Science curriculum alignment to the NGSS

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Abstract

The Next Generation Science Standards (NGSS) are a set of standards and criteria that support the most effective way to teach science. Twenty states and the District of Columbia (representing over 36% of U.S. Students) have officially adopted the NGSS as their science standards. In addition, twenty-four states (representing 35% of U.S. students) have developed their own standards based on recommendations in the National Research Council (NRC) Framework for K-12 Science Education, which is the same framework that the NGSS was developed from (NSTA) (NRC, 2012). In those 44 states (71% of the U.S. student population) teachers should ask students to learn science by making claims, evaluating evidence, and utilizing reason. The NGSS supports a way to teach science that puts the learning in the hands of the students. These activities include designing investigations, collecting data, formulating claims, and arguing based on found evidence. However, many of the most popular elementary school science curricula that are used in those 44 states are not aligned to the expectations and rigor of the NGSS. This study was done to evaluate current popular elementary science curricula to see if they align with the expectations of the NGSS. As the NGSS has been peer-reviewed and determined to be the most effective way to teach science, all science curricula should align to the standards that it outlines. In this study, the Evaluating Quality in Instructional Products (EQUIP) Rubric, which is designed to evaluate curricula based on how well they meet the NGSS, was used to analyze each curriculum. In this study, five readily available science curricula that claim to be aligned to the NGSS were evaluated using this research-based evaluation tool. It was found that four of the five most widely-used science curricula do not fall close to meeting the expectations of the NGSS, thus supporting the claim that elementary science curricula needs improvements.
Introduction

The Next Generation Science Standards (NGSS) are a set of standards and criteria that support the most effective way to teach science. Twenty states and the District of Columbia have officially adopted the NGSS as their science standards. In addition, twenty-four states have developed their own standards based on recommendations in the National Research Council (NRC) Framework for K-12 Science Education, which is the same framework that the NGSS was developed from (NSTA) (NRC, 2012). In those 44 states, representing 71% of the U.S. student population, teachers are being asked to teach science to students by having them make claims, evaluate evidence based on data, and utilize reason to argue their claims. However, many of the most popular elementary school science curricula that are used in those 44 states are not actually aligned to the expectations and rigor of the NGSS, even though the states have adopted those standards. In this study, 57 qualified college students analyzed five of the most popular elementary science curricula using the Evaluating Quality in Instructional Products (EQUIP) Rubric, which is designed to evaluate curricula based on how well they meet the NGSS. The results of this study show that elementary science curricula need a lot of revisions in order to meet the standards and rigor of the NGSS.

Importance of the NGSS

The NGSS dictate standards and criteria that support the most effective way to teach science to students. Sadler and Brown claim that the NGSS, “Represent the latest articulation of K-12 science learning standards in the United States” (2018, pg. 903). The NGSS is based on “Three-Dimensional Learning” (or 3D Learning). The first of these dimensions is the Science and Engineering Practices (SEP)(Sadler & Brown, 2013, pg. xv). This involves teaching students science by using tools, skills, and methods that real scientists would use, including asking their own questions, making claims, and designing their own investigations.
The second of these dimensions is Cross-Cutting Concepts (CCC) (Sadler & Brown, 2013, pg. xv). This dimension involves purposefully connecting different concepts and ideas across different scientific units. These concepts include: patterns, cause and effect, scale, proportion, and quantity, systems and system models, energy and matter, structure and function, and stability and change. All of these concepts can be used in several scientific units. By using this structure, students should be able to cover these concepts and make connections between what they are learning in different units.

The third of these dimensions is Disciplinary Core Ideas (DCI) (Sadler & Brown, 2013, pg. xv). This dimension requires that teachers move away from having students focus on specific facts, and move towards preparing students with core knowledge, which would then prepare them to discover deeper learning on their own. In other words, rather than giving students a list of facts to memorize, teachers should give students general, conceptual knowledge about a topic as well as the tools they would need to further investigate that topic and debate their claims based on the evidence they find. In summary, this dimension is asking that teachers create an environment where students learn through the collaborative process of argumentation.

Three-Dimensional learning is one part of the NGSS, but there are other qualities that are just as important. The NGSS asks teachers to teach a curriculum that is phenomena-based. Phenomena-based instruction asks teachers to intrigue students with an anchoring scientific phenomenon, and then let them discuss what they saw, ask questions about it, and design an investigation to answer those questions. Although the NGSS is not a curriculum, it does suggest an effective curriculum structure.

In the following sections I will outline the recommendations of instruction outlined in the NRC (2012) and promoted in the NGSS (NGSS Lead States, 2013) that asks students to (a) explore phenomena, (b) analyze the results of the investigation and engage in argumentation, and
(c) compare claims to the consensus of the scientific community. These recommendations are intended to illustrate an effective elementary science lesson that aligns with standards of the NGSS. As the recommended science instruction outlined in the NRC (2012) looks a bit unfamiliar to most students who have gone through elementary science classes, this shows that the current elementary science curricula do not meet the standards set by the NGSS.

NGSS-Aligned science units begin with a phenomena-exploration (Reiser, 2014). By exploring phenomena, students have opportunities to apply science and engineering practices and to build their own larger conceptual understanding of science. For this, the teacher may physically demonstrate something, show students a video, or have students observe something in nature. From there, the teacher would guide a class discussion about what the students observed, with the intention of developing questions to investigate. Students would then begin to ask questions about what they saw, which would then be used to guide an investigation (Moore, 2015).

Teachers should inform students of what tools and resources they have available to them, and then let them brainstorm ideas of how they can go about investigating their driving question (Cunningham & Kelly, 2017; Reiser, 2014). Once a driving question has been chosen, students should make a claim based on their own background knowledge (Bursal, 2013). This claim could be written in a class workbook, student notebook, or teacher-created work packet. Students would keep a copy of this claim, so they can refer back to it once the investigation is complete.

The next step is to carry out the investigation that students have planned (Reiser, 2014). They should make note of anything they observe that might help them answer their driving question. After the investigation, students would engage in a class discussion, where they discuss, argue, and ask questions about what they observed and what data they collected in the investigation (Resier, 2014; Southerland, et al., 2016). In this discussion, it is important for
teachers to recognize that any student idea is valid, but discussion needs to include evidence from the investigation that supports their idea. An important aspect of this discussion is that teachers should never say whether a student’s idea is correct or incorrect. By doing this, students will continue to ask and answer their own and their peers’ questions. This connects back to the idea of “doing what scientists do.” No scientist working in the field has someone who tells them if their claims are right or wrong; they have to discover that for themselves. By the end of this first discussion, students should have a tentative answer to their driving question; they can have a more narrowed list of possible answers, but they should not have one answer that they are sure is correct.

After this first discussion, students should be presented with literature that can help them answer their questions (Bursal, 2013). This is a way to provide closure for the argument. Students need to learn the correct information, but the teacher should promote practices of inquiry by allowing the student to read text and decide if their claim is supported by evidence or not. The teacher should provide literature that provides information that directly helps to answer student questions.

Once students have read the literature, another discussion can commence (Capps & Crawford, 2013). At this point, students should have one or two possible answers to their driving question. This final discussion is intended to work towards determining one final answer to the driving question. Once the class has found an answer to their question, students would be asked to revisit the claim that they made at the beginning of the lesson (Reiser, 2014). From there, they would either explain how their claim was correct, or revise the claim so that it is correct, with explanation as to what evidence supports this new claim. Once this has been done, the lesson can conclude.
The lesson structure mentioned above may seem unique to most people; it probably does not reflect the way they were taught science when they were in school. This is why the most available science curricula are in need of improvement. The NGSS has been adopted by many states and school districts, yet many of the curricula they use do not reflect the expectations of the NGSS. In the following pages, the most common science curricula have been critically analyzed based on how they meet or do not meet the NGSS, based on the EQUIP rubric.

**Literature Review**

As mentioned in previous sections, the NGSS represent a set of science teaching standards that promote the greatest chance of student success; and these standards have existed for many years. Sadler and Brown claimed that the Next Generation Science Standards, “Represent the latest articulation of K- 12 science learning standards in the United States” (2018, pg. 903). This article claimed that the reform of science education has been going on for nearly 30 years (Sadler et al, 2018, pg. 903). Experts in the community understand that the expectations of the NGSS are not brand new, yet the most common science curricula still do not meet those expectations.

Brian Reiser (a lead member of the NGSS task force) described the initial science lesson as beginning with an anchoring phenomenon (Reiser, 2014, slide 6). This anchoring phenomenon is written as a “driving question” that creates curiosity in the eyes of the students. This “driving question” is intended to lead to a variety of other, more specific questions that students may wonder about or want to learn about. These furthering questions are referred to as “phenom-driven questions” (Reiser, 2014, slide 6).

From the driving question, students should be able to ask more specific, testable questions that interest them and target what they want to discover. From those “phenom-driven questions,” students would be expected to “make sense of phenomena with science practices”
In other words, students would take their phenom-driven question and develop methods to conduct an experiment to test their hypothesis, and/or look to published resources to investigate their question.

Finally, once students have used their scientific skills to make discoveries, they would be asked to create a model to express their understanding (Reiser, 2014, slide 9). This process can be adapted to do more than answer just one phenom-based question. Reiser designed this process to allow students to go back to their driving question, come up with a different phenom-driven question, work through the scientific process again, and then add to or modify their model (2014, slide 9). By asking more questions, students will develop a more comprehensive understanding of the scientific content.

Several journal articles and presentations have also been written in an effort to show that there are numerous benefits to incorporating the NGSS into science classrooms. Duschl and Bybee proposed the idea of the 5D model (2014). This model lists five steps towards developing a testable question and conducting an experiment to try to answer that question. Those five steps are: 1) Deciding what and how to measure, observe, and sample, 2) Developing or selecting procedures/tools to measure and collect data, 3) Documenting and systematically recording results and observations, 4) Devising representations for structuring data and patterns of observations, and 5) Determining if a) the data are valid, reliable, and can be used evidence, b) additional or new data are needed, or c) a new investigation design or set of measurements are needed (Duschl & Bybee, 2014). Duschl and Bybee explained that “The 5D model provides struggle type experiences for students to acquire not only conceptual, procedural and epistemic knowledge but also to attain desired ‘knowledge problematic’ images of the nature of science” (2014, pg. 1). In other words, students are learning how to conduct scientific investigations through trying, failing, and trying again, just as real scientists would. Right now in science
classrooms, students are getting a false idea of what it means to be a scientist and to ask questions about the world around them (Duschl & Bybee, 2014, pg. 2). Many students are raised to believe that when real scientists investigate something, the desired outcome will always occur, which is not the case. This article also mentions that,

Students who complete too many investigations...that are designed to follow a set of procedures thus ensuring sound results, fail to recognize that the results of investigations are used in science to engage in model building and revision activities. In other words, the impression students acquire is that science investigations typically work and the anticipated outcomes are usually achieved. Absent are the struggles that scientists encounter. (Duschl & Bybee, 2014, pg. 4)

In summary, science curricula that are being taught in most classrooms do not accurately reflect how scientific discoveries are made in the real world. However, curricula that do align with the NGSS do reflect this idea. Change is difficult with a reform-based teaching program, and it often comes with a lot of resistance. The Journal of Research in Science Teaching explained that it is very difficult to align science curricula to the NGSS without completely changing the curriculum (Fulmer, Tanas, & Weiss, 2018, pg. 1077). Methods and tests that attempt to analyze the degree of alignment that a curriculum has to the NGSS were also described in this text (ex; American Association for the Advancement of Science (AAAS) has created tests to analyze science curricula, but this test fails to analyze all components of the NGSS and ensure that they are all being met.)

An important thing to note is that the NGSS can be difficult to implement into classrooms. As Anderson, et.al. explained, “Large-scale reform efforts sometimes attempt ‘one size fits all’ programs. This fails to account for the enduring diversity of American students, classrooms, and schools, which is one of the great strengths of our country” (2018, pg. 1028). In
other words, some schools are trying to implement the same science curriculum as other schools, without accounting for individual student differences. Schools see this “one-size fits all” idea as an easy way to have a science program at all, because implementing the NGSS can be difficult.

Another reason why the NGSS can be difficult to implement is because it requires a high degree of teacher training in order to be used effectively (Pruit, 2015, pg. 18). Years of training are required in order to entirely change how teachers teach science, and many schools see that as too time-consuming and too expensive. However, this article did counter that argument, by saying “It’s hard, but clear instruction about how cross-cutting concepts fit with the other dimensions will change science education” (Pruit, 2015, pg. 19). That “change” that is mentioned in that article is the key idea; if we make changes to teacher training, we will see changes in success in science education as a whole.

Resources have also provided data on the number of schools and states that have adopted the NGSS into their science curriculum. By 2015, 12 states and Washington D.C. had adopted the NGSS (Pruit, 2015). As of 2019, 20 states have adopted the NGSS, representing 36% of the student population in America (NSTA). Although it is apparent that the number of schools implementing the NGSS is growing, 36% of students is still a low percentage. Also, since it has been determined that it is difficult to fully and effectively implement the NGSS, it is possible that the schools that have technically adopted the standards are not completely meeting the standards. For example, according to the NGSS Hub, Iowa is one of the states that has adopted the NGSS, but many schools are still using science curricula that do not meet those standards. In summary, school districts may claim to use science curricula that align with the NGSS, and science curricula themselves may claim to align with the NGSS, but when critically analyzed, it is found that most of them are very far from adequately aligning with the NGSS.
Research Methodology

To determine the effectiveness of elementary school science curricula based on their alignment to the NGSS, 57 college students were collected to analyze five of the most popular science curricula on how well they align to the criteria set by the NGSS. Each of the students had completed the Teaching Elementary School Science class, taught by Dr. Mason Kuhn at the University of Northern Iowa (UNI). Throughout the course of the class, students learned about the NGSS and learned how to use it in their own science classrooms. This wealth of knowledge on this topic led them to be seen as qualified to analyze each of the science curricula chosen for this project.

There are several elementary science curricula that school districts use. It was decided that five of the most common curricula would be analyzed for this project. These curricula will not be named, for the sake of anonymity, but they were chosen for this research because they are the curricula that are most often used in elementary schools, and therefore, impact the highest number of students. The way that it was determined that these five curricula are the most commonly used in the state of Iowa came from Dr. Kuhn reaching out to various Area Education Agency Science Consultants across the state and they listed these five as the curriculum used most frequently in classrooms. Not only would the findings show just how inadequate many common curricula are in meeting the expectations of the NGSS, but the findings could also be used to show the most school districts that their science curriculum could be improved in regards to meeting the expectations set by the NGSS.

In the college course mentioned above, Dr. Kuhn taught students how to analyze each curriculum, using the Educators Evaluating the Quality of Instructional Products Rubric (EQUIP Rubric). This rubric provides a set list of criteria that measure how well a curriculum and its lessons align with the NGSS. The EQUIP Rubric divides the criteria into three categories: 3D
Design, Instructional Support, and Evaluating Student Progress. Each of these categories contains several criteria, but for the purposes of this project, only three criteria, or subcategories, as they will be referred to from this point on, from each category were used (see Appendix A for a copy of the adjusted rubric participants were presented with).

Each participant was then shown the five elementary science curricula that were chosen to be analyzed. They were then asked to look critically at each curriculum, the lessons within the curriculum, and the resources that the curriculum provided. Next, they were asked to score each curriculum a score of 0-3 for each of the subcategories. Once each participant had scored each curriculum in every subcategory, the data was compiled into one document. In this document (see Appendix B), the average score for each subcategory is listed (found by finding the sum of each participant’s score, then dividing by the total number of participants to find the mean score). This was found to give the most accurate picture of how well a curriculum meets each criterion.

After looking at the collected data, each chosen curriculum was analyzed by the author of this research. Notes were taken on what resources each curriculum provided, and what each lesson consisted of, paying particular attention to the EQUIP Rubric criteria. Finally, conclusions were made about each curriculum, and participant ratings were supported by specific details from each curriculum. This analysis can be found in the following pages.

**Curriculum Analysis**

To get an idea of which elementary science curricula met the NGSS and which did not, 5 of the most common curricula were evaluated (Curricula A-E). Each curriculum was examined and scored on its effectiveness in meeting the Next Generation Science Standards (NGSS) using the EQUIP Rubric. Within this rubric, evaluators scored each curriculum in three different categories: 3D Design, Instructional Support, and Evaluating Student Progress. Each of those
categories was then divided into 3 sub-categories, specified later in the analysis. Evaluators then scored each curriculum on a scale of 0-3 based on how well they met the standards provided in each subcategory. Notes were also taken on what resources and lessons the curriculum provides. The following covers the information that was found.

**Curriculum A**

Curriculum A claims to be used in all 50 states, being used to teach more than 3.5 million students. This curriculum is split into different kits for different units, each priced at around $100-$200. It claims to meet the NGSS and be student-focused. It also claims to have won several awards and have improved science standardized test scores in several school districts. Upon closer examination of this curriculum, it was found that it does not meet the NGSS to the extent to which it advertises.

When looking at the resources provided, this curriculum provides the following: a physical kit in a box for each content unit that contains a teacher booklet, several copies of student booklets, materials for hands-on experiments, and plastic tubs for holding those resources. Each teacher booklet includes a module matrix with a module summary, focus questions, content related to disciplinary core ideas, reading and technology, and an assessment. It also gives a suggested timeline for the teaching of each module, and suggested differentiated instruction specifically for English Language Learners (ELLs).

This curriculum advertises that it meets the NGSS, and even has a few pages in the teacher’s booklet dedicated to explaining how it does so. However, upon further examination, it was found that it has a lot to improve in its alignment to the NGSS. To get a better look at where it meets the NGSS and where it can improve, the curriculum will be analyzed by each category and subcategory of the EQUIP rubric.
Category 1, NGSS 3D Design, earned an average overall score of 3.6 out of 9. Subcategory 1A, referring to the presence and effectiveness of an anchoring phenomenon, scored a 1.3 out of 3. Upon investigation, it was found that this curriculum does not provide an anchoring phenomenon for each unit, which therefore means that it does not provide students the opportunity to ask questions based on the science they would be seeing.

Subcategory 1B, referring to 3-Dimensional learning (SEP, DCI, and CCC), earned a score of 0.8 out of 3. This curriculum does not give students the opportunity to study all disciplinary core ideas, nor does it incorporate a lot of crosscutting concepts. For example, one lesson does discuss physical science, but does not connect that learning to life science or Earth and space science. It was also found that each unit and its subsequent science experiments are very structured, with expected outcomes, no opportunity for evidence-based arguments, and no room for students to plan and carry out their own investigations based on their own questions about the subject area.

Subcategory 1C, referring to unit coherence, or how the lessons flow and fit together as a whole unit, earned a score of 1.5 out of 3. The lessons all covered the same subject area and built on the main ideas of the whole unit, but they did not directly build off of each other or connect new ideas to previous lessons and experiments.

Category 2, NGSS Instructional Support earned an average overall score of 2.9 out of 9. Subcategory 2A, referring to differentiated instruction, earned a score of 0.7 out of 3. Upon investigation, it was found that only a two-page overview explaining that there was opportunity for students with different needs to learn and succeed was provided. However, there were no specifics on how the teacher could go about helping those students. This curriculum also dedicated a section of this overview to explaining that it is effective for ELL students, but again, does not give specific examples of how to do so.
Subcategory 2B, referring to student ideas and providing the opportunity for students to express, clarify, and interpret their ideas, earned a score of 1.2 out of 3. This curriculum does provide opportunities for students to observe some phenomena and discuss what they are observing, but it still did not fully meet the criteria for this standard.

Subcategory 2C, referring to scientific accuracy and whether the content is appropriate for the age of the students, earned a score of 1 out of 3. This curriculum included vocabulary that could be seen as too advanced for the age of students that the unit is planned for.

In Category 3, Monitoring NGSS Student Progress, this curriculum earned an overall average score of 3.7 out of 9. Subcategory 3A, referring to the inclusion of unbiased tasks and items, earned a score of 1.2 out of 3. This curriculum does not include any specified adjustments for students with specific learning or cultural needs.

Subcategory 3B, referring to the inclusion of formative assessments, earned a score of 1.5 out of 3. This curriculum does include some forms of summative assessment, allowing students to discuss and reflect on their learning, as well as take notes on what they are observing in their experiments. Although these forms of summative assessment are included, there could be more opportunity for formative assessment, as well as less structured ways for students to show their understanding.

Subcategory 3C, referring to scoring guidance, earned a score of 1 out of 3. This curriculum includes expectations for formative and summative assessments. However, the summative assessments in particular promote only rote memorization, so there is only one exact right answer. Therefore, expectations are obvious and rubrics are not used. If this curriculum gave more opportunities for students to share their thinking in their own words, then a rubric would be necessary.
In summary, based on the EQUIP Rubric, Curriculum A earned an overall score of 10.9 out of 27, thus showing that this curriculum has a lot of room for improvement, and needs a lot of revision in order to meet the NGSS.

**Curriculum B**

Curriculum B provides resources entirely online. Pricing for this curriculum is relatively cheap, only costing $99 for one classroom, or $1,249 for an entire school or district. It is used in classrooms often because of the low pricing, but it has been found to severely miss the mark in meeting the criteria set by the NGSS.

Each unit consisted of a bundle of activities covering a variety of different scientific subjects. The basis of this curriculum was that each lesson is based on a mystery that students must investigate. Each lesson begins with an activity to spark student curiosity. This activity usually involves videos and then time to encourage discussion over what the video showed. Each lesson also provides a list of materials, extensions for additional readings, assessments, and other videos. For the actual teaching of the lesson, teachers need only use the videos and PowerPoints provided for each lesson. These PowerPoints structure the entire lesson and little outside planning is needed.

After initial notes were taken on Curriculum B, it was then analyzed using the EQUIP Rubric. Category 1, NGSS 3D design, earned an overall average score of 2.7 out of 9. Subcategory 1A (Exploring Phenomena/Designing Solutions) received a 1.5 out of 3. This curriculum is based on investigating a mystery, thus meeting the need for an anchoring phenomenon. However, the mysteries provided in some of the lessons do not spark a lot of conversation or questioning, and once students have seen that initial phenomenon, they are only asked to discuss the phenomenon in small groups, and no further questioning or the designing of solutions occur.
Subcategory 1B (3-Dimensional Learning) earned a score of 0.5 out of 3. This curriculum seriously lacked in providing opportunities for students to design their own investigations or work with several important areas of science and engineering.

Subcategory 1C (Unit Coherence) earned a score of 0.7 out of 3. This curriculum once again fell short in meeting a key NGSS standard. Several lessons and units are provided, but they are more just a bundle of activities, rather than a set of lessons that build off one another.

Category 2, NGSS Instructional Supports, earned an overall average score of 3.1 out of 9. Subcategory 2A (Differentiated Instruction) received 0.3 out of 3. This curriculum did not seem to provide any specific suggestions for adjusting the lesson to students with academic, linguistic, or cultural needs. All adjustments would need to be determined and made by the instructor.

Subcategory 2B (Student Ideas) received a score of 0.5 out of 3. Very little opportunity is provided for students to create their own ideas and work towards investigating a question. Although this curriculum is based on creating a sense of mystery that students should investigate, the “investigation” is very structured, and the question(s) that need to be answered are already provided, therefore not allowing students to ask questions about the areas of the topic that interest them.

Subcategory 2C (Scientific Accuracy) received a 2.5 out of 3. This curriculum fell a bit closer to meeting the standard. Age-appropriate videos and activities are included. However, some of the vocabulary may be a bit complicated for the students at a specific age.

Category 3, Monitoring NGSS Student Progress, earned an overall average score of 4.1 out of 9. Subcategory 3A (Unbiased Tasks/Items) received a 1.3 out of 3. This curriculum does not provide activities that will be relevant to every student. For example, one unit focuses on sound and gives students examples of different things that make a sound. This activity could be
improved upon if students were able to use their own experiences to think of some things that make sound and why it makes that sound.

Subcategory 3B (Formative Assessment) received a 2.3 out of 3. This curriculum falls a little closer towards meeting the NGSS standard. Throughout the provided powerpoint, there are opportunities for students to write and reflect on their understanding of the material.

Subcategory 3C (Scoring Guidance) received a score of 0.5 out of 3, meaning that there is a lot of room for improvement in this area. The summative assessments provided for each unit are incredibly short, and only include low-level questions. There is no opportunity for students to reflect on their understanding in their own words.

In summary, based on the EQUIP Rubric, Curriculum B only scored a 9.2 out of 27, thus showing that this curriculum needs a lot of improvement before being able to meet the NGSS.

Curriculum C

Curriculum C is a curriculum that is based on a textbook, with a DVD and a few online resources. This is a big-name curriculum, and many schools use it in their elementary classrooms. From the textbooks examined, this curriculum is over 10 years old. The NGSS was adopted 5 years ago in Iowa, so this curriculum is outdated, yet there are some schools that still use it as the base for their science curriculum.

When looking overall at Curriculum C, all learning was intended to be done through reading the text. For each unit, there is recommended vocabulary, reading skills to be learned, and writing activities to complete, but there was little mention of hands-on investigation. Where experiments were suggested, there were also specified “expected results,” which the NGSS argues is not how real scientists discover new things. This curriculum also provided different texts for different learning levels. In each student textbook, there is a section titled “Think Like a Scientist.” This section talks about how to create hypotheses and ask questions. This seems like a
good inclusion at first, but looking through the rest of the textbook, there are no specified opportunities to put those skills into practice.

Curriculum C also provides assessments for each unit, but each assessment only includes matching, fill-in-the-blank, multiple choice, and short answer questions, which all only require low-level thinking skills, and often do not accurately reflect student understanding of a unit. Lastly, each student is provided a science notebook with structured questions and data tables that directly connect to the text. The structure of this notebook once again only requires low-level thinking skills, and if one were to observe a classroom in which this curriculum was used, it would be very likely that every student notebook would have the exact same answers in each blank area.

After initial notes were taken on Curriculum C, it was then evaluated using the EQUIP Rubric. Category 1, NGSS 3D design, earned an overall average score of 1.1 out of 9. Subcategory 1A (Explaining Phenomena/Designing Solutions) received a 0.4 out of 3. This curriculum does not provide many, or any quality, opportunities for students to observe something that sparks their curiosity and inspires questions.

Subcategory 1B (3-Dimensional Learning) earned a score of 0.5 out of 3. This curriculum does not incorporate the use of multiple scientific practices, nor does it allow for students to have a say in their own learning.

Subcategory 1C (Unit Coherence) earned a score of 0.2 out of 3. Each unit is entirely its own, and there are no connections between units. This would make it difficult for students to understand how different aspects of science work together and why what they are learning is meaningful.

Category 2, NGSS Instructional Supports, earned an overall average score of 2 out of 9. Subcategory 2A (Differentiated Instruction) received a 0.2 out of 3. This curriculum provided
little to no aid for students with learning difficulties or language barriers. There were different levels of text provided for varying levels of achievement, but this does not really help students who have specific learning difficulties. In other words, there were no specifications on how to adjust the reading to meet the needs of different students. This curriculum believed that if a student has learning difficulties, they just need an easier text to read. In reality, much more accommodation is needed.

Subcategory 2B (Student Ideas) received a score of 0.6 out of 3. This curriculum left very little opportunity for students to share their own ideas. Any questions they were asked were short-answer, with an expected correct answer. The only opportunity found for the sharing of student ideas included a few discussions.

Subcategory 2C (Scientific Accuracy) received a 1.2 out of 3. It could be argued that the provided text is at an appropriate level for the specified age of student. However, the structure is not elementary-student-friendly, as it does not provide opportunities for movement and hands-on activities, which are vital for young students. Also, the fact that this curriculum is rather old compared to some of the other curricula studied means that the information provided in the text is likely outdated.

Category 3, Monitoring NGSS Student Progress, earned an overall average score of 3.9 out of 9. Subcategory 3A (unbiased tasks/items) earned a score of 0.3 out of 3. This curriculum did not take the students and their unique backgrounds into account. Also, since there are different texts provided for differing achievement levels, it seems that the separation of students based on their academic level is encouraged. Studies show that when students are separated based on academic level, students in the lower groups develop self-confidence issues and do not expect highly of themselves, therefore greatly decreasing their chance of success (Meier, & Wood, 2005).
Subcategory 3B (Formative Assessment) received a 1.4 out of 3. This curriculum did provide opportunities for formative assessment, but those assessments were typically very structured and only assessed whether or not students had memorized the facts they had read in the text.

Subcategory 3C (Scoring Guidance) earned a score of 2.2 out of 3. This curriculum did provide scoring guides and rubrics where they were needed. Still, the summative assessments only reflected low-level understanding.

In summary, Curriculum C needs a lot of improvement in order to meet the NGSS. Of the curricula analyzed, Curriculum C earned the lowest overall score of 7 out of a possible 27. Iowa has adopted the NGSS into science curricula, yet some school districts are still using Curriculum C.

**Curriculum D**

Curriculum D is a curriculum that is entirely online and is relatively low in cost. This curriculum is based on the scientific practices in STEM (Science, Technology, Engineering, and Mathematics), which many schools began moving towards in recent years. The fact that this curriculum is entirely online could be seen as beneficial, since students can work entirely on school-provided laptops and students can still keep up with their science curriculum during unique times such as the COVID-19 pandemic.

When looking overall at Curriculum D, each unit is built into a “bundle.” Each bundle has a set of lessons that are all clearly organized towards a learning end goal. Within each bundle, there is a specified anchoring phenomenon, a driving question, and a performance task. These things do align with the NGSS on the surface, but a deeper dive into the structure shows that it gets close to meeting the standards, but still misses the mark a bit. Each bundle of topics also includes a teacher’s guide, which provides a list of materials, questions to ask the students,
and a progression of events within the lesson. From an initial look at the curriculum, it appears that it allows each unit to be pretty open-ended and student-driven, thus showing an improvement over previously examined curricula.

After Curriculum D was analyzed based on surface-level qualities, it was then evaluated using the EQUIP Rubric. Category 1, NGSS 3D design, earned an overall average score of 8.3 out of 9. Subcategory 1A (Explaining Phenomena/Designing Solutions) received a score of 2.1 out of 3. This curriculum did provide a specific anchoring phenomenon for each unit, and the rest of the unit would be spent working to answer the driving question based on that anchoring phenomenon. One critique for this would be that the driving question is provided rather than determined by the students. However, teachers could take some liberty and allow students to create their own driving question similar to the one provided by this curriculum.

Subcategory 1B (3-Dimensional Learning) received a score of 2.1 out of 3. This curriculum does include several aspects of science, seeing as it is based on STEM. However, it still lacks in areas such as Disciplinary Core Ideas (DCI).

Subcategory 1C (Unit Coherence) earned a score of 3 out of 3. This curriculum excelled at creating units that built off one another. Of the curricula analyzed thus far, this curriculum is the first to adequately meet this standard.

Category 2, NGSS Instructional Supports, earned an overall average score of 6 out of 9. Subcategory 2A (Differentiated Instruction) received a 2.2 out of 3. This curriculum was designed in such a way as to be achievable by most, if not all, students. The NGSS was designed in such a way that children of any academic level can succeed in learning any scientific topic. Curriculum D leaves much of the learning open-ended and in the students’ hands, thus following the base lesson structure that the NGSS suggests. One critique would be that it does not provide suggestions on how to help English Language Learners or students with other reading needs.
difficulties. This type of obstacle is something that should be specified in a unit, as it may require that students have additional help in certain areas.

Subcategory 2B (Student Ideas) received a 2 out of 3. Opportunities for student discussion were provided, and established that a lot of the initial investigation steps to be student-driven. However, as previously mentioned, a driving question is predetermined by the curriculum rather than created by the students. Also, the investigation and end goal (or as this curriculum calls it, “action plan”) is already predetermined. With that being said, the Action Plan is still pretty broad and leaves a lot of the investigation up to the students.

Subcategory 2C (Scientific Accuracy) received a score of 1.8 out of 3. This curriculum did meet the mark in conveying accurate scientific information, however, some of the language and vocabulary were not appropriate for the age level specified. For example, one driving question from a unit was as follows: “How can we respond to different weather conditions and the effects of the sun?” This driving question was from a Kindergarten level lesson. It is obvious that this is not phrased to be child-friendly.

Category 3, Monitoring NGSS Student Progress, earned an overall average score of 4.7 out of 9, meaning that this curriculum seriously lacked in meeting the standards of this category compared to the other two categories. Subcategory 3A (unbiased tasks/items) earned a score of 2.1 out of 3. This curriculum was not designed in a way that would be culturally relevant or meaningful to the vast population of students. For example, one driving question from a 6th grade unit asks, “How can models of thermal energy transfer help us to understand the different kinds of weather in California?” This curriculum is available to students in all states, so why is the driving question specified to California? It also begs the question, will the lesson result in the same learning if a teacher were to adjust the lesson to be specific for their state? With all that
being said, each unit is still friendly to students of all academic achievement levels, and does not discriminate against students based on their level.

Subcategory 3B (Formative Assessment) received a score of 1.8 out of 3. This curriculum did provide some opportunities for formative assessment, but they really only included a few small discussion questions and nothing else.

Subcategory 3C (Scoring Guidance) received a score of 0.8 out of 3. This curriculum did not provide summative assessments, and provided little to no scoring guidance for the action plan activity.

In summary, this curriculum did come closer to meeting the standards set by the NGSS, but there are still definitely areas for improvement. Curriculum D earned an overall score of 19 out of a possible 27 in terms of meeting the NGSS. In other words, this curriculum is a better choice than Curricula A-C, but there are still areas where it does not meet the standards, and other curricula, like Curriculum E, do make up for those weaknesses.

**Curriculum E**

Curriculum E is a curriculum that is mostly online but is pretty expensive. On average, the curriculum costs $300-$400 initially, and then $100-$200 every year after that. Once again, the fact that this curriculum has online aspects could definitely help to keep students caught up with their science curriculum during unique circumstances like the COVID-19 pandemic. This curriculum claims to engage students in relevant, real-world problems where they investigate scientific phenomena, engage in collaboration and discussion, and develop models or explanations in order to arrive at solutions. It also promotes the “Do, Talk, Read, Write” Model of Learning. Both of these things align directly with NGSS.

When looking overall at Curriculum E, each unit is separated into chapters, and each chapter is separated into four to five lessons. Each lesson contains a pre-assessment, an
anchoring phenomenon, suggested readings, and a formative assessment where students work to explain the phenomenon they witnessed at the beginning of the lesson. This structure aligns very closely with the structure recommended by the NGSS. Another thing to look at in regards to Curriculum E is the resources that it provides. This curriculum not only provides online teacher guides, but it also provides student books, online resources, student-investigation notebooks, simulations and practice tools, and hands-on material kits. The inclusion of these items combined with the overall structure of the curriculum follows the NGSS more closely than any of the other curricula analyzed in this study. It is probably the best option for schools who work to implement the NGSS, but there are still a few areas for improvement that will be specified in the following paragraphs.

Curriculum E was evaluated using the EQUIP Rubric, just as the other four curricula were. Category 1, NGSS 3D design, earned an overall average score of 7.4 out of 9. Subcategory 1A (Explaining Phenomena/Designing Solutions) earned a score of 2.5 out of 3. This curriculum did provide an anchoring phenomenon for each chapter in each unit, and the rest of the chapter and unit would be spent working to create a driving question and finding an answer to that question.

Subcategory 1B (3-Dimensional Learning) received a score of 2.1 out of 3. This curriculum does incorporate all three dimensions of learning, but each dimension covered could be more integrated.

Subcategory 1C (Unit Coherence) earned a score of 2.8 out of 3. This curriculum excelled at creating units that built off one another. Each lesson in each chapter refers back to the anchoring phenomenon and driving question for that unit.

Category 2, NGSS Instructional Supports, earned an overall average score of 7.6 out of 9, thus earning the highest rating of any of the curricula analyzed. Subcategory 2A (Differentiated
Instruction) received a 2.6 out of 3. This curriculum dedicates a specific section of the teacher’s guide to explaining how the lesson can be modified for English Language Learners and students who need extra instructional support.

Subcategory 2B (Student Ideas) received a 2.5 out of 3. At least one opportunity for student discussion is provided in each lesson. This means that more opportunities for discussion and the sharing of student ideas are provided than in other curricula, but there could still be more opportunities for students to discuss what they are observing and come to their own conclusions based on what they have observed.

Subcategory 2C (Scientific Accuracy) received a score of 2.5 out of 3. Accurate scientific information is included and the structure of lessons is student-friendly. One critique would be that some of the vocabulary and terminology used is not entirely child-friendly.

Category 3, Monitoring NGSS Student Progress, earned an overall average score of 6.9 out of 9. Subcategory 3A (unbiased tasks/items) received a 2.6 out of 3. The lessons provided are lessons that all students could find meaningful and relevant. There are no specifics that make a lesson more meaningful for some students and less meaningful for others, and each of the lessons are structured in such a way that all students have the chance to share their ideas and observations.

Subcategory 3B (Formative Assessment) received a score of 2.3 out of 3. Formative assessment in the form of discussion and writing scientific explanations based on student observations was provided. Both of these are forms of formative assessment that are highly encouraged by the NGSS.

Subcategory 3C (Scoring Guidance) earned a score of 2 out of 3. Summative assessments in the form of writing scientific explanations were provided, but a rubric explaining expectations for the writing of the scientific explanations was not found.
In summary, this curriculum came the closest to meeting the standards set by the NGSS, but there are still some areas for improvement. An important thing to note regarding this curriculum is that each lesson included notes explaining how the lesson aligned to the NGSS, and would help teachers who may be uncomfortable teaching using the NGSS. Curriculum E earned an overall score of 21.9 out of a possible 27 in terms of meeting the NGSS. In other words, this curriculum is the best choice of the curricula analyzed, but there are still areas for improvement.

**Conclusion**

With all of this information, it is apparent that many of the current science curricula used in elementary schools throughout the United States are falling short of meeting the standards set by the NGSS. The NGSS has been shown to be one of the most effective sets of standards for science curriculum, yet most curricula claim they meet the NGSS and do not, or do not claim to meet the standards at all. Using the results of this study, school districts, teachers, and even the science curricula developers need to critically analyze in what ways they can improve their science curriculum so it better aligns with the NGSS.

To give elementary school students a better, more effective, and more meaningful science education, they need to be taught using the NGSS. There are two ways to do this. The first way is for each of the science curricula analyzed above to revise their curriculum to meet the NGSS. If this is done, teachers should have a guide to use while teaching the curriculum, and if they follow it, the way they teach a science unit should align with the NGSS.

Unfortunately, these curricula are already fully developed, and seeing changes in any of them is unlikely. Instead, there is a second option: teachers learn to adapt the provided curriculum to align with the NGSS. This second option requires teachers to be trained in the NGSS and learn how to adapt their provided curriculum to meet the NGSS. As the NGSS
suggests a teaching method that is very different from how most teachers were taught themselves, this may seem a daunting task. However, if teachers are properly trained in the NGSS, they should be able to make the necessary changes to the curriculum and create a more meaningful science learning experience for their students.

In conclusion, science curricula and science classrooms need to start making the shift towards meeting the standards set by the NGSS. As of right now, only one of the five most popular elementary science curricula even comes close, meaning that the majority of elementary school students are being taught science by a subpar science curriculum. Science curricula that do not align with the NGSS are not as effective in promoting real science learning and retention. If schools and curricula make the necessary changes in order to meet the NGSS, elementary school students will have a more meaningful, comprehensive, and successful science education.
Appendix A: Modified EQUIP Rubric

ECUIP Rubric for Lessons & Units: Science (Version 3.0)

Reviewer Name or ID:

**Category I: NGSS 3D Design (lessons and units):** The lesson/unit is designed so students make sense of phenomena and/or design solutions to problems by engaging in student performances that integrate the three dimensions of the NGSS.

<table>
<thead>
<tr>
<th>Lesson and Unit Criteria</th>
<th>Specific evidence from materials (what happened/where did it happen) and reviewer’s reasoning (how/why is this evidence)</th>
<th>Evidence of Quality?</th>
<th>Circle Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Explaining Phenomena/Designing Solutions: Making sense of phenomena and/or designing solutions to a problem drive student learning.</td>
<td>Document evidence and reasoning, and evaluate whether or not there is sufficient evidence of quality for each dimension separately</td>
<td>□ None □ Inadequate □ Adequate □ Extensive</td>
<td>1</td>
</tr>
<tr>
<td>i. Student questions and prior experiences related to the phenomena or problem motivate sense-making and/or problem solving.</td>
<td>i.</td>
<td>□ None □ Inadequate □ Adequate □ Extensive</td>
<td></td>
</tr>
<tr>
<td>ii. The focus of the lesson is to support students in making sense of phenomena and/or designing solutions to problems.</td>
<td>ii.</td>
<td>□ None □ Inadequate □ Adequate □ Extensive</td>
<td></td>
</tr>
<tr>
<td>iii. When engineering is a learning focus, it is integrated with developing disciplinary core ideas from physical, life, and/or earth and space sciences.</td>
<td>iii.</td>
<td>□ None □ Inadequate □ Adequate □ Extensive</td>
<td></td>
</tr>
<tr>
<td>B. Three Dimensions: Builds understanding of multiple grade-appropriate elements of the science and engineering practices (SEP), disciplinary core ideas (DCI), and crosscutting concepts (CCC) that are deliberately selected to aid student sense-making of phenomena and/or designing solutions.</td>
<td>Document evidence and reasoning, and evaluate whether or not there is sufficient evidence of quality for each dimension separately</td>
<td>□ None □ Inadequate □ Adequate □ Extensive</td>
<td>1</td>
</tr>
<tr>
<td>i. Provides opportunities to develop and use specific elements of the SEP(i).</td>
<td>i.</td>
<td>□ None □ Inadequate □ Adequate □ Extensive</td>
<td></td>
</tr>
<tr>
<td>ii. Provides opportunities to develop and use specific elements of the DCI(ii).</td>
<td>ii.</td>
<td>□ None □ Inadequate □ Adequate □ Extensive</td>
<td></td>
</tr>
<tr>
<td>iii. Provides opportunities to develop and use specific elements of the CCC(iii).</td>
<td>iii.</td>
<td>□ None □ Inadequate □ Adequate □ Extensive</td>
<td></td>
</tr>
<tr>
<td>Evidence needs to be at the element level of the dimensions (see rubric introduction for a description of what is meant by “element’’).</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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Educators may use or adapt. If modified, please attribute EQUIP and re-title.

C. Unit Coherence: Lessons fit together to target a set of performance expectations.

<table>
<thead>
<tr>
<th></th>
<th>□ None □ Inadequate □ Adequate □ Extensive</th>
</tr>
</thead>
<tbody>
<tr>
<td>i. Each lesson builds on prior lessons by addressing questions raised in those lessons, cultivating new questions that build on what students figured out, or cultivating new questions from related phenomena, problems, and prior student experiences. Lessons help students develop toward proficiency in a targeted set of performance expectations.</td>
<td></td>
</tr>
</tbody>
</table>

Rating for Category I, NGSS 3D Design—lessons

After carefully weighing the evidence, reasoning, and suggestions for improvement, rate the degree to which there is enough evidence to support a claim that the lesson meets these criteria.

If you are evaluating an Instructional unit rather than a single lesson, continue on to evaluate criteria D-F and rate Category I overall below.

Lesson Rating scale for Category I (Criteria A–C only):

- 9-7: Extensive evidence to meet at least two criteria (and at least adequate evidence for the third)
- 6-5: Adequate evidence to meet at least three criteria in the category
- 5-4: Adequate evidence to meet at least one criterion in the category, but insufficient evidence for at least one other criterion
- 0: Inadequate (or no) evidence to meet any of the criteria in the category
### Category II: NGSS Instructional Supports (lessons and units)

The lesson/unit supports three-dimensional teaching and learning for all students by placing the lessons in a sequence of learning for all three dimensions and providing support for teachers to engage all students.

<table>
<thead>
<tr>
<th>Lesson and Unit Criteria</th>
<th>Specific evidence from materials and reviewers’ reasoning</th>
<th>Evidence of Quality?</th>
<th>Circle Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Differentiated Instruction: Provides guidance for teachers to support differentiated instruction by including appropriate reading, writing, listening, and/or speaking alternatives (e.g., translations, picture support, graphic organizers, etc.) for students who are English language learners, have special needs, or need to learn below the grade level. Extra support (e.g., phenomena, representations, tasks) for students who are struggling to meet the targeted expectations. Lessons for students with high interest or who have already met the performance expectations to develop deeper understanding of the practices, disciplinary core ideas, and crosscutting concepts.</td>
<td></td>
<td>None</td>
<td>0 1 2 3</td>
</tr>
<tr>
<td>B. Student Ideas: Provides opportunities for students to express, clarify, justify, interpret, and represent their ideas and respond to peer and teacher feedback orally and/or in written form as appropriate.</td>
<td></td>
<td>None</td>
<td>0 1 2 3</td>
</tr>
<tr>
<td>C. Scientific Accuracy: Uses scientifically accurate and grade-appropriate scientific information, phenomena, and representations to support students’ three-dimensional learning.</td>
<td></td>
<td>None</td>
<td>0 1 2 3</td>
</tr>
</tbody>
</table>

**Note:**

- **Category II Instructional Supports—lessons**
  - fully weighing the evidence, reasoning, and suggestions for improvement, rate the degree to which the lesson met this category.
  - If you are evaluating an instructional unit rather than a single lesson, continue on to evaluate criteria 4–6 and rate Category II overall below.

**Lesson Rating scale for Category II (Criteria A–C only):**

- **0:** Inadequate evidence to meet any of the criteria in the category
- **1:** Inadequate evidence to meet at least one criterion in the category, but insufficient evidence for at least one other criterion
- **2:** Adequate evidence to meet at least two criteria (and at least adequate evidence for the third)
- **3:** Adequate evidence to meet all three criteria in the category
Category III: Monitoring NGSS Student Progress (lessons and units)

The lesson/unit supports monitoring student progress in all three dimensions of the NGSS as students make sense of phenomena and/or design solutions to problems.

**Lesson and Unit Criteria**

Lessons and units designed for the NGSS include clear and compelling evidence of the following:

A. **Unbiased tasks/Items:** Assesses student proficiency using methods, vocabulary, representations, and examples that are accessible and unbiased for all students.

B. **Formative:** Embed formative assessment processes throughout that evaluate student learning to inform instruction.

C. **Scoring guide:** Includes aligned rubrics and scoring guidelines that provide guidance for interpreting student performance along the three dimensions to support teachers in (a) planning instruction and (b) providing ongoing feedback to students.

**Evidence of quality?**

- None
- Inadequate
- Adequate
- Extensive

**Circle Rating**

0 1 2 3

**QsuP Rubric for Lessons & Units: Science (Version 3.0)**

**Category Ratings:**

Transfer your team's ratings from each category to the following chart and add the scores together for the overall score:

<table>
<thead>
<tr>
<th>Category I: NGSS 3D Design</th>
<th>Category II: NGSS Instructional Supports</th>
<th>Category III: Monitoring NGSS Student Progress</th>
<th>Total Score</th>
</tr>
</thead>
</table>

**Overall ratings:**

The score total is an approximate guide for the rating. Reviewers should use the evidence of quality across categories to guide the final rating. In other words, the rating could differ from the total score recommendations if the reviewer has evidence to support this variation.

- E: example of high quality NGSS design—High quality design for the NGSS across all three categories of the rubric; a lesson or unit with this rating will still need adjustments for a specific classroom, but the support is there to make this possible: exemplifies most criteria across categories I, II, & III of the rubric. (Total score = 27-21)
- E/I: example of high quality NGSS design if improved—Adequate design for the NGSS, but would benefit from some improvement in one or more categories; most criteria have at least adequate evidence (total score = 20-13)
- I: Revision needed—Partial/ground level evidence of the NGSS, but needs significant revision in one or more categories (total score = 3-11)
- N: Not ready to review—Not designed for the NGSS, does not meet criteria (total score = 0-2)

Circle the overall rating below:

E E/I I R N
### Appendix B: Curriculum Analysis Data

<table>
<thead>
<tr>
<th>Category (Label)</th>
<th>Category (Description)</th>
<th>Curriculum A</th>
<th>Curriculum B</th>
<th>Curriculum C</th>
<th>Curriculum D</th>
<th>Curriculum E</th>
</tr>
</thead>
<tbody>
<tr>
<td>Category 1 (Total)</td>
<td>NGSS 3D Design</td>
<td>3.6</td>
<td>2.7</td>
<td>1.1</td>
<td>8.3</td>
<td>7.4</td>
</tr>
<tr>
<td>Subcategory 1A</td>
<td>Explaining Phenomena/Designing Solutions</td>
<td>1.3</td>
<td>1.5</td>
<td>0.4</td>
<td>2.1</td>
<td>2.5</td>
</tr>
<tr>
<td>Subcategory 1B</td>
<td>Three Dimensions</td>
<td>0.8</td>
<td>0.5</td>
<td>0.5</td>
<td>2.1</td>
<td>2.1</td>
</tr>
<tr>
<td>Subcategory 1C</td>
<td>Unit Coherence</td>
<td>1.5</td>
<td>0.7</td>
<td>0.2</td>
<td>3</td>
<td>2.8</td>
</tr>
<tr>
<td>Category 2 (Total)</td>
<td>NGSS Instructional Supports</td>
<td>2.9</td>
<td>3.1</td>
<td>2</td>
<td>6</td>
<td>7.6</td>
</tr>
<tr>
<td>Subcategory 2A</td>
<td>Differentiated Instruction</td>
<td>0.7</td>
<td>0.3</td>
<td>0.2</td>
<td>2.2</td>
<td>2.6</td>
</tr>
<tr>
<td>Subcategory 2B</td>
<td>Student Ideas</td>
<td>1.2</td>
<td>0.5</td>
<td>0.6</td>
<td>2</td>
<td>2.5</td>
</tr>
<tr>
<td>Subcategory 2C</td>
<td>Scientific Accuracy</td>
<td>1</td>
<td>2.3</td>
<td>1.2</td>
<td>1.8</td>
<td>2.5</td>
</tr>
<tr>
<td>Category 3 (Total)</td>
<td>Monitoring NGSS Student Progress</td>
<td>3.7</td>
<td>4.1</td>
<td>3.9</td>
<td>4.7</td>
<td>6.9</td>
</tr>
<tr>
<td>Subcategory 3A</td>
<td>Unbiased Tasks/Items</td>
<td>1.2</td>
<td>1.3</td>
<td>0.3</td>
<td>2.1</td>
<td>2.6</td>
</tr>
<tr>
<td>Subcategory 3B</td>
<td>Formative Assessments</td>
<td>1.5</td>
<td>2.3</td>
<td>1.4</td>
<td>1.8</td>
<td>2.3</td>
</tr>
<tr>
<td>Subcategory 3C</td>
<td>Scoring Guidance</td>
<td>1</td>
<td>0.5</td>
<td>2.2</td>
<td>0.8</td>
<td>2</td>
</tr>
<tr>
<td>Overall Rating (Quantitative)</td>
<td></td>
<td>10.2</td>
<td>9.2</td>
<td>7</td>
<td>19</td>
<td>21.9</td>
</tr>
<tr>
<td>Overall Rating (Qualitative)</td>
<td></td>
<td>Revision Needed</td>
<td>Revision Needed</td>
<td>Not Ready to Review</td>
<td>Example of High Quality NGSS Design if Improved</td>
<td>Example of High Quality NGSS Design</td>
</tr>
</tbody>
</table>
Literature Cited


