regardless of whether or not their answer was correct,

> I think one way we can encourage our students to feel comfortable is by allowing them to have an opportunity to succeed and fail without consequence. I can pick a student who got part of the problem wrong and use that to deepen their mathematical thinking. This fosters an environment where it lets kids know it is safe to make a mistake.

In these environments, the students would have time to make observations about the given situation, and discuss their ideas in different formats such as a think-pair-share or a jigsaw activity (Kagan, 2009). Mr. Elliott also wanted to incorporate students' inquiries and encourage student-led discussions. He planned to use students' responses to discuss equity and fairness as they compared, analyzed, and evaluated various strategies, solutions, and mathematical representations of the data.

As Mr. Elliott planned, he also considered how to include the voice of students who are often reluctant to talk in large groups. He explained how some students are hesitant in presenting their ideas to a large group and brainstormed different strategies to include in his lesson plans. For example, he planned to provide students advance notice that he wanted them to share their ideas and also planned to give them a choice in how they wanted to share. He described how students could either display their representation and have another student in the class explain what was presented, or he could show the class the student's representation and the student could explain it themselves. He also planned for students

to participate with nonverbal communication (e.g., student circles the set of objects with greatest number of bandages) or gestures (e.g., student points to parts of two visual representations to compare data) so that every student could share ideas that would contribute to the mathematical storyline. Mr. Elliott described how these participatory structures gave his students agency as doers and thinkers of mathematics as they used their representations of data to critically examine a variety of bandage boxes and the availability of skin-toned bandages in their community.

Reflection on Implementation

The **What-How-Who** structure gave Mr. Elliott a framework to analyze how his activities extended beyond the tasks to focus on the students and their mathematical experience. At first, Mr. Elliott expressed concerns about incorporating "sensitive" topics such as race into his math time,

> My school does not have a lot of people of color. I am afraid [talking about race] would really make [students] and their parents uncomfortable with me being a white man. I really thought the kids would focus on how there are different sizes and shapes and colors [of bandages]. Or, that they would talk about what happens if someone doesn't get the Band-Aid they want. I thought those talking points would be a good transition into the math content with counting and comparing with data, but it could also be a transition into thinking about fairness in a less tricky way.

However, when reflecting on the activity through the lens of the **what,** the **how,** and the **who**, Mr. Elliott described how the lesson generated children's conversations about race and equity.

As he reflected on the lesson, Mr. Elliot compared his initial perceptions when planning the lesson to what he noticed when analyzing the experience. He described how the poem, the images, and the physical products motivated first graders to pose questions and discuss what they noticed and what they wondered. Mr. Elliott explained how students' comments initially focused on the sizes, shapes, and "fun" colors of the bandages, but the conversation did not stop there. Through the discussion, students also addressed the cost of bandages and the access to high-quality products. They noticed words on the boxes Mr. Elliott displayed such as "invisible" and "clear," and these observations were the catalyst to critical conversations:

> *"Some of those [bandages] don't even work. But we have to get those because my mom seen the others but she said they too much money."*
>
> *"Those ones we get don't have different colors and stuff. They just all that pink color."*
>
> *"Why do they make the Band-Aids clear?"*
>
> *"Are they really invisible? Like totally invisible?"*
>
> *"Why they Band-Aids look shinier on [student]?"*
>
> *"Those kind are more invisible for [student]."*

Mr. Elliott described how he provided the space for his students to investigate the bandages' colors and "invisibility." He encouraged them to apply the mathematical concepts in his planned activity and posed purposeful questions that prompted his first-graders to see the counting and data collection process as a relevant and meaningful tool to address their inquiries. He shared,

> The kids' conversations surprised me. We took the time to talk about what they noticed, which I think is even more important for equity's sake. They seemed to be more active in our discussions and, in my opinion, this is because they felt more included and counted. I think asking kids about their feelings on the lesson—wherever it may lead—is extremely important; like here they started to see that there are people who don't fall into the standard 'flesh' tone. I think by responding to their questions makes their ideas more heard and made them feel more valued, which added to their feelings of worth.

Reflecting on the experience of using the **What-How-Who** structure, Mr. Elliott described several benefits to his teaching and his students' mathematical learning. The most powerful takeaway from the experience, however, was how Mr. Elliot referred to the approach as "only the beginning."

Conclusion

In this article, we described how Mr. Elliott used the **What-How-Who** structure to plan a series of mathematics lessons that could prompt students' analyses of different bandages. By planning to have

students organize, represent, and interpret the data from real-world contexts, Mr. Elliott intended to engage his students in discussions on skin-toned bandages and how the product reflects equity and fairness. While initially hesitant to incorporate explicit conversations about a "sensitive issue" such as race, after engaging in the planning process and analyzing the lesson implementation, Mr. Elliott described how his thought process changed. He commented,

> After doing this lesson [my grade level team] and I spent a lot of time talking about the math behind everyday things. We need to get our students going on these ideas EARLY! Having students realize how we use math to problem solve is so valuable in the real world. I know [the race and equity discussions] don't stick to "traditional curriculum," but this is an opportunity to get ALL of our students thinking about these situations from a very early age.

Mathematics is a tool each and every student can use to explore critical issues in our society. As Mr. Elliott explained in his reflection, using the **What-How-Who** structure in the planning process opened his mind to consider how early childhood teachers could approach these conversations with young children. It is imperative that classroom teachers have the resources and strategies to help them recognize these opportunities and plan intentional investigations that foster discussions about race, equity, and injustice that permeate our daily lives. Mathematical investigations that provide opportunities to critically examine race, culture, and equity can be done, even with the youngest learners. Planning activities and reflecting on the implementation of lessons through the lens of the **What-How-Who** structure can stimulate teachers to look beyond the tasks as they are presented in the classroom and instead envision how these experiences could stimulate students' identities as powerful mathematicians who can use mathematics to advocate for change.

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Discussion And Reflection Enhancement (DARE) Post-Reading Questions

1. How can you integrate the **What-How-Who** structure in your practice?
2. How can you use mathematical content to address fairness and equity?
3. What other examples of children's literature lend themselves to equity explorations?

The mission of TODOS: Mathematics for ALL is to advocate for equity and high quality mathematics education for all students—in particular, Latina/o students.

Five goals define the activities and products of TODOS: Mathematics for ALL

1. To advance educators' knowledge and ability that lead to implementing an equitable, rigorous, and coherent mathematics program that incorporates the role language and culture play in teaching and learning mathematics.
2. To develop and support educational leaders who continue to carry out the mission of TODOS.
3. To generate and disseminate knowledge about equitable and high quality mathematics education.
4. To inform the public and influence educational policies in ways that enable students to become mathematically proficient in order to enhance college and career readiness.
5. To inform families about educational policies and learning strategies that will enable their children to become mathematically proficient.