1. Analyzing Student Learning
   
   a. Identify the specific learning targets measured by the assessment you chose for analysis.

   There are three learning targets and one state standard measured by assessment (Formal Assessment 4.1, Exponential Quiz). The learning targets measured by the assessment are:

   **Students will be able to name and describe the role of each part of an exponential model.** This is measured by having students write an exponential equation by identifying the role/part of values in a problem statement. Additionally, students demonstrate mastery of this learning target (LT) by describing the meaning of each value in an exponential equation.

   **Students will be able to identify the exponential rate of growth/decay from real world data.** This is measured by giving students a data table and asking them to write an exponential equation that models the data. Students must know the procedure for calculating the “constant multiplier” and identifying the starting value.

   **Students will be able to evaluate the effect changes in the starting value and constant multiplier have on the graph of an exponential function.** This is measured by having students graph an exponential equation. This is also measured in a challenge question in which students must describe how changing a physical situation of a bouncing ball by adding more air and lowering the starting height would be represented by a new starting value and a new constant multiplier.

   The state standard measured by the assessment is A1.1.E Solve problems that can be represented by exponential functions and equations. This is measure by having students solve for values in an exponential function. This is also measured by having students use exponential functions to make predictions about future costs of a product.]

   b. Provide the evaluation criteria you used to analyze student learning.

   The evaluation criteria used to analyze student learning is an Answer Key (See Lesson 4 Evaluation Criteria). On the assessment itself, each problem specifies in writing for the students how points are earned on each question. The Answer Key used to assess the students’ work contains additional details for the teacher to use in cases of student errors. The breakdown of criteria for each question follows:

<table>
<thead>
<tr>
<th>Question &amp; Part</th>
<th>Points Available</th>
<th>Criteria for Correctness</th>
<th>Deduction of Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>1a.</td>
<td>1</td>
<td>(1pt) Correct exponential equation with starting value and constant multiplier from the given context</td>
<td>-1/2 pt for each mistake, up to maximum for each criteria</td>
</tr>
<tr>
<td>1b.</td>
<td>4</td>
<td>(1pt) Correct substitution of values into the equation to solve the problem (2pt) Correct procedure based on set up (1pt) Correct answer based on</td>
<td>-1/2 pt for each mistake, up to maximum for each criteria</td>
</tr>
</tbody>
</table>
c. Provide a graphic (table or chart) or narrative that summarizes student learning for your whole class. Be sure to summarize student learning for all evaluation criteria described above.

Below is a summary of correctness on each question. This demonstrates student learning for the whole class. Two students out of 26 did not take the assessment.

<table>
<thead>
<tr>
<th>Question and Part</th>
<th>Objective</th>
<th>Students with full credit out of total students</th>
<th>Students with partial credit out of total students</th>
<th>Students with no credit out of total students</th>
</tr>
</thead>
<tbody>
<tr>
<td>1a.</td>
<td>Solve problems that can be represented by exponential functions and equations.</td>
<td>20/24</td>
<td>0/24</td>
<td>4/24</td>
</tr>
<tr>
<td>1b.</td>
<td>Solve problems that can be represented by exponential functions and equations.</td>
<td>14/24</td>
<td>6/24</td>
<td>4/24</td>
</tr>
<tr>
<td>1c.</td>
<td>Solve problems that can be represented by exponential functions and equations.</td>
<td>3/24</td>
<td>16/24</td>
<td>5/24</td>
</tr>
</tbody>
</table>
2a. Solve problems that can be represented by exponential functions and equations. | 18/24 | 3/24 | 3/24 |

2b. Students will be able to name and describe the role of each part of an exponential model. | 13/24 | 6/24 | 5/24 |

3 Equation Students will be able to identify the exponential rate of growth from real world data. | 14/24 | 7/24 | 3/24 |

3 Graph Students will be able to evaluate the effect changes in the starting value and constant multiplier have on the graph of an exponential function. | 17/24 | 2/24 | 5/24 |

As a class, the average score on the assessment was 74%. The average score on the Exponential Model section of the formative preassessment was 16%. This shows the average score is 58% higher on the assessment than on the pre-assessment. The pre-assessment had similar questions to the assessment. Students as a whole were successful in meeting the learning target: “students will be able to name and describe the role of each part of an exponential model”. This is demonstrated in the 19/24 full OR partial credit answers in 2a. Students varied in their abilities to consistently answer questions that required them to “Solve problems that can be represented by exponential functions and equations.” This is demonstrated in the statistics in question 1a, 1b, 1c, and 2a showing full credit for 14/24, 3/24, and 18/24 students. Students struggled to answer problem 1c., which required more mathematical reasoning than procedural fluency. Students were successful as a class correctly graphing an exponential function. This is demonstrated by the 17/24 students with full credit on question 3 (Graph). Few students completed the challenge problem (it was optional), so the data on this problem is not valid and therefore not included.

d. Provide a graphic (table or chart) or narrative that summarizes student understanding of their own learning progress (student voice).

The following is a summary of the student reflections on their understanding of their own learning progress after the Formal Assessment 4.1, Exponential Quiz. Students were asked to answer the following questions:

1) Rate your level of confidence on this assessment from 1 to 5: ______________________
2) Why did you select that level:
3) What resources could you use to improve your skills and knowledge related to mastering the learning target?
<table>
<thead>
<tr>
<th><strong>Summary of Student Reflections of Their Understanding of Their Learning Progress</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Student confidence rating</strong></td>
</tr>
<tr>
<td><strong>Number of students with this rating</strong></td>
</tr>
<tr>
<td><strong>Example reasons for selecting that level of mastery</strong></td>
</tr>
<tr>
<td><strong>Resources to improve mastery and understanding</strong></td>
</tr>
</tbody>
</table>

In general, student perception of their understanding fit well with the actual test average. This is demonstrated in the average score on the assessment 74% compared with the average student confidence rating of 3.85/5, which is 77%. Students generally provided realistic reasons for selecting a level. Many students did not reflect on the resources they could use to take the next steps to improve mastery.

e. Use evidence found in the 3 student work samples and student self-reflections, and the whole class summary to analyze the patterns of learning for the whole class and differences for groups or individual learners relative to conceptual understanding, procedural fluency and mathematical reasoning and/or problem solving skills

The 3 student work samples and student self-reflections are exemplars of different levels of achievement on the assessment. I split the students into 3 equal groups and then chose the samples. Focus Student 1 demonstrates a high level of achievement, Focus Student 2 represents a median level of achievement, and Focus Student 3 represents an underperforming level of achievement. As a whole, the class showed a pattern of weakness in problem solving/mathematical reasoning when asked to do more than calculate an output from an exponential equation. This is demonstrated in the 21/24 or 87.5% of students who received either partial or no credit on 1c. This problem required students to “predict the time when the price will first exceed $6.50.” Students struggled to show adequate work to justify their reasoning as well. This weakness in problem
solving appeared at all ability levels, but especially with students with Student Learning Plans for mathematics (e.g. Focus Student 3) or underperforming students. For example, Student 3 Work Sample has no answer for 1c. Student 2 Work Sample shows an answer to the question, but lacks proper logical justification, using only a chart without any work shown to get the answer. Many other students showed adequate work, but had errors in the calculations, such as incorrectly applying the order of operations and distributing instead of applying the exponent.

The class as a whole was more successful problem solving with a more structured (requiring less mathematical reasoning) problem such as 2a. Students were able to create an equation from the context given and use it to fill in the chart. They successfully identified each value in the problem statement with the correct value in the exponential model. This is demonstrated in Student 1 Work Sample, Student 2 Work Sample and Student 3 Work Sample. Each of these students received full credit on this question. Additionally, 18/24 or 75% of students received full credit on this question.

As a whole, the class was mildly successful naming and describing the role of each part of an exponential model. This was a conceptual understanding requirement. Specifically, students were able to name the parts of the equation, but often did not connect the values back to their meaning in the model with the correct language or in enough detail. This indicates an issue of conceptual understanding of how the values fit into the model or struggle to understand how to use academic language to describe quantities in the problem. This is demonstrated in the 13/24 students that received full credit and 6/24 students who received partial credit. This partial credit was due to more often to a lack of detail in the description than error in the description. Focus Student 3 received full credit on 2b, Focus Student 2 received partial credit on 2b and Focus Student 1 did not answer the question. This supports that the students on average had could answer the question, with varying levels of detail.

Students were mostly proficient graphing an exponential equation, which required procedural fluency related to plotting points and creating a scale. In problem 3 on the Lesson 4 assessment, 79% of students received full or partial credit. Students who did not get credit often omitted the graph. Students successfully plotted the points, created a scale and connected the points. Students are not quite clear that an exponential equation is a curve and used a ruler to connect the data points. Student proficiency is demonstrated throughout the Student Work Samples 1, 2, and 3, each of which represents a low, middle, and high score for the class.

A final common error was incorrectly calculating the “exponential rate of growth/decay from real world data,” which was part of a Learning Target in Lesson 2. Students especially in the math SLP group did not recall the procedure for calculating the constant multiplier or demonstrate a conceptual understanding of a multiplier. This is demonstrated in the Student 3 Work Sample where the student writes the constant multiplier as “0 ÷ 3”. The most common error for the class as a whole was mixing up the procedure for calculating the constant multiplier and writing it as 3/1 instead of 1/3. Due to improper procedure 7/24 or 29% of students received only partial credit for calculating the constant multiplier, identifying the starting value, and plugging into the given equation “y = a(b)^x”.

2. Feedback to Guide Further Learning

Refer to specific evidence of submitted feedback to support your explanations.

a. In what form did you submit your evidence of feedback for the 3 focus students?

Written directly on work samples or in a separate document;

b. Describe what you did to help each student understand his/her performance on the assessment.

To begin with, I had the students trade papers and superficially grade them by marking right or wrong based on an answer key. Then, the students received their papers back and were allowed to look them over before turning them in for more thorough grading and feedback. Then, I had students work on a supportive
assignment, Homework: After Quiz 1, which is included in my Instructional Materials. The numbering matched up with the test numbering, so, for example, if a student missed part of numbers 1 and 2 on the assessment, they were directed to focus on those problems on the support homework.

Students received their papers back with quantitative feedback through scores on the assessment, and qualitative feedback with an attached written feedback summary. The feedback covered clarity of student work, level of mastery of learning targets, next steps to take after the assessment, and resources for taking these next steps. I also used Socratic questioning to lead students to use the feedback to evaluate their own strengths/weaknesses.

c. Explain how feedback provided to the three focus students addresses their individual strengths and needs relative to the learning targets measured.

[For each of my students I provided both quantitative feedback through scores on the assessment, and qualitative feedback with an attached written feedback summary.]

Focus Student 1 is a highly capable student who does not often ask for more challenging work, but consistently demonstrates mastery of the material. For Focus Student 1, on the assessment itself I provided some feedback and scoring for an indication of correctness. For example, I underlined parts of student work that I wanted this student to look at on page 1 of the assessment. Feedback that is more extensive was attached to the front of the test after scoring it.

In two sentences of the Focus Student 1 feedback summary, I provided feedback on specific learning targets. For example, I helped Focus Student 1 to understand his/her performance by writing “your work shown is clear. Your mastery of the learning target: ‘describe the role of each part of an exponential model’ is clear from 2b.” This indicates exactly where the student demonstrates mastery of the learning target. For the second learning target, I indicated the student’s strength by writing, “Also your mastery of ‘applying exponential models to solve [problems]’ is clear from 1c.” Next, I provided next steps for the student to revise their current work and deepen understanding. To indicate an area of improvement to the student, because the student did not complete the optional question, I underlined the phrase “Prove your real work skills” on the Challenge problem on the back of the assessment (See Student 1 Feedback, page 3).

Focus Student 2 is a student who has demonstrated varying levels of mastery in prior units. This student often asks questions during class. On the assessment itself I provided some feedback and scoring for an indication of correctness. For Focus Student 2, I noticed a pattern of limited justification of work. To communicate this area of weakness to the student and to help Focus Student 2 to understand his/her performance I wrote, “Your work would benefit from more detail.” Furthermore, I indicated which questions on the assessment demonstrate this weakness by writing, “Problem 1b, 1c, and 2b require a more thorough explanation.” Also, I underlined on the assessment where the problem directions assign points for “procedure” or “1-2 sentences each.” This communicates where the student can look on future assignments to clearly understand the justification requirements. To guide Focus Student 2 to evaluate his/her own weakness, I asked, “Why is it important to show your process?”. In the Student 2 Feedback, I provided feedback on a specific learning target by writing, your “ability to ‘apply the exponential model to solve a problem’ is clearly demonstrated by the accuracy of your answers.” This communicates to the student that he/she has strength in accurately applying procedures and conceptual knowledge to problem solve.

Focus Student 3 is a student of concern for me and has a Student Learning Plan for math. It was important to communicate in detail with this student. For Focus Student 3, I provided some feedback along with scoring for an indication of correctness on the assessment itself. For example, I wrote, “x is the time passed; x =5” on page 1 of the assessment when the student did not demonstrate a conceptual understanding that “x” represents “time”. This indicated a conceptual weakness to the student. Feedback that is more extensive was attached to the front of the test after scoring it.

For Focus Student 3, I noticed a general confusion of conceptual understandings. I began by describing a strength, saying, “Your work shown is clear”. I then followed up by writing the learning target and commenting on his/her strengths by saying, “Our learning target was to understand the role of each part of an exponential
model. I see that you know what it looks like.” I followed up by guiding the student with questioning to consider, “How might you understand better what each part means? Why is it important to make connections between variables and what they represent?” This leads Focus Student 3 to evaluate his/her own strengths and weaknesses with respect to conceptual understanding.

Because Focus Student 3 showed procedural fluency in 2a, but struggled to explain the meaning of the values, I wanted Focus Student 3 to think about why this was the case. I used a leading question to support him/her to deepen understandings and skills related to the current work by asking, “What would help to clarify the meaning of these calculations as an answer to the problem statement?” This leads the student to make connections between procedural knowledge and conceptual understanding and mathematical reasoning. Then, I made another specific comment about Focus Student 3’s strength graphing, and supported a deepening of his understanding by asking Focus Student 3 to think about “What does this graph tell you about the trend or behavior of the data?”.

d. How will you support students to apply the feedback to guide improvement, either within the learning segment or at a later time?

I will begin supporting Focus Student 1 to apply feedback to guide improvement by providing him/her time to read my feedback in class. Because the student did not complete the challenge problem, I suggested on her feedback summary, “If you want to strengthen [your] skills, work on the challenge problem at the end of the test.” Focus Student 1 will apply the feedback by considering this question and answering future challenge problems to deepen understandings and skills related to the current work. On the assessment, I gave the following feedback to Focus Student 1, “Concepts such as the physics of a bouncing ball require more imagination. How might this apply to your future career goals?” Focus Student 1 will apply feedback by considering the question and thinking about what she might use these skills, understandings in a career. This requires the student to generalize feedback beyond the work sample.

I also provided supplemental resources for Focus Student 1 to support using the feedback to deepen understandings and skills related to future progress. For example, I wrote on the summary, “The solutions are on the fusion page. Use it to compare your answers to the standard. Check out the agenda board for more challenging supplements”. Therefore, I will be sure to keep the agenda board up to date with new problems for students to challenge themselves. Finally, I related Focus Student 1’s performance on the assessment to the current Unit Task by asking, “How might you use your strengths identifying exponential data and using the exponential model in the project?” The student will apply this feedback by using the skills tested on the assessment to complete a future assignment, the Unit Task.

I will begin supporting Focus Student 2 to apply feedback to guide improvement by providing him/her time to read my feedback in class. Also, I underlined on the assessment where the problem directions assign points for “procedure” or “1-2 sentences each.” This communicates where the student can look on future assignments to clearly understand how to justify. The student will apply this feedback by reading the directions carefully on future assessments. Next, I guided Focus Student 2 to generalize feedback beyond the current work sample by asking, “How will detailed writing help in future courses or in future careers?”. The student will apply this feedback by considering what future reasons he/she will need to provide clear explanations.

I also provided supplementary resources for Focus Student 2. For example, I wrote on the summary, “Answers are on the fusion page. To see how to show enough detail, compare your work and take notes to revise your practices.” Providing an Answer Key supports Focus Student 2 to use the feedback to deepen understandings and skills related to future work by showing how much procedural detail the student should show. I provided next steps for the student to revise their current work and deepen understanding by asking the question, “How will you combine your mastery of this learning target with a clearer explanation to progress on the Unit Task?”. The student will apply this feedback by using the skills tested on the assessment to complete a future assignment, the Unit Task.
I will support Focus Student 2 by meeting with the student to prepare for a retake where the student can revise/replace the current work. I wrote in the feedback, “See me to clarify questions before a retake”. This establishes that I want to support Focus Student 2 to deepen his/her understandings and skills related to their current work.

I will guide improvement by providing him/her time to read my feedback in class. I supported Focus Student 3 to deepen his/her understandings and skills related to their current work by giving feedback in the form of questions, such as, “Why is it important to make connections between variables and what they represent?” The student will apply this feedback by reflecting on what the purpose of a variable is. This reflection guides the student to generalize this mathematical understanding to other areas of algebra, so Focus Student 3 must generalize beyond the current work sample. Because Focus Student 3 showed procedural fluency in 2a, but struggled to explain the meaning of the values, I wanted Focus Student 3 to think about why this was the case. I used a leading question to support him/her to deepen understandings and skills related to the current work by asking, “What would help to clarify the meaning of these calculations as an answer to the problem statement?” Another instance where I used questioning to deepen understanding was, “What does this graph tell you about the trend or behavior of the data?”. The student will think about these questions and I will ask the student about them when we meet to talk about the exam and answer questions.

I provided the following resources and next steps for Focus Student 3 to revise the current work and deepen: “The solutions are on the fusion page. Use them to revise your notes. Make an appointment to discuss how to improve your mastery of the learning targets before a retake.” This establishes that I intend to support Focus Student 3 to deepen his/her understandings and skills related to their current work. Providing an Answer Key supports Focus Student 3 to use the feedback to deepen understandings and skills related to future work by seeing correct solutions and adding them to his/her notebook. For this student, I specifically plan on meeting individually before/after our session in the after school academic support program.

3. Evidence of Language Understanding and Use

When responding to the prompt below, use concrete examples from the clips (using time-stamp references) and/or student work samples as evidence. Evidence from the clips may focus on one or more students.

[ Students were asked to evaluate exponential functions. In Lesson 3, students evaluated how different starting values and constant multipliers affect the graph of exponential functions. Evidence of the extent to which students were able to use this language can be seen in Lesson_3_Clip 2. Specifically at 3:00, students are in the process of reasoning how to identify the constant multiplier and begin graphing the values. This evidence shows that the language demand was new for students. On the Lesson 4 Formal Assessment 4.1, this language demand appeared in the Challenge Problem on page 2: “If the ball is inflated further and it is dropped from a lower starting height, how will each of the numbers in the equation change? Why?” Most students did not complete this problem. The Student Work Sample 1 and Student Work Sample 2 demonstrate this with blank answers on the Challenge Problem. This indicates that students struggled to evaluate how a greater “constant multiplier” leads to slower decay rate or a larger growth rate. The Student Work Sample 3 provided the following answer, “The numbers would decrease”. This answer is correct, so this evidence shows that some students were able to use this language demand to develop their content understandings.

Students were asked to use vocabulary such as constant multiplier, starting value, predict, equation, stage, exponential and exponential graph. In each lesson, new vocabulary was added and students who struggled to understand prior terms, such as predict, ratio, constant multiplier, and starting value struggled to develop content understandings of these words in the new context. For example, question 2b asks students to “explain what the values $115 and 4% represent” and the Focus Student 3 Work Sample (student with a Student Learning Plan) has no answer for that question. Additionally, my student with a 504 for dyslexia and slow processing became confused by the difference between the constant multiplier and the rate (demonstrated in
“Language use at 0:10). She was working with a second student who correctly connected the vocabulary “constant multiplier” to the value. The class as a whole commonly misused the word “slope” instead of the “constant multiplier”. This is demonstrated in the clip “Language Use” at 1:40. Throughout Lesson 3, students entered into disequilibrium with connecting the new vocabulary with its mathematical meaning (demonstrated in “Lesson_3_Clip_2” at 3:30). Evidence of students using the language demand of vocabulary to develop content understandings can be seen in Lesson_2_Clip_1 at 3:34 when the first student says, “Ok, so a ratio is something to something”. The second student responds, “I know what a ratio is, I just don’t really... I don’t understand what it is asking for, ratios of this week’s total to last week’s total...” The first student responds, “So like last week, ok so like what week are you on?” The second student responds, “Uh, I guess the first week...” These students are working collaboratively to use discourse and vocabulary to uncover new meanings and connections with the word ratio.

Students were tasked with the additional language demand of using mathematical precision related to labeling coordinate plane axes and creating a graph of an exponential function. Overall, students were successful in this requirement. Evidence of this from question number 3 on the Formal Assessment 4.1, Exponential Quiz, is that Student Work Sample 1, Student Work Sample 2 and Student Work Sample 3 all received full credit for the graph. A vast majority students precisely chose a scale that was evenly spaced and of an appropriate magnitude for the data. Students were asked to additionally pay attention to the language demand of syntax related to plotting ordered pairs and how to write an exponential equation in the correct format. A majority of students met this language demand. This is exemplified by the correct responses to both parts of question 3 in the Student 1 and Student 2 Work Samples. Again, these 3 student samples are exemplars of different levels of achievement on the assessment. This evidence shows that students are using the language demand to develop their content understandings because students must conceptually understand the relationship between input and exponential output. Students who use correct syntax to graph an equation correctly visually reinforce the understanding of the outputs related by a constant multiplier.

Students were asked to write an equation and then explain the meaning of the values in the equation. A majority of students successfully engaged in the language demand of discourse in the Formal Assessment 4.1, Exponential Quiz, 2a and 2b, which asked students to “Write an equation to describe the current ticket price and explain what the values $115 and 4% represent in your equation.” However, the students do need more practice understanding the level of detail required to provide a description through discourse. This is exemplified in the Student 2 Work Sample on question 2b and the uncertainty writing “an equation to model the pattern of zombies turned each day” as in the Lesson 3 Zombie Investigation question 4 (demonstrated in Language Use at 0:32).

4. **Using Assessment to Inform Instruction**

a. Based on your analysis of student learning presented in prompts 1c—e, describe next steps for instruction to impact student learning for the whole class and for the 3 focus students and other individuals/groups with specific needs.

[One next step for the whole class is to integrate more “teaching through problem solving.” I think that my Unit Task certainly will accomplish part of this next step. If students are challenged to come up with strategies on their own, rather than having to memorize the ones I give them, it would engage them in higher levels of cognition. This means that I would make problem solving a more natural part of our everyday routine rather than something approached after the procedures are learned.

A second next step that would impact student learning for the whole group, my focus students, and students with Student Learning Plans is to practice using the language more through writing, speaking, and self-reflection on understanding of the meaning of the vocabulary and how to apply it. For example, with Focus student 2, I will plan language practice with intentional writing tasks to engage the student in more detailed explanations of his/her conceptual, procedural, and mathematical reasoning/problem-solving]
understandings. Focusing on tasks that practice identifying academic language meaning and use would be a next impactful step in my planning for Focus Student 3 as well.

A third next step for Focus Student 1, a next step is to provide further differentiation to support her high achievement and 504 (dyslexia, dysgraphia, slow processing) statuses. This means continuing to support the student with multiple modes of communication for both new academic language and directions for tasks.

A fourth next step would be to increase peer-tutoring. Focus Student 1 would be an excellent candidate to act as a peer tutor because she works well with other students (See Language Use clip). For Focus Student 3, I would match him with a student like Focus Student 3 to receive peer-tutoring. I have encouraged him to seek help from peers in the past, but more formally structuring the support from another student, by having a conversation with the both of them would make the expectations for each of them clearer.

Finally, for my students with Student Learning Plans for math, an important next step to impact student learning is to identify where students have gaps in their understandings through exit tickets and one on one conversations (potentially outside of class).

b. Explain how these next steps follow from your analysis of student learning and student self-reflections. Support your explanation with principles from research and/or theory.

First, choosing “teaching through problem solving” as a next step rather than teaching problem solving after concepts and procedures follows from the low level of accuracy on the Formal Assessment 4.1, Exponential Quiz, question 1c which required students to “solve problems that can be represented by exponential functions and equations. On this problem, only 3 out of 24 students received full credit. I chose this next step because mathematical problem solving is a skill my students will use in all future mathematics studies. Much research supports teaching with problem solving integrated into other parts of learning is better than keeping it separate. According to the National Council of Teachers of Mathematics (NCTM), “There is little or no evidence that students’ problem-solving abilities are improved by isolating problem solving from learning mathematics concepts and procedures” (2010, PDF p. 2). Additionally, the NCTM (2010) article says: “Empirically, teaching mathematics through problem solving helps students go beyond acquiring isolated ideas toward developing increasingly connected and complex system of knowledge (e.g., Cai, 2003; Carpenter, Franke, Jacobs, Fennema, & Empson, 1998; Cobb et al. 1991; Hiebert & Wearne, 1993; Lambdin, 2003).” This research clearly supports my choice to “teach through problem solving” to improve my student’s mathematical problem solving abilities.

Second, choosing to practice using the academic language more through writing, speaking, and self-reflection to understanding the meaning of the vocabulary and how to apply it follows from the Formal Assessment 4.1, Exponential Quiz, question 2b. Here 13/24 students received full credit, while others showed either conceptual misunderstanding or an insufficient description. In my focus students, Focus Student 2 did not adequately make connections between the context and the language use, and Focus Student 1 did not answer the question. I chose this next step because these academic language demands are necessary to understand future learning segments related to the central focus. One NCTM mathematics standard is communication:

“Communication is an essential part of mathematics and mathematics education. It is a way of sharing ideas and clarifying understanding. Through communication, ideas become objects of reflection, refinement, discussion, and amendment. The communication process also helps build meaning and permanence for ideas and makes them public. When students are challenged to think and reason about mathematics and to communicate the results of their thinking to others orally or in writing, they learn to be clear and convincing.” (p.60)
Therefore, more intentionally planning activities that practice language use would positively impact my students’ ability to accurately and effectively use mathematics vocabulary.

Third, further differentiation for my Focus Student 1 is in response to this student’s specific needs for both high achievement and 504 classification. Choosing to support the student with work at appropriate level is supported by Vygotsky’s theory of the Zone of Proximal Development (ZPD). Pressley and McCormick (2007)
explain that effective learning occurs within students’ ZPD. Since the student has dyslexia, I would continue to employ multiple modes of communication. Woodin (2014) writes that,

“Teachers should diagnose and treat math breakdowns with the same specificity and strategies they apply to language-based instruction. When math remediation is most effective and efficient, it employs the same best practices that are used to address reading struggles. [...] Likewise, the best math instruction utilizes student strengths to mitigate weaknesses, and uses context and the integration of multisensory techniques to help the student create meaning and improve memory.” This research supports my next step to increase differentiation for this student and continue to utilize multiple modes of communication.” (Overview: Importance of Integrating Visual and Language Systems Section). Therefore, my choices of differentiation and multiple types of communication for Focus Student 1 are justified by research.

Fourth, I would engage both Focus Student 3 and Focus Student 1 in Peer tutoring in response to their performances and reflections on the Formal Assessment 4.1, Exponential Quiz. Focus Student 1 had high achievement, while Focus Student 3 has many skills to develop further. I chose this step because it positively impact both students’ future learning. Research asserts that such peer tutoring is mutually beneficial (Pressley and McCormick, 2007, p. 276). Specifically, Pressley and McCormick indicate, “Learning of the material often is improved more by being a tutor than a tutee” (as cited in Semb, Ellis, & Araujo, 1993). Therefore, peer tutoring is a positive next step.

Finally, for my students with Student Learning Plans for math, an important next step to impact student learning is to identify where students have gaps in their understandings from these lessons through exit tickets and one-on-one conversations. I chose this next step because formative assessment can provide valuable feedback to students and the teacher about competencies and confusions. In fact, research supports that this would benefit all students and groups in my classroom. Black and William (1998) “concluded that the student gains in learning triggered by formative assessment were ‘amongst the largest ever reported for educational interventions’ (p. 61)” (as cited in Popham, 2014, 298). Additionally, research by Blatchford, Bassett, and Brown (2011) supports that “smaller classes can benefit all pupils in terms of individual, active attention from teachers, but that the lower attaining pupils in particular can benefit from small classes at secondary level” (p.728). So, speaking one on one with Focus Student 3, as I am able to do in our after school support program, would potentially support his/her future learning.]

References


Formal Assessment 4.1, Exponential Quiz
Exponential Equations: Quiz 1

Directions: Neatly show your work to answer questions in every section. Note the point value of each question. Spend around 6 minutes per question (including all parts of a question).

1) A box of cereal costs $4.98. Because of inflation, the price increases by 4% per year.
   (1 pt for correct equation)
   a. Write an equation to model the increase in the price of the cereal.

   b. (1 pt for set up; 2 pt for procedure; 1 pt for answer based on procedure)
   Use your equation from 1a to predict the price of the cereal 5 years from now.

   c. (2 pt for procedure; 1 pt for answer based on procedure)
   Use your equation from 1a to predict the time when the price will first exceed $6.50.

2) In 2000, Open Road Bus Lines charged $115.00 for a ticket from Denver to San Francisco. Since then, the price of the ticket has increased by 4% per year. Let x represent the number of years since 2000, and let y represent the ticket price.

   a. (1pt for correct equation; .5pt for each correct value in the table)
   Write an equation to describe the current ticket price: ___________________________ and complete the table below.

<table>
<thead>
<tr>
<th>Year</th>
<th>Years since 2000, x</th>
<th>Ticket price, y ($)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>2001</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>2002</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>2003</td>
<td>3</td>
<td></td>
</tr>
</tbody>
</table>

   b. (1 pt for each explanation of each value with 1-2 sentences each).
   Explain what the values $115 and 4% represent in your equation for this Open Road Bus Lines situation.
3) (3 pt for correct equation; 2 pt for correct graph)
Find the value of the constants \( a \) and \( b \) to create an exponential equation \( y = a(b)^x \) and then graph the data on the grid on the right.

Equation: __________________

<table>
<thead>
<tr>
<th>( x )</th>
<th>( y )</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>54</td>
</tr>
<tr>
<td>1</td>
<td>18</td>
</tr>
<tr>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>3</td>
<td>2</td>
</tr>
</tbody>
</table>

REFLECTION:
Rate your level of confidence on this assessment from 1 to 5: __________________

Why did you select that level:

What resources could you use to improve your skills and knowledge related to mastering the learning target?

Challenge Problem: Prove your real world skills:
A ball is dropped toward the earth and it bounces until it stops. The equation \( y = 1.5(1 - 0.27)^x \) gives the height of the ball in meters after \( x \) bounces.

a. What does the number 1.5 in the equation represent in this situation?

b. What does the number 0.27 in the equation represent in this situation?

c. If the ball is inflated further, and it is dropped from a lower starting height, how will each of the numbers in the equation change? Why?