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Preservice Teachers' Interpretations of a Fourth-grade Student's Visual Representation of a Division Word Problem

by Gwendolyn Johnson, Ali Shaqlaih, and Yolanda Graham

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AMTE-TX 2017 Fall Conference Photos

September 29-30, 2017
Fort Worth, Texas

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Announcing Our New Journal Name!

After a vote at our 2017 AMTE-TX Fall Conference, we are excited to share with you that we are now the *Journal of Mathematics Teacher Education in Texas*, or *JMTET*.

President's Message

Sarah Quebec Fuentes

Over the past year, organizations, such as the Association of Mathematics Teacher Educators and the National Council of Teachers of Mathematics, have purposefully addressed issues related to equity in mathematics education. In line with this focus, AMTE-TX hosted its 5th Annual Fall Conference with the theme of *Social Justice and Equity in Mathematics Education*. Both the national panel and breakout sessions (later in this issue) provided conference attendees with important ideas to consider with respect to our roles as mathematics teacher educators.

Continued…

What's Inside…

The national panel consisted of five leading scholars in the area of equity and social justice in mathematics education: Julia Aguirre (University of Washington Tacoma), Dorothy White (University of Georgia), Marta Civil (The University of Arizona), Danny Bernard Martin (University of Illinois at Chicago), and Eric "Rico" Gutstein (University of Illinois at Chicago). The following essential question framed the panel presentations:

> *What are key concepts for teachers and mathematics teacher educators to understand about equity and social justice in mathematics education?*

Across the five speakers, several big ideas emerged. First, mathematics is not culture free, and culture affects learning. In fact, mathematics classrooms are cultural spaces. As an educator, equity is a professional responsibility. Just as we do not incorporate problem solving in the absence of mathematics content, we must simultaneously address content and equity in the mathematics classroom.

A place to start is through the examination of our self and current practices. Our own reality is often the lens through which we interpret the world. However, we rarely think about our culture because it is the norm for us. Therefore, we need to take time to reflect on the characteristics of our culture. In this process, we can also contemplate our own mathematics experiences. In relation to the teaching and learning of mathematics, questions to ponder include: What, or whose, knowledge is valued? and Are reform efforts truly challenging the status quo?

Lastly, some practical strategies include avoiding a deficit discourse and instead affirming student identities by recognizing multiple competencies. Through a two-way dialogue, we can learn about the culture of students' families and communities and view parents as intellectual resources. The speakers also recommended several resources:

- AMTE *Standards for Preparing Teachers of Mathematics*
- *Mathematics Education Through the Lens of Social Justice: Acknowledgement, Actions, and Accountability* (A joint position statement from the National Council of Supervisors of Mathematics and TODOS: Mathematics for ALL)
- *Cases for Mathematics Teacher Educators: Facilitating Conversations About Inequities in Mathematics Classrooms* (AMTE Professional Book Series: Volume 1)

During the question-and-answer portion of the presentation, Dorothy White talked about how acknowledging and addressing issues of equity and social justice requires *courageous conversations*. Let us continue to have these critical and courageous conversations as an organization.

Preservice Teachers' Interpretations of a Fourth-grade Student's Visual Representation of a Division Word Problem

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Solving word problems is a key component of the elementary-school mathematics curriculum, both in the United States and internationally (Ng & Lee, 2009). Difficulty with word problems has been well documented, among both K-12 students (e.g., Ng & Lee, 2009; Nosegbe-Okoka, 2004) and preservice teachers (e.g., Ponce & Garrison, 2005). One aspect of word problems that can be challenging is that the reader must match the actions of characters in the problem to mathematical operations (Zhang & Xin, 2012).

Analyzing student work can provide interesting insights about children's thinking (Scheuermann & van Garderen, 2008). In many elementary-school mathematics classes, children are taught to create drawings to represent their thinking about a problem. Teachers must possess both pedagogical content knowledge (Shulman, 1986) and mathematics knowledge for teaching (Ball, Thames, & Phelps, 2008) to help students understand how to create a representation that accurately represents the problem to be solved. When teachers lack experience with using a variety of mathematical representations, the teachers themselves may incorrectly solve a problem as well as misinterpret a grade-school student error (Charalambous, 2016).

According to the Texas Essential Knowledge and Skills, fourth grade is the first grade level in which students master division beyond basic facts. Third-grade students are expected to recall multiplication facts up to 10 by 10 and the corresponding division facts. Fourth-grade students are expected to use strategies and algorithms to divide up to a four-digit dividend by a one-digit divisor. (Texas Education Agency, 2012). Thus, the transition from basic facts to division strategies and algorithms is an important facet of fourth-grade mathematics.

The purpose of our research was to investigate preservice teachers' (PSTs) understanding of a child's representation of a mathematics word problem related to division. Research questions included the following:

1. What percentage of PSTs can correctly solve a fourth-grade word problem that requires subtraction followed by division?
2. What percentage of PSTs can interpret a fourth-grade student's invented strategy for division when presented with a student's drawing depicting that invented strategy?

Methods

Fifty-one PSTs participated. Their average age was 25 years old; ages ranged from 18 to 48 years old. All participants were seeking certification to teach elementary or middle school. About half (53%) of the participants were Hispanic/Latino, 26% were African American/Black, 18% were Caucasian/White, and 4% had other ethnicities.

A local elementary-school teacher provided the researchers with drawings created by fourth-grade students responding to division word problems that were part of the regular curriculum. When presented with the word problems, the fourth-grade students had not yet been taught the standard algorithm for division. The researchers decided to focus on one fourth-grader's response to the "Buses" problem (Figure 1) because it included a clear and correct representation of a student-invented strategy for division (Van de Walle, Karp, & Bay-Williams, 2016). The researchers asked the participants to solve the word problem before looking at the fourth-grader's work and then to examine the student's work and write a brief explanation of the fourth-grader's representation.

The Survey

The participants were presented with the word problem shown in Figure 1.

331 students went on a field trip. Six buses were filled and 7 students traveled in cars. How many students were in each bus?

Figure 1. The "Buses" problem.

The participants were first asked to solve the "Buses" problem without a calculator. Then, they were presented with the work of a fourth-grade student shown in Figure 2.

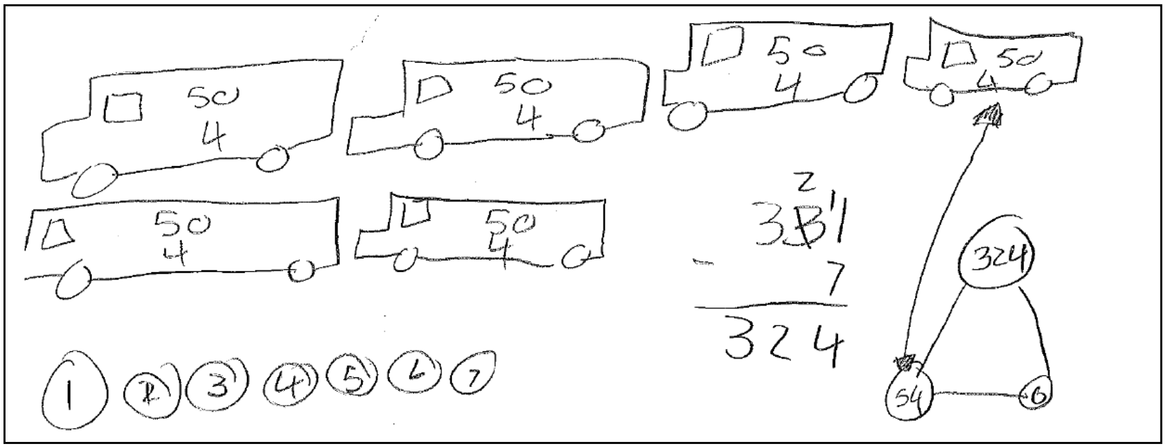


Figure 2. A fourth-grade student's work.

The fourth-grade student's work is correct and illustrates an invented strategy for division. The participants were asked to examine the student work and respond in writing to the following prompt: "Explain HOW the student performed the division. Where did the numbers 50 and 4 come from?"

Data Analysis

It is not clear from the student's work whether he used a counting-up strategy or a division strategy. (A counting-up strategy would involve counting by 50 to arrive at 300 and counting by 4 to arrive at 24. A division strategy would involve dividing 300 by six, resulting in 50, and dividing 24 by 6, resulting in 4.) In either case, the numbers 300 and 24 are important parts of the strategy, even though the student did not record these numbers. Once the fourth-grade student arrived at the numbers 50 and 4, he added these to reach the correct answer of 54. Thus, an ideal PST interpretation of the student work would involve an explanation of how the student may have arrived at 50 and 4 and a recognition that 50 and 4 must be added to reach the final answer.

Thus, to analyze the data, the researchers grouped the PSTs' interpretations into three categories. In Category 1, there is no mention of the numbers 300 or 24 and no mention of adding 50 and 4. Figures 3 and 4 contain examples of Category 1 interpretations.

In this case, the division was performed by factoring. $54 \times 6 = 324$

Figure 3. Example of a Category 1 interpretation.

Round to or estimate that 50 students would or could ride the bus which leaves 4.

Figure 4. Example of a Category 1 interpretation.

In Category 2, the PST mentions division, but does not specifically explain how the student arrived at the numbers 50 and 4. (The PST does not mention dividing 300 by 6 or dividing 24 by 6.) Figure 4 contains an example of a Category 2 interpretation.

The student drew 6 buses then 7 cars. Then subtracted the total of students from 7 which was the total of people in the cars. Finally he divided 324 by the six buses. He got 50 and 4 to make a total of 54 for the answer.

Figure 5. Example of a Category 2 interpretation.

In Category 3, the PST explains how the student obtained the numbers 50 and 4 by mentioning 300 and 24. Figure 5 contains an example of a Category 3 interpretation.

The student put 50 students in each bus. 50 times 6 is 300. This leaves 24 students to be divided among the 6 buses, adding 4 students to each bus.

Figure 6. Example of a Category 3 interpretation.

Results

What percentage of PSTs can correctly solve a fourth-grade word problem that requires subtraction followed by division?

Before viewing the fourth-grader's work, PSTs attempted to solve the "Buses" problem. Forty-eight of the 51 PSTs (94%) computed the correct answer of 54. One of the PSTs who failed to correctly answer the problem subtracted incorrectly. The other two left the question blank.

What percentage of PSTs can interpret a fourth-grade student's invented strategy for division?

Table 1
Number and Percentage of Participants in Each Category of Response

	Number of PSTs	Percentage of PSTs
Category 1	16	31%
Category 2	17	33%
Category 3	18	35%

In both Category 1 and Category 2, the PST did not explain how the student arrived at the numbers 50 and 4. Thus, approximately two-thirds of our participants (Categories 1 and 2) were not able to give a clear explanation of the student-invented strategy for division. Only 35% of participants seemed to understand that 324 can be broken down into 300 and 24 to facilitate division by 6.

Conclusion

Having teachers who can interpret student work is essential in the learning process. When teachers make thoughtful analyses of their students' work, they will discover patterns in the errors that their student make which will help teachers change their teaching approaches accordingly. One reason that is causing our PSTs to not be able to interpret student work could be that most of the PSTs may not have been taught this method of division in elementary school and are, thus, unfamiliar with this method. Hence, it would be helpful to have more curriculum resources for use in teacher-education programs that contain samples of children's mathematical work that PSTs can be challenged to interpret.

References

Ball, D. L., Thames, M. H., & Phelps, G. (2008). Content knowledge for teaching: What makes it special? *Journal of Teacher Education, 59*, 389-407.

Charalambous, C. Y. (2016). Investigating the knowledge needed for teaching mathematics: An exploratory validation study focusing on teaching practices. *Journal of Teacher Education, 67*, 220-237.

Ng, S. F., & Lee, K. (2009). The model method: Singapore children's tool for representing and solving algebraic word problems. *Journal for Research in Mathematics Education, 40*, 282-313.

Nosegbe-Okoka, C. (2004). A sense-making approach to word problems. *Mathematics Teaching in the Middle School, 10*, 41-45.

Ponce, G., & Garrison, L. (2005). Overcoming the walls surrounding word problems. *Teaching Children Mathematics, 11*, 256-262.

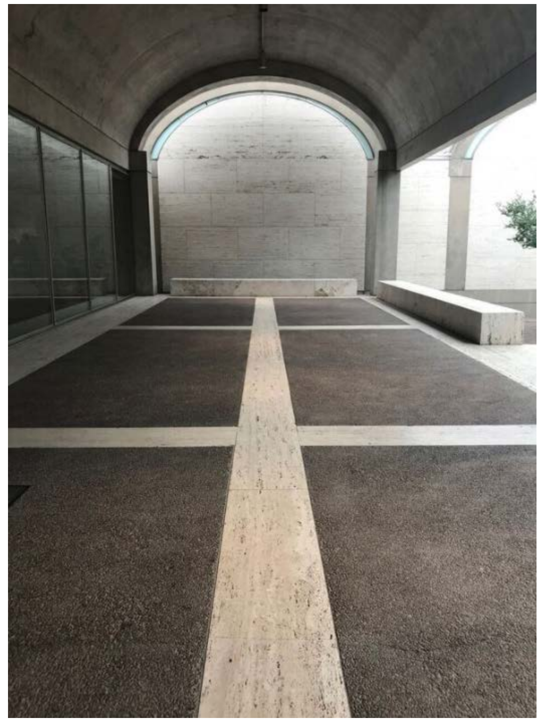
Scheuermann, A., & van Garderen, D. (2008). Analyzing students' use of graphic representations: Determining misconceptions and error patterns for instruction. *Mathematics Teaching in the Middle School, 13*, 471-477.

Shulman, L. S. (1986). Those who understand: Knowledge growth in teaching. *Educational Researcher*, *15*(2), 4-14.

Texas Education Agency. (2012). *Texas Essential Knowledge and Skills for Mathematics Subchapter A. Elementary*. Retrieved from http://ritter.tea.state.tx.us/rules/tac/chapter111/ch111a.html

Van de Walle, J. A., Karp, K. S., & Bay-Williams, J. M. (2016). *Elementary and middle school mathematics: Teaching developmentally* (ninth edition). Boston: Pearson.

Zhang, D., & Xin, Y. P. (2012). A follow-up meta-analysis for word-problem-solving interventions for students with mathematics difficulties. *The Journal of Educational Research, 105*, 303-318.




Reflections from AMTE
Dr. Randy Philipp
President, AMTE
San Diego State University
Fifth Annual AMTE Texas Conference
September 30, 2017

Conference Break-Out Sessions

Preparing Pre-Service Teachers to Engage all Students, Including Students of Poverty
Jim Ewing

Ethnomathematics Meets Math History: Incorporating Equity into a Middle School Content Course
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Building a Community of Graduate Student Mathematics Teacher Educators
Ryann Shelton, Keith Kerschen

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Relationships Between Perceptions of Gender-Roles, Mathematics Anxiety, and an End-of-Course Oral Exam
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Texas Lesson Study Initiative: The What, When, Where, How, and Challenges
Connie Yarema

Looking Ahead: Upcoming Conferences

Upcoming Conferences

January 10-13, 2018	MAA-AMS Meeting	San Diego
February 8-10, 2018	AMTE Conference	Houston
February 22-24, 2018	RCML Conference	Baton Rouge
April 23-25, 2018	NCTM Research Conference	Washington, D.C.
April 25-28, 2018	NCTM Annual Meeting	Washington, D.C.
July 16-18, 2018	CAMT	Houston
Sept. 21-22, 2018	AMTE-TX Fall Conference	Nacogdoches
October 4-6, 2018	NCTM Regional Conference	Hartford
October 18-20, 2018	SSMA Annual Convention	Little Rock
November 1-3, 2018	NCTM Regional Conference	Kansas City
November 15-18, 2018	AMATYC	Orlando
November 15-18, 2018	PMENA Conference	Greenville
November 28-30, 2018	NCTM Regional Conference	Seattle

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Visit the AMTE-TX website for criteria.

Don't forget our call!
See page 6 of this issue.

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