Appendix N

Adoption Task 3: NGSS Conceptual Shifts

Adoption Task 3 asked participants to submit responses to a series of questions after reading through Adoption Task 2. Each of the six shifts is evaluated based on how difficult that shift will be to accomplish across our state. The following are some of the explanations as perceived of the respondents that reflect how difficult it will be to accomplish each of these shifts.

1. K–12 science education should reflect the interconnected nature of science as it is practiced and experienced in the real world. The NGSS Review Committees perceived this as a moderately difficult shift to accomplish.

Grades K–2:

> Our current state standards do not support current science and engineering practices, crosscutting concepts, and the integration of CCSS. What we currently use at this time was based on the first national effort to improve science instruction with the creation of the National Science Education Standards (NRC, 1996). After twenty years of changes in education and research completed on how students learn science, the NGSS reflects what we now know as best, research–based practices. So while difficult, this is obtainable and necessary to propel the state of Arkansas into a new era where our students must compete in a global economy and competitive job market.

Grades 3–5:

> The interconnectedness is a critical concept and should greatly increase knowledge levels and effectiveness of instruction. Many teachers may find this conceptual shift challenging at first and may be daunted by the amount of work needed to alter lesson plans, but it will not be too difficult for them to accomplish. The biggest stumbling block will be altering assessment expectations and aligning standardized tests, which will need to be restructured.

Grades 6–8:

> Our standards currently focus on specific, sequenced content based on the different areas of science. Straying away from this way of thinking and process may be difficult. Because many teachers do not understand some of the interconnected concepts, it will be imperative to provide necessary training to help them develop a deeper understanding so they can facilitate the student learning properly. Our teachers have the knowledge; however, many of them do not fully understand how it all works together. It will be important when

developing professional development to focus on the connected nature and concepts of science as a whole.

Grades 9–12:

For some educators this would be a very easy shift to implement as they already teach in a way that emphasizes the interconnected nature of science and the science and engineering practices. The challenge here will be getting teachers who currently do not have this emphasis to "buy in" and see this as a necessary and worthwhile change in their curriculum. This should be easily achieved. Teachers have to be willing to present science as an interconnected body of knowledge.

1. **The NGSS are student performance expectations – NOT curriculum. The NGSS Review Committees perceived this as a moderately difficult shift to accomplish.**

Grades K–2:

The performance expectations are written so succinctly that teachers should not have a difficult time understanding what students need to know. The curriculum should reflect these expectations but also integrate other areas of science, literacy, and math, and include real world connections to make it more meaningful for students.

Grades 3–5:

There will be some confusion about separating performance expectations and curriculum, but with appropriate communication, it should not be too difficult to get educators to internalize this concept. Again, the difficulty will come during assessment.

Grades 6–8:

There still seems to be confusion among many educators when discussing standards compared to a school curriculum. If the state implements the NGSS, it will need to be made clear that the science and engineering practices and crosscutting concepts can be taught in a multitude of ways.

Grades 9–12:

Educators are going to have to be trained and knowledgeable in order to implement the science and engineering practices within their content area. The

science and engineering practices have to be consistent and aligned vertically for full implementation. In addition, the major part of this shift may be in assessment. The time required to create and to test performance–based assessment items will take time.

2. **The science concepts in the NGSS build coherently from K–12. The NGSS Review Committees perceived this as a difficult shift to accomplish.**

Grades K–2:

This shift will be difficult to achieve due to the lack of coherent emphasis on teaching the current *Arkansas Science Curriculum Frameworks* in elementary grade levels. Our current standards do build, but there is no requirement for vertical teaming that would help teachers in our schools realize the scope and sequence of the student learning expectations. There is also no requirement that is supported by legislation that science is as vital as math and literacy. For educators to realize the important role the scope and sequence of core science concepts play in math and English literacy, they must be required to teach science as an integral component weekly as is mandated but not monitored for adherence.

Grades 3–5:

Teaching concepts will be a huge shift from teaching a body of facts, which is what is typically (though not appropriately) done now.

Grades 6–8:

Coherency throughout Grades K–12 is a must. However, elementary teachers have great responsibilities already in building students' foundational skills. Professional development and teacher prep courses will need to help elementary teachers see how they can easily integrate science into what they already do. They may need the greatest support. Science teachers in Grades 7–12 may have the content knowledge, but have less experience in setting up and facilitating problem–based learning opportunities. Professional development and opportunities for teachers to collaborate and network will be needed.

Grades 9–12:

Creating this coherence in science education through all grade levels will be one of the biggest challenges in a shift to the NGSS standards. Especially in migrant

areas, if students do not actually reach the goals that are set forth, the learning curve to catch up may be very difficult if not impossible.

3. **The NGSS focus on deeper understanding of content as well as application of content. The NGSS Review Committee perceived this as a moderately difficult shift to accomplish.**

Grades K–2:

If the standards and assessments reduce the number of content items and factual knowledge, teachers will adjust their instruction to reflect this. This will require teachers to have a deeper understanding of content so that they can delve deeper into the subject. This will not occur overnight and many hours of professional development will be required to accomplish this shift.

Grades 3–5:

The difficulty of applying deeper understanding of content and the science and engineering practices will be one of the most challenging shifts. This will take time. The difficulty is not in whether students will be able to handle the deeper content, but in the teachers' understanding of science content. If university level programs will begin to train future teachers at this depth simultaneously with schools training current teachers, then we will be hitting both ends of the spectrum.

Grades 6–8:

This shift is not that difficult but may take time in order to see the results. Teachers will need to learn how to be facilitators of learning that will allow students to actively engage in the science and engineering practices. Teachers may need training in how to create and assess performance tasks. Focused professional development and educator collaboration will be needed.

Grades 9–12:

This shift is rated as moderately difficult because districts will have to ensure that the teachers have a deeper understanding of the content in order to facilitate that deeper understanding in their students. This will require focused, more involved professional development.

4. **Science and engineering are integrated in the NGSS from Grade K through Grade 12. The NGSS Review Committees perceived this as a difficult shift to accomplish.**

Grades K–2:

Engineering is not included in our current standards at all. This will be an adjustment for all teachers because it is a new and uncharted territory. To effectively implement engineering design and integrate it into a science curriculum, teachers will need quality professional development.

Grades 3–5:

Integration of science and engineering practices in the elementary grades will be difficult because most teachers are neither trained deeply enough in content nor comfortable enough with conducting investigations. This can be handled with appropriate professional development, but it will be a challenge to sufficiently provide professional development to handle the number of teachers who will need it.

Grades 6–8:

It will be very difficult to implement this aspect of the NGSS because teachers have no background in engineering and even the current graduates coming out of college are not taught engineering concepts or the science and engineering practices.

Grades 9–12:

The difficulty will be implementing the NGSS effectively so that students realize that a student-created product is not complete when it is turned in. Beginning in kindergarten, students will need to create products according to requirements, regardless of the number of times it takes, and to realize that it might not be right the first time. Professional development for engineering may need to come from engineers or engineering educators so teachers have a complete idea of engineering processes and skills that are used in the real world.

6. The NGSS and CCSS (English Language Arts and Mathematics) are aligned. The NGSS Review Committees perceived this as an easy shift to accomplish.

Grades K–2:

This shift will take the least amount of time and effort for success. The NGSS incorporate science and engineering practices and crosscutting concepts that align with many of the CCSS mathematical practices and literacy capacities. Thanks to the vision of the writers and critical input of many states across the country, the NGSS include a connection box in each standard that lists the relevant CCSS standards.

Grades 3–5:

We see little difficulty in accomplishing this shift. From the science perspective, they are easily coordinated. Math and literacy are the tools to do science.

Grades 6–8:

We have already begun this work; the foundation for this began with the implementation of the CCSS. This will take some time, but with little training it will be easy to do. Alignment will be necessary with cross–disciplinary teams working toward meeting the goals of CCSS.

Grades 9–12:

This will not be difficult at all considering that the NGSS are already aligned to CCSS.