Shopping for Shoes

Katie and Amy went shoe shopping this week. They each found a cool pair of shoes to buy. The shoe store was having a special sale: Buy 1 pair and get the 2nd pair at 1/2 price. Katie's pair of shoes cost $50 and Amy's cost $35.

If Katie and Amy buy their shoes together in order to get the discount, how much should each person pay? What is fair? Explain your answer and explain why you chose the answer that you did.

Note:

It is understood in this type of a sale that you pay full price for the more expensive item.

Grade Levels 3 - 5

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Context

The context of this problem was an everyday situation that seemed simple, but actually required some pretty in-depth mathematical knowledge and problem solving skills. The task dealt with a concept that is very important to all third and fourth graders: What is fair? This shoe shopping dilemma really occurred with Amy and Katie, two of the children's teachers.

What This Task Accomplishes

This task allows the teacher to assess children's conceptual knowledge in many areas. Below are listed some of most prevalent ones:

Fractions:

Do the students understand that one half off one price is not necessarily equal to one fourth off one price and one fourth off another price even though 1/4 + 1/4 = 1/2?

Money:

How well do students understand the addition, subtraction and division of money?

Reasoning:

How do students deal with a fairness issue in a situation where what is fair may not be equal? For example, do children believe that what is fair is that Amy and Katie both pay the same amount for different valued products? Do they feel that Amy should get the entire discount since the discount is taken from her shoe price? Do they think that what is fair is to have the same amount discounted off each original price?

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Percents:

Do the students relate their knowledge of percents to this problem? For example, we just finished a unit on probability. Some children said that 50 percent of the M&Ms® in a big bag are more than 50 percent of the M&M's® in a small bag, therefore one half off one pair of shoes does not necessarily equal 25 percent off each pair.

What the Student Will Do

My students were pretty well split into three categories on this problem although evidence of all these categories is not seen in the benchmarks presented. (See examples of reasoning listed above.)

Most students started by finding one half of the less expensive pair and adding that amount to the more expensive pair to find the total amount of money owed, $67.50. The task now became a problem and strategies varied. Many children split the total amount due in half and said that Amy and Katie each paid $33.75. Some felt this was okay, others felt it was not due to the difference in the original prices of the shoes. This solution meant that Amy saved $1.25 and Katie saved $16.25. It also meant that Katie got much nicer boots for the same price as Amy's cheaper ones.

I think most children got sidetracked by looking at the one half off the lowest price not as a discount, ($17.50 off), but as the amount owed for that pair of shoes. Once children realized that $17.50 was also the amount saved it seemed to be clearer that the amount should be split so that Amy and Katie save the same amount, not pay the same amount.

What seemed to be the biggest issue here in assessing these tasks was the children's varying levels of reasoning. It did seem that the older children in my class displayed more mature reasoning skills when thinking about what might be fair.

Time Required for Task

Three - four, 45-minute periods

Interdisciplinary Links

The largest link with this unit seems to be with real life situations. There are often stores that offer sales like the one in this task. Presently, my students are doing a unit on the United States. It is a simulation in which they travel across the country visiting places, buying souvenirs and supplies, etc. The Shoe Shopping problem could have been easily adapted to be tickets for an amusement park or souvenir shirts, etc.

Certainly with a little creativity the problem could be adapted for many types of units dealing with anything that is purchased: food, toys, ski tickets, clothes, etc.

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I think the fairness issue presented in this problem could also be a very interesting link.

Teaching Tips

I introduced this problem by first talking about what fair meant. We discussed sharing a candy bar, sharing a game, buying things together, even consequences for late homework for different kids!

I then told the story of shoe shopping, passed out the task and told the kids they could work in pairs. Although I do not often have the kids work in pairs for an entire task, it really seemed to help them on this one, especially with the reasoning.

For an adapted version, you could do a similar task in which the shoes cost the same amount of money. Also, changing the cost of the shoes so that there is a larger difference between the prices such as $60 and $20 might help children to realize that splitting the total cost might not be fair. In this example, that would mean that each person would pay $35. Children might have an easier time seeing this does not work well for both people.

If the children seem to be having a lot of difficulty understanding the issue of fairness, I might try having a list of questions for children to answer after they think they have solved the task: How much does each person pay? Why is this fair? How much money is saved? How much does each person save? If some of these questions are asked, the task should probably be considered a practice or teaching task versus an assessment task due to the prompts.

Suggested Materials

- Calculators
- Money manipulatives

Possible Solutions

The total amount paid for the shoes is $67.50. If children reasoned that the fairest way to pay was to split the discount, then Amy and Katie each got $8.75 off their original shoe prices. This would mean that Amy paid $26.25 and Katie paid $41.25. Other answers varied depending on the reasoning used.

Benchmark Descriptors

Novice
This student has an incomplete solution. There is no evidence of a strategy used, no evidence of reasoning, no explanation and no representation.

Apprentice
This student shows understanding of part of the problem. S/he uses a strategy that is partially useful by finding the amount of the discounted pair of shoes and the total amount of money that

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is owed. Although s/he gets stuck and cannot carry out the mathematical procedures necessary to solve the problem, there is evidence of reasoning. There is an explanation although it is not complete.

Practitioner
This student shows understanding of the task. Effective reasoning is shown through the student's choice to split the money saved versus the money paid. There is some use of effective math notation and language and an attempt at using accurate representation.

Expert
This student shows a deep understanding of the problem and the information necessary to solve it. S/he uses a straightforward approach and uses refined reasoning to clearly explain the decisions made and the solution. Accurate representation is included with the student's solution.

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Novice

No evidence of a strategy that helps solve the problem.

Amy's pair costed $35.00

Katie's pair costed $50.00

Incomplete solution.

No explanation and no representation.

Katie's pair now costs $25.0 0

Amy's pair now cost's

Apprentice

> The student finds a way to get the discounted pair of shoes then finds the total amount due.

Hlaf of 35 ~~is~~ is hard to do so think of it this way   20 + 10 + 5
10 + 5 + 2½

Half of 35 is 17½ = 15 + 2½ =
so $50.00   17 ½
+$17 ½   or you can
_____   think of
$67.0½   the   ½ as
The Totatl price $.50 ¢
of the shoes
~~is~~ is $67.50

> There is some use of appropriate math language.

and Half of
$67.50 ~~is~~
Half of 60 is 30   and
Half of 7 is 3 ½ and
Half of 50¢ is 25¢

+ 30   I am Stuck
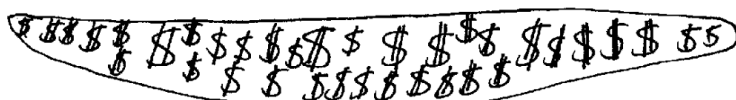 3½
+ 25¢
_____
$385½

> The student gets stuck trying to divide the total amount due in half. This shows some reasoning although the result might not be the most "fair" way.

Practitioner

Student attempts to use representation, but does not use effective notation and language.

$1.00 SHOE SHOPPING $1.00

we think tht each person gets $8.75 off their shoes.

$ 1,2.25
+ $2 ,25
————
$ 6 .50

How we got $17.50 is by
the cost of AMY'S Shoes is 17.50,
Because half of $35.00 is 17.50
and half of that is $8.75

Amy	has to pay $35.00	But we think that Amy, katie shouldget $8.75 off	has to buy $26.25. That means that someone						
Katie	has to pay $50.00	their shoes that means that katie has to pay $41.25 and Amy	should write out a check for $67.50						

How we got $17.50 is by spliting $35.00 in half. Then half
of $17.50 woitch is $8.75
(the cost of Amy's shoes)

The student's solution shows good understanding and effective reasoning by splitting the money saved versus the money spent.

Expert

Final Draft

~~Katie~~ Katie has to
pay $41.25 for her shoes

$$\begin{array}{r} \$50.00 \\ -\ \$8.75 \\ \hline \$41.25 \end{array}$$

Amy has to pay $26.25
for her shoes.

$$\begin{array}{r} \$35.00 \\ -\ \$8.75 \\ \hline \$26.25 \end{array}$$

> The student shows a deep understanding of what needs to be done to solve the problem in a straight forward manner.

The reason I did this was
because I did half of
Amy's shoes and got $17.50
then I did half of that
and got $8.75 and then
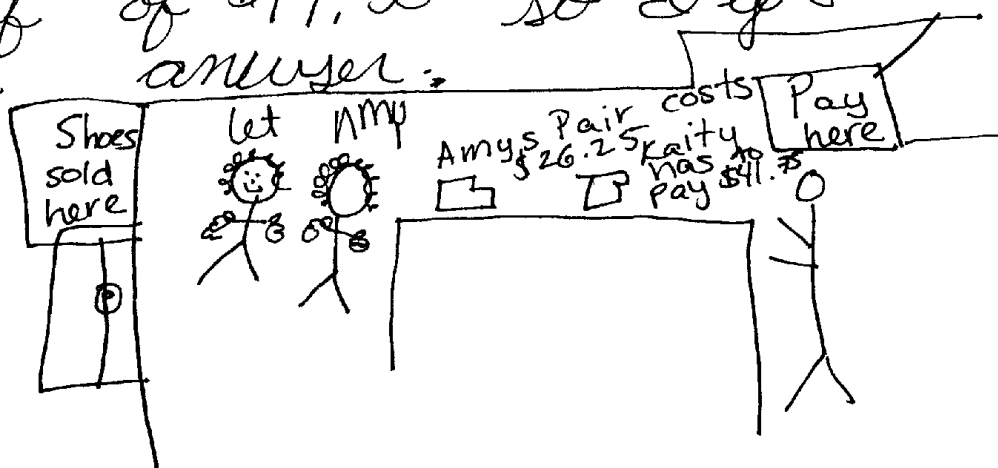I — from Amy's cost of
shoes and KX's pair

Expert

and I found out
KT has to pay $411.25
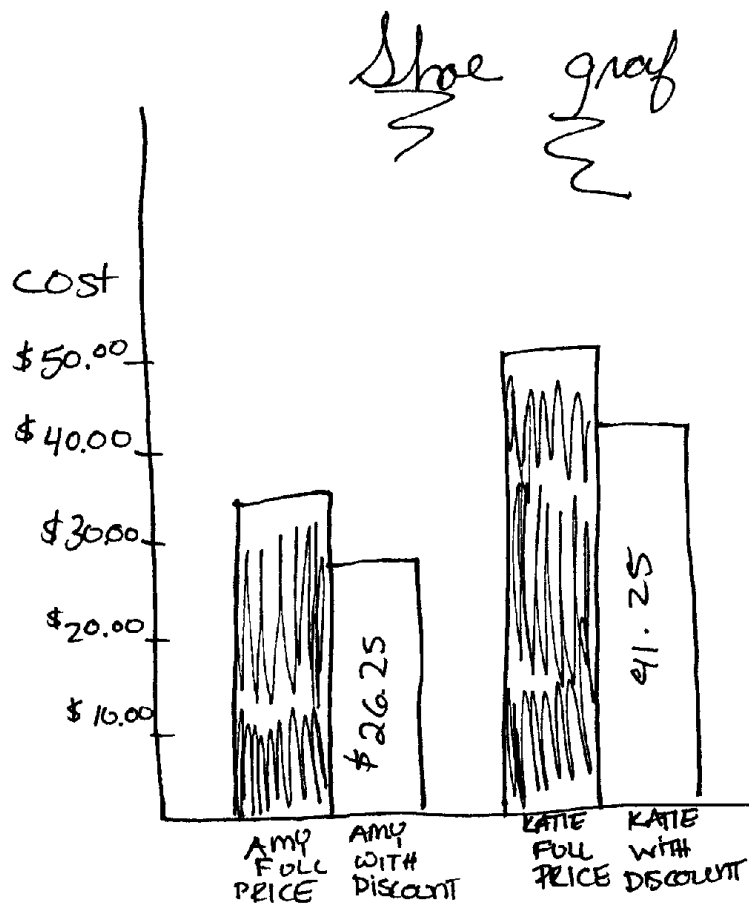and Amy has to
pay $26.78

(half of the lowest price)

> Complex reasoning explained in explanation of money paid.

I thought this was fair because the sole was half of the lowest cost so I did half of amy's pair of shoes and so they save $17.50. Then they both get $8.75 of because that's half of $17.50 so I got the answer.

Shoes sold here

let Amy

Amys Pair costs $26.25 Kaity has to pay $41.5

Pay here

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Expert

Shoe graf

$$2 \overline{) \$35.00}$$

$$\$30 \div 2 = \$15$$

$$\$5 \div 2 = \$2.50 + 15 =$$

$$\$17.50$$

$$= discount$$

cost

$50.00

$40.00

$30.00

$20.00

$10.00

$26.25

41.25

Amy Full Price

Amy with Discount

Katie Full Price

Katie with Discount

Student explains how problem is solved and why decisions were made. Includes representation.