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Astronomy and Space Science

Lesson Implementation and Reflection

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The lesson I chose, Let's Go to Mars: Calculating Launch Windows, was one of the lessons that was part of my 5E unit plan. The lesson was timed about midpoint in the unit plan. Since my students are 8th graders who have diverse mathematical abilities, I modified the lesson from the JPL website by using different language and tools, so my students could be successful.

Prior to completing the activity, I led a classroom discussion on traveling to other planets. Many students were perplexed as to why the focus would not be to Venus since it is closer most of the time and seems so like Earth. Through this discussion and their research, the students understood the reasoning why Venus is not a good choice over Mars. Having addressed this misconception helped the students focus on the activity as it was now something that they could visualize. This was a critical step as at this age these students are just entering the analytical thinking stage and still require concrete thinking to build their knowledge upon. During the activity, I used vocabulary that was more familiar to the students and assisted those students with lower mathematical abilities so that all of them could be successful.

All the students were able to correctly illustrate the sun at the center of the coordinate system and Earth on the positive x-axis. I let the students chose the distance from the sun where they would place Earth. I instructed them to measure in centimeters the distance from the center of the sun to the center of Earth. Using this distance, they set up a proportion to determine the location of Mars on the negative x-axis. Instead of using string and push pins, I provided each

student with a compass, so they could draw the orbits of each planet. As per the lesson, the orbits were assumed to be circular and instructed the students that the orbits are elliptical. From the radii data on Earth and Mars the students then calculated the length of the semi-major axis. All students struggled with understanding the term, semi-major axis, even after I illustrated it on the board. I explained this position as the equidistant point between the two planets. About half of the students were able calculate this position without assistance. The other half of students were assisted by me or a peer to complete their calculations. To determine the Hohmann transfer orbit path, I instructed the students to place the point of the compass on the calculated midpoint and the pencil on Earth. Then they were told to rotate their paper counterclockwise until they intersect Mars. All but two students were successful in drawing the orbit. In reviewing those two students' work, one had made a calculation error thus placing the midpoint in the wrong position and the other did not have their compass radius secured causing the orbit path to be skewed. As a class we calculated the travel time to Mars as well as the position of Mars at the time of launch, and the position of Earth at the time of landing on Mars. A few of the lower level math students struggled with understanding how we calculated the period of the Hohmann transfer orbit. They were able to succeed when I was able to do small group instruction while the other students moved on.

Overall, I believe that the lesson was moderately successful since they were able to illustrate the Hohmann transfer orbit correctly after guided instruction. The diverse mathematical abilities as well as confidence in solving one step math problems had an impact on the length of time of the lesson. Those students in algebra (9^{th} grade math at the 8^{th} grade level) completed the calculations quickly and accurately. Unfortunately, because these students completed the tasks so quickly they soon became bored as I had to assist the other students.

Another item I noticed on their drawings was that not one of the students correctly drew an accurate proportional relationship in the size of Earth and Mars. For all the illustrations either Earth and Mars are drawn equal in size or Mars is larger. This surprised me as we had just completed a TechSteps activity two weeks prior in which they created a bar graph demonstrating the proportional sizes of the planets. When I reminded them of this, the students said that they had just used pennies to draw the planets and had nothing smaller in which to draw Mars.

When I teach this lesson again I will review the mathematically abilities of my students. Knowing that information now, I would have grouped the students so that a higher-level student was paired with one or two on level or lower level students. Before executing the lesson, I would have the students complete some simple activities that relate to use of a compass, protractor, and the importance of accuracy in the proportions. I think having that background information would permit the students' drawing to reflect a better understanding of the lesson. I do think that timing the lesson to later in the school year when the students would have a more mathematical knowledge could improve the students' performance. For the higher-level students, I will probably provide written instructions so that they can continue with the lesson independently while I assist the others. Another issue that I will address in future lessons is the limited vocabulary background this group of students have. This is something I have noticed across all my classes this year. In questioning their teachers from last year, I found out about half of them had a long-term substitute in science last year who did not incorporate hands-on activities or math into science lessons. Now that I know this I am making a concerted effort to include vocabulary development in my lesson planning as well as emphasizing the students' application of the vocabulary in their analysis of our activities.

References

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