

**University of Washington**

**College of Education**

Teaching, Learning, and Curriculum in Math and Science

*Final Master's Report*

Levina Robin

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## **Social Justice & Mathematics: “*That’s Nøt Fair!*” the Picture Book**

*Written and Illustrated by Levina Robin*

### **I. INTRODUCTION**

It is vital that the future of mathematics education and curriculum transcends old practices and traditional ways of teaching particularly during the foundational elementary years. This is especially important as it pertains to how this type of mathematics education could relate to our daily lives and how complex dynamic world problems could be solved. It is for that reason that I chose to use the remainder of my time at the University of Washington to write and illustrate a picture book showing the intersection of mathematics and social justice. With the completion of this picture book, I have also created lesson plans and materials for a lower elementary school teacher (1-3) on one way to integrate relational understanding and social justice for doing/learning mathematics in their classrooms.

In summary, I created the following products to support the idea that math education should be relational and accessible to all and reflect the intersection of social justice and numbers.

- a) Fully illustrated picture book and storyboard (meant to be read aloud)
- b) Lesson plans on integrating interactive math journals as a means to form relational understanding
- c) Worksheet Materials
- d) Literature Research
- e) Field Research (scheduled reading to 2nd graders for May 24th, 2019)

## II. PURPOSE & RATIONALE

The purpose of this project was to:

- a) to empower elementary students to use math as a tool for change making and explaining equity
- b) to help teachers and students see the integration of mathematics and literacy and offer conversations around it

This project is important because a) it contributes to my learning, b) it has the potential to become a resource for teachers, and c) there are currently minimal picture books showing mathematics education intersecting with social justice. Here I defined mathematics education as the curriculum and teaching that occurs in a lower elementary classroom. I defined social justice as issues of accessibility, opportunity, and privilege pertaining to the broader community and world. This project forced me out of my current content knowledge and allowed my registry of mathematical knowledge to become much more expansive and rich.

By carrying out such an intense project in the span of 8 weeks, my work ethic was pushed and tested that I produced my most in depth work so far at the University of Washington as well as formed a clearer path of where to take this work. It used knowledge and skills I have collected from all my classes and experiences, especially Race, Equity, and Conceptions of Social Justice in Mathematics, Foundations of Curriculum and Instruction, Action Research, and my experience as a 2nd grade teacher. During my time as a 2nd grade teacher, I first handedly learned of the gap that exists with mathematics for our students of color and marginalized

communities. This felt unjust, especially because in order to solve these gaps, social justice tools are required. In order to properly investigate social justice issues, however, mathematical education and rationale was needed. As I moved into my graduate classes, I realized there was research behind this and it became an area of interest and potential impact. This project serves as a new resource for teachers who are looking for ways to incorporate relational understanding and social justice in their mathematics teaching in a way that relates lower elementary learners. The lesson plans provide a way to make mathematics more accessible to our students in a way that is learner-centered, relational, and easy for teachers to implement. The picture book serves as a tool to engage and ignite conversations in the classroom. Lastly, the materials that were created provide support and further investigation for these topics. These factors of the project make it a worthwhile resource for lower elementary math teachers.

### **III. LITERATURE REVIEW**

#### ***Access to Mathematics/ Math as a Gatekeeper***

Without mathematical literacy, opportunities and career options become limited for our students because of the way our world elevates mathematical skill sets. Mathematics becomes a gatekeeper for our students and their success. In order to implement successful learning environments where mathematics is accessible to all our learners, especially for those traditionally marginalized, educators need to *create space*: for thinking, for solving complex problems, for adapting, and for connections (Finkel 2016; Boaler 12, 2008). Authentic math has the potential to change the world because it means more representation and exposure to and in

mathematics for our learners. When we set up mathematical norms that create space for the opportunities mentioned above, our students begin to ask questions, become empowered to learn mathematics because of their knowledge of mathematics and mathematicians, and form a safer relationship with mathematics so they may view it as a tool for them to interpret the world around them. (Gutstein 2007; Boaler ). This is where relational understanding comes in. Relational understanding of a topic means that students understand what they are learning in school in relation to the world around them and can make connections. With relational understanding, students are able to teach others the concept they understand relationally. Teacher can facilitate is an environment where students can ask about the topics they are curious about, giving them ownership and voices to name their concerns within the concepts of mathematics (which is very connected to equity). This also allows for an extremely collaborative environment where students not only learn through their peers but also have opportunities to collaborate with all stakeholders (teachers, admin, paraprofessionals, community members, family, etc...) (Gutstein 2007). Most students' relationships with mathematics is purely based on their early experiences in the classroom and they are taught the subject as a set of rules and given answers rather than taught the language of mathematics that is dynamic and can interact with them. Since mathematics is a tool used by everyone to interpret the world, these mathematical tools need to be accessible in every math learning environment.

### ***Integrating Social Justice into Elementary Mathematics***

The focus of this project is particularly teaching mathematics with relational understanding while integrating social justice as a regular part of mathematics learning. When it

comes to math, we have this “number numbness” where we keep mathematics segregated from the rest of our curriculum and are afraid to show our students how mathematics truly plays a role in our daily lives (Peterson 10, 2005). Our students have become accustomed to the idea that when we present them with a math problem, it should and could be solved in 30 seconds (Finkel 2016). This isn’t the case when it comes to our real world. When we set up mathematical norms of non closure, lack of labels, and ideas that every learner is capable of mathematics, we can set our students up to believe they have what it takes to confront these social justice issues of power and equity. A social justice approach to mathematics would allow students to bring their knowledge and experiences from their own communities that would empower them (Gonzalez 2005).

In order for this integration or approach to effectively transform, the following must be defined and occur before: acknowledgment, action, and accountability (TODOS and NCSM 2016). This project would serve as acknowledgement and action while the accountability will be in effect simultaneously but especially present when teachers begin to integrate.

### ***Why A Picture Book?***

Writing and reading have programs like “reading across curriculum” or “writing across curriculum”. We even try to incorporate subjects like history into our other subjects or pair science up with literature. But when it comes to numbers, symbols, and shapes, we pause because we have limited resources to understand what that integration can look like (Stanic 1989). Students understand how to read picture book, not only through the words but through the context, pictures, and emphasis of text through color, size, and font. When these words and

illustrations dance together, it can create conceptual understanding and depth of a the different concepts because of the open ended interpretation for learners (Coats, Enciso, Wolf, and Jenkins 2011). Picture books have become a largely incorporated part of curriculum for younger learners. Children as young as four years old understand contradictions between text and imagery when posed questions about the pictures truly illustrating the words. This means that the details in these illustrations are extremely important for our learners' takeaways from each picture book. Picture books can serve as an extremely important tool when it comes to starting discussions instead of traditional close ended questions (Gill 2015).

#### **IV. PROCEDURE**

The following is the process I forewent, however, many of these were circular/cyclical steps and not linearly defined.

##### ***1. Researching***

During winter quarter, I had the chance to begin my research within mathematics especially as it pertains to picture books and social justice. In the beginning of this quarter, I consolidated this literature to create a review that accurately reflected the purpose of this project. Throughout the last few months however, I revisited literature to help me form the direction of the picture book and its products. I used literature, informal teacher interviews, and teacher blogs to inform my sample lesson plans and materials.

## ***2. Storyboarding***

This book is actually based on real conversations and projects that we did in our second grade classroom in 2018. First, I created a physical storyboard in efforts to map out the major plot line, characters, and setting. This went through many drafts and I finally solidified the story I was going to tell after talking with college of education peers, Kara Jackson, and friends. After the storyboard was finalized, it was turned into powerpoint slides to properly lay out the set up of pages so it created an interesting story visually. The powerpoint slides were again reviewed by peers within the college of education and revised accordingly. Then, I wrote a synopsis and summary to add a layer of structure solidity to the picture book.

### *Summary*

This picture book tells the story of a class of 2nd graders dedicated to changing their small town. Students are coming back from spring break and working on 3-digit addition when they find out that the school made a plan to not allow cupcakes, chips, or cookies at their school anymore and were now encouraged to bring fruits and vegetable as snacks. At first, the class is upset, but one brave student decides to acknowledge that they do not have a grocery store in their town and only a market full of junk food snacks. The class all agrees and realizes that they all have to travel 20 miles to get vegetables but only walk 5 minutes to get the items the school banned. Through their various ideas and tactics, 20 second graders come up with ideas (all in relation to mathematics) on how to make healthier foods more accessible in their town.

### *Logistics*

The book is 32 pages (an average for picture books) and was illustrated through the application procreate on an ipad through an apple pencil. The book is based on a 2nd grade



reading level and uses 2nd grade sight words as well as new vocabulary words based on the 2nd grade standards as well as the mathematical standards that appear in the Engaged New York Math curriculum.

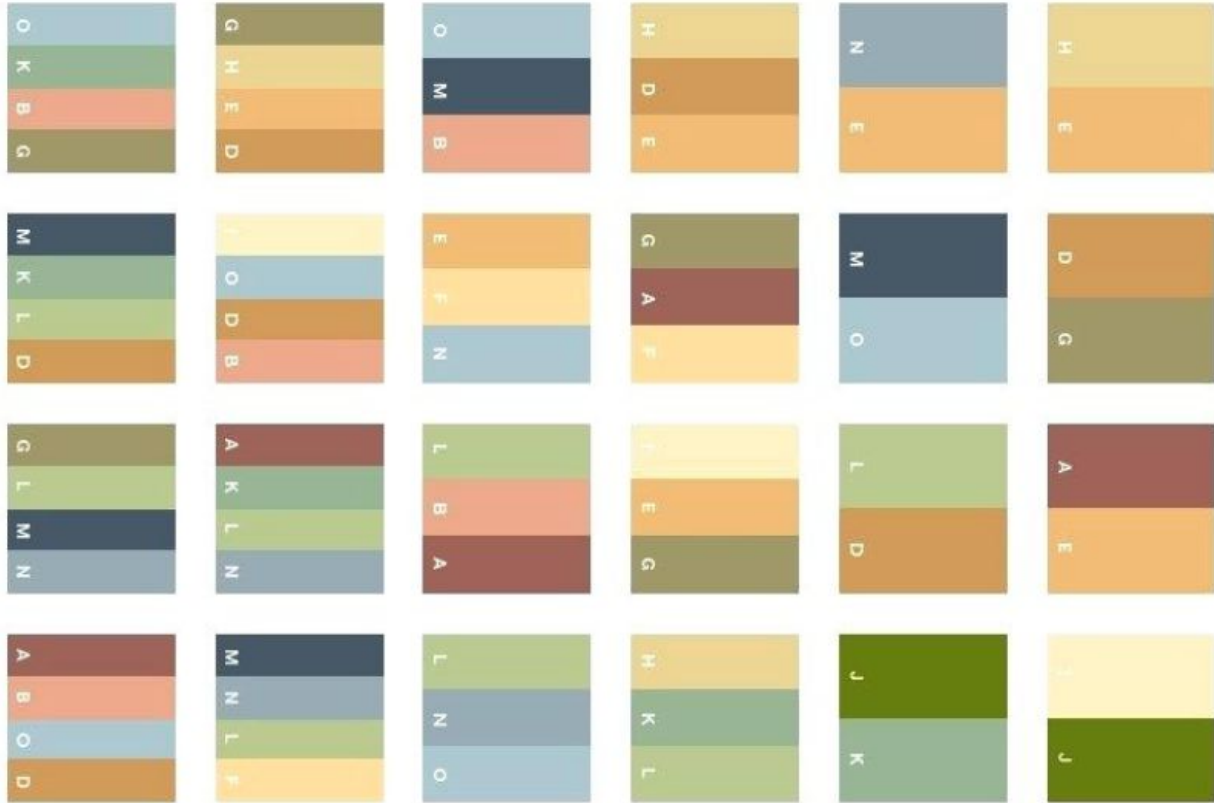
### 3. *Illustrating*

After my storyboard was finalized, I began illustrating the key pages in the story through Procreate, an application on the iPad that I illustrate with. The process I foresaw to take the longest amount of time was illustrating each page in a way that told a story.

First, I researched and picked out picture books similar to my drawing style in order to determine the best drawing style for this story. This also included paying attention to brushes. I downloaded and tested out 15-20 brushes and then eventually chose two to stay consistent with throughout the whole book.



Next, I created a color palette so that I could stay consistent throughout the whole book.



Then, I started drawing characters to figure out the style of drawing my characters would appear as in the book.



The details in this process were significant for learners who have a strong visuals and text correspondence and especially important for emerging readers that might be purely rely on illustrations to understand the story.

During these few weeks, I drew whenever I had time or inspiration and it proved to be the most difficult part of this project (more on this in the discussion portion below).

#### ***4. Forming Lesson Plans***

I decided that an interactive math journal encompassed the purpose of this project especially if we were to reach relational understanding and social justice year round with our elementary students. In order to provide teachers with the balance of giving them autonomy over their math lessons (because our teachers truly know their students best) but still providing structure, I created lessons on implementing these journals and then listed out ideas and the directions it could go. These journals are not meant to be a place where daily problems are sorted out but rather a place of exploration and wonderings for students which is what is explained in that portion of the project.

#### ***5. Creating Materials***

The worksheets and anchor charts were created at the end when the picture book was close to done in accordance to what I thought a teacher would benefit from which is why these materials are limited and the interactive journal is what takes precedence.

## **6. *Book Readings & Send to Publishers***

This is the part of the procedure that has yet to be completed. On May 24, 2019, Friday, I will be reading this book to a classroom full of 2nd graders at Rainier View Elementary in Federal Way with Mr. Hersey.

Later, I will be sending off my storyboard to publishers to see if this is a story they are willing to invest in. After doing much research on this, it seems as though publishers actually do not want to see any illustrations when they are first being proposed an idea for a picture book and then later it is decided whether you want to publish your own book or find an illustrator.

## **V. PRODUCTS**

The following is a list of products produced for this final project:

- ***Storyboard***

The copy of the book laid out in 32 pages

- ***Picture Book (with Illustrations and Text) -***

The physical product of the combination of the book and the illustrations bind together

- ***Interactive Math Journal Lesson Plan***

Lesson plans for teachers on how to integrate math journals into their classrooms and topics for how to make it truly interactive

- ***Sample Interactive Math Journal***

A physical example of what an interactive math journal could look like based on the lesson plans above

- ***Materials***

- ***Sequencing Chart***

Worksheets that help students put together what they just heard

- ***Big List of Words***

List of words that will be used for vocabulary from the read-aloud

- ***Socratic Discussions***

List of discussion questions and topics as lower elementary students navigate their own understanding of mathematics

- ***Using Math for Change (Letter writing)***

A plan on writing letters of change but using mathematics to guide their arguments

## **VI. DISCUSSION**

Through this project, I gained academic insights as well as personal insight on myself and on creating a picture book. I learned of the lack of resources that link social justice and mathematics, the importance of a illustration, and the labor that comes with creating a picture book.

A lot of the insight I gained from this project came from the literature review I conducted before starting the actual book. I knew that I was passionate about math and social justice. I knew my 2nd graders deserved access to a better mathematics education than they were receiving. And I knew numbers were important, especially when it comes to arguing logically and convincing others of your claim. I think I realized how important all of this truly is even more so when I came by the research but also the lack of research that existed in these areas. One thing that truly stunned me was how much research there is about math education but not much about what it means to relationally understand math in elementary school or what it means to integrate math and social justice and why it matters. It showed me how important this is and that this is where we should be heading when it comes to math education. I also found it interesting to see the lack of picture books that have to do with math, but then when I sat down to write one, it was harder than it seems. I learned that even I, an elementary certified teacher, had trouble relating math and pictures and social justice even though I so badly wanted to. I kept having this vision of how many numbers are involved with social justice issues (isn't that how we know there's a gap?) but how we do not allow access to those numbers to our marginalized communities. I knew a picture book couldn't solve these problems but it was a conversation starter and the more conversations there are about certain issues, the more we actively do something about it.

Through the practice of illustrating (my first picture book ever), I learned the importance of illustration. Through research and reading to my 2nd graders, I knew how important illustrations were to their learning, especially for our english language learners, but I do not think I realized how important it was until I started illustrating my own book. I started out illustrating

page 3 first and it was not so bad and made sense in the context of what the words were saying. As I started drawing more and more, I realized most of my illustrations *did not* tell a story, but were more of a simple minimal aide to the words. But illustrations are the most important part of a picture book for our learners especially when students as young as four years old are learning stories before being able to read. It really dawned on me how important *what* was on the page or how it was illustrated or what part of the text was illustrated was extremely important. This brings me to my next insight.

Picture books are laborious, especially when I self set the deadline to finish it in the span of six weeks. Due to the limited time, I do not think my illustrations fully reflect how rich of a story the words tell. I also did not realize how much time and thought would go into each illustration and being crunched for time, I drew the first idea that came to my mind when I read the text. If there was more time, I would have carefully crafted each page through art, come up with multiple possibilities for each page, and added great detail to every page that students would be able to pick out and appreciate even if they could not read the words. This does not discourage me, however, and the next time I set out to write and illustrate a picture book, it will have a timeline of a year to two years to appropriately allow time for ideas for illustrations to simmer and build out detail in each illustration! I am very excited for what this means for my future of picture book writing and this was definitely just the first. The biggest insight gained from the illustrations being so laborious was to be gentle with myself and allow time for myself to think of ideas because the creative process truly takes time.

A lot of learning occurred through this project and I am grateful to have learned so much more about mathematics and social justice, the importance of illustrations, and the process and labor that it takes to illustrate a book.

## **VII. CONCLUSION**

This project aimed to inform educators about how vital the integration between social justice and mathematics can be while providing a few tools for conversations in their classrooms. It uses the power of a picture book to set our learners up as the changemakers and the norm creators so they may feel empowered every day as they explore the numbers within a classroom and connect it with the world outside of them. The dance of visuals and words will serve as a reminder of mathematics as a tool to solve real life issues while collaborating, interacting, and having fun. The curriculum will serve our facilitators and educators in a way that they are also empowered and inspired to rid old practices of mathematics so we may all move forward together in competency within the world of mathematics and provide access to our students to see mathematics in the light of social justice.