M&M® Mini-Bus Challenge

Present orally to students

The other day I was standing in line at the grocery store when I noticed a display of little cardboard school busses filled with miniature M&M's. I bought them thinking I could create a fun math problem with them and sure enough, I did!

You will notice that these mini-buses have 10 boxes/seats. My challenge to you is to mathematically determine how many of each color M&M® is riding on that mini-bus without counting all of the M&M's®.

You may count the contents of up to 5 of the boxes/seats.

At least 5 of the boxes/seats must remain closed until the end of the activity.

At the end of the activity you may open all of the boxes/seats and evaluate the accuracy of your determination.

Grade Levels 3 - 5

M&M® Mini-Bus Challenge

Present orally to students

The other day I was standing in line at the grocery store when I noticed a display of little cardboard school busses filled with miniature M&M's. I bought them thinking I could create a fun math problem with them and sure enough, I did!

You will notice that these mini-buses have 10 boxes/seats. My challenge to you is to mathematically determine how many of each color M&M® is riding on that mini-bus without counting all of the M&M's®.

You may count the contents of up to 5 of the boxes/seats.

At least 5 of the boxes/seats must remain closed until the end of the activity.

At the end of the activity you may open all of the boxes/seats and evaluate the accuracy of your determination.

Context

This task was presented to a class of low-performing fourth grade students after a unit on estimation. Students had experiences with sampling, graphing and different estimation strategies prior to being presented with this activity. Students had also been reading *The Math Curse* by Jon Scieszka and Lane Smith which is a terrific book to read to students to get them thinking about how everything in life can be thought of as a math problem.

What This Task Accomplishes

This task allowed the classroom teacher to see which concepts of estimation the students have internalized and can apply to an appropriate mathematical situation. The mastery of concepts such as determining a sample size and applying a ratio were necessary in successfully solving this task. The student products allowed us to determine the degree to which students have mastered these skills. We also required that students determine the reasonableness of their results (a goal stated in the NCTM Standards). The standards also encourage that students identify a range for "good estimates," and that students should always check their solutions against their original estimates so that students can use the feedback to refine their estimating skills.

What the Student Will Do

Some students emptied out five boxes in a pile, sorted by color, counted them and then

doubled these numbers to make their determination. Other students opened one or two boxes, sorted them by color, counted them and then multiplied by five or ten. Neither group tended to discuss sample size in making their decision to open the number of boxes that they did. This was disappointing. We had a follow-up discussion about this with students after the activity and realized that although they had the concept of "the larger the sample, the more accurate your results are likely to be," students had difficulty explaining this idea. Students who have had a unit on probability before undertaking this activity may take a different approach by determining the typical number of each color candy per box and then using those results to predict the number of each color in ten boxes. This was how I approached this activity when I solved it myself and my results tended to be more accurate.

Time Required for Task

Three 45 - 60 minute periods

This includes time for introducing the task and discussing expectations, as well as allowing for time for students to assess their own performance.

Interdisciplinary Links

Estimation is a mathematical topic that cuts across many fields of knowledge. Park Rangers often estimate the numbers of animals in their forests based on a sample. Samples of blood are drawn from patients to make a determination of an entire patient's blood. It would be a terrific idea to keep a running list in your classroom of real-world applications of estimation and sampling in the real world.

Teaching Tips

Although this task was presented orally to students, supplemental print information was provided as well. On charts in the classroom were listed the following:

Task:

Mathematically determine the number of each color of M&M's® there are in the bus without counting all of the M&M's®.

Guidelines:

- You may count the contents of up to 5 boxes.
- At least 5 of the boxes must remain closed until the end of the activity.
- When you have gotten the "OK", open all the boxes and evaluate your determination.

Must Haves:

- Explain/show what you did and why;
- Mathematical representation (chart, table, graph, etc.);

- Good use of mathematical language;
- A mathematical conclusion; and
- An "I noticed..." statement.
- Evaluate the reasonableness of your determination before looking at all 10 open boxes.
- Compare your determination to the actual number of M&M's®. How close were you? Why do you think so?

Students also brainstormed a list of mathematical terminology they might use when communicating their solution. This was kept up so students could easily refer to it when writing up their solutions. Students also brainstormed ideas for "I noticed..." statements such as finding the range of each color of M&M's®, the mode, the median, etc.

In order to make sure students did not eat their data before the task was completed and to avoid other potential disruptions, we had students sign the following contract before they were given their M&M's®:

Candy Eating Contract:

I understand that I may not eat any M&M's® until I have been given permission to do so. I will not ask about when I can eat my candy or I am breaking this contract and will need to write a new contract with the teacher. If I follow the rules above, I will get 5 mini-boxes of M&M's® to eat.

This contract worked very well, with only one student needing to make a new contract.

Suggested Materials

Mini M&M® Buses or another candy/object that has a sorting attribute and comes as a whole broken into smaller parts.**

**Halloween candy bags of M&M's® could work, books of Life Savers®, etc. Our students worked in partners, eliminating the need to buy a bus of candy for every student.

Possible Solutions

Solutions will vary, but the reasoning behind the solution should be valued more than an actual numerical answer. When I did this activity, these were the results I obtained:

Color	Box 1	Box 2	Box 3	Box 4	Box5
Green	6	5	5	5	3
Brown	9	7	11	5	7
Blue	10	11	9	13	11
Red/Pink	15	14	13	13	17
Orange	6	8	5	10	9
Yellow	6	7	8	6	6

I then took the average of each color in each box and multiplied by 10 to make my estimate:

Average in each box	Candy Color Times 10	Equals Prediction	Actual Number in 10 Boxes	Difference between estimate and actual
4.8	Green x 10	48	47	1
7	Brown x 10	70	66	4
12	Blue x 10	120	115	5
14.4	Red x 10	144	154	-10
7.6	Orange x 10	76	77	-1
6.6	Yellow x 10	66	62	4

Benchmark Descriptors

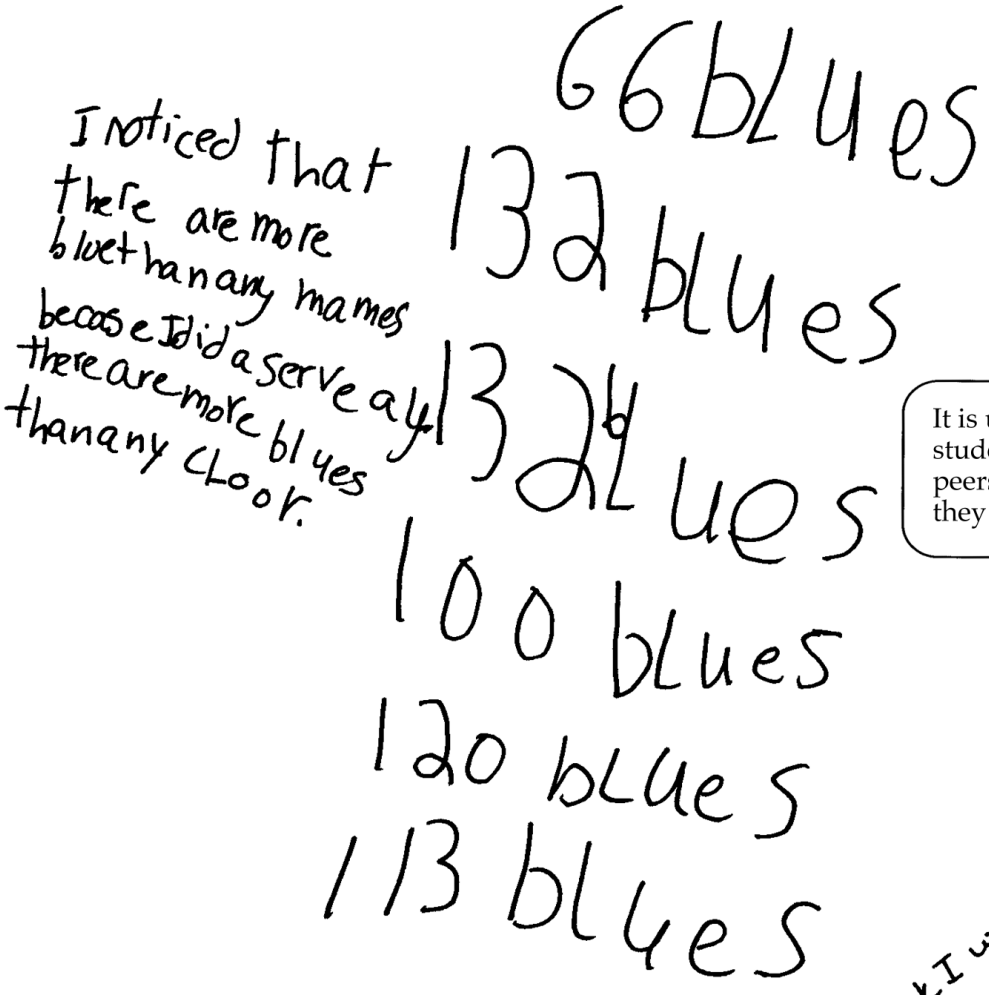
Novice
A Novice will tend to have little or no reasoning behind his/her approach. The Novice will make a guess with no mathematical logic or consistency. The Novice will use little or no mathematical language and will not clearly document his/her work.

Apprentice
An Apprentice will have some mathematical reasoning behind his/her approach, but the reader will question whether or not the student's final conclusion has a mathematical basis. The Apprentice will confuse the "answer" with being the total number of candies and not the number of each color candy. The Apprentice may use some limited mathematical language and representation to communicate his/her solution.

Practitioner
A Practitioner will obtain a solution that has a mathematical basis. The Practitioner will document his/her work so that one can clearly tell what was done to solve the task and why. A Practitioner will use a variety of mathematical language and representation and will attempt to make some mathematically relevant observation, although it will be rudimentary in nature.

Expert
An Expert will obtain a solution that is supported with a mathematical argument. Procedures and reasoning will be explained, all work documented and the student will make a mathematically relevant observation. The Expert will use a variety of mathematical language and representation to clearly communicate his/her solution.

Novice



It is unclear here that the student surveyed his/her peers to see what color they had the most of.

The student evaluates his/her solution based on solutions obtained by the class.

"I think I will be pretty close, because I got blue the most and everyone else did too. That's why I did a same."

Novice

This is how many of each color m&m there are in 5 boxes

color m&m	number of m&m
blue	60
red	55
yellow	35
orange	48
brown	27
pink	32
green	25
This is how many of each of color m&m there are in boxes (1oor!	
blue	80
red	70
yellow	50
orange	60
brown	40
Pink	50
green	35

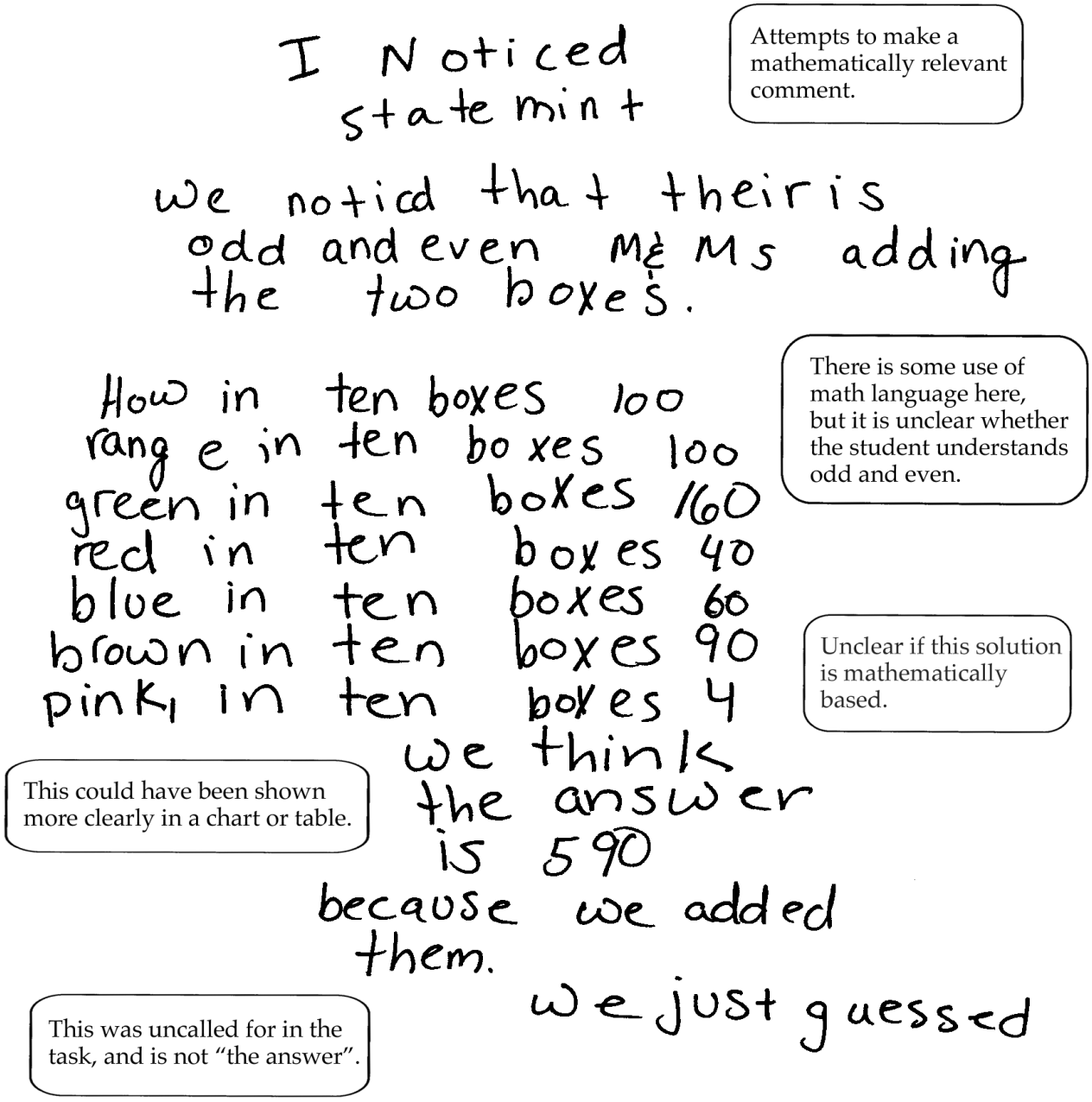
"we sorted them → like Chris took 2 and I took 3 boxes. He took all the ones he had and we put them all together, and we counted them and that's how we got them"

Very little math language is used to communicate. This representation is basic, but communicates the student's solution.

This determination is not based on sound mathematical reasoning the student lacks the concept of a 1:2 ratio.

" I just guessed. Like I got blue and we counted 60 in 5 boxes so I guessed 80 because there are more boxes."

Apprentice



Attempts to make a mathematically relevant comment.

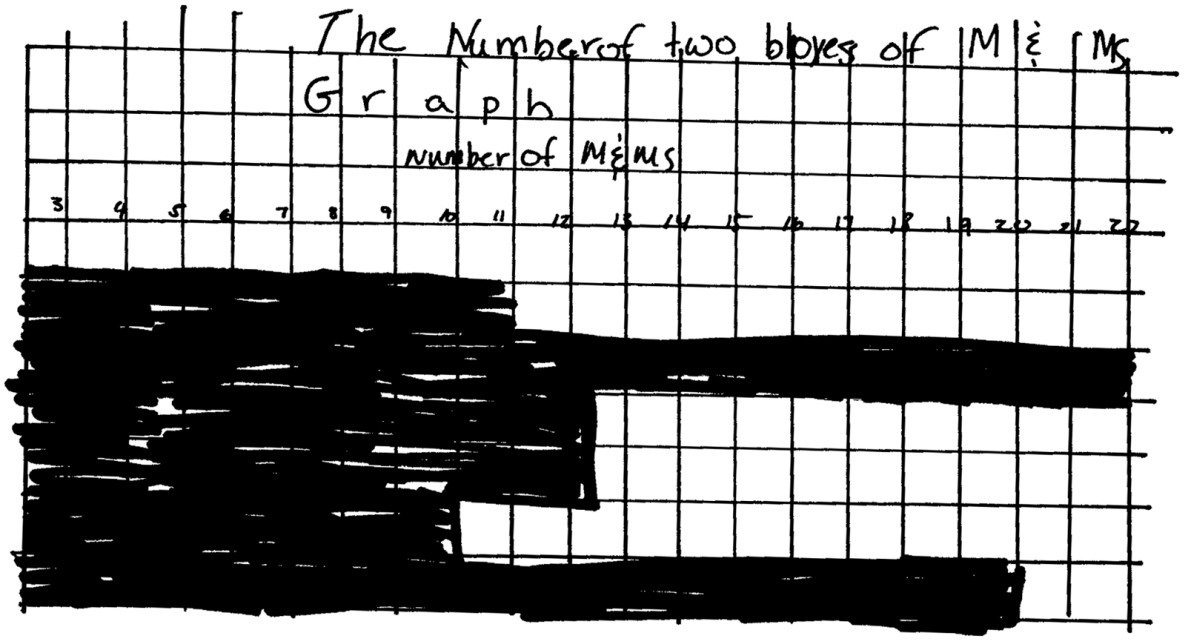
There is some use of math language here, but it is unclear whether the student understands odd and even.

Unclear if this solution is mathematically based.

This could have been shown more clearly in a chart or table.

This was uncalled for in the task, and is not "the answer".

Apprentice

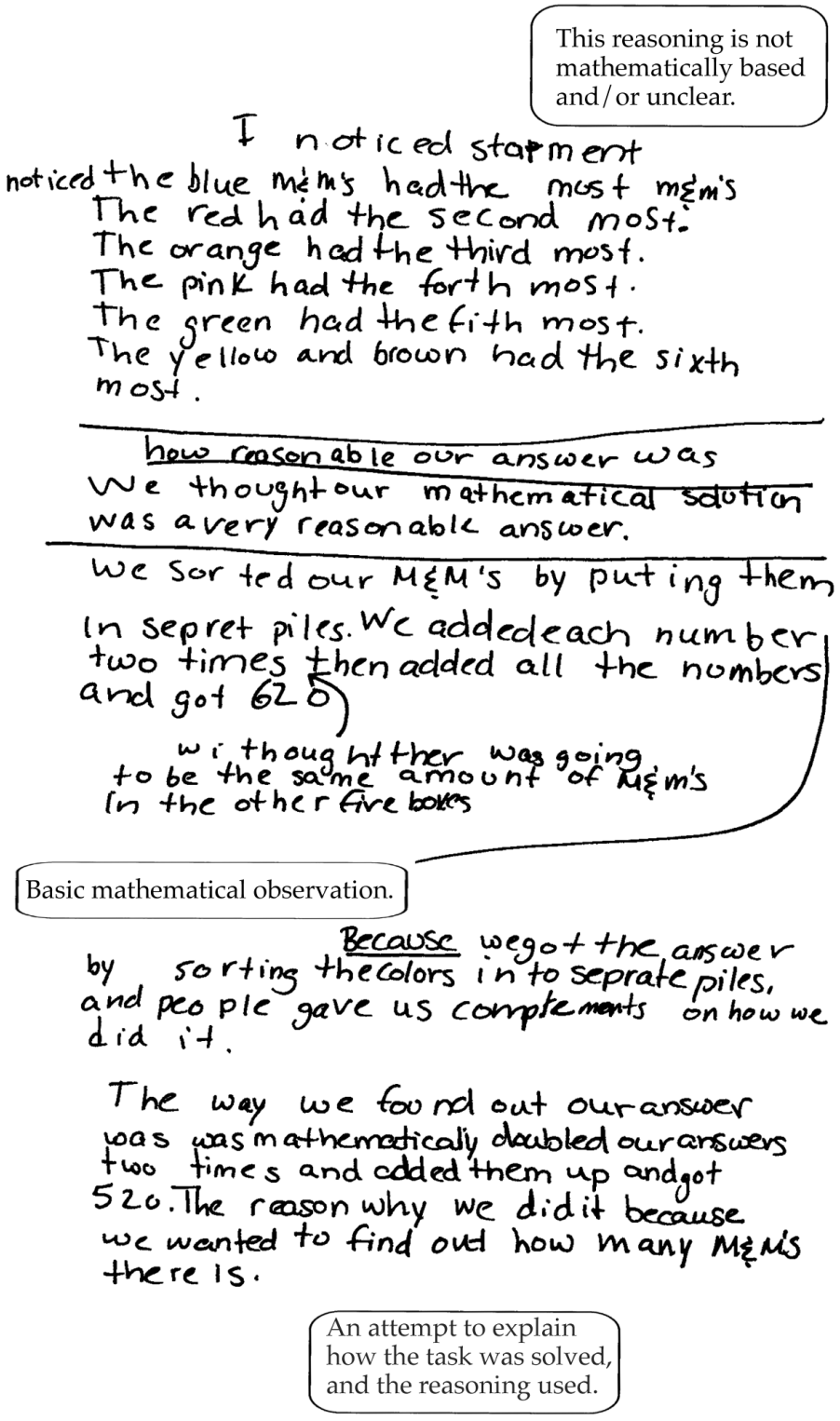


Title is confusing.

X axis does not seem clearly labeled.

Key: This

Practitioner



This reasoning is not mathematically based and/or unclear.

I noticed statment
noticed the blue m&m's had the most m&m's
The red had the second most.
The orange had the third most.
The pink had the forth most.
The green had the fith most.
The yellow and brown had the sixth most.

how reasonable our answer was
We thought our mathematical sdution was a very reasonable answer.

We sorted our M&M's by puting them in sepret piles. We added each number two times then added all the nombers and got 620

wi thought ther was going to be the same amount of M&m's in the other five bokes

Basic mathematical observation.

Because we got the answer by sorting the colors into seprate piles, and people gave us compliments on how we did it.

The way we found out our answer was was mathematically doubled our answers two times and added them up and got 520. The reason why we did it because we wanted to find out how many M&M's there is.

An attempt to explain how the task was solved, and the reasoning used.

Practitioner

I think there will be 72 pink M&M's from the 10 boxes.

I think there will be 50 brown M&M's from the 10 boxes.

I think there will be 50 yellow M&M's from the 10 boxes.

I think there will be 52 green M&M's from the 10 boxes.

I think there will be 102 red M&M's from the ten boxes.
I think there will be 82 orange M&M's.

Student states his/her prediction.

Practitioner

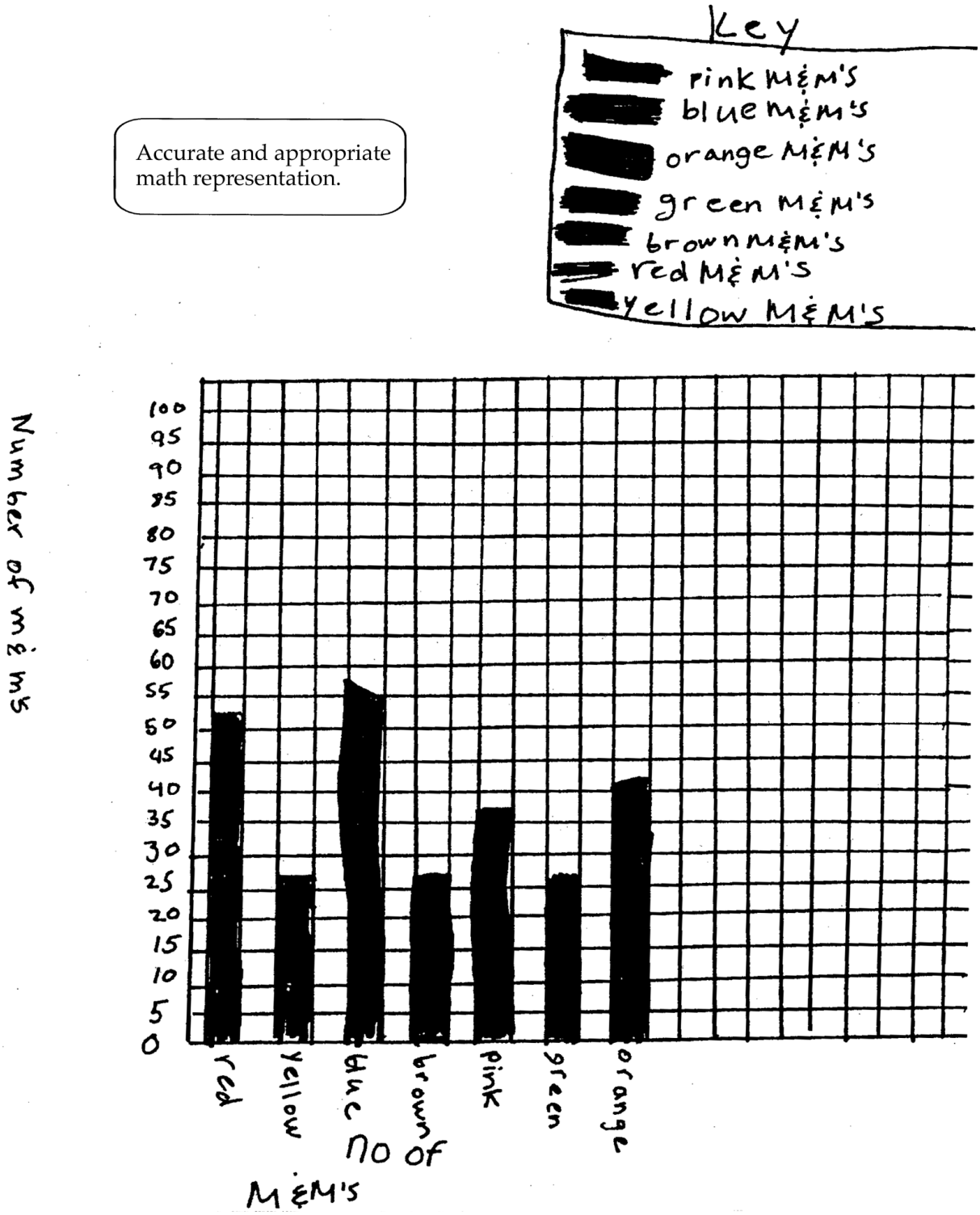
	estimation	Count
Blue	112	120
Pink	72	60
orange	82	73
green	52	62
red	102	88
brown	50	66
Yellow	50	63

The Student lists estimate versus actual number of M&M's© in 10 boxes.

We got the amount of M&M's by added of each color the nubers^ two times in our heads and a calculator.

Practitioner

Accurate and appropriate math representation.



Expert

what we did with the M&Ms.

Explains reasoning.

We opened five boxes of M&Ms. We counted each color. Then we doubled each number of M&Ms. Then we made a graph with a key. Then we wrote this paper.

We doubled the number of M&M's becaus we saw half of the M&Ms and we estimate that it would be the same amount of M&Ms in the other five boxes.

I think there are 56 reds, 58 oranges, 60 yellow 12 greens, 108 blue, 62 pink, 84 brown

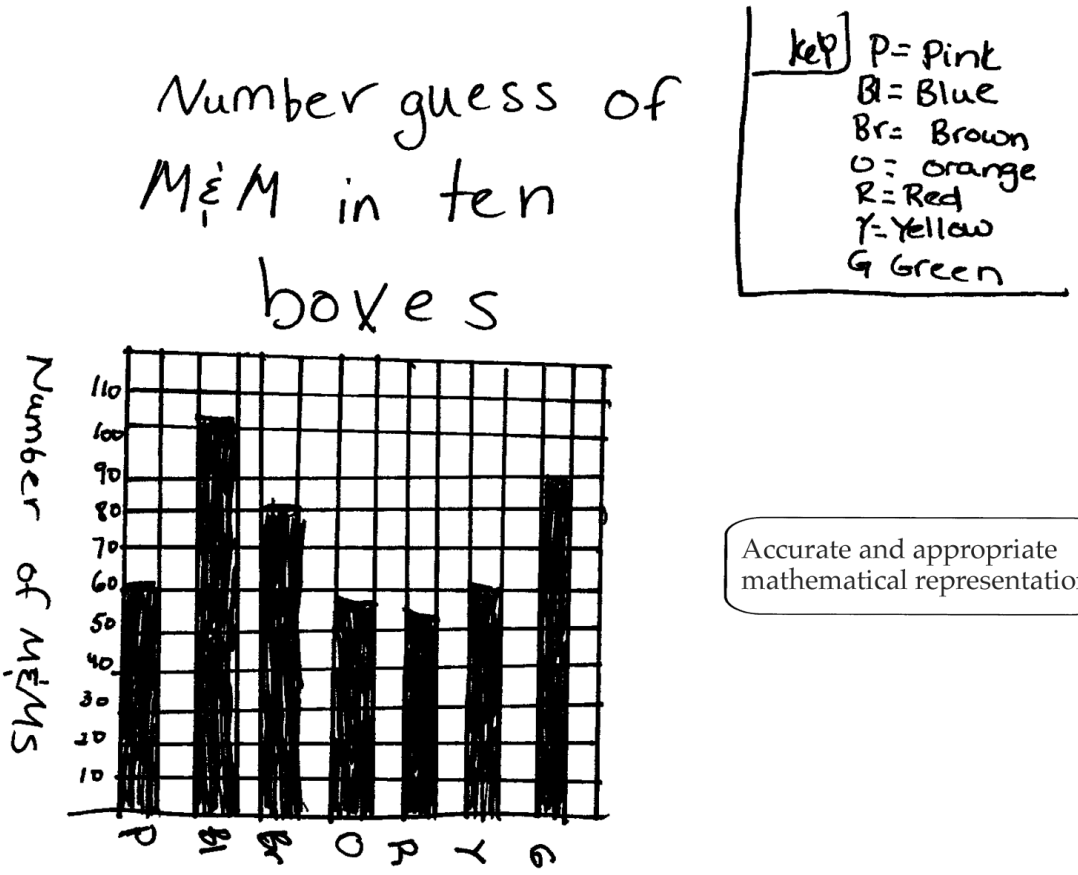
Makes a mathematically relevant observation.

States conclusion.

I noticed that blue is the most.

Expert

We think our solution is good because we sampled five boxes of M&Ms and counted them then doubled that number and five boxes is half of ten and thet's what we wanted to guess the number of.

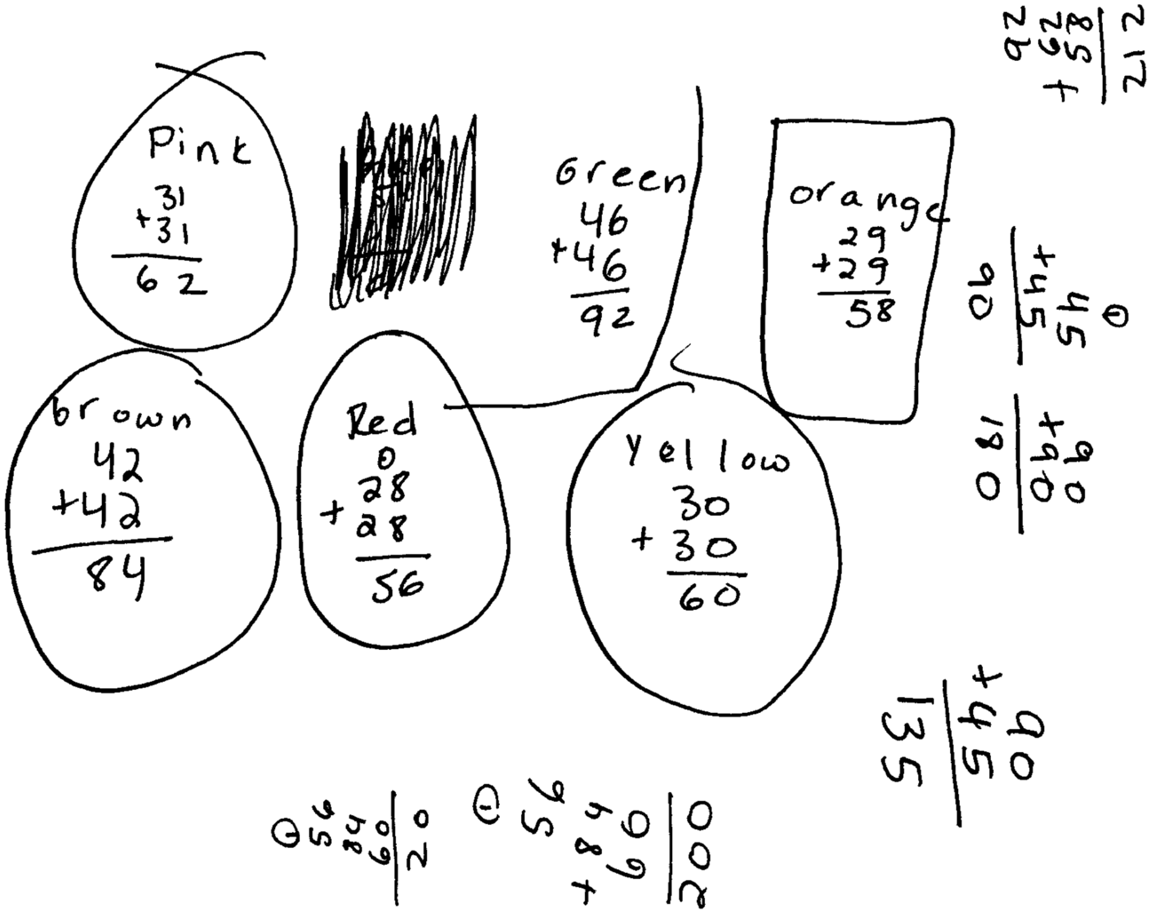


Accurate and appropriate mathematical representation.

Expert

842 r28

Blue 54 Red 28 Brown 42 Orange 29 Yellow 30
Green 46 Pink 31



Expert

	estimate	How many off	Answer
	108	8	100
green	92	10	102
pink	62	2	60
yellow	60	4	64
orange	58	3	61
red	56	2	58
brown	84	12	72

We subtracted the estimate and the answer to get how many were off.