SCIENCE INSTRUCTIONAL MATERIALS SELECTION AND MODIFICATION

A LANDSCAPE ANALYSIS

INTRODUCTION

Since the 2012 release of *A Framework for K–12 Science Education (Framework),*[1] almost all states in the United States have adopted new academic science standards based on the *Framework*, describing what students should know and be able to do in K–12 science education. A key lever to successfully implementing those state science standards is the use of classroom instructional materials. High-quality instructional materials[2] can help ensure that students are prepared to meet the vision and goals of the *Framework*, which asks students to make sense of the world around them and solve meaningful problems using science ideas and practices.

Although more high-quality, standards-aligned instructional materials have become available to support science classrooms in recent years, it is rare for scripted instructional materials to be implemented exactly as written word for word.[3] Whether districts and schools select science instructional materials from publishers or develop their own, instructional materials are almost always modified or supplemented to meet particular needs and contexts. Educators modify instructional materials for many reasons, including for individual students, relevance to local phenomena and cultures, and the constraints of their available time and equipment. Understanding how and why educators select and make changes to science instructional materials is critical to supporting classroom implementation of science standards.

Data Collection to Understand Instructional Materials Selection and Modification

To learn more about the factors that affect instructional materials selection and modification at each level of the education system, NextGenScience conducted a landscape analysis that included:

- A national survey[4] of state leaders, regional leaders, district leaders, and classroom teachers where data were collected on policies and practices related to science instructional materials and the tools and resources decision-makers need to support them in selecting and modifying those materials;
- A national survey of developers of instructional materials to learn more about the types of supports they provide to help educators modify their materials for their local contexts; and
- Several focus groups with classroom teachers, school leaders, and district leaders to gather more detailed, qualitative information about educators' experiences using and modifying instructional materials.

Overall, over 600 respondents completed the full survey, including classroom teachers in all grades K–12, school leaders, district leaders, regional leaders, state leaders, and curriculum developers. Due to the small sample size in comparison to the number of K–12 educators nationally, survey results will be most useful in generating questions that can be answered in future research.

For the purposes of this landscape analysis, **modification** was defined for participants as *making small changes* to existing instructional materials, such as by skipping a suggested teacher prompt. **Supplemental materials** were defined for participants as *adding* to existing instructional materials, such as inserting a new activity or lesson into an existing instructional unit, and therefore are a subset of possible kinds of modifications.

FINDINGS SUMMARY

Although today's state science standards have transformed expectations for students in science across the country, decisions about implementing the standards are primarily made at the school or district level, and therefore vary widely. Many districts develop or select instructional materials to support classroom science teaching and learning. However, classroom teachers are unlikely to use those instructional materials exactly as written, and they often individually choose or create the instructional materials that they actually use in the classroom.

Many district leaders, school leaders, and classroom teachers have the perception that their district's current core instructional programs are not aligned with their newest state science standards, and they also have to operate within systems that don't provide sufficient time to fully implement the science standards, such as through instructional time for science in the classroom. For these and many other reasons, educators modify or supplement instructional materials. To make matters more challenging, educators also reported having little training or support to ensure their modifications are of high quality. The newest generation of instructional materials has started to provide some modification supports for educators, and educators are interested in learning more about how to make modifications to materials that best support all of their students. This will require time, training, and models to do so.

WHO MAKES DECISIONS ABOUT SCIENCE MATERIALS?

State Standards Influence Decisions about K–12 Science Education.

What happens in science classrooms is often heavily influenced by the policies in each state, notably the state academic standards for science. Forty-eight states currently have K–12 academic science content standards that were adopted after the release of the *Framework* (2012). Almost all states responding to the survey indicated that their standards are influenced by the *Framework*. **Therefore, almost all states now have learning goals for science that call for engaging and rigorous three-dimensional learning and assessment for all students.**

Cycles of revision and implementation of new science standards vary by state. Although most states reported in the survey that their current science standards should have begun statewide implementation as of 2023, seven states (DE, MN, PA, RI, TN, TX, and VA) reported that they are still in the early stages of implementation. Three states (AL, NC, and SD) indicated that they're currently revising their science state standards as of February 2023. The adoption of new standards does not indicate immediate changes to classroom instruction, though. It typically takes many years before enough training and support is generated to enable classroom practice to change, including through the selection and use of aligned instructional materials.

State and District Policies Influence Decisions about Science Instructional Materials.

Transitioning to new science standards requires adjustments to all parts of the educational system, including curriculum, assessments, school structures, administrator support, and professional learning. Although standards are determined at the state level, most states can be described as "local control" states, where decisions about instructional materials are determined locally, at the district or school level. **Only about half of state leaders reported that their state provides a list of required or recommended science instructional materials**, although about two-thirds of states indicated that they provide some kind of guidance to district leaders, school leaders, or classroom teachers related to the selection, use, or modification of science instructional materials.

This kind of guidance often includes criteria for quality and the recommendation that educators select existing high-quality materials and then make modifications as necessary for local contexts rather than creating new materials from scratch. It is important to note that the modifications recommended by these states are often focused on taking materials that *already fully align* to state standards and modifying the materials to make them more accessible to students, such as making connections to relevant phenomena. Some states emphasized that they do not recommend that educators take instructional materials that align to previous standards and try to completely rewrite the materials, which can be very difficult and time consuming.

> *"We don't recommend modification of traditional curricula not designed for 3D standards as an ideal approach or the best use of implementation efforts."*
>
> STATE LEADER

In many cases, it is individual districts or educators in those districts who make selection decisions about science instructional materials without state oversight. **Most states reported that they use their state assessment as the primary way to monitor implementation of standards**, including the alignment of district science programs.

To learn more about district plans for science standards implementation, the survey asked district leaders about the policies, strategies, and recommendations they provide related to science instructional materials and professional learning. **Over 70% of district leaders indicated on the survey that their district has a plan with strategies for implementing their state's science standards**, and these plans often include guidance related to instructional materials. While less than half (47%) of science district leaders reported that their district leads either the creation or selection of science instructional materials, most districts provide high-level guidance for science instructional materials. Of all district leader respondents:

68% reported providing a science curriculum framework

64% reported providing a scope and sequence for science instruction, organizing the standards into a sequence of courses across grade levels

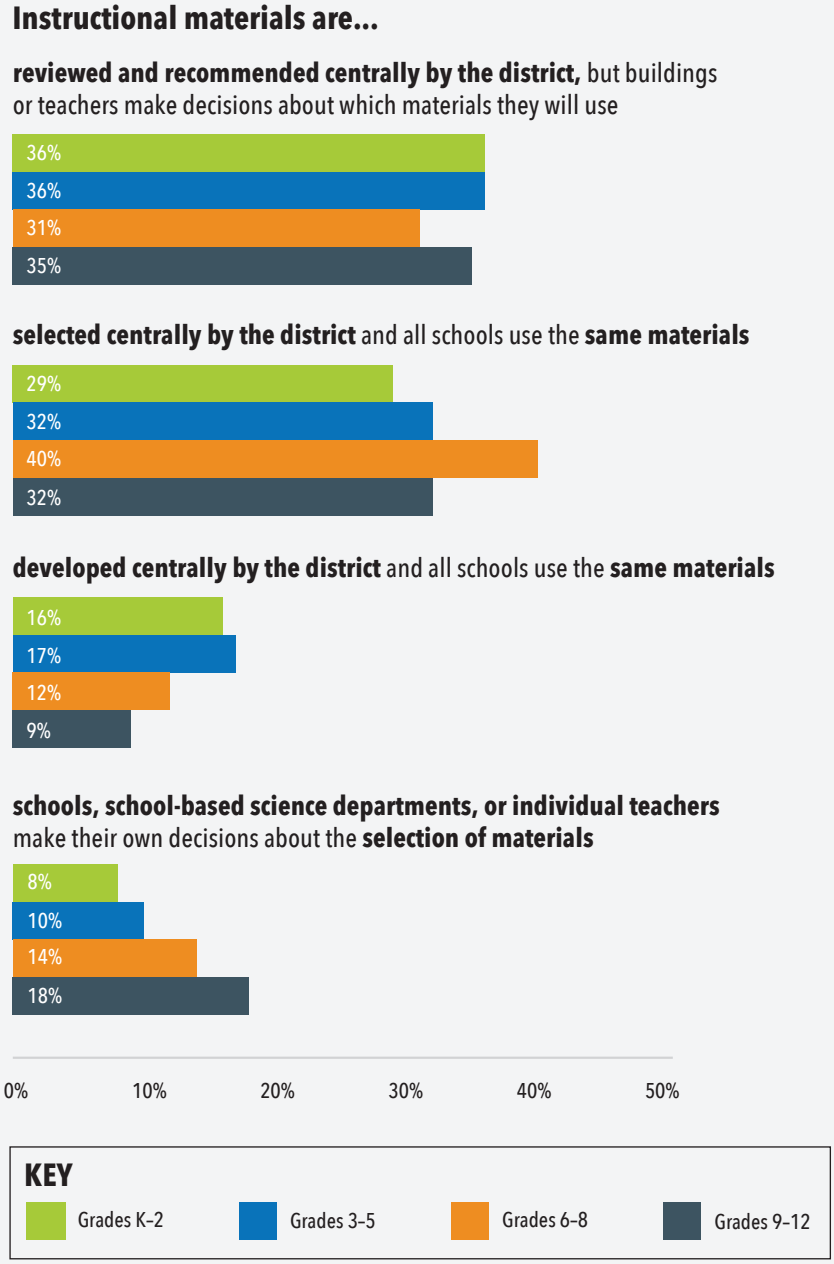
46% reported making modifications to science instructional materials at the district level

37% reported approving instructional and supplemental materials after schools and teachers selected them

30% required use of a specific full instructional program

27% reported conducting an audit to evaluate the quality of materials used in schools across their district

Figure 1: District leaders were asked, *"Who makes decisions about core materials?"*

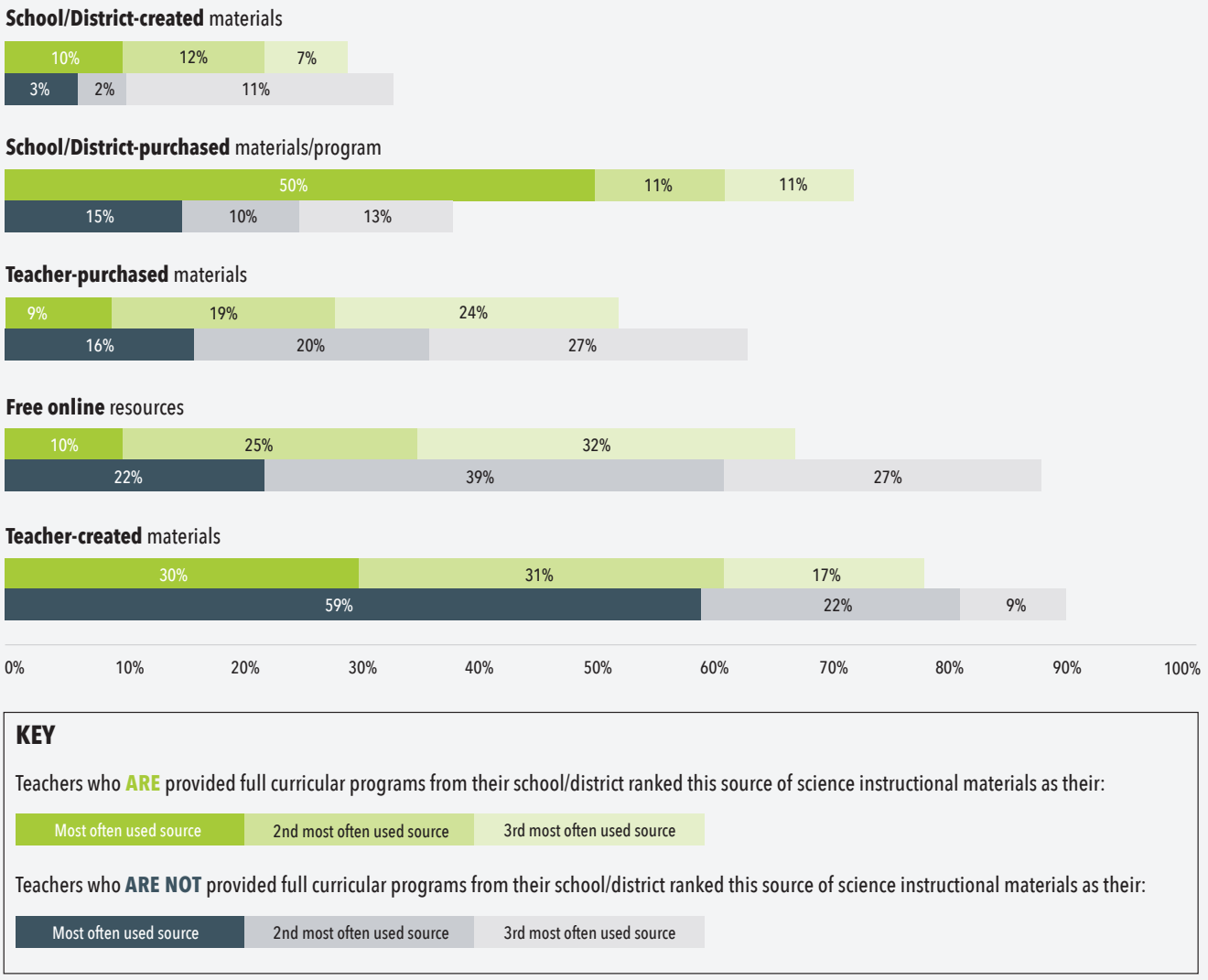


Note: Responses to "None of the options provided" were Grades K–2 9%, Grades 3–5 7%, Grades 6–8 8%, and Grades 9–12 6%. Responses to "Unsure" were Grades K–2 4%, Grades 3–5 4%, Grades 6–8 4%, and Grades 9–12 5%.

Of those districts that select or recommend instructional materials centrally, **52% reported that a district committee applies an evaluation tool**, such as the EQuIP Rubric for Science, to help ensure that high-quality materials are selected. **Thirty-one percent of all district leaders reported using external third-party reviews of science materials**, such as those from EdReports or NextGenScience, which consider alignment to standards, coherence of instruction, and supports for both teachers and students.

Some of the district policies and procedures related to core instructional program selection differed slightly by grade band (*see Figure 1*). Notably, **science instructional programs for K–2 students are least likely to be selected by individual schools or teachers**. Focus group data indicated that this difference might be partially due to a lack of science instructional programs for K–2 students. In many districts, participants commented that science is not expected to be taught, so science materials are not prioritized in the early grades.

Figure 2: Teachers were asked, *"When planning lessons for science, what materials do you draw from most?"*



Teachers Often Create Their Own Science Instructional Materials.

Even though most teachers reported that their districts provide them with core science instructional programs, teachers are not always using what they're given. **Only half of the teachers who are given full curricular programs reported that these materials are what they use most often when they plan lessons**. As seen in *Figure 2* and as described in prior research,[5] teachers are most likely to use materials they create themselves. Of the teachers who are not provided full curricular programs, only 22% said that free online resources are what they use most often. However, these resources were the second and third most common choices for these teachers. Overall for all teachers, 82% said that one of the top three sources of instructional materials that they used was teacher-created.

WHY DO EDUCATORS CREATE OR MODIFY INSTRUCTIONAL MATERIALS?

Educators Perceive That Core Instructional Programs Are Not Aligned With Standards.

To learn more about why teachers are not using the core instructional programs provided by their districts, the survey asked district leaders, school leaders, and classroom teachers to describe the biggest missing piece in their district's current core science instructional programs for supporting high-quality student experiences. **Overwhelmingly, the most cited missing piece was alignment with the newest state science standards.** In most states that have *Framework*-aligned science standards, instructional materials that help implement the standards need to support three-dimensional, phenomena-driven learning. However, in their reviews of instructional materials, NextGenScience and EdReports both noted that many current instructional materials are more likely to support student learning in the disciplinary core ideas than in the other two dimensions (science and engineering practices and crosscutting concepts).[6] In the survey, many educators noted the same pattern, commenting that their materials focused on only one of the three dimensions used in the state standards (disciplinary core ideas), and lacked support for the other two dimensions.

Other missing pieces in core science instructional programs cited by at least 10% of respondents included:

Support for teachers to understand the materials and their instructional model;

Funding to purchase the materials or equipment necessary to use the materials;

Coherence across K–12, which would better support students to be ready for the next level of learning; and

Time allotted for teaching science, particularly in elementary schools.

Note that some of these missing pieces (funding and time) relate to parts of the education system that could hinder the use of quality instructional materials, rather than missing parts of the instructional materials themselves.

The most cited missing support for high-quality student experiences was alignment with the current state science standards.

Educators Often Modify Instructional Materials to Reduce the Time They Will Take.

In reaction to the perception of "missing pieces" in their core instructional programs, many educators make changes to their science instructional materials. The survey asked educators for the top reasons they modify or supplement instructional materials — whether or not those materials come from core science instructional programs (*see Figure 3*). **District leaders, school leaders, and classroom teachers all reported that one of the top three reasons they modify materials is to reduce the amount of time required to teach them.**

In line with the perception that core instructional programs often do not align with science standards, **all three groups also emphasized the need to modify science instructional materials to better align with the content in the discipline or state standards**. Many teachers described needing to fill gaps in the support for students to meet the standards. Several teachers also noted that multi-dimensional assessment guidance was absent in their current instructional materials, resulting in each teacher trying to determine how to assess all dimensions on their own.

The issue of time was a recurring theme among focus group participants as well. **All focus group participants discussed the limited amount of time available for science instruction**, especially at the elementary level, and discussed the need to modify materials to fit into shorter time periods than were stated in the original teacher guides.

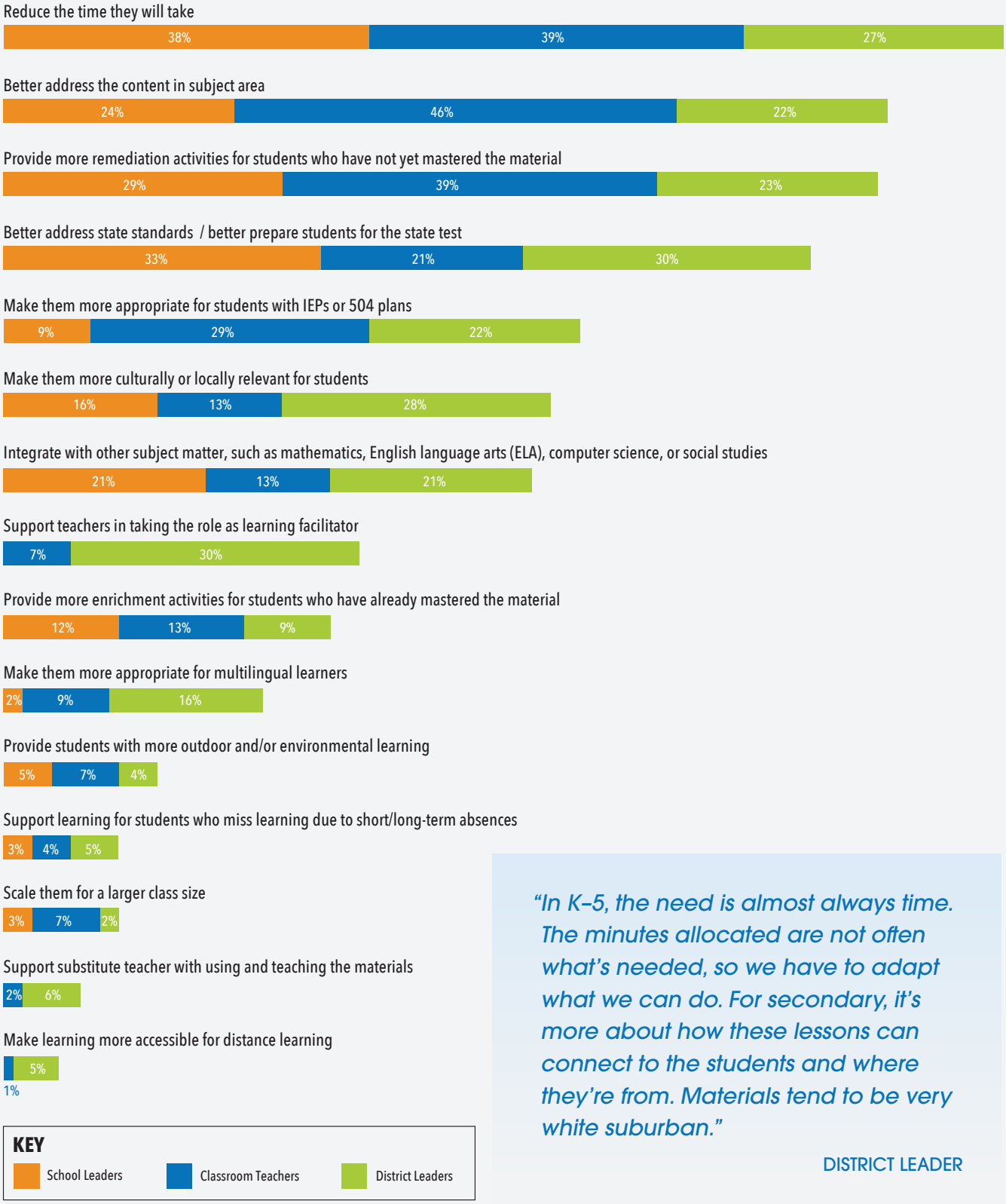
> *"I wish I could just teach with the materials I have, but they are boring and not NGSS-aligned. I am trying to balance learning, engagement, and differentiation, and it is hard work."*
>
> HIGH SCHOOL TEACHER

Some state and district policies may influence time allotted for science instruction in classrooms, but as is the case with instructional materials, recommendations about instructional time for science are often left up to districts. Fewer than 20% of state leaders reported on the survey that their state provides specific recommendations about either daily or weekly K–5 science instructional minutes, and this figure is even lower for secondary science (about 10%). **Sixty percent of district leaders reported that their district provides specific recommendations or requirements for K–12 science instructional minutes**, and this figure was roughly similar across all grade bands. The issue of insufficient instructional time for science is not new and has been discussed extensively in the science education field. Particularly at the lower elementary level, little time is spent on science instruction.[7]

All three groups emphasized the need to modify science instructional materials to better align with the content in the discipline or state standards. Additionally, multi-dimensional assessment guidance is often absent in current instructional materials.

Figure 3: District leaders, school leaders, and teachers were asked,
"When making modifications to science materials, what are the top three reasons you alter the materials?"

Percent of respondents who selected this choice as one of their top three reasons:



"In K–5, the need is almost always time. The minutes allocated are not often what's needed, so we have to adapt what we can do. For secondary, it's more about how these lessons can connect to the students and where they're from. Materials tend to be very white suburban."

DISTRICT LEADER

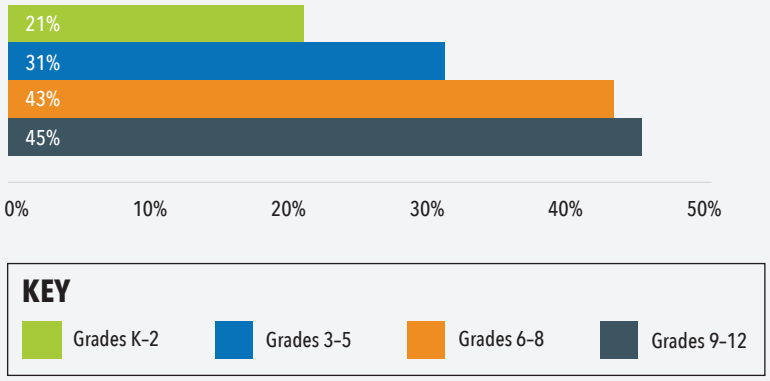
A lack of science instructional time in elementary grades has other implications for instructional materials modification. District leaders, school leaders, and classroom teachers all emphasized that many students entering the classroom have not had enough preparation in prior grade levels to begin engaging with grade-appropriate science instruction. Participants cited students' missing preparation not only in science but in mathematics and literacy as well. It is possible that the small number of hours spent on K–5 science instruction is likely to contribute to educators' perceptions that their students are not prepared in upper grades. Providing remediation for students who have not yet mastered the material ranked high among the reasons survey respondents cited for modifying materials, especially for secondary school teachers (*see Figure 3a*). In focus group conversations, participants clarified that they modified materials not just for students who haven't yet mastered the current instruction; **they also needed to modify materials for students who haven't mastered the pre-requisite learning goals**.

Another factor that leads participants to modify materials is the **lack of coherence in course structure between various schools and districts**. In both the survey and focus groups, educators mentioned that when instructional materials are intended for a specific course sequence but are used in a school or district with a different course sequence, adjustments often need to be made to provide additional scaffolding for students who haven't had the expected prior instruction. Fewer than half of the states reported in the survey that they specify a course structure for grades 6–8, so the ordering of courses varies widely between different districts.

Figure 3a: Teachers were asked,
"When making modifications to science materials, what are the top three reasons you alter the materials?"

The following percent of teachers at each grade band selected:

"Provide more remediation activities for students who have not yet mastered the material."



"The materials are written to grade level, but my students don't come in at grade level."

MIDDLE SCHOOL TEACHER

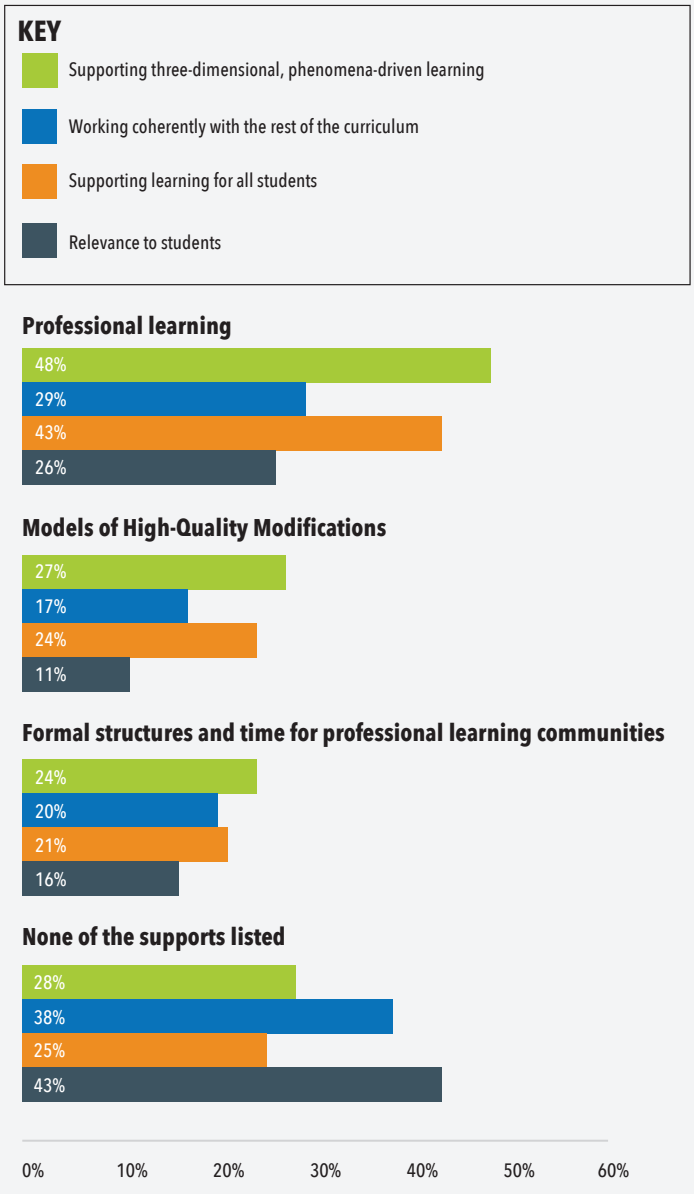
WHAT KINDS OF SUPPORTS HELP EDUCATORS MAKE MODIFICATIONS TO INSTRUCTIONAL MATERIALS?

Educators Currently Have Few Supports for Modifying Instructional Materials.

School leaders and teachers were asked in the survey about the kinds of supports they have already received to help make modifications to better align materials with standards, increase the coherence of the instructional sequence, support learning for all students, or increase the relevance of the materials for their students. Overall, **respondents reported having little support for making changes to their instructional materials**. When supports are provided, they are most likely to be in the form of professional learning. As described in *Figure 4*, **almost half of respondents said they had some professional learning on making materials more phenomena-driven and three-dimensional**. However, few respondents reported that they had access to models for what high-quality modifications to instructional materials could look like. Similarly, few respondents said their schools had formal structures or time for professional learning communities (PLCs) to discuss modifications to instructional materials. Across the board, educators reported receiving the least support for modifying materials to make them more relevant for students.

> *"There are many models in the country for phenomena or 3D learning, but not for materials modification. Models that exist are just the ideal. It would be helpful to see what it could look like to change materials when students aren't at grade level."*
>
> DISTRICT LEADER

Figure 4: Teachers and school leaders were asked, *"What kinds of supports have you received to help make or select modifications for the following purposes?"*



As professional learning is a common way district leaders, school leaders, and classroom teachers receive support for implementing science standards, including for modifying instructional materials, district leaders were asked about areas of focus that are prioritized when offering science professional learning in their districts. As seen in *Figure 5*, **the top three priority topics for professional learning were differentiating instruction for learners with diverse needs (such as multilingual learners), literacy in science, and pedagogy independent of instructional materials**. Over 30% of district leaders reported that providing professional learning about either increasing the cultural relevance of science instructional materials for all students or increasing the alignment of instructional materials to standards is not a priority in their district.

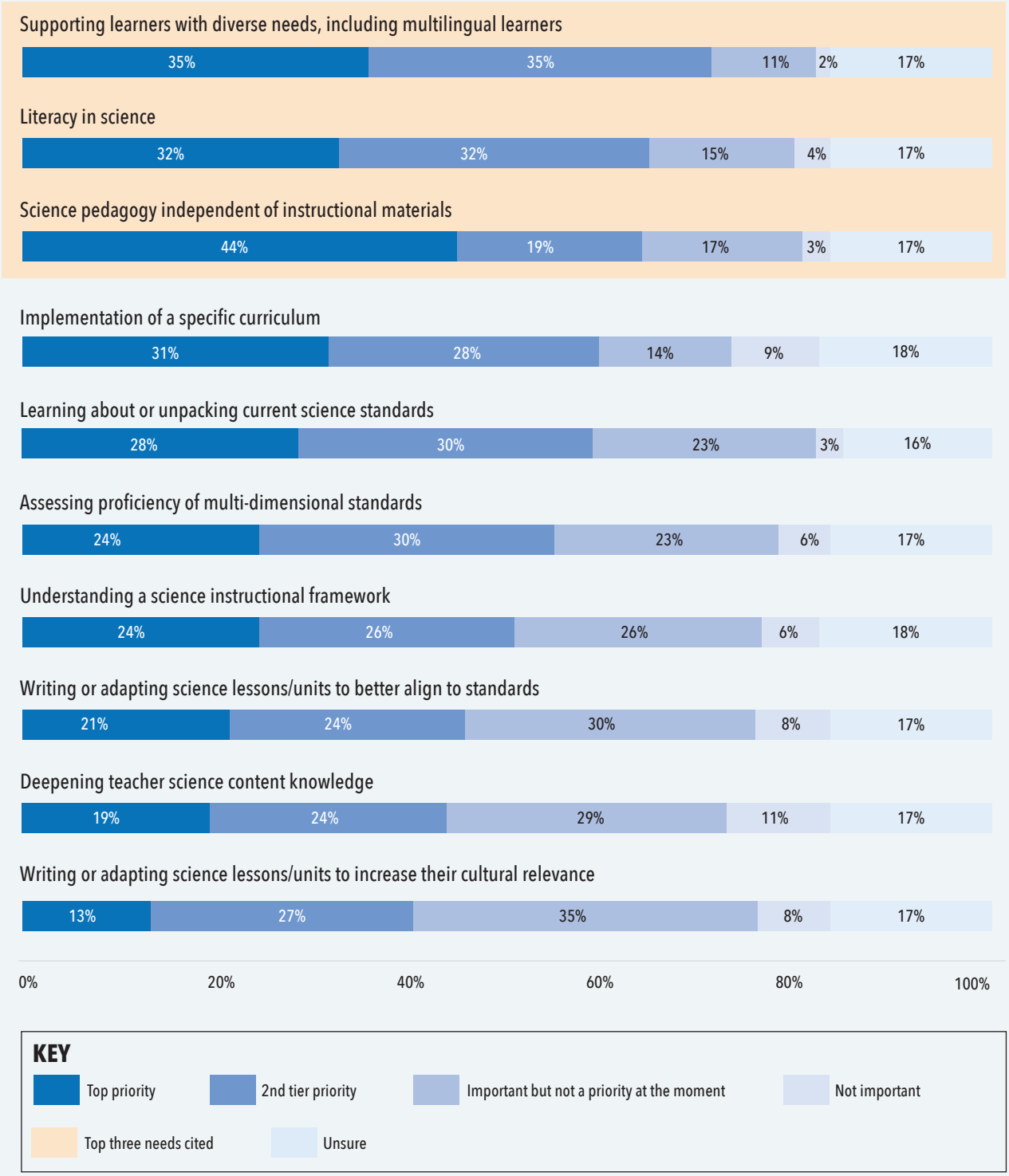
Science professional learning in all of these areas is important for both classroom teachers and school leaders. As described in the publication *Guide to Implementing the Next Generation Science Standards* (2015)[8], principals' understanding of and support for high-quality science instruction is essential to implementation in classrooms. However, **science professional learning for school leaders is not a high priority for many districts**. Of the districts that have a science standards implementation plan, 65% of district leaders reported including professional learning for teachers in their plan, but only 38% reported discussing professional learning for school leaders in their plan.

Top Three Priority Topics for Professional Learning

1. **Differentiating instruction** *for learners with diverse needs*
2. **Literacy in science**
3. **Science pedagogy** *independent of instructional materials*

> *"The science instructional specialist will co-teach, model teach, assist with planning to help support teachers. The missing link is building admin support of science and a district plan to support science in the elementary classrooms."*
>
> DISTRICT LEADER

Figure 5: District leaders were asked, *"How much of a priority are the following topics for professional learning offered in your district?"*



Many Instructional Materials Provide Support for Making Modifications.

Many developers of instructional materials are listening to the needs in the field. **Almost all respondents to the developer survey reported that they currently provide some guidance to teachers for making modifications to their instructional materials.** Of those developers who provide guidance:

100%
provided guidance about adjusting phenomena or problems to be more locally or culturally relevant;

85%
provided guidance for integrating science with ELA;

70%
provided supports for the needs of individual students, including providing a foundation for students who do not have expected levels of proficiency in prerequisite standards; and

70%
reported that teachers liked their guidance for modifying materials.

> *"We receive very positive feedback about any advice we provide on how to make lessons more culturally relevant, or easier for all student groups to access."*
>
> DEVELOPER OF INSTRUCTIONAL MATERIALS

> *"(I wish there were) clear statements of specific strategies embedded or in a call-out within curriculum materials. Often materials will allude to adaptations, but the recommendations are vague or generic."*
>
> REGIONAL LEADER

> *"I wish I had ways of finding how to be a better NGSS teacher. I feel so unsupported and don't know how to do better."*
>
> HIGH SCHOOL TEACHER

Educators Want Time and Professional Learning to Support High-Quality Modifications.

While publisher guidance about how to make modifications to instructional materials may be useful, it alone likely won't be sufficient to support high-quality modifications. Effective modification requires a deep understanding of the standards themselves along with specialized knowledge about the materials' design, such as its instructional model and assessment system. In the survey, teachers and school leaders were asked about the supports they still need to make modifications for their existing science instructional materials. **Both time and professional learning were consistently in the top three needs cited**. This includes support for understanding the standards and related instructional models. Lack of knowledge of how to make modifications to current materials (32%) and what modification needs are (27%) were frequently cited reasons for not making modifications to materials. In particular, about 8% of respondents said they didn't know how to make materials more three-dimensional and phenomena-based because they didn't understand the meaning of "three-dimensional, phenomena-driven learning."

In addition to time and professional learning, many teachers and school leaders indicated a need for resources and strategies related to Universal Design Learning (UDL) and local and cultural relevance in order to choose or make modifications that support learning for all students. Finances to purchase science instructional materials and equipment were also often noted as being a large missing piece of education systems in districts that did not provide science instructional materials to teachers, preventing teachers from offering the type of instruction they want to provide for their students.

RECOMMENDATIONS

Based on the findings from this landscape analysis, many different parts of the education system could act as levers to help bring science classrooms more in line with the vision of the *Framework*. The following steps are recommended for policymakers and instructional materials developers:

Provide adequate time and funding for science instruction K–12.

To implement science standards, students need time and materials for instruction. Adequate science instructional time at the elementary level will help ensure that students get to experience meaningful science learning and are prepared to successfully participate in science instruction at the secondary level.

Communicate the importance of using high-quality instructional materials in classrooms.

The quality of the materials enacted in the classroom — not just selected at the district level — is a critical part of implementing science standards and effectively supporting student learning. It is therefore important for all decision-makers, including state leaders, district leaders, school leaders, and teachers, to develop a common vision of quality science instructional materials and what they look like in classrooms.

Provide or select high-quality instructional materials that are locally and culturally relevant.

Development of high-quality instructional programs is an extremely time-consuming endeavor. With limited time to prepare for science instruction, teachers benefit from access to instructional materials that will meet most of their students' needs, including for phenomena or problems that are relevant to both the local environment as well as students' specific cultures, with only minor modifications necessary.

RECOMMENDATIONS *continued*

Engage teachers in the curriculum evaluation and selection process.

Providing high-quality materials is important, but how those materials are selected matters as well. Involving teachers in a transparent and rigorous curriculum evaluation and selection process will increase the likelihood the materials will meet their needs and actually be used to support student learning.

Engage in curriculum-based professional learning.

Implementation and modification of science instructional materials will be the strongest when all decision-makers, including state leaders, district leaders, school leaders, and classroom teachers, engage in professional learning to develop a common understanding of quality instructional materials, modifications necessary to meet all students' needs, and effective strategies and methods to modify materials.

Provide models of high-quality modifications to science instructional materials.

Even with the best possible instructional materials, small changes will always need to be made to meet local needs. After they develop a deep understanding of quality instructional materials, educators need examples of what kinds of modifications could be made and information about how to ensure that any changes will maintain alignment to science standards.

Invest in further research on science materials modifications.

In depth research will be necessary to answer questions raised in this landscape analysis as well as in prior reports, such as 'To what extent are materials used as intended?' 'What is the effect of different kinds of materials modifications on student learning?' 'What models can support high-quality modifications of materials at a local level?' 'How can educators modify high-quality materials to scaffold learning for students who haven't had the expected pre-requisite learning?'

ACKNOWLEDGMENTS

NextGenScience would like to thank all of the participants for their time and cooperation in completing the survey and engaging in focus group discussions. We would also like to express gratitude to the National Dairy Council for providing an educational stipend to support the development of this report.

ENDNOTES

[1] National Research Council. (2012). *A framework for K–12 science education: Practices, crosscutting concepts, and core ideas*. The National Academies Press. https://doi.org/10.17226/13165

[2] See a definition of instructional materials and high-quality instructional materials in: Short, J., & Hirsh, S. (2020). *The elements: Transforming teaching through curriculum-based professional learning*. Carnegie Corporation of New York. https://www.carnegie.org/our-work/article/elements-transforming-teaching-through-curriculum-based-professional-learning/

[3] See: Polikoff, M., & Dean, J. (2019). *The supplemental-curriculum bazaar: Is what's online any good?* Thomas B. Fordham Institute. https://fordhaminstitute.org/national/research/supplemental-curriculum-bazaar

[4] District, school, and classroom survey participants were self-selected and were offered a chance to win one of 10 gift cards in return for their participation. NextGenScience distributed links to the online surveys through targeted contacts with state science leaders as well as public distribution on @OfficialNGSS Twitter, the NGSS Now Newsletter, and through partner email distribution lists. Participants who are connected to NGSS Communications are therefore likely to be over-represented in the sample.

[5] See: Doan, S., Greer, L., Schwartz, H. L., Steiner, E. D., & Woo, A. (2022). *State of the American Teacher and State of the American Principal surveys: 2022 technical documentation and survey results* (Document No. RR-A1108-3). RAND Corporation. https://doi.org/10.7249/RRA1108-3

[6] See: EdReports & NextGenScience. (2021). *Critical features of instructional materials design for today's science standards: A resource for science curriculum developers and the education field*. WestEd. https://www.wested.org/resources/critical-features-of-instructional-materials-design-for-todays-science-standards/

[7] National Academies of Sciences, Engineering, and Medicine. (2022). *Science and engineering in preschool through elementary grades: The brilliance of children and the strengths of educators*. The National Academies Press. https://doi.org/10.17226/26215

[8] National Research Council. (2015). *Guide to implementing the Next Generation Science Standards*. National Academies Press. https://doi.org/10.17226/18802

ABOUT NEXTGENSCIENCE

NextGenScience supports states, districts, educators, and other partners to design and identify quality, coherent programs that align science standards, instructional materials, professional learning, and assessments. Now part of WestEd, NextGenScience was formerly the science team — the nonprofit organization that coordinated the development of the Next Generation Science Standards (NGSS) — and continues Achieve's work with NGSS stewardship and implementation.

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Suggested Citation: NextGenScience (2023). *Science instructional materials selection and modification: A landscape analysis*. WestEd.