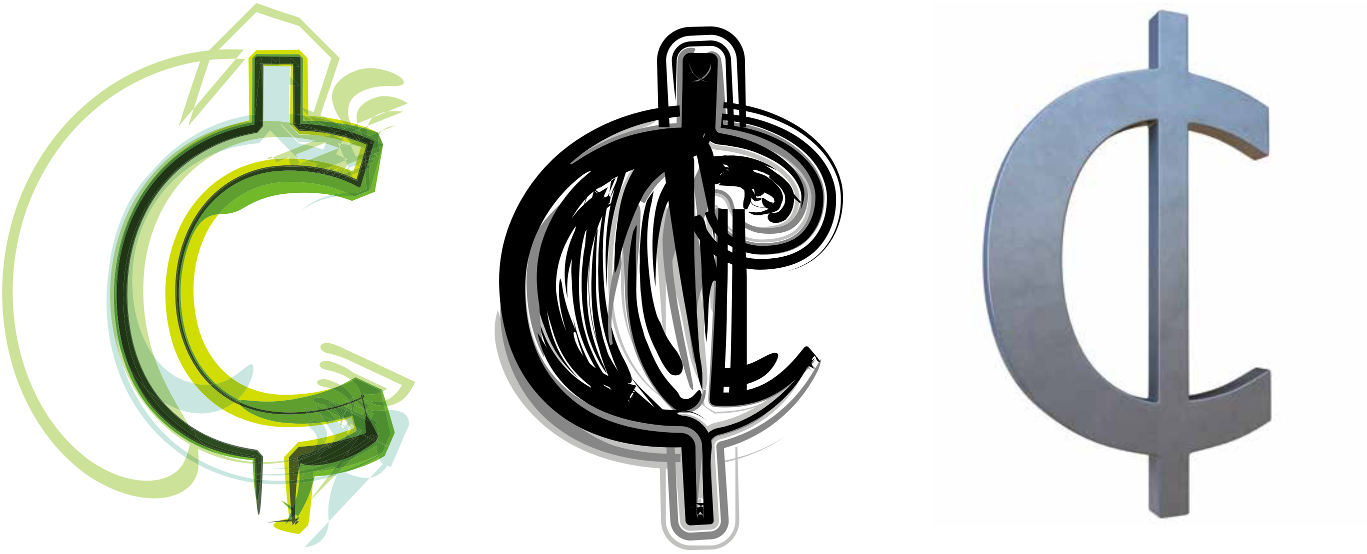

LEFT: AROAS/THINKSTOCK; CENTER: AROAS/THINKSTOCK; RIGHT: MATEJMO/THINKSTOCK

The Unit Makes All the Difference

Mary Beth Rollick

“What’s the unit?” The answer to this question makes all the difference. A young child who is asked to count shoes needs to know if the unit to be counted is “pairs” of shoes or individual shoes. A middle school student who is asked for the length of a table will want to know if the number should be in inches, feet, or meters. The importance of the unit is cited as early as prekindergarten as an essential understanding, Big Idea 2a, “Using numbers to describe relationships between or among quantities depends on identifying a unit” (Dougherty et al. 2010, p. 8). Judging whether an answer is expressed in the appropriate unit is also cited as a key element of reasoning and sense making and is considered foundational for high school (NCTM 2009, p. 21).

Mistakes stemming from not attending to the unit are common. A case in point is the sign found at a bakery (see **fig. 1**). On the basis of this highly visible mistake, 133 preservice elementary teachers who were enrolled in a Mathematics for

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Fig. 1 This sign in a bakery window spurred on a teachable moment about the importance of the unit.

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Fig. 2 Preservice teachers were shown a restaurant's message, given a prompt, and asked to compute the cost of the meal.

Value Meal—Just .99 cents with your college ID

Merinda has invited three of her friends to Fresh Fried Chicken Restaurant for dinner. She wants to be sure that she has enough money to pay the bill. If everyone orders the special, just one special for each person and nothing else, how much money will she need? Assume that everyone drinks water and that there is no tax. Support your answer as you create a poster to show your answer and your reasoning.

Elementary Teachers course were asked this question in a formative assessment before beginning a unit on decimals:

Is .99 cents the same as $.99?

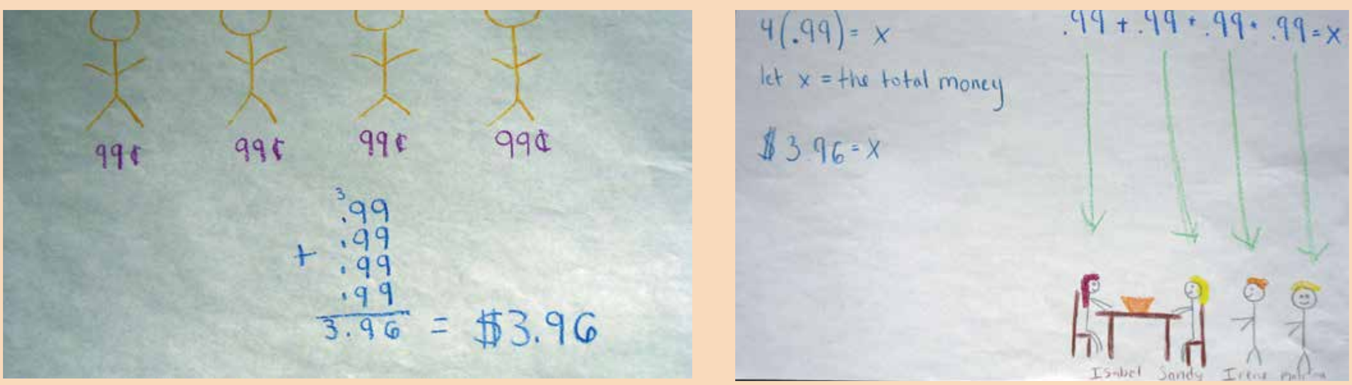
Almost 65 percent (86/133) of the students incorrectly responded "Yes, $.99 = .99 cents." To eliminate this misunderstanding, we designed an in-class project to help the students understand the importance of the unit. The students formed groups of two to four students and looked at the question in **figure 2**. Initially, most groups either ignored the improperly placed decimal and used 99 cents in calculating the total bill (see **fig. 3a**) or kept the decimal and translated the amount to read $.99 (see **fig. 3b**). In both cases, the groups ended up with a bill of $3.96.

As we circulated around our classrooms, we asked students if a penny was the same amount as a dollar, and they vehemently disagreed. When they returned to their work on the project, many students paused to consider both our question and the advertisement, which specified that the value meal cost a little less than 1 cent. They became bothered because the advertised price seemed ridiculous.

The groups continued to discuss the issues, and several groups illustrated their explanation (see **fig. 4**). As student groups shared their posters, they discussed how the advertisement should have been written. They emphasized the importance of the unit being either dollars or cents and how that decision affected the number. The correct answer to the question as stated was that Merinda needed only 3.96 cents, just a little less than 4 cents. The students wanted the advertisement to be rewritten so that the special would cost a more reasonable $0.99; the restaurant would then charge the expected $3.96, or 396 cents.

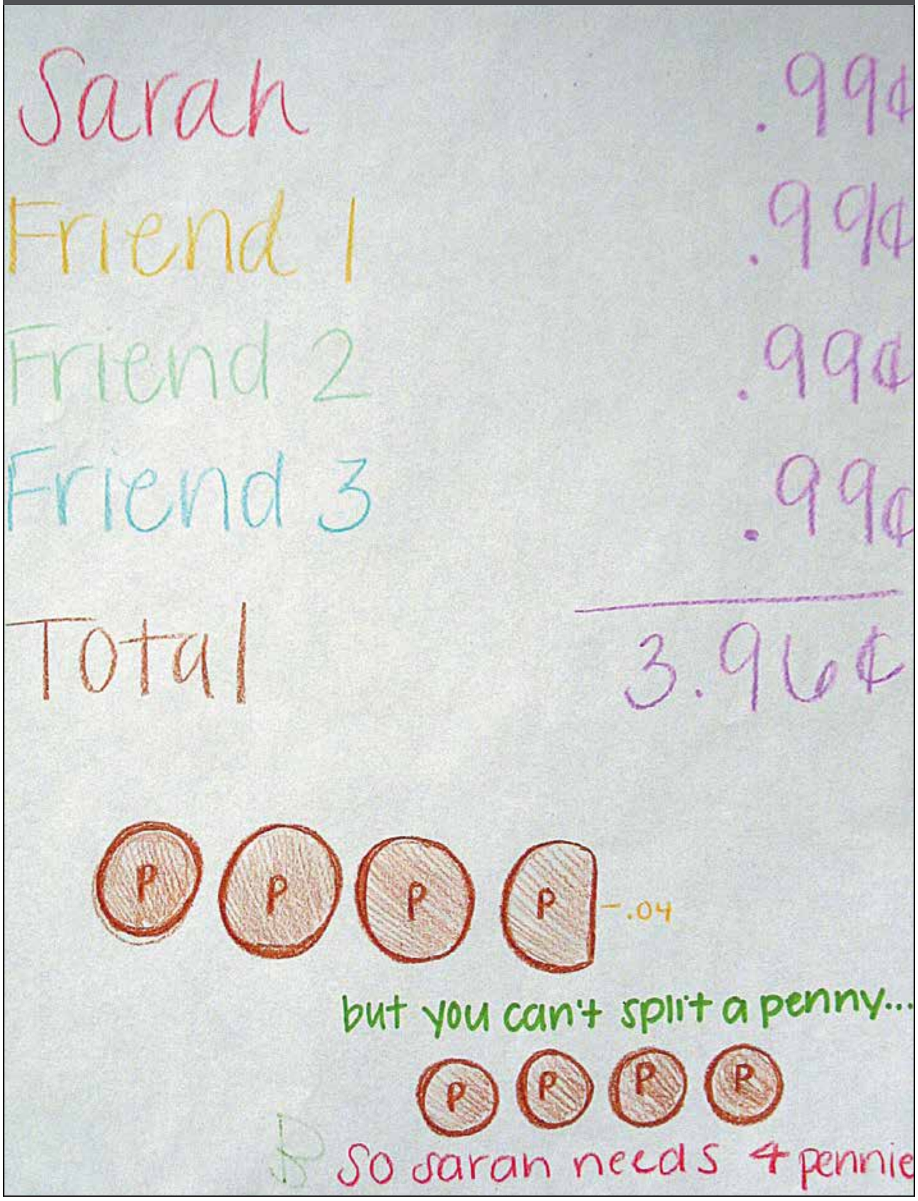
After completing the class project, the students were asked to view a video on YouTube™ in which a dissatisfied customer calls his phone company to complain about his bill. The customer had been quoted a

Fig. 3 These posters show the unit being treated in different, incorrect ways. Poster (a) read, "Value meal = 99¢."



(a) **(b)**

Fig. 4 After a new understanding occurred, the penny as a unit made an appearance.



price of .002 cents per kilobyte of data, and he had used 35,893 kilobytes. The customer first checks to be sure the quote was still .002 cents per kilobyte. When this is confirmed, he lodges his complaint (http://www.youtube.com/watch?v=zN9LZ3ojnxY). After the students completed a writing assignment on this video, they were given a posttest. Ninety-one percent of the students recognized that .99 cents was not the same as $0.99, but we found a second confounding issue: Students had difficulty determining what to do with the remainder even when the question is asked in context.

To test this posttest observation, we presented another question:

> Candy bars are on sale this week 3 for $1. You want to buy only one candy bar. How much would you pay for this one candy bar?"

Only 14 percent of the students correctly answered $0.34 or 34 cents; 86 percent of the students rounded down to 33 cents. In the follow-up discussion to this question, the unit was identified as "cent," which necessitated the reality that fractions of a cent would be rounded up in this context. Some students explained that although the question was asked in context, they focused only on the rule of rounding. Others admitted that they had never bought just one when the sale stated a certain number for a sale price, like 3 bars for $1. In the discussion, the students showed evidence of using the Standards for Mathematical Practice as they listened to and critiqued one another's arguments and made sense of the answer for this scenario.

This article presents an example of why paying attention to the unit under discussion makes all the difference. Because advertisements like the one at the bakery window are not uncommon, teachers must be careful to discuss with students the proper use of units. Students should expect their answers to make sense and recognize errors when they see them in advertisements.

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