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A Picture is Worth a Thousand Words: Understanding our Students' Mathematical Experiences through Drawing

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***Abstract:** Learning about our students' perceptions of mathematics can help teachers better understand students' mathematical efficacy and aid in the creation of lessons that foster positive mathematical learning experiences. In this article, we share some students' perceptions of doing mathematics through their drawings. We looked at students from three different grade levels in three different countries: China, Fiji, and the United States. We discuss what we learned from these drawings as teachers and how teachers can use the drawing task to learn more about their student's perceptions of doing mathematics.*

***Keywords:** mathematics, student perceptions, student drawings, international*

Introduction

Understanding how students perceive the subject matter we teach can aid us in designing classroom ecologies and curricular experiences that promote positive student learning experiences. Toward this end, there are a variety of ways teachers can begin to know about students' views of academic content. For example, they often make revealing comments in class, in passing, or to their friends. Teachers may also give students a writing prompt, a perceptions survey, or ask students directly about how they feel or what they enjoy mathematics. Teachers use these tools to better understand students' prior knowledge and perceptions about academic content. In this article, we share another way to learn about students' perceptions of mathematics through a drawing task. Drawings often give different kinds of information than other ways of investigating students' perceptions. Some students are better able to explain their thoughts through drawings and give reasons why they hold the perceptions they do (Anim, 2012; Anning & Ring, 2004; Malchiodi, 1998). These drawings can then inform teachers and teacher leaders about the positive or negative perceptions students hold and may give details not gathered through other methods. We share some of our student's drawings to illuminate what teachers might come to know about their students' perceptions of doing mathematics. The student drawings come from students in Chinese, Fijian, and American schools.

Drawing Opportunities for Students

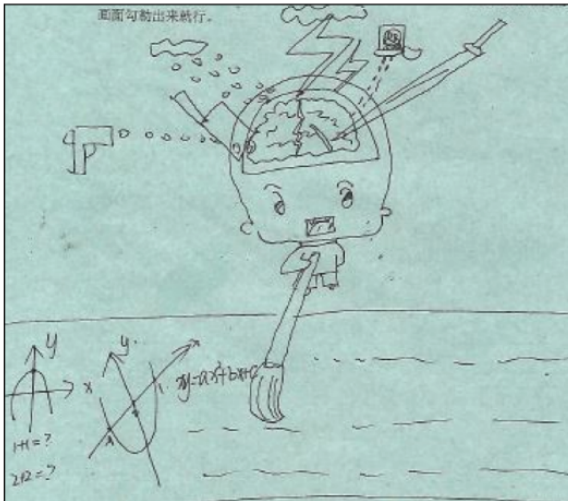
Children are encouraged to draw in their younger years to develop their fine motor skills, brains, and creativity. Whether drawing houses, schools, or family, each child's picture is a window into who the artist is and "how they view the world" (Farland-Smith, 2012, p. 110). The drawing often describes what things the child likes and dislikes. Some parts of the drawing represent enjoyment while others might show things the child considers negative, but these provide evidence about how the child views the world. In drawings about mathematics, students' items of enjoyment often include smiles, excitement revealed in thought bubbles, and good grades on their mathematics work, but sometimes items are included that are negative: weapons inflicting self-harm, defeated faces, and thought bubbles of discontent (Fischer, Matney, and Jackson, 2022). The type and variance of these items make the drawings "multidimensional" (Farland-Smith, 2012, p. 109) and aid teachers to develop interventions for students.

Drawing can be useful in gathering insight into a student's point of view of the world across all ages (Borthwick, 2011). From the intermediate grades through young adolescence, students continue developing their vocabularies and ways of expressing meaning. Therefore, using drawings to empathize and understand their perception of a situation can be very effective (Aguilar, Rosas, Zavaleta, Romo-Vázquez, 2016, Finson, Beaver, & Cramond, 1995, Weber & Mitchell, 1996). Briell, Elen, Depaepe, and Clarebout (2010) stated, "drawings may provide a unique and valuable route of expression even for the older participant who might find it difficult to express such abstract beliefs in verbal or written words articulately" (p. 662). Drawing is a valuable tool to gain insights into students' worlds at all grade levels.

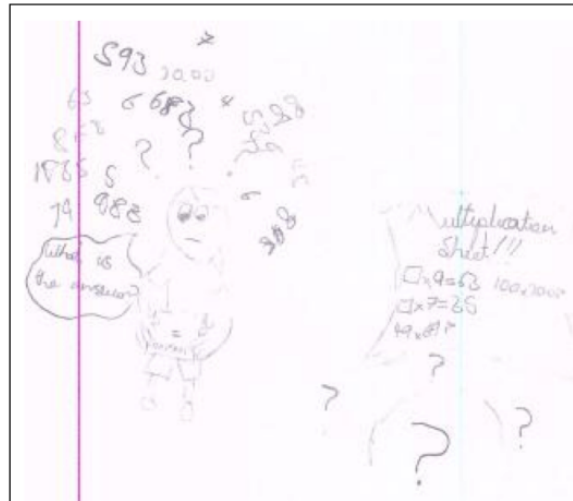
Learning from Students' Drawings

As teachers of mathematics, we were interested to know how our students perceived what it means to "do mathematics." Hence, we asked nearly 300 students from China, Fiji, and the U.S. to "Draw yourself doing mathematics. Don't worry about the quality of your drawing. Just sketch what comes to mind" (Bachman et. al., 2016). We have found that many students who often struggle to relay how they feel through words appreciate the opportunity to express their ideas and feelings through the drawing exercise. Furthermore, we found that in all three countries, as students get older, their enjoyment of doing mathematics tends to diminish (Fischer, Matney, and Jackson, 2022). Through their drawings, students were able to share their elation in doing mathematics as well as their fear or indifference (see Figures 1 and 2). As students have drawn themselves doing mathematics, we have come to better understand their experiences and learn what they think about the nature of mathematics itself. Examples from Figure 1 show students sharing their difficulties with mathematics. Students express these difficulties in various ways, from sharing that it is difficult to understand all the way to drawing weapons attacking their brains. Knowing how these students perceive doing mathematics has helped us and other teachers understand the importance of approaching students in ways that promote a change in mindset and not just an increase in mathematics knowledge. On the other hand, Figure 2 shows students smiling while doing mathematical exercises and a student who recognizes that solving mathematics problems isn't easy, but that they can do it. These drawings reveal to teachers which students enjoy doing mathematics and which mathematical tasks different students find most appealing.

Figure 1: Student drawing samples reflecting student difficulties with mathematics.

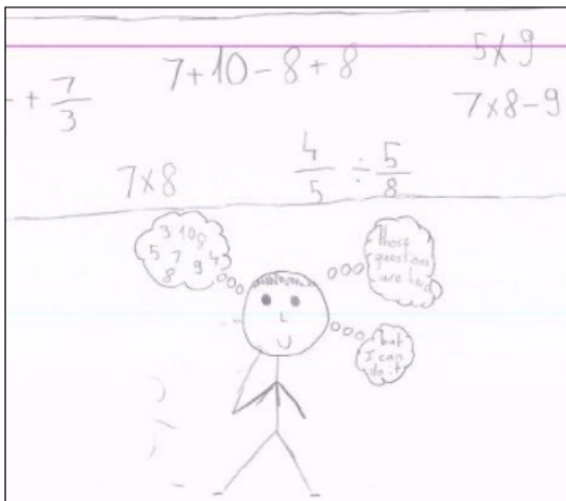


(Doing Mathematics is Brain Violence)

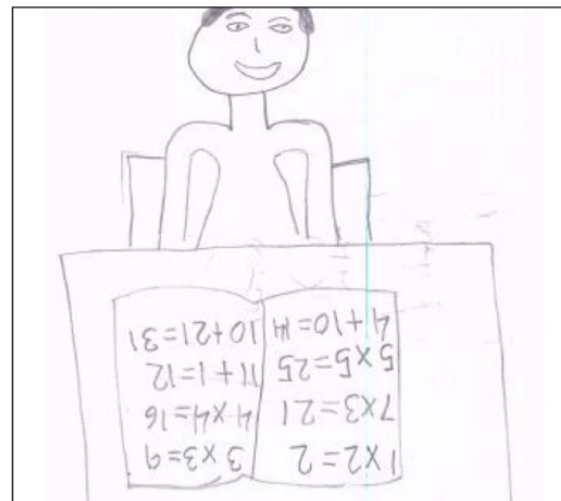


(Mathematics is Difficult to Understand)

Figure 2: Student drawing samples reflecting student enjoyment with mathematics.



(Poised to Persevere while Doing Mathematics)



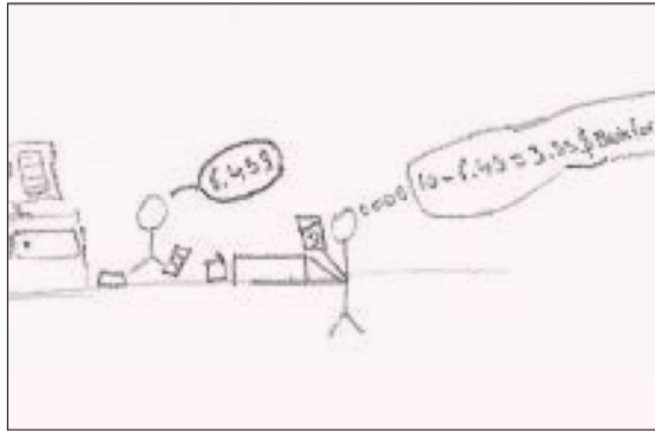
(Smiling While Doing Mathematics)

Students' drawings also revealed how some students perceived that mathematics is used outside school. Figure 3 shows a couple of examples from the United States and Fiji in which students are doing mathematics as they cook, as they purchase items at a store, or as they build important structures, such as a house. Other students connected mathematics to patterns in nature or advancements in culture and technology. Although no Chinese students drew themselves doing mathematics in real life or outside of school, they did indicate that mathematics is an important part of their life and some referenced working hard to pass important national tests (see Figure 3).

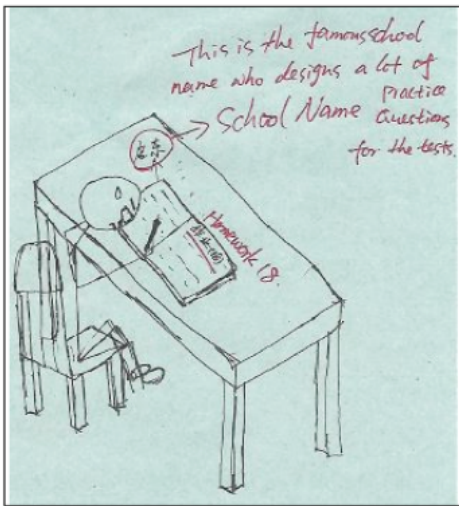
Figure 3: Examples of Student Work Expressing Life Importance.



(US grade 8 Real World)



(Fiji grade 8 Real World)



(Chinese grade 8 Cultural Reference)



(US grade 11 Real World)

Student Drawings Inform Teaching

This is a simple and quick activity that any teacher can do to learn more about their students' perceptions of mathematics, as well as revelations about the students themselves (Farland-Smith, 2012). Students took between 5 and 10 minutes to complete their drawings, and we found them to be highly informative. Specifically from our sample, when some students' drawings revealed that doing mathematics makes them want to invoke some kind of self-harm, this acted as an important signal to us and their teachers to plan instructional time devoted to creating and conversing about a safe space for these students to engage in mathematics. On the other end, some students' drawings revealed specific details about how excited students were about mathematics and how proud it made them feel when they could solve mathematics problems on their own. Knowing which students experience problem-solving this way allowed the teachers to work with those students to nurture a classroom culture in which more and more students enjoy mathematical problem-solving.

From our large sample of students from China, Fiji, and the United States, we noted that students who drew images containing themselves doing mathematics with others were more than twice as

likely to have a positive perception of doing mathematics (Fischer, Matney, and Jackson, 2022). This evidence supports the implication that doing mathematics with others tends to help students yield a more positive disposition toward mathematics, a desired aspect for mathematics educators (Kilpatrick, Swafford, & Findell, 2001).

Teachers who have asked students to “draw themselves doing mathematics,” shared with us their excitement to see whether aspects of their teaching philosophy, such as allowing students to work with peers and not be confined to their desks, were prevalent in students’ drawings. These teachers have found this drawing activity to be informative, not only for learning about their students’ perceptions, but also as an opportunity for reflection about aspects of their own teaching.

Lastly, this drawing activity allows for collaboration with teachers of multiple disciplines. We have found it beneficial to work with colleagues who are teachers of art or language. Art teachers provide instruction and guidance about topics that would improve students’ ability to express themselves through drawing. The enactment of the students engaging in the drawing activity in conjunction with their instruction about techniques related to drawing people has enriched the information gathered by mathematics teachers while providing a space for students to explore their artistic skill and creativity. Similarly, while working alongside teachers of language and writing, it is conceivable that a written prompt could be given that asks students to write about what it is like to do mathematics. The students’ drawings and writing could then be used to triangulate data about students’ perceptions of doing mathematics in addition to the assessment of students writing and drawing proficiency.

Drawing activities hold a lot of promise in identifying student perceptions (Chambers, 1983). The drawing activity can be easily implemented and adapted by teachers and teacher leaders. It affords teachers an important view into their students’ ideas and experiences about “doing mathematics”. When teachers are better informed about their students’ experiences, they can make knowledgeable decisions about how to approach students and improve their classroom lesson and ecologies to improve student perceptions (Fischer, Matney, and Jackson, 2022). We have found the drawing task useful with students of all ages and in various countries and cultures. We encourage teachers to use the drawing task to learn about their students and inform their teaching.

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