EQuIP Review Feedback

Lesson/Unit Name: Writing and Evaluating Exponential Expressions
Content Area: Mathematics
Grade Level: 6

Overall Rating:

E

Exemplar

Dimension I – Alignment to the Depth of the CCSS

The lesson/unit aligns with the letter and spirit of the CCSS: ✓ Targets a set of grade-level CCSS mathematics standard(s) to the full depth of the standards for teaching and learning. ✓ Standards for Mathematical Practice that are central to the lesson are identified, handled in a grade-appropriate way, and well connected to the content being addressed. ✓ Presents a balance of mathematical procedures and deeper conceptual understanding inherent in the CCSS.	The standard primarily addressed in this extended lesson (6.EE.A.1- Write and evaluate numerical expressions among whole number exponents) is clearly stated and is part of a larger unit related to Cluster A (Apply and Extend previous understandings of arithmetic to algebraic expressions), which is considered to be Major work of Grade 6. The lesson progressions are aligned to the standards and lead to an appropriate depth of understanding of the concepts and procedures. Appropriate Standards for Mathematical Practice are identified and explained where the students are using them, and there are specific comments on how the students are engaging in the identified practice. One advantage to this is that it helps teachers learn to identify what it looks like in specific content areas and contexts to engage in Mathematical Practices. Six of the eight Mathematical Practices are identified as being part of the extended lesson, with each activity embedding several of those Mathematical Practices. The formative assessment in Activity 2, the exit ticket question asks, "Cindy states that 43 equals 12. Do you agree or disagree? Justify your reasoning." The identified Mathematics Practices are #1, #4, #6 and #7. However, this question is more aligned with MP #3 Construct viable arguments and critique the reasoning of others. Students see several examples of numerical expressions which have exponents, and also see repeated multiplication examples and connect the two concepts. Conceptual understanding is developed in Activity I where students have an opportunity to work with a squares grid and make connections between the lengths of sides, both the number of squares, and the structure of the answer. Activity 2 begins with a problem-solving task that helps students experience the power of exponential growth and use it to make a decision. Teacher questions during the lesson help students gain the understanding of exponents are being shorthand for repeated addition. Students get several examples of both types of expressions in the gallery walk. Activity 3 primarily targets the actual practice of writing and evaluating expressions with exponents. With those two activities and the exit task, students will get many opportunities to develop procedural skill, as students have an opportunity to calculate products of numbers and connect products with exponential notation.
Rating: **3 – Meets most to all of the criteria in the dimension**	

Dimension II – Key Shifts the CCSS

The lesson/unit reflects evidence of key shifts that are reflected in the CCSS: ✓ **Focus:** Lessons and units targeting the major work of the grade provide an especially in-depth treatment, with especially high expectations. Lessons and units targeting supporting work of the grade have visible connection to the major work of the grade and are sufficiently brief. Lessons and units do not hold students responsible for material from later grades. ✓ **Coherence:** The content develops through reasoning about the new concepts on the basis of previous understandings. Where appropriate, provides opportunities for students to connect knowledge and skills within or across clusters, domains and learning progressions. ✓ **Rigor:** Requires students to engage with and demonstrate challenging mathematics with appropriate balance among the following: – **Application:** Provides opportunities for students to independently apply mathematical concepts in real-world situations and solve challenging problems with persistence, choosing and applying an appropriate model or strategy to new situations. – **Conceptual Understanding:** Develops students' conceptual understanding through tasks, brief problems, questions, multiple representations and opportunities for students to write and speak about their understanding. – **Procedural Skill and Fluency:** Expects, supports and provides guidelines for procedural skill and fluency with core calculations and mathematical procedures (when called for in the standards for the grade) to be performed quickly and accurately.	The FOCUS, COHERENCE and RIGOR are clearly identified in the Background Information section of the Lesson Plan. - FOCUS - The lesson is focused on 6.EE.1, and students have enough time and enough activity opportunities to really understand the meaning of this standard. The skills of reading, writing, and evaluating expressions are essential for future work with expressions and equations, and are a Critical Area of Focus for Grade 6. Expectations for students evaluating expressions are limited to whole numbers. A suggestion for improvement in this dimension would be to appropriately add terms with fractions in some expressions to connect with prior learning and support the work students will be doing (or have done) in the Number System Domain. Also add to the lesson the meaning of exponents of 1. The lesson uses area as a model for exponents of 2. A suggestion would be to connect an exponent of 3 to volume which is a grade level standard (6.G.A.2). Perhaps asking the question "Can you think of a real world situation on which you would multiply a number by itself 3 times?" The Genie Activity briefly makes note of volume but could be overlooked -COHERENCE - There are explicit connections to across-grade coherence (3.OS.A.3; 5.NBT.A.2; and 5.OA.A.1) as well as within-grade coherence (6.EE.A.3; 6.EE.A.4). In this standard, students should focus on what terms are to be solved first rather than invoking the PEMDAS rule. This will lead to a greater conceptual understanding. - RIGOR -There is rigor in the areas of procedural skill as students move fluently in representations of exponential values and in representing large numbers in exponential notation. The gallery walk and the index card activity allow students to get enough practice with numerical exponential expressions to develop procedural fluency. It would be helpful if there was a follow-up or homework assignment that students were given in order to more develop their fluency. Conceptual understanding is developed through the use of the grid to draw attention to squared numbers and their representation graphically and numerically. As a suggestion, there might be some students who would benefit from actually placing centimeter cubes on the grid as the squared numbers are represented, others might benefit from developing a table to clearly see the exponential growth (i.e. headings of size, dimensions, number of small squares - the area, and exponential form). That information is connected on the Square Grid Template Attachment #1, but some students might find it challenging to see the pattern clearly when the numbers become "crunched" at the top of the template. The use of the table to help students process the gold coin decision is also useful in developing the conceptual understanding. As a suggestion, some students might benefit from initiating the development of the table in the gold coin problem with concrete objects. As the numbers become larger the concrete objects are not as easily used, but starting with them may bridge the conceptual gap for some students. Also, including more written discussion of the concept of exponentiation could give the teacher more information about the strength of the student's conceptual understanding. - Applications and problem solving are evident throughout (Gymnastics mat & Gold Coin problems). A suggestion for improvement in this shift would be to connect exponent expressions to real world contexts beyond area and the Genie problem such as in cell growth that triples every hour, etc.

	Suggestions for focus and clarity: - Users of this lesson might also need to realize that in future grades students will need to be able to use exponents to simplify numeric expressions in a variety of settings, so writing and evaluating exponents is a foundational skill that is critical for future mathematics. -It might be necessary to expand on the various representations of exponential values element within the rigor category to convey importance of this conceptual understanding in concrete ways. - Students and teachers might find it more rigorous and will acquire greater understanding of how exponents are used in writing numerical expressions for real world situations if there were some applications that are relevant to them. An example might be an adaptation of The Djinni's Offer to student's allowance.
Rating: **3 – Meets most to all of the criteria in the dimension**	

Dimension III – Instructional Supports

The lesson/unit is responsive to varied student learning needs: ✓ Includes clear and sufficient guidance to support teaching and learning of the targeted standards, including, when appropriate, the use of technology and media. ✓ Uses and encourages precise and accurate mathematics, academic language, terminology and concrete or abstract representations (e.g., pictures, symbols, expressions, equations, graphics, models) in the discipline. ✓ Engages students in productive struggle through relevant, thought-provoking questions, problems and tasks that stimulate interest and elicit mathematical thinking. ✓ Addresses instructional expectations and is easy to understand and use. ✓ Provides appropriate level and type of scaffolding, differentiation, intervention and support for a broad range of learners. – Supports diverse cultural and linguistic backgrounds, interests and styles. – Provides extra supports for students working below grade level. – Provides extensions for students with high interest or working above grade level. <u>*A unit or longer lesson should:*</u> ❒ Recommend and facilitate a mix of instructional approaches for a variety of learners such as using multiple representations (e.g., including models, using a range of questions, checking for understanding, flexible grouping, pair-share). ❒ Gradually remove supports, requiring students to demonstrate their mathematical understanding independently. ❒ Demonstrate an effective sequence and a progression of learning where the concepts or skills advance and deepen over time.	Background Information: The overall structure of the Background information helped make it clear regarding the intent of the extended lesson. The information makes it clear how this lesson fits into the larger picture and how it connects to previous learning. One component of the background that may be unclear to users was the section of "Method for determining student readiness for the lesson." In terms of when that might take place is obvious to a veteran teacher, but not necessarily to a novice educator. It might be helpful to more clearly indicate how and when the suggested activity could be used to determine readiness. The purpose of the activity (finding areas of rectangles) wasn't quite clear. Here are some questions - -Will it be clear to students that a square is a regular rectangle? Will students realize that the square is the foundational idea of squared numbers? 6 x 6 = 36 = 6 squared? -Where is the connection to squared numbers made clear? It appears is that all the students are doing is just finding the area of a quadrilateral. Learning Experience: There is a great deal of valuable information in the Learning Experience, especially in the details section. The components of Warm-up, Motivation, Activities (including UDL components, key questions, formative assessment), Closure, Interventions/Enrichments, Materials, Technology and Resources are good components. There is clear support suggestions for both struggling and advanced learners. The format of switching between describing lesson activities and UDL components is confusing, and may make it difficult to see the full picture of the lesson. It might be helpful if the UDL components were a separate section from the Activity. Then the actual movement through the Activity would be easier to follow for teachers who wouldn't have to jump around in the document to find the flow of the lesson. Another suggestion is that each activity more clearly define "What the Teacher does" and "What the student does". For instance, at the end of activity 2, it says "students will respond to the following exit ticket . . ." It would be more helpful if it said something like, "The teacher passes out a half-sheet exit ticket that has been prepared with the following problem. Students work the problem for x minutes and turn it in to the teacher at the

❒ Expect, support and provide guidelines for procedural skill and fluency with core calculations and mathematical procedures (when called for in the standards for the grade) to be performed quickly and accurately.	end of class. After class, the teacher sorts the exit tickets into those that show understanding and those that show misconceptions. Common misconceptions are . . . In the following lesson, the teacher addresses any misconceptions by doing . . ." It would also be helpful to users if the problems on which the students are to work were in ready-to-use, printable formats as an attachment. In the component column, there is a list which includes Key Questions, Formative Assessment, and Summary sections. Each activity had some of these components, but not consistently. A suggestion is to either remove the unused ones from the list, or adjust the activities to include all three. It would also help to have some idea how much time this set of activities is meant to take. Is each activity meant for one 45-minute class period? While lessons don't always take the same amount of time with different groups of students, some rough guidance would help teachers know how much approximate time to allot to this lesson. The Gallery Walk activity is a nice way to engage students with the mathematics in a physically different way. Consider providing instructions for novice teachers about how to conduct a Gallery Walk, because they may not know. The Djinni's Offer could be launched more clearly in order to engage students better. It might be worth considering leaving the solving of this question more open ended, so that students struggle more with how to determine the better offer, rather than providing them a fill-in table. It is important to emphasize in the activity that the point of the Djinni's Offer is for students to see how quickly doubling grows, and to motivate the need for exponents to represent large numbers. The lesson does not fully develop the 'hook' for wanting to use exponents . This is a great motivator, however. Asking students to write out the amount for the first ten days (2 x 2 x 2 x2 ....etc) would make the point for students to consider abbreviated methods. Activity 3 starts with a pre-assessment which serves as a good bridge to the next step of evaluating the expressions with exponents. This activity seems to have a clear path leading students to the desired outcome. In the Interventions/Enrichments section, bullet three under Students with Disabilities/Struggling Learners there is some missing information. There is a mention of some videos, but the details are not given. Also, in the Gifted and Talented Students section, consider whether or not the drawing of perfect squares on blank paper is actually an extension of this standard. This may be a printing problem but check for pages 19 and 20 that are part of the Gallery walk that the formatting is correct.
Rating: **3 – Meets most to all of the criteria in the dimension**	

Dimension IV – Assessment

The lesson/unit regularly assesses whether students are mastering standards-based content and skills: ✓ Is designed to elicit direct, observable evidence of the degree to which a student can independently demonstrate the targeted CCSS. ✓ Assesses student proficiency using methods that are accessible and unbiased, including the use of grade-level language in student prompts. ❒ Includes aligned rubrics, answer keys and	There is evidence of formative assessment for Activities 1 and 3 and a pre-assessment for Activity 3. The Closure activity is a form of post-assessment. Students do have opportunities to demonstrate learning throughout as they engage in discussion, cooperative and independent work, and through teacher observations. At the end of activity 1, students complete an exit ticket in which they explain whether or not they agree with a fictional student's statement and explain why. It is unclear if this was meant to be formative or summative, but appears to be more summative. In the closure activity at the end of activity 3, students write an expression

scoring guidelines that provide sufficient guidance for interpreting student performance. *A unit or longer lesson should:* ❒ Use varied modes of curriculum-embedded assessments that may include pre-, formative, summative and self-assessment measures.	on one side of an index card and evaluate it on the other side, and turn it in to the teacher. Because it is critical that the identified learning target is measured by the assessment tool, one should consider whether or not the Closure activity effectively measures all three of the student learning outcomes, "writing numeric expressions into exponential form from repeated multiplication problems, the reverse, and evaluating numeric expressions using order of operations"? This would allow students to independently demonstrate the full depths of 6.EE.1. An improvement might be "Sam says 3 to the 4th power equals 12, but Mary says 3 to the fourth power equals 81. Who is right? Explain how you know." The next item on the assessment might measure students' ability to evaluate an expression using exponents, then the closure activity to see if students can generate three expressions using exponents whose solutions are greater than 80 and less than 100. Providing a range of understanding within the assessment, yields better understanding as to which students know which parts of the expectations in the standard and will provide more information for formative instructional practices. There is no evidence of any scoring guide/rubric or progress-monitoring to indicate that the teacher or the students are clear about the expectations or how they are progressing towards the target. Answers to some problems are embedded into the lesson details. A rubric for evaluating the index card exit ticket would be a helpful addition. The index card activity allows students to make an expression as simple or as complicated as they want, which means that it is accessible by all students. Nothing in the wording or language of the assessment prompts causes concern about bias or accessibility. This lesson could be made stronger if there were a suggestion as to how to do a more formal assessment of this standard, like suggested test or quiz questions that could be used on a larger summative assessment. Users might find it useful to use a generic problem-solving rubric when they are having students work on problems either independently or cooperatively. The rubric could include expectations of showing mathematics knowledge, using problem-solving strategies and writing an explanation.
Rating: **2 – Meets many of the criteria in the dimension**	

Summary Comments

This is a good lesson towards reaching the identified Common Core State Standards for Mathematics in content and in the use of the mathematical practices. It is focused on a major standard, the learning builds coherently within the lesson and makes connections to prior content and skills. It sets the foundations for rigor through conceptual understanding, procedural skills and application. This lesson considers student prior knowledge, student interest, and differences in student learning, and provides enough guidance to the teacher that he can also consider these elements. There is careful attention to the Standards for Math Practice throughout the lesson notes, and this will help teachers recognize, identify, and describe what it means to be doing one of the Standards for Math Practice at this grade level and with this content. Motivation for using exponents was an expectation of the lesson. The motivating aspect was not fully developed and would be a tool to get students 'hooked' onto the need for exponents in certain written expressions.

The information included in the plan is high quality; however, there is room for improvement in the layout and procedures such that veteran and novice teachers can implement the lesson coherently.

There is also room for improvement in the range and consistent measurement of the assessments towards the identified learning outcomes. Answer keys and rubrics would be helpful to teachers.

Rating Scales

Rating Scale for Dimensions I, II, III, IV:

3: Meets most to all of the criteria in the dimension

2: Meets many of the criteria in the dimension

1: Meets some of the criteria in the dimension

0: Does not meet the criteria in the dimension

Overall Rating for the Lesson/Unit:

E: Exemplar – Aligned and meets most to all of the criteria in dimensions II, III, IV **(total 11 – 12)**

E/I: Exemplar *if* Improved – Aligned and needs some improvement in one or more dimensions **(total 8 – 10)**

R: Revision Needed – Aligned partially and needs significant revision in one or more dimensions **(total 3 – 7)**

N: Not Ready to Review – Not aligned and does not meet criteria **(total 0 – 2)**

Rating Descriptors

Descriptors for Dimensions I, II, III, IV:

3: **Exemplifies CCSS Quality -** meets the standard described by criteria in the dimension, as explained in criterion-based observations.

2: **Approaching CCSS Quality -** meets many criteria but will benefit from revision in others, as suggested in criterion-based observations.

1: **Developing toward CCSS Quality -** needs significant revision, as suggested in criterion-based observations.

0: **Not representing CCSS Quality -** does not address the criteria in the dimension.

Descriptor for Overall Ratings:

E: Exemplifies CCSS Quality – Aligned and exemplifies the quality standard and exemplifies most of the criteria across Dimensions II, III, IV of the rubric.

E/I: Approaching CCSS Quality – Aligned and exemplifies the quality standard in some dimensions but will benefit from some revision in others.

R: Developing toward CCSS Quality – Aligned partially and approaches the quality standard in some dimensions and needs significant revision in others.

N: Not representing CCSS Quality – Not aligned and does not address criteria.