Developing a List and a Rubric of Interactive Open Education Resources (OER) for Science Teacher Candidates of Diverse Students

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Abstract **– To find the *interactive* OER (OER) that fits to teach diverse students in science classrooms, this study designs a selection rubric and a list of OER and asks fifty science teacher-candidates to use them for their teaching diverse students. At the end of the study, a survey is conducted and finds that teaching with the *interactive* OER furnishes the science teacher candidates with knowledge and skills of developing a learning environment for diverse students.**

Keywords **– Open Educational Resources, Science Teacher Education, Interactive Learning, Educational Technology, Diverse Students.**

1. Introduction

The Open Educational Resources (OER) provides an equal opportunity for students, especially students from low socioeconomic status, to save substantial amounts of money by eliminating the need to purchase expensive textbooks (Bliss, et al, 2013 [1]; Hilton & Wiley, 2011 [2]). Educators are able to use OERs to replace their traditional textbooks, dramatically lowering the cost that students pay for their education (Caswell, 2012 [3]). As they have access to the reading materials at little or no cost, the students from low SES are better prepared (Hilton et al., 2013 [4]). The students are more engaged and have more interest in learning.

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Also, the Open Educational Resources (OER) excels and leads the transition from passive to *interactive* learning by *using* digital resources instead of traditional physical books. Especially as the *interactive* OER that includes interactive lesson plans, games, textbooks, tests, audio, video, and simulations is emerging as a powerful tool to transform the way of on- and off-line teaching and learning, American classrooms continue to increase using interactive OER with diverse students.

The *interactive* OER further meet students' diverse learning needs by engaging students in hands-on learning, collaborating with their peers and evaluating their progress rather than traditional direct instruction delivery. The *interactive* OER can provide one-on-one assistance, guidance, and inspiration. This facilitates a shift from an instructor-centered classroom to a student-centered learning environment. Therefore, it is necessary to equip teacher-candidates with this powerful teaching tool that can help their diverse students be actively involved in learning on- and off-line.

Problem of OER

There are so many *interactive* OER available online. The teacher-candidates are not having difficulties finding the interactive OER but it is a challenge to judge their quality and relevance for the teacher-candidates' teaching. Although numerous researchers recognize the importance of using *interactive* OER in classrooms and students' success, little attention has been paid to develop criteria in selecting *interactive* OER appropriate to teach specific science concepts. As it becomes clearer that the growth of *interactive* OER offers real opportunities for improving access and transfer of knowledge and information from instructors to a wide range of learners, there is an urgent which needs to clarify the issue with special focus on the selection criteria of *interactive* OER.

Purpose of Research

This study is designed to develop rubrics for selecting the *interactive* OER appropriate to teach science concepts to *all* students and measure the effects of using rubric of *interactive* OER on the teacher-candidates' knowledge and skills in teaching science. The following research questions are addressed:

- To what extent does the list of *interactive* OER enhance the teacher-candidates in developing science lessons?
- To what extent is the rubric of *interactive* OER helpful for the teacher-candidates to select the *interactive* OER for teaching science lessons?

Teaching with *interactive* OER project is designed in this study. A rubric that is for the teacher-candidates to evaluate *interactive* OER with and a sample list of OER that is for them to use for teaching their science lessons are provided at the beginning of this study. The teacher-candidates who are enrolled in Science Education program of a teacher license program are asked to update the list of the *interactive* OER that fits their teaching. The first version of the OER list is revised and updated after the teacher-candidates teach their students. The effects of using the *interactive* OER on teaching are measured through a survey with the teacher-candidates at the end of the study.

2. Theoretical Frame Work

To provide a structure for systematically, purposefully, and comprehensively evaluating *interactive* OER, the selection rubric includes eight dimensions:

- Degree of Alignment to Standards
- Quality of Explanation of the Subject Matter
- Opportunities for Deeper Learning
- Quality of Assessment
- Quality of Instructional Tasks and Practice Exercises
- Utility of Materials Designed to Support Teaching
- Quality of Technological Interactivity
- Assurance of Accessibility

These rubrics are adapted from the Educators Evaluating the Quality of Instructional Products (EQuIP) Rubric. The EQuIP rubrics for science measure the alignment and overall quality of educational resources with respect to the Next Generation Science Standards (NGSS), instructional supports, and monitoring student progress (NSTA, 2014 [5]). The purposes of the first two dimensions of the *interactive* OER rubrics, Degree of Alignment to Standards and Quality of Explanation of the Subject Matter, provide overviewing and evaluating the quality of OER related to the NGSS. The third, fourth, and fifth dimensions, Opportunities for Deeper Learning, Quality of Assessment, and Quality of Instructional Tasks and Practice Exercises, provide constructive criterion for the improvement of students' understanding, the importance of authentic opportunities for student engagement in high-quality science lessons, and the development of meaningful student progress.

In assessing the qualities of *interactive* OER, the impact on students' learning is importantly counted in constructional approach (Wilson & Peterson, 2006 [6]). The *interactive* OER needs to help students to deeply understand and construct their learning through teaching with the interactive OER. Students respond to effectively (or ineffectively) designed *interactive* OER with observable behaviors. These dimensions evidence themselves most often in an increased or decreased willingness to use the *interactive* OER to collaborate with other students, to take responsibility for requesting needed information from the instructor, and to participate in class activities. Therefore, the *Interactive* OER must be designed to assure maximum interaction and construct students' knowledge in classrooms.

As the last component to be included for evaluating *interactive* OERs is the instructional design. The *Interactive* OER needs to encourage active reflection and discussion on the topics and concepts to be learned. The instructional designs of the *interactive* OER serve for increasing participation and feedback of the students in discussion and class activities (Kimeldorf, 1995 [7]; Roblyer & Ekhaml, 1999 [8]). The rest of the dimensions, Utility of Materials Designed to Support Teaching, Quality of Technological Interactivity, and Assurance of Accessibility, focus on measuring how much the *interactive* OER is designed to facilitates students' learning. The rubrics with these dimensions are shown in Table 2. of Appendix A.

3. Methodology

A cross-sectional study is conducted in which a survey is administered one time to participants at the end of the study for measuring how much OER rubrics were helpful. Cross-sectional study has been shown to be an effective method to provide a snapshot of the current behaviors, attitudes, and perspectives of participants (Gay, Mills, & Airasian, 2009 [9]).

Sample of Research

Fifty participants in this study are recruited through an online science method course that is a required course for all the graduate students of a teacher license program. This graduate program is fully online and the students enrolled in the course are generally educators working in math, science, and STEM areas from Grade 7 through college levels and have teaching practicum required as part of the course.

Instrument and Procedures

At the beginning of the study, several science lessons integrated with *interactive* OER are presented by the instructor and also a list of *interactive* OER to teach science are provided to the teacher-candidates. Then, rubrics modified from the EQuIP model (see Table 2. of Appendix A) are given for the teacher-candidates to use in selecting their own *interactive* OER to teach. The direction for teaching with *interactive* OER project is shown in Appendix A.

Before the teaching with *interactive* OER project, the teacher-candidates in groups are asked to develop a science lesson to teach. Then, each of the lessons needs to be integrated with the *interactive* OER. The groups of teacher-candidates explore OER available online based on the rubric and put together a comprehensive list of the *interactive* OER for their future teaching. After they teach the lessons integrated with *interactive* OER to their students, the teacher candidates take a survey at the end of the course. One lesson from a group of the teacher-candidates that was integrated with the *interactive* OER can be found in Table 1. of Appendix B.

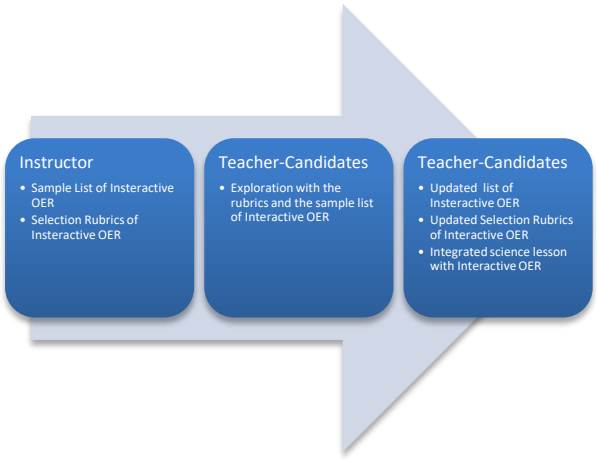

Figure 1. Overview of the Research Design

Data Analysis

To measure the efficacy of using the *Interactive* OER, the teacher-candidates' satisfaction levels and their reflective responses to the survey are used at the end of the study. The instrument is based on five Customer Satisfaction Surveys (CSS; Smith, 2012 [10]). The CSS is composed of two questioning formats: 5-point Likert scales and 3 reflective questions. The 5-point Likert scale survey contains *questions about the teacher-candidates'* satisfaction levels of using the list of the *interactive* OER. High levels of class satisfaction, which are closely associated with teacher-candidates and their students' meaningful experiences, are strong predictors of positive effects of the use of *interactive* OER in understanding science concepts and teaching science (Graham & Scarborough, 2001 [11]; Chang Zhu, 2012 [12]). In addition, the instrument includes *three reflective questions* aiming to assess the participants' insights and thoughts on the *interactive* OER. The survey questions are administered to a cross-section of the graduate Science Education candidates through an online survey tool.

4. Results

Based on the satisfaction survey with the fifty candidates at the end of the "Teaching with Interactive OER" project, the data is collected and summarized below.

Revised list of interactive OER

Some of the fifty teacher candidates used the interactive OERs from the provided list of interactive OERs but some of them searched for new interactive OERs that fit to teach their science lessons. The revised list of *interactive* OER is found in Table 2. of Appendix B.

The Survey Results about the Rubrics in Selecting Interactive OER

94% of the teacher-candidates (47 out of 50) say that the rubrics to select *interactive* OER were helpful, giving them a guideline of what needed to be in place and how the *interactive* OER should look for better learning. The rubrics also encouraged the teacher-candidates to prepare their lessons more interactive.

However, three of the teacher-candidates responded negatively in using the rubrics. It was not

necessary that the *interactive* OER for lower grade levels, when their students are in the preoperational/early concrete stages of development, have to be in high level of interactive quality. They experienced that some of the high quality *interactive* OER had low scores because of the interactivity. One of the responses expressed interestingly about the complication of finding the *interactive* OER for teaching specific subject areas, for example, chemistry. Their essay responses after they use the rubric are shown in Table 1.

Table 1. Essay Responses from the Survey

Positive Responses
"The rubric was helpful because it let me know how to pick one and what the OER should provide for my instruction and for the students."
"I liked that it kept me focused on finding activities that would score higher due to quality of student-peer interaction and student-teacher interaction. When writing assignments, I am usually focused on the student understanding the concept and forget to focus on the interaction quality."
"Yes, the rubric allowed me to select OER's in a way that flowed and made sense. I was able to rate the OER based on its characteristics and quality."
"It was helpful. It helped me to understand what kind of Interactive OER to look for."
"The rubric was helpful for assessing interactive OER's and it will help me create walkthroughs that are more interactive in the future."
"It was helpful, in giving me a guideline of what needed to be in place on my rubric and how it should look."
"Yes, it was very helpful. It helps me reflect on my modified lesson and re-evaluate if the quality of the lesson is best for the students."
"Yes. I appreciated knowing what the expectation was for the Interactive OER I chose for my lesson. It was helpful to know up front that I needed to choose a resource that would help my students to build social rapport, collaborate with one another and communicate their thoughts to me, the teacher, and be rich in opportunities to create new knowledge and relate it to real world situations."
"I thought that it was helpful, …... It definitely made me think about what to look for in a high-quality website, though."
" I think it was good information and guided me to look at all facets of a resource. For example I didn't consider social interaction as a good quality of the OER but I see its benefits and that it would make it more appealing to students as well."
"The rubric was helpful in determining if the activities I integrated into this lesson from the old …..Website."
Negative Responses
"The rubric made it a little difficult because many of the sites I can across for the grade intended did not supply higher quality Interactive OER. I might change it to reflect an integration piece for language arts/social studies for students in the preoperational/early concrete stages of development. "
"I thought that it was helpful, but also discouraging because I couldn't find any websites that I would qualify as highly interactive for this lesson."
"I have yet to find any stand-alone OER's that provided even moderate levels of interaction in the list provided for Physical Sciences that covered the topic of chemical reactions"

5. Discussion

Teaching with *interactive* OER is helpful for the teacher-candidates to teach their science lessons to their students. The list of Interactive OER provides great resources that make the students interactively engaged in and understand the lessons better. Also, the teacher-candidates update the list with additional *interactive* OER. The rubric as a criterion to select the *interactive* OER appropriate to teach science works as a guidance for the teacher-candidates to decide the *interactive* OER and understand the interaction between the teacher and their students and among students. However, the rubric needs to be revised according to grade level. For the students in the preoperatnal/early concrete stages of development, Pre-K to Grade 2, the interaction levels of the *interactive* OER are few to the moderate level. With the updated OER list and the revised rubrics of selecting *interactive* OER, the teacher-candidates enabled to find the interactive OER that facilitate the learning environment where students were more interactively engaged in and understand better the lessons. More selection criteria of *interactive* OER demand is to be developed, especially for learning specific science areas, like chemical reactions.

6. Conclusions

This study helped meeting the demand for high-quality science teacher education, by strengthening science instructional content and practice specifically through the selection and integration of *interactive* OER into their science instructions. The study designed the Teaching with the *interactive* OER project for teacher-candidates to use OERs pertinent to their science instruction. To assess the widely available and free *interactive* OER for appropriate integration into lessons, this study provided the information of the selection rubric and the list of the *interactive* OER that could be easily customizable for teacher-candidates.

Also, the selection rubrics and the finalized list of the *interactive* OER supported that the teacher-candidates developed the environment where the teachers and their students were interactive. This study provides an opportunity that the teacher-

candidates furnish with the knowledge and the skills of using *interactive* OER in their teaching.

Science teacher education needs to include the *interactive* OER for providing the critical assessment dimensions and the flexible and accessible supplements to science instructions. More studies are required to revise and develop the rubrics and the list of *interactive* OER appropriate to grade levels and discipline areas.

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Appendix A. Direction for Teaching Science with Open Educational Resources (OER)

Direction

To integrate your inquiry-based Learning Cycle lesson with Interactive Open Educational Resources, please choose the right one for your lesson(s) from the following table (Table 1.). Also, you can search for your own Open Educational textbooks through online resources. The rubrics in Table 2. are given for you to use as criteria in selecting your OER to teach your lesson(s).

Table 1. Sample interactive OERs to Teach Science

Contents	***Physical Science***	***Life Science***	***Earth/Space Science***
interactive OERs	• 101 in 1 Physics Solver • Active Sonar • Alchemy Glossary • AP Physics • Atom in a Box • Chemical Equation • Chemical Formulas • Chemistry Formulas • Chemistry Terms • Colour Collider • Dictionary of Chemistry • Dictionary of Physics • Elemental Table Formulary: Physics • Gear Ratio • iChemistryLab • iLab Timer • Molecules • Mr Science Show • Mythbusters • Newton's Cradle Physics • Newton's Laws • Oxford Dictionary of Chemistry • Pendulums • Periodic • Periodic Table • Physics Formulas • Physics Puzzles • Physics XL • Physiology Glossary • Wolfram General Chemistry Course • XChem • Touch Physics • Toy Physics • Titration Simulator • Rocket Universe	• 3D Brain • 3D Cell Simulator • 3D4Medical • A Life Cycle App • Anatomy and Physiology • Anatomy Flash • Bio Dictionary • Biology Memory • Biology Body Parts - Human Body • Reproduction • Bugs and Insects • Bugism • Buzz Aldrin Portal to Science • Cellular Biology Digestion • Frog dissection • Genetic Decoder • Genetic History • Genetics Study Guide • HD Marine Life • Human Anatomy • iAnatomy • Insects HD • Marine Life • Nanosaur 2 • Nature Human Genome • Rat Dissection • Respiratory System • Virtual Frog Dissection	• 8 Planets • Astronomy HD • Beautiful Planet • Cosmic Discoveries • Deep Sky • Earth Observer • ExoplanetGravity Balls • Google Earth • Grand Tour 3D: Pocket Solar System • HD Astronomy • HD Solar System • Jupiter Study Guide • Mars Globe HD • Mars Study Guide • Moon Globe HD • NASA • Orion StarSeek PRO • Planets • Planet's New • Pluto Study Guide • WeatherBug • Venus Study Guide • Saturn Study Guide • Solar System • Solar System Guide • Space Images • SpaceTime for iPad • Star Chart • Star Gazer • StarMap 3D Plus • Star New • Stars • Star Walk • Stellarium XL • The Weather Channel • Solar System Simulation

The rubrics shown below in Table 2. are modified from the Educators Evaluating the Quality of Instructional Products (EQuIP) Rubric including eight separate dimensions that contribute to overview and evaluate the quality of OER related to Degree of Alignment to NGSS Standards and Quality of Explanation of the Subject Matter, instructional supports, and monitoring student progress.

Table 2. Rubric for Assessing Interactive Qualities of Open Educational Resources

Scale (point)	Degree of Alignment of Standards	Quality of Explanation of Subject Matter	Utility of Materials Designed to Support Teaching	Quality of Assessment	Quality of Technological Interactivity	Quality of Instructional and Practice Exercises	Opportunities for Deeper Learning	Assurance of Accessibility
Superior (3)	All of the content and performance expectations in the identified standard are completely addressed by the object. The content and performance expectations of the identified standard are the focus of the object. While some objects may cover a range of standards that could potentially be aligned, for a superior alignment the content and performance expectations must not be a peripheral part of the object.	The object provides comprehensive information so effectively that the target audience should be able to understand the subject matter. The object connects important associated concepts within the subject matter. The object does not need to be augmented with additional explanation or materials. The main ideas of the subject matter addressed in the object are clearly identified for the learner.	The object provides materials that are comprehensive and easy to understand and use. The object includes suggestions for ways to use the materials with a variety of learners. These suggestions include materials such as “common error analysis tips” and “precursor skills and knowledge” that go beyond the basic lesson or unit elements. All objects and all components are provided and function as intended and described. For example, the time needed for lesson planning appears accurately estimated, materials lists are complete, and explanations make sense. For larger objects like units, materials facilitate the use of a mix of instructional approaches (direct and interactive instruction, group work, investigations, etc.).	All of the skills and knowledge assessed align clearly to the content and performance expectations intended, as stated or implied in the object. Nothing is assessed that is not included in the scope of intended material unless it is differentiated as extension material. The most important aspects of the expectations are targeted and are given appropriate weight/attention in the assessment. The assessment modes used in the object, such as selected response, long and short constructed response, or group work require the student to demonstrate proficiency in the intended concept/skill. The level of difficulty is a result of the complexity of the subject-area content and performance expectations and of the degree of cognitive demand, rather than a result of unrelated issues (e.g. overly complex vocabulary used in math word problems).	The object is responsive to student input in a way that creates an individualized learning experience. This means the object adapts to the user based on what s/he does, or the object allows the user some flexibility or individual control during the learning experience. The interactive element is purposeful and directly related to learning. The object is well-designed and easy to use, encouraging learner use. The object appears to function flawlessly on the intended platform.	The object offers more exercises than needed for the average student to facilitate mastery of the targeted skills, as stated or implied in the object. For complex tasks, one or two rich practice exercises may be considered more than enough. The exercises are clearly written and supported by accurate answer keys or scoring guidelines as applicable. There are a variety of exercise types and/or the exercises are available in a variety of formats, as appropriate to the targeted concepts and skills. For more complex practice exercises the formats used provide an opportunity for the learner to integrate a variety of skills.	At least three of the deeper learning skills from the list identified in this rubric (a.Think critically and solve complex problems. b.Work collaboratively and interactively. c.Communicate effectively. d.Learn how to learn. e.Reason abstractly. f.Construct viable arguments and critique the reasoning of others. g.Apply discrete knowledge and skills to real-world situations. h.Construct, use, or analyze models.) are required in the object. The object offers a range of cognitive demand that is appropriate and supportive of the material. Appropriate scaffolding and direction are provided.	The object displays the characteristic or complies with the standards, recommendations or guidelines.

Strong (2)	Minor elements of the standard are not addressed in the object. The content and performance expectations of the standard align to a minor part of the object.	An object explains the subject matter in a way that makes skills, procedures, concepts, and/or information understandable.	An object does not include suggestions for ways to use the materials with a variety of learners (e.g., error analysis tips). Some core components (e.g., directions and interaction) are underdeveloped in the object.	An object assesses all of the content and performance expectations intended, but the assessment modes used do not consistently offer the student opportunities to demonstrate proficiency in the intended concept/skill.	An object has an interactive feature that is purposeful and directly related to learning, but does not provide an individualized learning experience. Similarly to the *superior* objects, *strong* interactive objects must be well designed, easy-to-use, and function flawlessly on the intended platform. Some technological elements may not be directly related to the content but for a *strong* rating they must not detract from the learning experience. These kinds of interactive elements, including earning points or achieving levels for correct answers, might be designed to increase student motivation and to build content understanding by rewarding or entertaining the learner, and may extend the time the user engages with the content.	An object offers only a sufficient number of well-written exercises to facilitate mastery of targeted skills, which are supported by accurate answer keys or scoring guidelines, but there is little variety of exercise types or formats.	An object includes one or two deeper learning skills identified in this rubric.
Limited (1)	An object has *limited* alignment if a significant part of the content or performance expectations of the identified standard is not addressed in the object, as long as there is fidelity to the part it does cover.	An object explains the subject matter correctly but in a limited way. This cursory treatment of the content is not sufficiently developed for a first-time learner of the content. The explanations are not thorough and would likely serve as a review for most learners.	The object is missing important elements (e.g. directions for some parts of a lesson are not included). Important elements do not function as they are intended to (e.g. directions are unclear or practice exercises are missing or inadequate). Teachers would need to supplement this object to use it effectively.	An object assesses some of the content or performance expectations intended, as stated or implicit in the object, but omits some important content or performance expectations and/or fails to offer the student opportunities to demonstrate proficiency in the intended content/skill.	An object's technological interactivity if its interactive element does not relate to the subject matter and may detract from the learning experience. These kinds of interactive elements may slightly increase motivation but do not provide strong support for understanding the subject matter addressed in the object. It is unlikely that this interactive feature will increase understanding or extend the time a user engages with the content.	An object has some, but too few exercises to facilitate mastery of the targeted skills, is without answer keys, and provides no variation in type or format.	An object includes one deeper learning skill identified in the rubric but is missing clear guidance on how to tap into the various aspects of deeper learning.

Very week/None (0)	The object does not match the intended standards. The object matches only to minimally important aspects of a standard. These objects will not typically be useful for instruction of core concepts and performances covered by the standard.	An object's explanations are confusing or contain errors. There is little likelihood that this object will contribute to understanding.	An object is confusing, contains errors, is missing important elements, or is for some other reason simply not useful, in spite of an intention to be used as a support for teachers in planning or preparation.	An object's assessments contain significant errors, do not assess important content/skills, are written in a way that is confusing to students, or are unsound for other reasons.	An object has interactive features that are poorly conceived and/or executed. The interactive features might fail to operate as intended, distract the user, or unnecessarily take up user time.	The exercises provided do not facilitate mastery of the targeted skills, contain errors, or are unsound for other reasons.	An object appears to be designed to provide some of the deeper learning opportunities identified in this rubric, but it is not useful as it is presented.	The object does NOT display the characteristic or comply with the standards, recommendations or guidelines.
Total for each:	_____ pts.	_____ pts.	_____pts.	_____ pts.	_____ pts.	_____ pts.	_____ pts.	_____ pts.
Total overall:	_____ pts.							

Appendix B. Science Lesson Integrated with Interactive OER and the Revised List of Interactive OER

The following table (Table 1.) shows the science lesson integrated with interactive OER that was developed by one of the teacher-candidates. The interactive OER is highlighted in yellow.

Table 1. Science Lesson integrated with Interactive OER

Grade 2		
NSES (or you can use NGSS) Content Standard B. Physical Science for K-4. All students should develop an understanding of properties of objects and materials. Content Standard D. Earth and Space Science for K-4. All students should develop an understanding of properties of earth materials, objects in the sky, changes in earth and sky.		
TEKS Science, Grade 2. (7) Earth and space. The student knows that the natural world includes earth materials. The student is expected to: (A) observe and describe rocks by size, texture, and color;		
Topic question What are the characteristics of various types of rocks? (I.e. Igneous, sedimentary, and metamorphic)		
Objectives 1. Students will identify characteristics of rocks by size, texture, and colors.		
Materials Different types of rocks Paper Writing Utensils Interactive OER: • **The Rock Cycle by Base 12 Innovations http://appcrawlr.com/app/show/991456** • **Common Rocks Reference by Malcolm Hall http://appcrawlr.com/app/show/940770**		
Stages of the 5E model	**Time**	**Questions**
Engage. Ask questions about objects, organisms, and event in the environment.	5 min	1. What is the rock cycle? (Knowledge) 2. How would you compare and contrast the rocks that you see in your backyard to the ones you see on the playground? (Comprehension) 3. What materials do you think rocks are made from? (Knowledge) 4. How would you categorize different types of rocks? (Analysis) *Show photos of different rocks and ask them to analyze them.*
Explore. Ask questions to gather evidence to answer the	15 min	1. Can you formulate a theory for how rocks form? (synthesis) 2. Explore the ways rocks can change forms. (Synthesis). 3. Discuss the characteristics of the given rocks. 4. What is the process that rocks go through when changing

question posed.		forms? *A bag of rocks will be given to each group. They will observe and discuss the different properties of the rocks, including texture, size, and color. They will explore these characteristics using their five senses.* • **The Rock Cycle by Base 12 Innovations http://appcrawlr.com/app/show/991456** • **Common Rocks Reference by Malcolm Hall http://appcrawlr.com/app/show/940770**
Explain. Ask questions to use new knowledge and observable evidence to construct scientific explanations and answer initiating questions.	5	1. Categorize the types of rocks based on the characteristics you identified. 2. Based on your observations, make an inference about the categories of rocks you observed. (Analysis) *Observe the similarities and differences between the rocks.* List the textures you feel. Rank the rocks by size from smallest to largest or vice versa. Rank the rocks by color from lightest to darkest or vice versa.
Elaborate. Ask questions to apply new understandings to new problems.	5	1. Is it possible for rocks to change from one type to another? (Applications) 2. How many different ways can the rock cycle happen? (synthesis) Create your own rock cycle using one rock from each category and place them in the corresponding section.
Evaluate. Ask questions to assess developing understandings and inquiry skills.	5	Observe your neighbors' rock cycles, what changes would you recommend? If any? Use a rubric to check other groups' rock cycles. Each student will write down the rock cycle and their observations on the rocks in their science journal. .

The new list of the following table (Table 2.) has more interactive OERs in yellow:

Table 2. Revised List of Interactive OER

Contents	***Physical Science***	***Life Science***	***Earth/Space Science***
***interactive* OERs**	• 101 in 1 Physics Solver • Active Sonar • Alchemy Glossary • AP Physics • Atom in a Box • Chemical Equation • Chemical Formulas • Chemistry Formulas • Chemistry Terms • Colour Collider • Dictionary of Chemistry • Dictionary of Physics • Elemental Table Formulary: Physics • Gear Ratio • iChemistryLab • iLab Timer • Molecules • Mr Science Show • Mythbusters • Newton's Cradle Physics • Newton's Laws • Oxford Dictionary of Chemistry • Pendulums • Periodic • Periodic Table • Physics Formulas • Physics Puzzles • Physics XL • Physiology Glossary • Wolfram General Chemistry Course • XChem • Touch Physics • Toy Physics • Titration Simulator • Rocket Universe • Glencoe/Science Virtual Labs • Vital Lab/Ohio University: Chemical and Physical change lab • Quia/pop	• 3D Brain • 3D Cell Simulator • 3D4Medical • A Life Cycle App • Anatomy and Physiology • Anatomy Flash • Bio Dictionary • Biology Memory • Biology Body Parts - Human Body • Reproduction • Bugs and Insects • Bugism • Buzz Aldrin Portal to Science • Cellular Biology Digestion • Frog dissection • Genetic Decoder • Genetic History • Genetics Study Guide • HD Marine Life • Human Anatomy • iAnatomy • Insects HD • Marine Life • Nanosaur 2 • Nature Human Genome • Rat Dissection • Respiratory System • Virtual Frog Dissection • ZeroBio • Livebinders	• 8 Planets • Astronomy HD • Beautiful Planet • Cosmic Discoveries • Deep Sky • Earth Observer • EnchantedLearning/Astronomy • ExoplanetGravity Balls • Google Earth • Grand Tour 3D: Pocket Solar System • HD Astronomy • HD Solar System • Highered.mheducation • Jupiter Study Guide • Mars Globe HD • Mars Study Guide • Moon Globe HD • National Geography: Reason for Seasons • Orion StarSeek PRO • Planets • Planet's New • Pluto Study Guide • Saturn Study Guide • Scienceu/observatory • Solar System • Solar System Guide • Space Images • SpaceTime for iPad • Star Chart • Star Gazer • StarMap 3D Plus • Star New • Stars • Star Walk • Stellarium XL • SchoolMedia interactive • The Weather Channel • Solar System Simulation • Bootslearningstore: Sunshine and Shadow • Science Games for Kids: Sun, Light, & Shadows • E-learning for Kids: Science – Scotland-Sun & Shadows • Why Do We Have Seasons Interactive • UNL Astronomy: Sun's Rays Simulator • UNL Astronomy: Seasons and

Ecliptic Simulator
- StudyJams/Science: Rocks & Minerals
- NASA: Earth Observatory
- Venus Study Guide
- WeatherBug
- Weather Channels
- Weatherwizkids