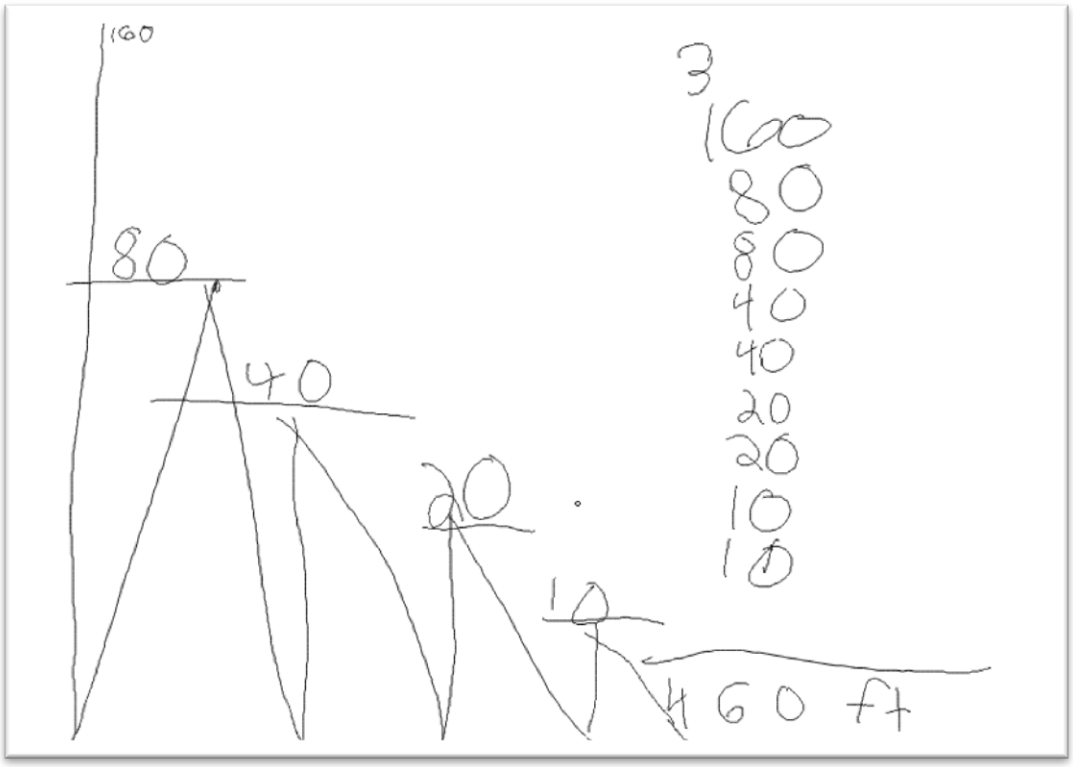
Cynthia Duncan
Case Study for ED 608
Chapter 1 Problem Set A #3
Following the Bouncing Ball.

For my case study I chose to use the math problem: Follow the Bouncing Ball. I originally had two 2nd grade students solve the problem. However after the students worked on the problem I realized they were very similar in their approach and method so I decided to modify my case study to include one 2nd grade student and one 7th grade student. The results were not quite what I was expecting. I learned a big lesson through this case study, one that will forever change my approach in teaching

The 2nd Grade Student:

The second grader in this case study is a high ability student who loves a challenge. She is a confident, hard worker but she is also inquisitive and eager to learn. When I asked her if she would help me with my math homework she wanted to make sure that she was allowed to; she was concerned that I was cheating. I used the screen recorder on the Promethean Active Board to record the conversation and the work. Following the Bouncing Ball was not my first attempt with this student. I had attempted to do the Worm Wall problem. With that problem I read it to the child and she worked it out on the Activboard. I gave her no guidance and she got very off and ended up with a drawing that made it impossible to find the correct answer. I decided to wait a day and try a new problem, "Follow the Bouncing Ball". Knowing that she is just a 2nd grader, I decided to offer a little guidance and direction on this second go around.

2nd Grade Student solution:



Script for the 2nd Grade Student - Follow the Bouncing Ball Problem:

Teacher: Ok, a ball bounces one-half of the height from which it was dropped. The ball is dropped from 160 feet and keeps on bouncing. What is the total vertical distance the ball will travel from the moment it drops to the moment the ball hits the floor for the 5th time? And I'll help you. I'll walk you through.

Student: (takes pen and gets ready to work)

Teacher: So how far does the ball drop?

Student: 160 feet.

Teacher: hmm so let's go ahead and draw a picture of this. Maybe it starts here (points to top of the board to encourage a large picture) and drops down and hits the ground (student draws a straight line from the top of the board to the bottom of the board to represent building). How many feet is that?

Student: 160 feet (student writes 160 on the board at the top of her line).

Teacher: The ball rebounds or bounces back half of the height. Where is it going to end up? (Student draws a new line down and then back up). Now what is that height? (student thinks hard but isn't coming up with an answer.) We could break down this number (teacher points 160). What is half of 100?

Student: 50

Teacher: What is half of 60?

Student: 80

Teacher: Half of 60?.. oh, ok you did the math in your head (student smiles at the teacher). I am going to make a suggestion, you see how you made the. If you keep making the line there it is going to get hard to count. (student undid last line). If you go like this (teacher motions diagonal line and student draws it). So 160 feet and then it said it goes up to?

Student: 80 (student labels 80 on diagram).

Teacher: Awesome. Good job. Then it goes… (student draws line going down then a line going up) Then its going to bounce up. How far?

Student: 40

Teacher: Alright (student labels 40 on the diagram). Then its going to bounce?

Student: 20 (student labels 20) then 10, then 5

Teacher: Why don't you label 10 and then we stop and count (student labels 10) because remember it said how far until it hits the floor for the fifth time. Here lets count

Teacher and student: 1, 2, 3, 4, and this will be 5 (student draws line down to hit the floor for the 5^{th} time) So now (student continues drawing up and starts to label 5). It just wants to know this much. Your right the ball is going to keep bouncing but they just want to know this much. (student erases the 5 they labeled on the board previously). So now we need to know the distance. (student looks at teacher confused). If we took a tape measure and measured all this what would be the distance? (student looks at teacher confused). Could we make a big math problems. How far did it travel the first time?

Student: 160 (writes it on the board)

Teacher: and then?

Student: 80 (writes 80 on boad)

Teacher: and then?

Student: 40 (starts to write 40 on the board)

Teacher: well hold on. It went up 80 and then?

Student: and then down 80 (student erases 40 and writes another 80)

Teacher: up

Student: up 40

Teacher: down

Student: 40

Teacher: up

Student: 20 (writes 20 twice)

Teacher: up

Student: 10 and down 10 (writes 10 twice) up

Teacher: nope, 1, 2, 3, 4, 5 now how do we find out the total?

Student: Add it up.

Teacher: ok (student adds up ones column and writes down 0) Should we make an equal sign so we know (student makes an equal bar)?

Student: 0 and then I know this is 1 in the hundreds place (student writes down 1 in hundreds column).

Teacher: Ok so you think a 1 goes there but what happens if we add this up (teacher points to tens column) and we have to regroup. Remember how we are learning about that? (student says something quietly and erases the 1 in the hundreds place).

Student: I have to add up all the numbers in this column. (student quietly adds up the numbers) 36

Teacher: so how are you going to write it down?

Student: I put the 3 up here and the 6 down here and I get 460 feet

Teacher: do you know how to represent feet?

Student: ft

Teacher: excellent

Reflection on 2nd Grade Student:

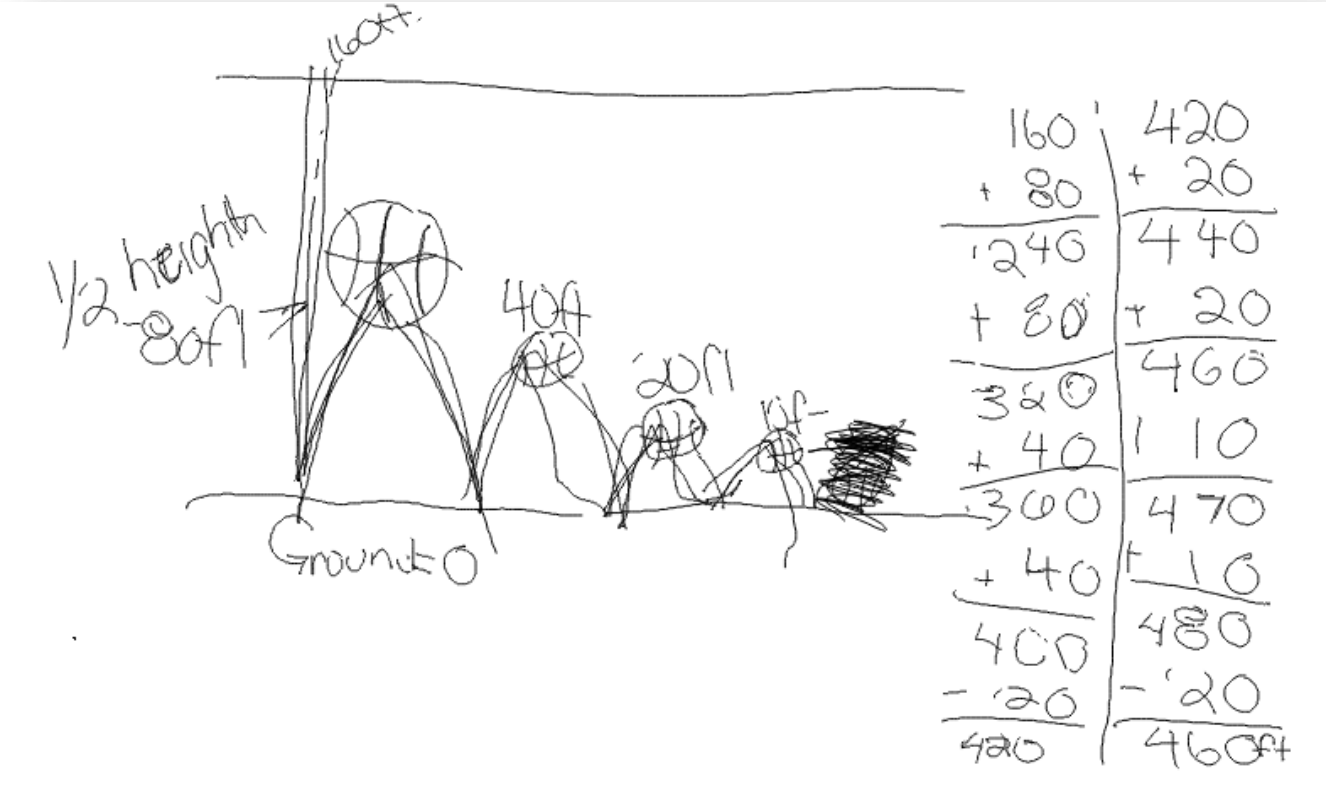
This student enjoyed solving this problem. She even asked that I send her dad, an English professor, a copy of her video. When I listened back to the recording I cringed. I knew she struggled with the worm problem the day before and I wanted her to be successful with this problem so I think I was more apprehensive then she was about solving this problem. As a teacher I struggle with the probing for understanding. I find myself probing when student make mistakes or have misconceptions but I do not probe enough when students are successfully working a problem. As a result when I probe students, they automatically think they did something wrong or perhaps I just notice the times I probe when there is a mistake. In class we are learning how to do addition with regrouping. At one point the student added the numbers in the hundreds column before the tens column. I should have let the student complete the computation and see what they would have done when they got a two digit number after adding up the tens.

The 7th Grade Student:

The 7th grade student is my daughter. She loves math and is a good student. I thought this problem would be easy for her. I predicted she would hear the problem and take off. However

through this process I learned how much attitude & confidence can impact how one approaches math.

The 7th Grade Student Solution:



Script for the 7th Grade Student- Follow the Bouncing Ball Problem:

Teacher: A ball bounces one-half of the height from which it was dropped. The ball is dropped from 160 feet and keeps on bouncing. What is the total vertical distance the ball will travel from the moment it drops to the moment the ball hits the floor for the 5th time? So this chapter it says to draw a diagram to solve each picture. Do you know what a diagram is? (7th grade student shakes her head no). A diagram is a picture. (student just looks at teacher) So draw a picture to solve the problem. (student just looks at teacher) Do you want me to read the problem again?

Student: yes

Teacher: A ball bounces one-half of the height from which it was dropped. The ball is dropped from 160 feet and keeps on bouncing. What is the total vertical distance the ball will travel from the moment it drops to the moment the ball hits the floor for the 5th time? And you can read it if you want.

Student: Now do I have to answer it? (Teacher shakes her head yes) Is it like a baskeball or like…

Teacher: Yeah, it's a ball it doesn't matter.

Student: How do I draw it?

Teacher: However you want.

Student: I'm gonna do it like this (draws basketball) You're not going to show people this? (student continues to draw ball) So I put down numbers too? (Teacher doesn't answer question and student draws line at top of board). Should I put 160 here? (teacher doesn't answer and she thinks about. Student writes "1/2 height" (long pause by student)

Teacher: Alright so what is this line up here?

Student: 160 feet.

Teacher: Ok. So the ball…what happens to the ball?

Student: It drops of the building.

Teacher: Well no, when you drop a ball…

Student: It bounces

Teacher: Ok then draw a picture. (student just looks a teacher) You don't have to draw a picture. When I say draw a picture in math are you actually the drawing or are you drawing something that helps you figure out the problem so it doesn't have to actually be a drawing of a building or something right? (student shakes her head yes and appears more confident, and starts drawing).

Teacher: I am confused on the distances. So I would suggest you put some numbers up there so you can see. (student writes 80 feet on the board and adds an equal sign and a 0 next to ground. Student then starts drawing the other bounces). Did you forget the problem? You may want to read it again. (student reads problem to themselves). So how many times are you supposed to count it hit the ground?

Student: 5

Teacher 5, so how many times did it hit the ground?

Student: 4

Teacher: so I want you to, don't actually draw on the board but I want you to mimic the ball, I mean you could draw on the board but I want you to mimic the ball dropping at the beginning and see where you end up. (student traces bounces and points to where she thinks she should end

up) Ok so continue that (Student adds 5th bounce). Ok so (student mimic bounces again) what's the next part of the problem. So it drops, and goes up, 5 times. Now what are we looking for? What is the rest of the problem?

Student: the vertical distance.
Teacher: So how are you going to find the vertical distance? (student looks at teacher for long period of time). If we take a tape measure and measure it what would we get? The distance the ball is traveling? They are calling it vertical because it's up and down. How much is the ball traveling?

Student: 160+80+80+40+40+20+20+10+10 (student writes 160 on the board)

Teacher: What's the 160? What is happening with the 160?

Student: it dropped

Teacher: ok it dropped 160. (student starts working out the computation on the board). You know you say 160 and 80 but you never show the line, you were really good at showing the line on the other ones.

Student: should I add it?

Teacher: Yeah I think so. Ok. (student draws lines and continues with computation and then pauses when she is unsure what number to add, student traces ball bouncing). You have a number there what number is it? Goes down 160, goes up 80 then what does it do?

Student: It goes down 80. (adds 80 and solves) then it goes up 40 (adds 40 and solves) then it goes down 40 (adds 40 and solves), then it goes up 20 (adds 20 and solves, adds 20 and solves, adds 20 and solves adds 10 and solves and add 10solves).

Teacher: now let's count how many time it hits the ground?

Student: 1,2,3,4,5,6 oh man (crosses out 6)

Teacher: So now I want you to match up your numbers with the actual one you wrote. 160 and 160.

Student: oh ok,

Teacher and student: down 160

Student: up 80, down 80, up 40, down 40, up 20, down 20, oh man (student notice that she added an extra 20).

Teacher: so you have an extra 20 but lets check the rest. How can we fix the extra 20?

Student: We can take away 20 (subtracts 20 from the total she had).

Teacher: So what is the total vertical distance the ball traveled.

Student: 460 feet.
Teacher: How are you going represent feet?

Student: ft (writes f. next to 460)

Reflection on 7th Grade Student:

At first the 7th grade student was excited and very confident; I would even say smug at the thought of doing a 2nd grade math problem. However that changed the instant she heard that it was a problem from my college class. She immediately said she couldn't do it. I tried to help by telling her the 2nd grade student was able to successful solved it. That however did not help her confidence. She immediately felt pressure to outperform the 2nd grader on a problem she thought she wouldn't be able to do. The interesting thing - she hadn't even heard the problem yet but in her mind she was already thinking she couldn't do it. By the time she did hear the problem her attitude towards the problem hindered her ability to see the problem for what it was. She seemed very unsure of herself and was very worried about making mistakes. She had long pauses and would look to me for guidance. I was a little surprise by the lack of vocabulary. The 7th grade student portrayed confusion with the words "diagram" and "vertical". It could be that she was unsure what they meant in the relation to a problem she viewed as higher level, or perhaps it was nerves. When she got to the addition she was able to do the computation with ease. She added the numbers as she went. She wasn't very careful and added 20 twice but I was able to get her back on track.

Final Reflections:
This case study was an eye opener. I learned how much attitude and confidence can play in the area of math. The 2nd grade student approached the problem with confidence believing she was going to be successful. Her confidence was not natural; it was something she has been working on throughout the semester. For the last couple months I had the class solve problems from my math book. She learned that she can solve some college level problems. The 7th grade student lost all confidence when she found out that the problem was a college level question. She had already decided she couldn't do it. She didn't have the same background experience as the 2nd grade student. I had predicted that the 7th grade student would complete this problem with ease and in all honesty she should have but I didn't realize the impact attitude plays in math. It reminded me of adults who cringe at the word algebra and automatically say they can't do it before they even see the problem. I need to remember that creating an "I can" attitude in math is crucial and will help students be successful in math.