Student Interview Reflection

For my student interview, I wanted to touch on the subject of scientific notation. The SOL objective 7.1.c indicates, "The student will compare and order fractions, decimals, percents, and numbers written in scientific notation," so my cooperating teacher sometimes has students complete problems that reflect this objective. Many of the students I observe do not seem to have a thorough conceptual understanding of the value of numbers represented in scientific notation.

I interviewed a student (named D.S.) in my cooperating teacher's first period Math 7 class. He was a student who seemed to do pretty well: he is almost always engaged in class discussions yet struggles somewhat in math. I wanted to find out about his understanding of numbers in scientific notation.

For my interview questions, I constructed a problem set involving (A) converting between numbers between 0 and 1 in scientific notation and standard decimal form, (B) counting place values of numbers greater than 0, (C) comparing positive and negative numbers with magnitude less than 1, and (D) adding and subtracting numbers in scientific notation. See attached *Student Interview Problem Set* with D.S.'s answers for a full description. Each part of the problem set contained two to four problems. Accompanying the problem set, I laid out a set of green and white centimeter cubes and a placeholder mat, in case D.S. wanted to use manipulatives when solving the problems. However as most of his class's work involves pencil and paper, it was a tool with which he was not completely familiar.

I created these problems to gain a better understanding of a student's knowledge of place value and scientific notation. The first part (Tasks 1 and 2 on the *Problem Set*) involves pure conversion, which may or may not require conceptual understanding of place value. However

Task 3 requires the student to understand the magnitude and values of the digits in a decimal. Some problems were in scientific notation and others were not, so I had hoped the task would also serve as a learning situation, to help the student see connections between decimal form and scientific notation. Task 4 simply included comparison problems, again for the purposes of insight on magnitude, and Tasks 5 and 6 contained addition and subtraction problems respectively. I tried to include different types of addition and subtraction problems (i.e., different methods required to evaluate) in the event the student would use the blocks and place value mat.

I chose to limit the interview time to 30 minutes because I believed this to be ample time to gain information about D.S.'s learning. I knew he wouldn't get to all the problems but I told him to do as many as he is comfortable with.

D.S. had no trouble converting numbers in scientific notation to standard form, because he had plenty of practice with this in the classroom. His understanding of conversion was very procedural. He understood that if the exponent of 10 was negative, this required a leftward movement of the decimal place, and a positive exponent required a rightward move. He seemed to view the notation as a set of digits and a "dot" rather than a value being multiplied by another value. This kind of thinking stunted his performance on the backwards conversions, from decimal form to scientific notation in Task 2. In both problems given, D.S. had used the opposite of the correct exponent, because he thought that a negative exponent, for instance, indicated a leftward movement in both directions of conversion, not just in the forward direction—from scientific notation to decimal form. Problem 2.a. asks the scientific notation form of 0.031415, and D.S. answered 3.1415×10^{2} instead of the correct 3.1415×10^{-2}. Had he taken a moment to see the value of his first answer, 3.1415×100, he would have realized that there was a gap in his thought process.

His view of decimals is evidenced by his verbalization of them. He has a lot of trouble reading the decimals as their correct place values, e.g., “Six and two thousand eight hundred and thirty-one ten-thousandths.” In this case he would forget which placeholder corresponded to which place value, so I suggested using the blocks to help him. After counting and seeing the blocks in different place values, he was able to understand the quantities of the decimals. Later on in the interview this language barrier was holding back his performance so I allowed him to read the digits individually, e.g., “Six point two eight three one.”

While D.S. was completing problem 1.b., he had some confusion about the names of the place holders even with the blocks and mat in front of him. For a while, he kept saying there was 1 in the thousandths place, but corrected himself to say, “ten-thousandths.” I then asked him, “How many ten-thousandths make one-thousandth?” He hesitated but then answered, “Ten.”

Another key question I asked D.S. was, “What do you need to have for scientific notation?” He responded, “It has to have times 10 and then how many places you moved it.” It seems that he understands scientific notation literally as a set of directions, or an algorithm, of representing a number. He failed to see a number represented in scientific notation as an actual *value*. He also understood that the decimal point in scientific notation form must be “behind the first whole number” rather than a decimal between 1 and 10. He has an extremely symbolic view of decimals. This is evidenced by his difficulty in understanding, in problem 3.b. (which D.S. skipped before finding an answer), that ten hundredths is equal to one tenth.

There is one more big idea I noticed that D.S. had trouble with. He seems to understand that positive decimals with more leading zeros are greater than those with fewer leading zeros. This view is consistent with positive numbers greater than 1 with ending zeros, e.g., 5000 is bigger than 900 because there are more zeros on the end of 5000. He seems to carry this property into the realm of small numbers, except it is incorrect. Thus both answers in Task 4 that D.S. completed were incorrect. Even though his understanding of this pattern is incorrect, I am glad to see he was developing a better sense of creating magnitude from scientific notation, rather than thinking of it as an algorithm.

Overall, the interview process was an educational experience for both D.S. and me. My biggest regret is that I used a large number of tasks and problems and provided no context, rather than using a small number of larger tasks in context. I might have gained a better look into the mind of this seventh grade student by asking him more questions about a specific topic instead of asking him to complete a greater number of problems. Two things I would have liked to see more of is D.S.'s thinking on converting place values (trading in ten ones for one ten, or vice versa) and his thinking on leading zeros in a decimal. I think I did a good job of asking D.S. intermediate questions in his performance to understand what he is thinking. Sometimes he would go quiet and write or work with the blocks without telling me what he was doing, and I frequently had to push him to "think out loud."

I think the blocks have really helped, because toward the end of the interview he was able to correctly compare decimals with differing numbers of leading zeros. I think that the manipulative served as a visual tool that D.S. could extend from the symbolic representation and gain better insight about decimals.