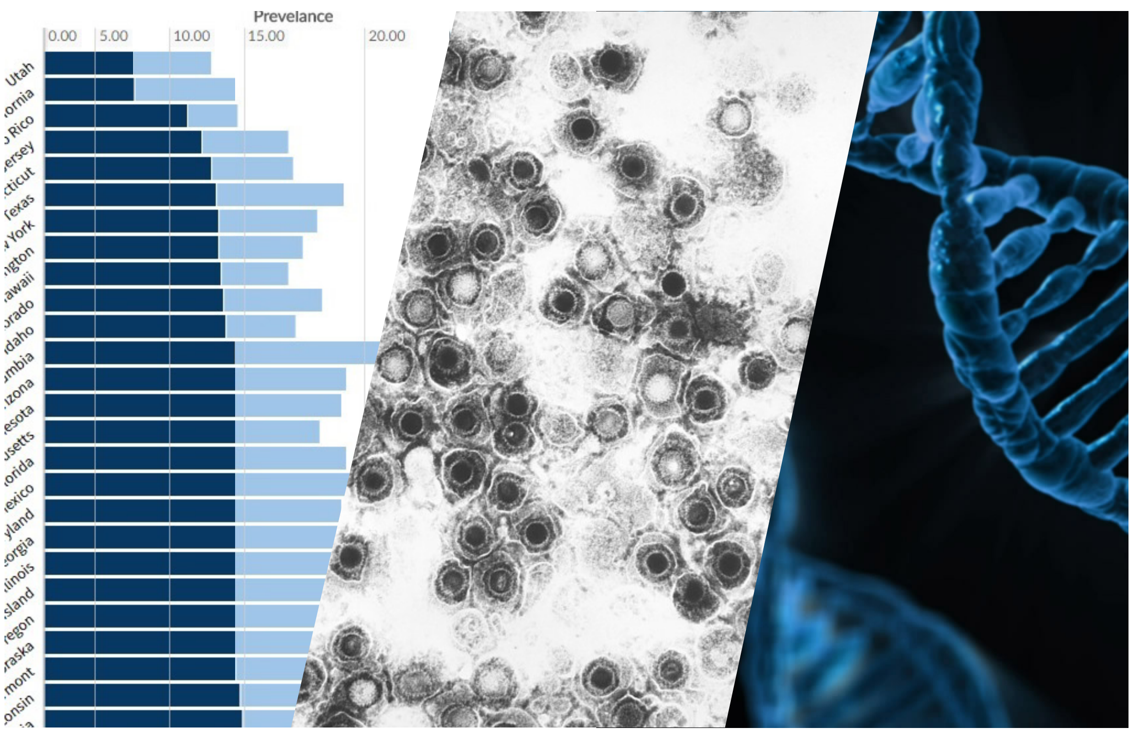
NEBRASKA VISION FOR SCIENCE

Conference Evaluation Report



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with thanks to Sidney Vandyke-Ries and Jorge Ledesma
for help with coding, data analyses and graphing

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Biology of HUMAN

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Nebraska Vision for Science

Conference Evaluation Report 2016

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Executive Summary

The Nebraska Vision for Science professional development conference on June 27, 2016 involved over 200 K-12 education professionals from around the state. Sponsored through a collaboration of multiple partners, this one-day, hands-on workshop focused on familiarizing teachers with the new vision for science education put forth by the National Academy of Sciences (2012) that centers around three essential dimensions of science: science and engineering practices, crosscutting concepts, and disciplinary core ideas (called "3-D"). This evaluation, funded through the Biology of Human project, a National Institutes of Health (NIH) Science Education Partnership Award (SEPA), assesses teachers' perceptions of the utility of the workshop in preparing them to use the 3-D model, provides insights into teachers' needs to successfully incorporate the three dimensions in their classrooms, and probes teachers' use of resources and inclusion of the topic of viruses and infectious disease.

Pre- and post-surveys were administered to participating educators; 190 post-survey respondents provided most of the data reported in this summary. About 37% of the respondents taught science at the high school level; 10% at the secondary level (7th - 12th grade); 37% at the middle school level; and 16% at the elementary level. Three-fourths of the teachers were female, 90% identified as "White"; two-thirds had attained a master's degree, and 57% taught in the Lincoln or greater Omaha urban/ suburban areas, while 43% taught in more rural areas. They reported an average of 15 years of teaching experience.

Comparing pre- to post-test responses about the 3-D instructional approach, participation in the workshop significantly increased teachers' confidence in understanding the 3-D approach and their preparedness to apply it in their classrooms. They were also significantly more confident in being able to design assessment aligned with the 3-D model and rated this way of teaching as significantly more useful than they did before the workshop.

To successfully implement the 3-D approach, the majority of teachers indicated they very much needed some additional supports and resources. These included additional example lesson plans, instructional materials better aligned with the 3-D model, more practice with the 3-D approach, and additional techniques for meeting needs of diverse learners. In addition, between 30% and 40% felt they very much needed clearer guidance on district requirement for content coverage, more support from both administrators and teachers, and individual mentoring/coaching with 3-D instructional practices. Nevertheless, teachers overwhelmingly reported that they anticipated that their students would respond positively to this approach, that it would result in increased engagement and excitement about science, and would lead to greater understanding and ownership of the content. Some teachers, however, noted the importance of appropriate implementation and recognized that it would take time for students to adjust.

Teachers reported they use a wide variety of outside resources to enhance their teaching, including internet and YouTube sites, print materials, as well as professional associations and governmental agencies, colleagues and locally available resources. When asked how they could integrate ideas about viruses and infectious diseases in their teaching, about two-thirds of the teachers indicated they could do this via a variety of content areas, methods or media approaches. When asked how likely they were to access the EPSCoR mobile equipment labs, between 40% to 50% of teachers said they would be somewhat or very likely to access the labs, with teachers at the middle and high school level much more likely than those at the elementary level.

Overall, this workshop was very well received and succeeded in helping teachers become familiar with and begin to embrace the Nebraska vision of engaging students through three key dimensions of science: practice, crosscutting concepts and core ideas. While more work and support is obviously needed for full implementation, this workshop created a positive step forward in the collective vision for Nebraska K-12 Science education.

Introduction

The Biology of Human ("BioHuman") project, funded by the National Institutes of Health (NIH) Science Education Partnership Award (SEPA), focuses on helping youth and adults understand themselves by exploring scientific principles that underlie modern research in human biology. Currently in its final year of a five-year grant, the project is creating innovative outreach materials for youth and families, educators and librarians, and providing professional development experiences for middle and high school level teachers.

One project goal is to increase the capacity of educators to interest and engage youth in biology topics, and to generate greater interest in biomedical careers among youth. To help facilitate this goal, the BioHuman project has conducted a variety of different professional development activities for area middle and high school science teachers. The Nebraska Vision for Science Professional Development workshop was a collaboration of multiple partners, including the Nebraska Department of Education, Lincoln Public Schools, and several partners within the University of Nebraska. This workshop was designed to help teachers become more familiar and comfortable with the vision of science education described in *A Framework for K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas*, a report published by the National Academy of Science in 2012. This vision "centers on engaging students in progressively deeper understanding of science and the abilities they need to make sense of novel phenomena in the natural and designed world." (Moulding, Bybee, & Paulsen, p. 1).

Based on years of research on teaching and learning in science, the vision supports a focus on a limited number of disciplinary core ideas and crosscutting concepts, taught in a way so that students continually learn and revise their knowledge over multiple years, integrated with the practices of scientific inquiry and engineering design. It is built around these three major dimensions:

- *Scientific and engineering practices* as the ways and means of conducting science
- *Crosscutting concepts* that unify the study of science and engineering through their common application across fields, and provide tools and scaffolding for unifying the science disciplines
- *Core ideas* in four disciplinary areas: physical sciences; life sciences; earth and space sciences; and engineering, technology, and applications of science, drawn from the American Association for the Advancement of Science (AAAS) Benchmarks and the National Science Education Standards
  (National Academy of Sciences, 2012)

These three dimensions are the foundation of this new vision of science education and are sometimes referred to as the "3-D instructional approach," "3-D learning," or "teaching in 3-D." The new vision for science teaching engages students at the intersection of these three essential dimensions. The framework also illustrates how assessment standards and student performance expectations can be developed in alignment with the three dimensional approach. Because the Next Generation Science Standards (NGSS) are an example of assessment standards aligned with the 3-D approach, some discussion of NGSS was also included within the scope of this workshop.

The scheduled agenda for the workshop, including the full list of sponsors, is shown below:

Nebraska Vision for Science

Professional Development Schedule for June 27, 2016

Join teachers from across the state for a full day of 3-dimensional learning. This event promises to be a great opportunity with national and state leaders in science to explore the future of Nebraska science education. We will help bridge the gap between current educational research and practice using hands-on experiences. Facilitating this event will be special guests and authors of "*A Vision for Science Teaching and Learning*," Rodger Bybee, Brett Moulding, and Nicole Paulsen.

7:30 am	Registration at Innovation Campus, University of Nebraska – Lincoln, 2021 Transformation Drive, Lincoln. Parking is available in lot directly north of Transformation Drive.
8:30–8:45	Welcome – *Judy Diamond, Sara Cooper, James Blake, Deb Paulman*
8:45–10:15	Vision for K-12 Science Education as Described in the Framework – *Brett Moulding*
10:15–10:30	Break
10:30–11:45	Breakout Session I* (Repeated in Breakout Session II) 1. Disciplinary Core Ideas in the Classroom (LINKS participants pick another session) 2. Implications of the Framework for Standards and Classroom Instruction 3. Supporting Science Understanding through Literacy 4. Engaging Students in the Science & Engineering Practices (LINKS participants pick another session) 5. Engineering Practices Consistent with the Framework
11:45–12:45	Lunch
12:45–2:00	Breakout Session II* (Repeat of Breakout Session I)
2:00–2:15	Break
2:15–3:15	Using Crosscutting Concept Prompts to Engage Students in Structured Responses *Brett Moulding*
3:15–3:30	Nebraska EPSCoR Presentation – *Lindsey Moore*
3:30–4:00	Evaluation – *Amy Spiegel*
4:00–5:00	Break
5:00–9:00	Reception at the University of Nebraska State Museum, Morrill Hall, 14th and Vine Streets. Parking available in lot A/F3/C in front of the museum. Guest can park in any spot and pick-up a parking pass at the visitors services desk inside the museum.

**Breakouts subject to minor changes.*

Nebraska Vision for Science Sponsors

Biology of Human NIH-SEPA project
University of Nebraska State Museum
Nebraska Center for Virology
Nebraska EPSCoR
LINKS Nebraska MSP
Lincoln Public Schools
Nebraska State Dept. of Education
Colleges of Agricultural Sciences and Natural Resources, Education and Human Sciences, Arts and Sciences, and NebraskaSCIENCE
College of Engineering
Dept. of Sociology
Vice Chancellor for Research & Economic Development

Thanks to STEMscopes for graciously providing lunch for this event

About 250 teachers across Nebraska were invited to participate in this one-day event. Approximately 100 of these teachers were involved in the LINKS Nebraska Math Science Partnership award and participated in two additional days of professional development on June 28 and 29. This evaluation focuses only on the events occurring on June 27.

Purpose of Evaluation

The evaluation was designed to:

- assess teachers' perceptions of the utility of the workshop in preparing teachers to use the three-dimensional (3-D) instructional approach that was the focus of the professional development,
- gain insight into teachers' needs to implement the 3-D approach in their classrooms,
- answer some specific questions about their need for and use of resources for teaching, and
- probe how teachers could integrate ideas about viruses and infectious disease in their teaching (these topics are a particular focus of the BioHuman project).

This report provides a brief summary of the event and an analysis of evaluation feedback from teachers about the professional development.

Methods

Two hundred forty-five (245) teachers who had signed up for the workshop were invited by email to participate in a web-based pre-survey. This instrument included four baseline items asking teachers to rate aspects of their perceptions of the 3-D approach. Two hundred seventeen (217, 89%) respondents completed these pre-survey items[1]. Of the estimated 215 teachers who attended the event, 190 (88%) completed a post-survey[2]. Teachers had the option to omit answers to any items in the post-survey, and 32 (17%) did not include their names on the post-survey. Altogether, 139 individuals had matched pre and post data.

A copy of the post-survey is provided in the appendix. The first four Likert-scale items on the post-survey are identical to the baseline items administered in the pre-survey thus enabling a pre-post comparison on those few items. All instruments and procedures were approved by the UNL Institutional Review Board prior to data collection.

Respondents

Attendees of the conference included elementary, middle and high school teachers of science. To better understand who these teachers are, what grade level students they teach, and in what types of schools, this information is provided through a series of descriptive tables and figures. To help summarize the information, I sorted teachers into four levels of grades taught: elementary (1st -5th), middle (6th-8th), secondary (7th-12th) and high school (9th-12th). Because many rural schools in Nebraska span 7th-12th grade, and these schools tend to be distinct from middle schools and high

[1] The original 245 were the teachers that had signed up for the June PD workshop, and Sara Cooper, Nebraska Department of Education Science Director, provided me with her master list of registered participants. This list was updated a few times, and with each update, additional teachers were added; email addresses and duplications were also corrected. The survey was initially sent on June 7, with two reminders sent to non-respondents approximately one and two weeks later. 219 teachers responded to the survey (89% response rate). 2 opted not to agree to the informed consent, so 217 (89%) completed, or mostly completed the pre-survey.

[2] 227 individuals signed in as participants on the day of the professional development. Nineteen (19) of these were individuals who were not part of the original participant list and did not complete the post-survey, comprising mostly state, district and school administrators. Some individuals did not sign in, but did participate in the post-survey at the end of the day. 190 individuals completed the post-survey, including 32 who did not provide their names. Nine individuals who provided their names on the post-survey were not invited to complete the pre-survey, attended (signed in at) the PD and completed the post-survey. Seven (7) individuals were not signed in as attending, but did complete the post-survey (and the pre-survey). Seventy-five (75) were marked as attending, but did not include their name on a post-survey. Thus, 208 participant teachers were signed in (not counting administrators), plus 7 that did not sign in, but completed the survey, so we estimate a total of 215 individuals attending, of whom 190 completed a survey (88% response rate).

schools, I included this additional category of school. For the few teachers who taught both elementary and middle school (primarily 5th and 6th grade), I placed them with middle school teachers. Table 1 shows the number of attending teachers at each level, gender, years of teaching experience, average number of grade levels taught, average number of students taught, level of education, and type of school district setting (rural or urban/suburban). This descriptive information is also shown in the figures that follow.

TABLE 1. DESCRIPTIVE INFORMATION ABOUT CONFERENCE ATTENDEES BY GRADE LEVEL TEACHING*

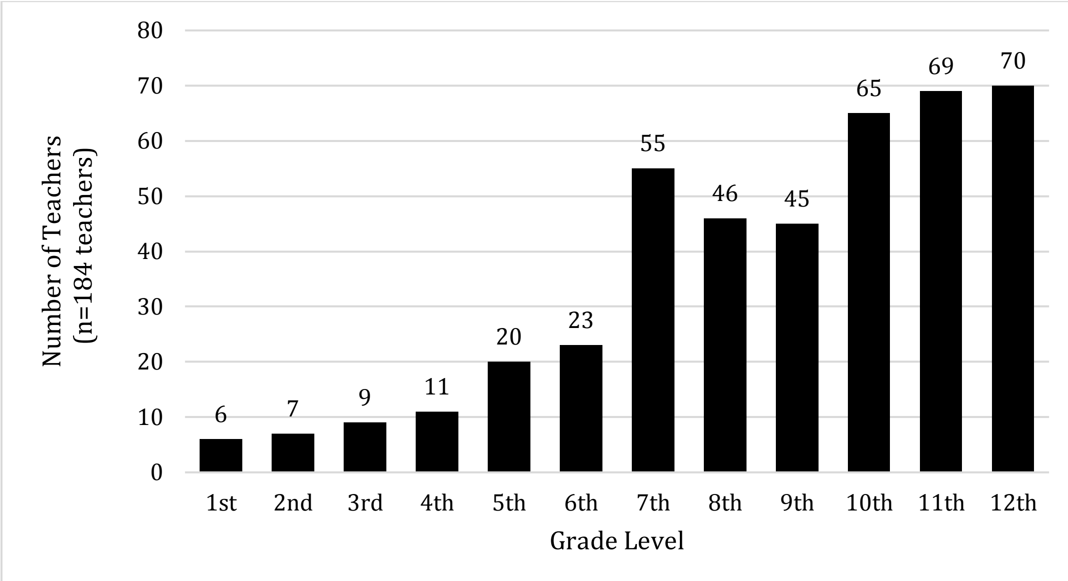
	Elementary (1st -5th grade)	Middle (6th - 8th grade)	Secondary (7th - 12th grade)	High (9th -12th grade)	All teachers
Number of teachers	27	64	18	63	n=190
Gender	89% (24) female 11% (3) male	80%(47) female 20% (12) male	83%(15) female 17%(3) male	61%(37) female 39%(24) male	75%(123) female 25%(42) male
Years of teaching experience	$\bar{x}$ =16.0 (sd=10.1) range (3 - 41)	$\bar{x}$ =13.5 (sd=9.6) range (1-39)	$\bar{x}$ =18.1 (sd=9.2) range (4-34)	$\bar{x}$ = 12.8 (sd=9.4) range (0 - 34)	$\bar{x}$ =14.6 (sd=9.9) range (1 - 41)
Number of grade levels taught	$\bar{x}$ = 1.6 (sd=1.4) range (1 - 5)	$\bar{x}$ = 1.6 (sd=0.8) range (1 - 5)	$\bar{x}$ = 5.1 (sd=1.2) range (2 - 6)	$\bar{x}$ = 3.0 (sd=0.9) range (1 - 4)	$\bar{x}$ =2.3 (sd=1.6) range (1 - 6)
Number of students taught, 2015-16	$\bar{x}$ =82, (sd=165.9) range (12 - 720)	$\bar{x}$ = 118 (sd=42.9) range (15 - 300)	$\bar{x}$ =103 (sd=60.5) range (40 - 300)	$\bar{x}$ = 138 (sd=61.7) range (40 - 300)	$\bar{x}$ =117 (sd=82.7)
Highest degree attained	37%(10)B.A./B.S. 63%(17)M.A./M.S.	30%(19)B.A./B.S. 69%(44)M.A./M.S. 2%(1)Ed.D./Ph.D.	44%(8)B.A./B.S. 56%(10)M.A./M.S.	33%(21)B.A./B.S. 65%(41)M.A./M.S. 2%(1)Ed.D./Ph.D.	34% B.A./B.S. 65% M.A./M.S. 1% Ed.D./Ph.D.
Type of school district setting	37%(10) rural 63%(17) urban/ suburban	39%(23) rural 61%(36) urban/ suburban	89%(16) rural 11%(2) urban/ suburban	36%(22) rural 64%39) urban/ suburban	43%(71) rural 57%(94) urban/ suburban

* respondents did not answer all questions, so reported numbers for variables do always not equal total number of teachers attending

Grade levels taught

Figure 1 shows the number of teachers teaching at each of the different grade levels from 1st through 12th grade. On average, teachers were responsible for teaching students from slightly more than two grade levels; the majority of teachers attending this professional development teach at the secondary level and, consequently, the majority of students potentially impacted are also at this level.

FIGURE 1. GRADE LEVELS TAUGHT BY ATTENDING TEACHERS

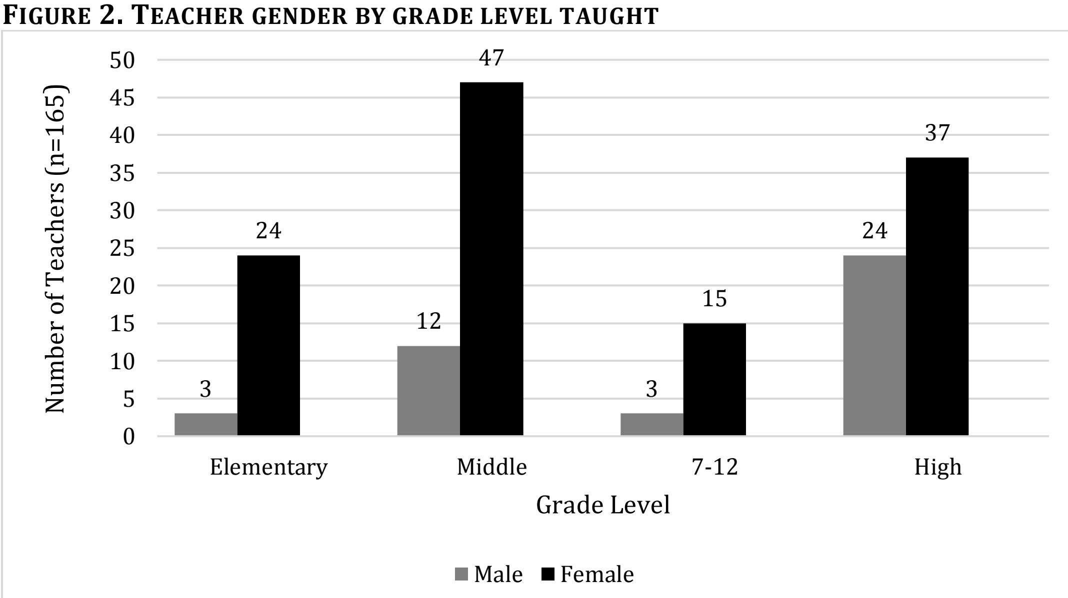


*total number of teachers teaching at the different grade levels exceeds the actual number of teachers because many teach multiple grade levels at their schools.

Gender

Seventy-five percent of teachers attending were female. Figure 2 shows teacher sex by grade level taught.

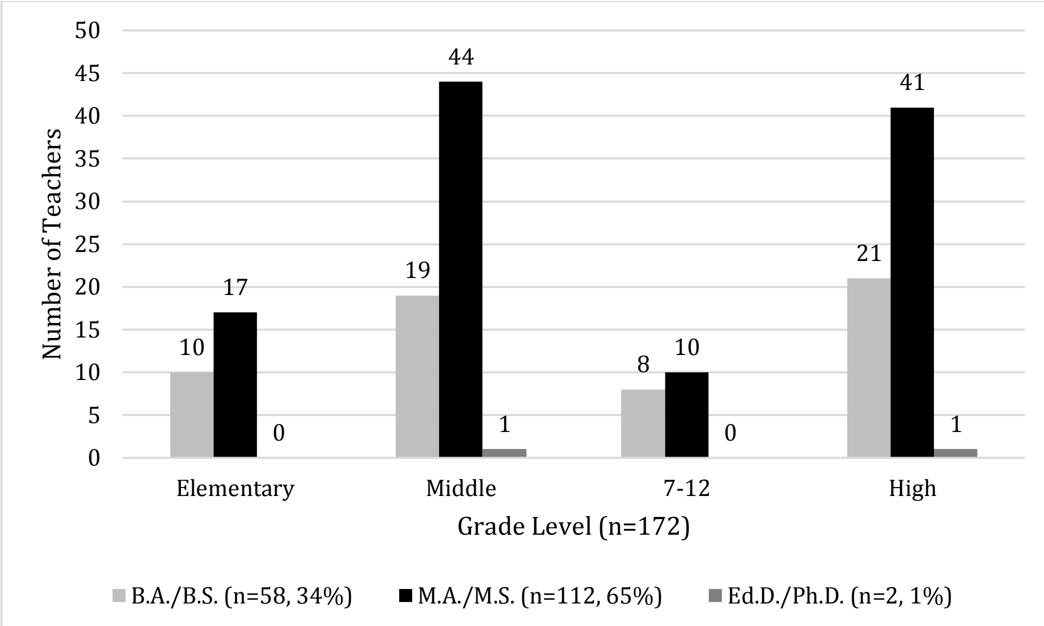
FIGURE 2. TEACHER GENDER BY GRADE LEVEL TAUGHT



Highest level of education

Nearly two-thirds of all teachers had attained a master's degree or doctorate (see Figure 3); the rest indicated their highest degree was a bachelor of science or bachelor of arts.

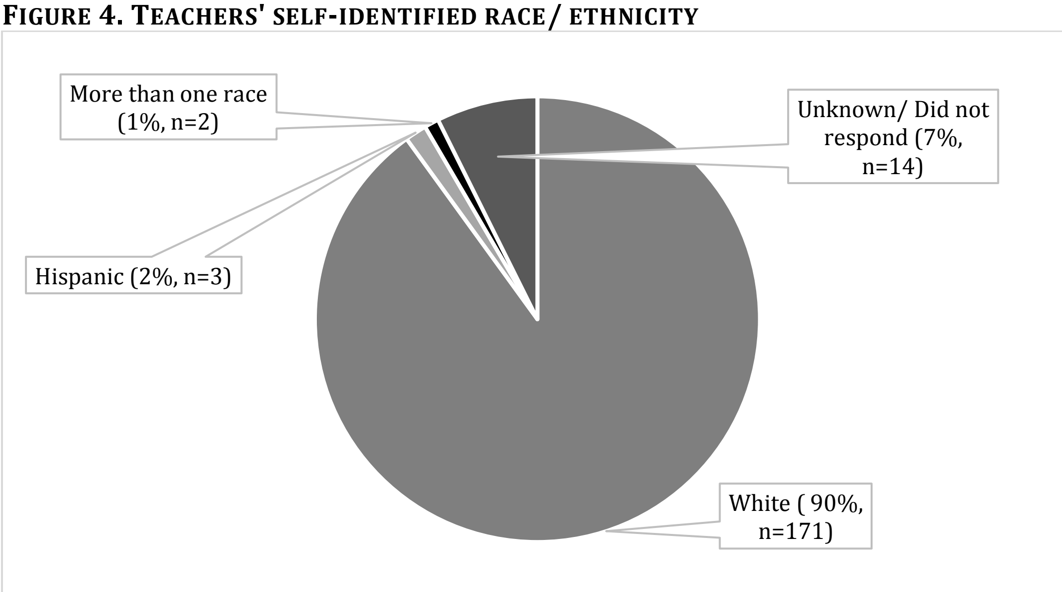
FIGURE 3. TEACHERS' HIGHEST LEVEL OF EDUCATION BY GRADE LEVEL TAUGHT



Ethnicity and Race

The large majority, 90%, of teachers indicated they were White (see Figure 4), and only 3% indicated that they were a minority or of mixed race. No teachers indicated they were Black/ African American or Asian.

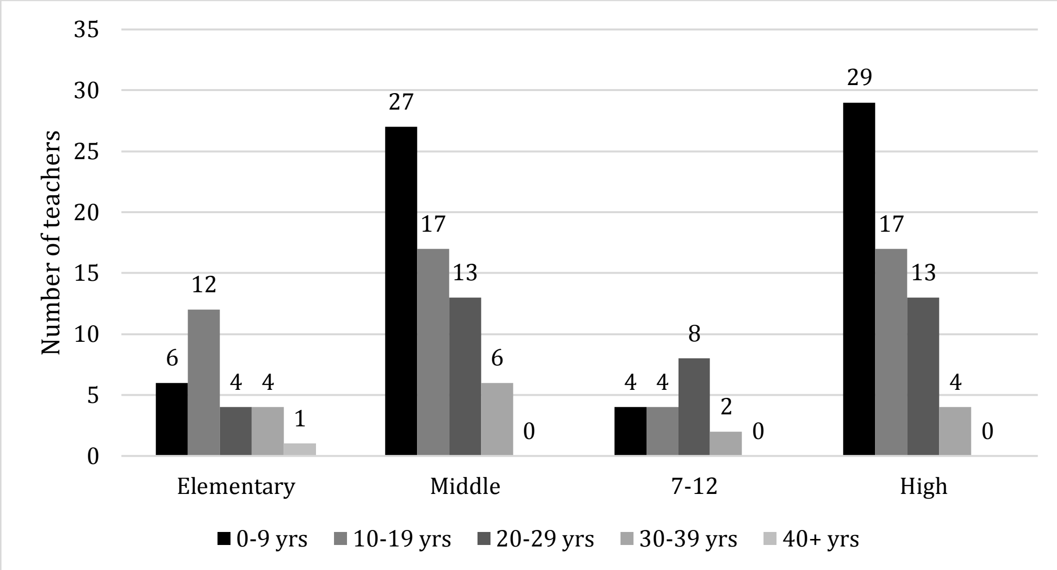
FIGURE 4. TEACHERS' SELF-IDENTIFIED RACE/ ETHNICITY



Teaching experience

Teachers reported they had, on average, nearly 15 years of teaching experience. This varied widely, from no experience to over forty years of experience. Figure 5 shows years of teaching experience by grade levels taught.

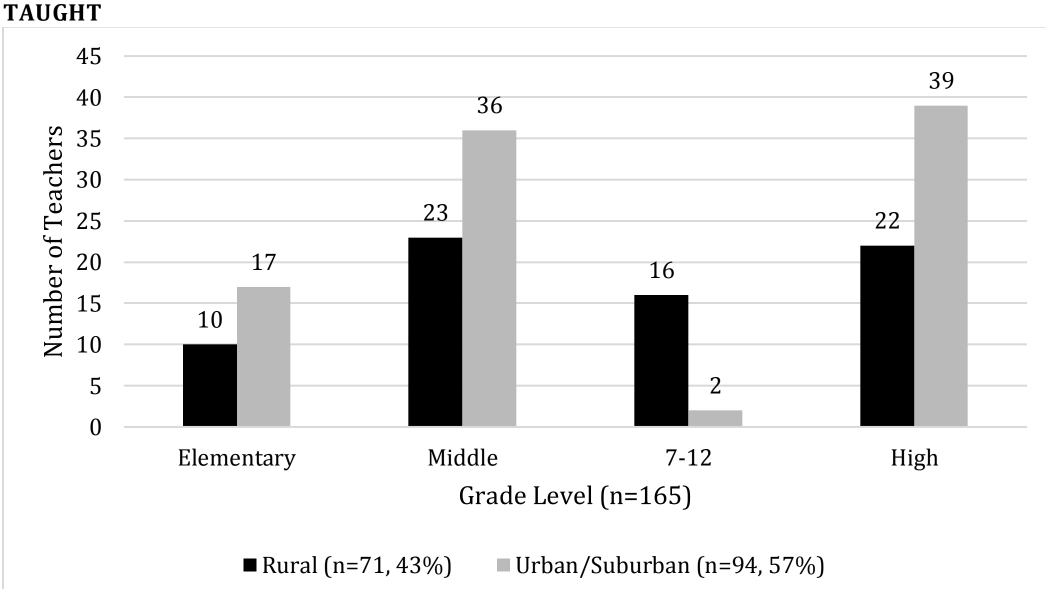
FIGURE 5. TEACHERS' YEARS OF TEACHING EXPERIENCE BY GRADE LEVEL



School district setting

Teachers provided the names of their school districts, and these were sorted into rural and urban/suburban schools. Schools in the Omaha metropolitan area, including Bellevue, Elkhorn, Millard, Omaha Catholic, Omaha Public Schools, Papillion-LaVista and Westside, and the Lincoln Public Schools were identified as urban/suburban. All other schools were classified as rural. Over half of the teachers participating taught in urban/suburban settings (see Figure 6).

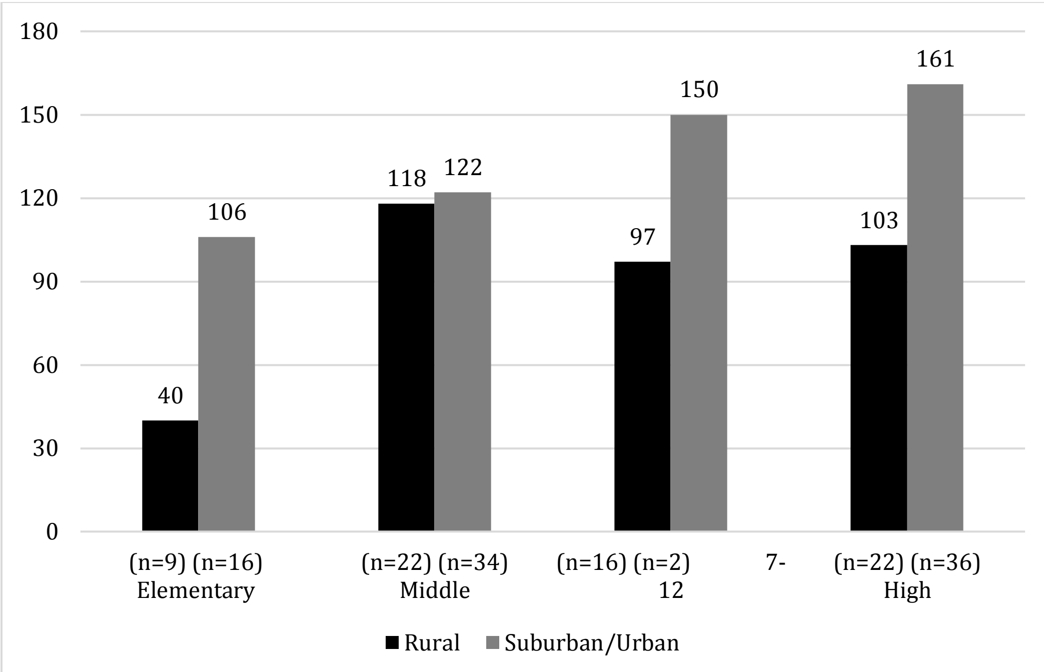
FIGURE 6. TEACHERS' SCHOOL DISTRICT SETTING (RURAL OR URBAN/ SUBURBAN) BY GRADE LEVELS TAUGHT



Number of students taught

On average, teachers estimated that they taught 117 students in the 2015-16 school year. Rural teachers taught, on average, fewer students during the year than urban teachers (see Figure 7). Altogether, these science teachers taught over 19,600 students last year.

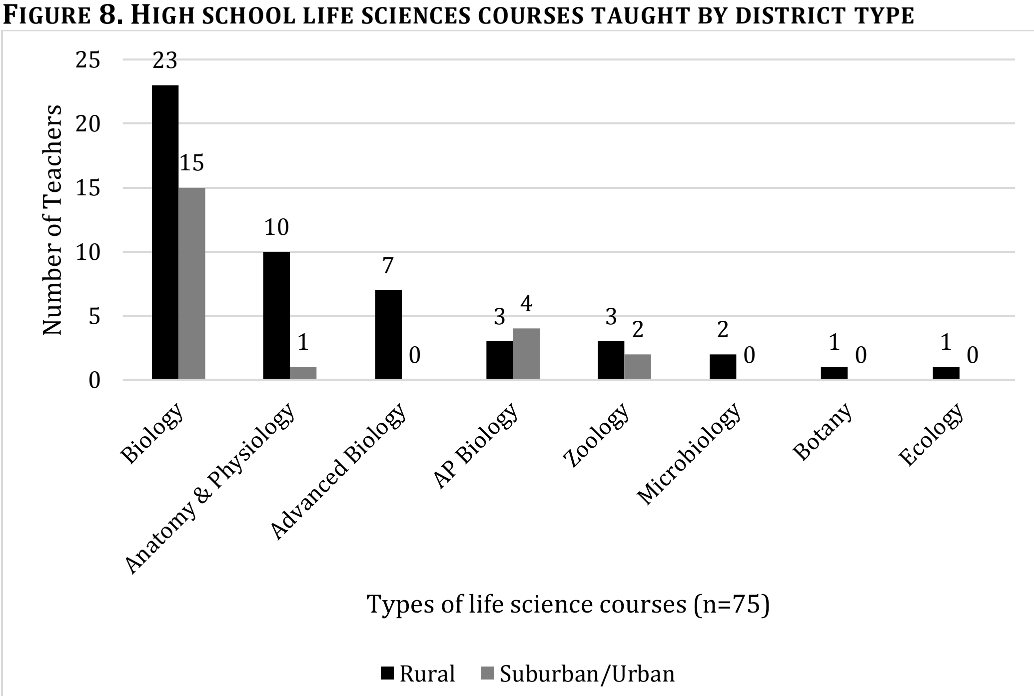
FIGURE 7. NUMBER OF STUDENTS TAUGHT PER TEACHER PER YEAR BY GRADE LEVEL AND DISTRICT TYPE



Life science courses taught

We asked teachers to list, if any, what life science courses they teach. Of the 81 teachers teaching at the high school level, 43(53%) indicated that they teach some type of life science course. The types of life science courses taught varied somewhat by type of school setting (see Figure 8).

FIGURE 8. HIGH SCHOOL LIFE SCIENCES COURSES TAUGHT BY DISTRICT TYPE



Results

The primary focus of the professional development workshop was to help teachers become more familiar with *A Vision and Plan for Science Teaching and Learning: An educator's guide to a Framework for K-12 Science Education, Next Generation Science Standards, and State Science Standards*, written by Brett Moulding, Rodger Bybee and Nicole Paulsen. At the heart of this vision is the engagement of students in science performances that encompass three dimensions of science described in the *Framework* as the primary tools. The three dimensions are: 1) Science and engineering practices, 2) Cross-cutting concepts, and 3) Disciplinary core ideas.

> *The framework is designed to help realize a vision for education in the sciences and engineering in which students, over multiple years of school, actively engage in scientific and engineering practices and apply crosscutting concepts to deepen their understanding of the core ideas in these fields. The learning experiences provided for students should engage them with fundamental questions about the world and with how scientists have investigated and found answers to those questions. (p. 8-9, National Academy of Sciences, 2012).*

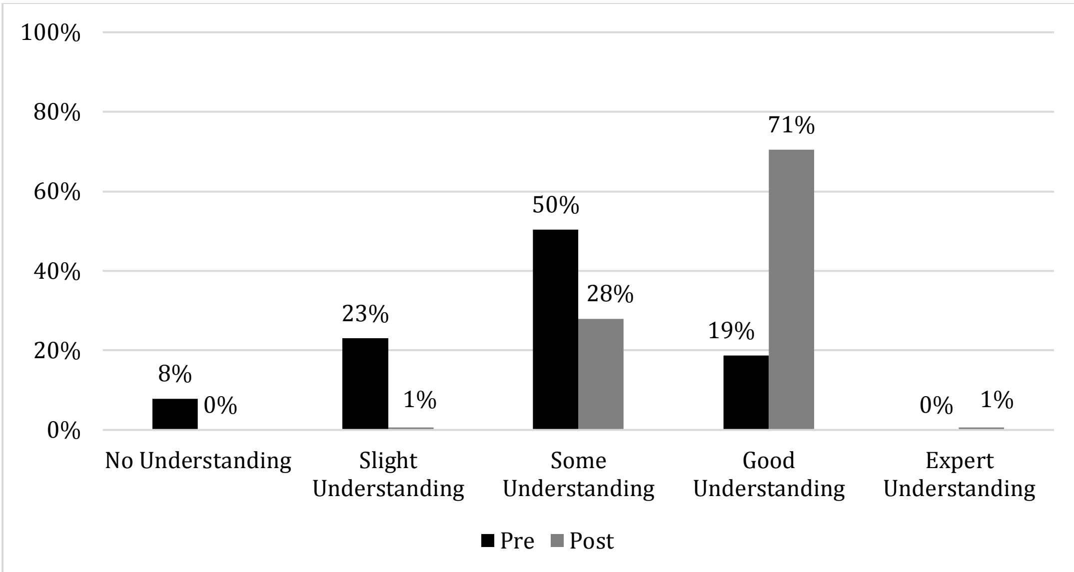
As the agenda (listed earlier in this report) shows, the day was spent providing teachers with hands-on activities and sessions designed to help them shift their thinking and pedagogical practice "moving from students knowing *what* and *that* to understanding *how* and *why*" (p. 3).

Teachers were asked to rate different aspects of the 3-D instructional approach both prior to the workshop and then immediately following the workshop. On each of the four items, there was a significant change from pre- to post-survey.

Teachers' understanding 3-dimensional instructional approach

Prior to the workshop, half of the teachers rated themselves as having "some understanding" of the integration of the three dimensions, and nearly a third indicated they had "slight" or "no understanding." At the conclusion of the workshop, the majority of teachers (71%) rated themselves as having "good understanding," with only 1% indicating they had "slight" or "no understanding" (see Figure 9).

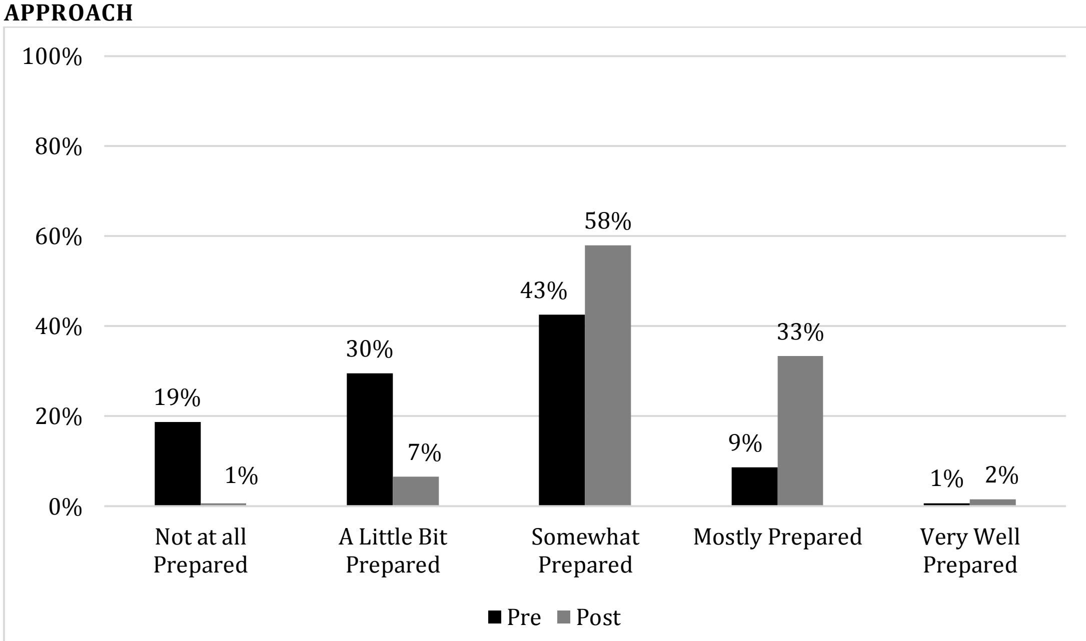
FIGURE 9. TEACHERS' RATINGS, PRE- AND POST-WORKSHOP, OF THEIR UNDERSTANDING OF 3-D INTEGRATION



Teachers' preparedness to apply 3-dimensional approach in their classrooms

Prior to the workshop, nearly half (49%) of teachers felt that they were "not at all" or only "a little bit prepared" to apply the 3-D approach in their classrooms, and just 10% indicated they felt "mostly" or "very well prepared" to do so." By the end of the one-day workshop, 35% felt "mostly" to "very well prepared" and an additional 58% felt "somewhat prepared" (see Figure 10).

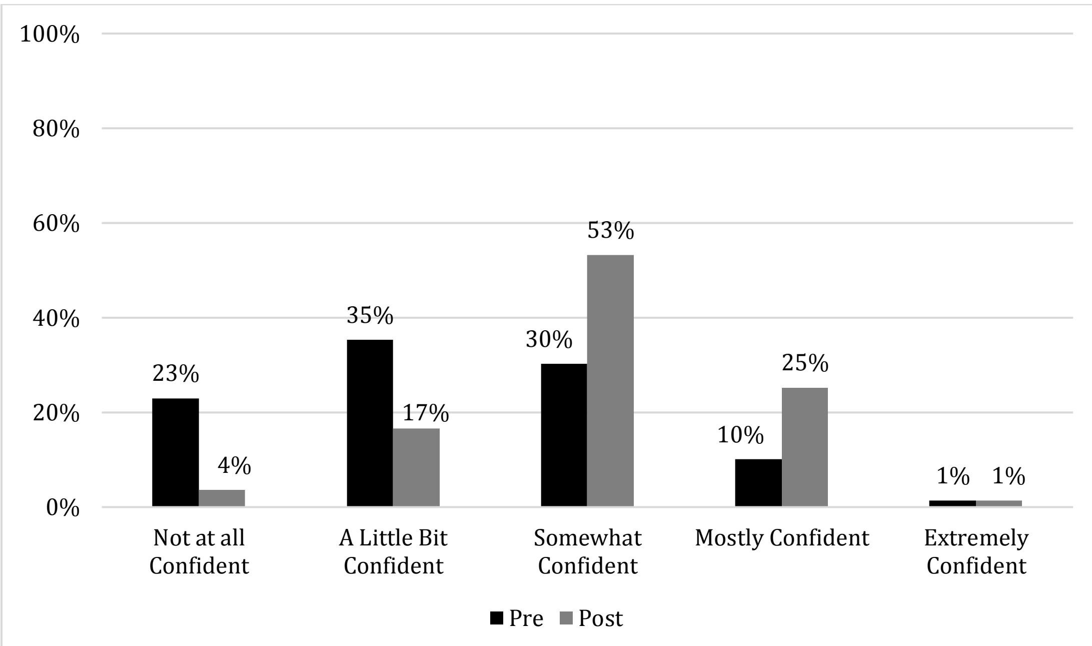
FIGURE 10. TEACHERS' RATINGS, PRE- AND POST-WORKSHOP, OF THEIR PREPAREDNESS TO APPLY 3-D APPROACH



Teachers' confidence in developing student assessment aligned with the 3-D approach

Similarly, teachers' confidence in their ability to develop student assessment aligned with the 3-D approach was relatively low prior to the workshop, with 58% "not at all" or "a little bit confident." By the end of the workshop, 78% indicated they were "somewhat" to "mostly confident" (see Figure 11).

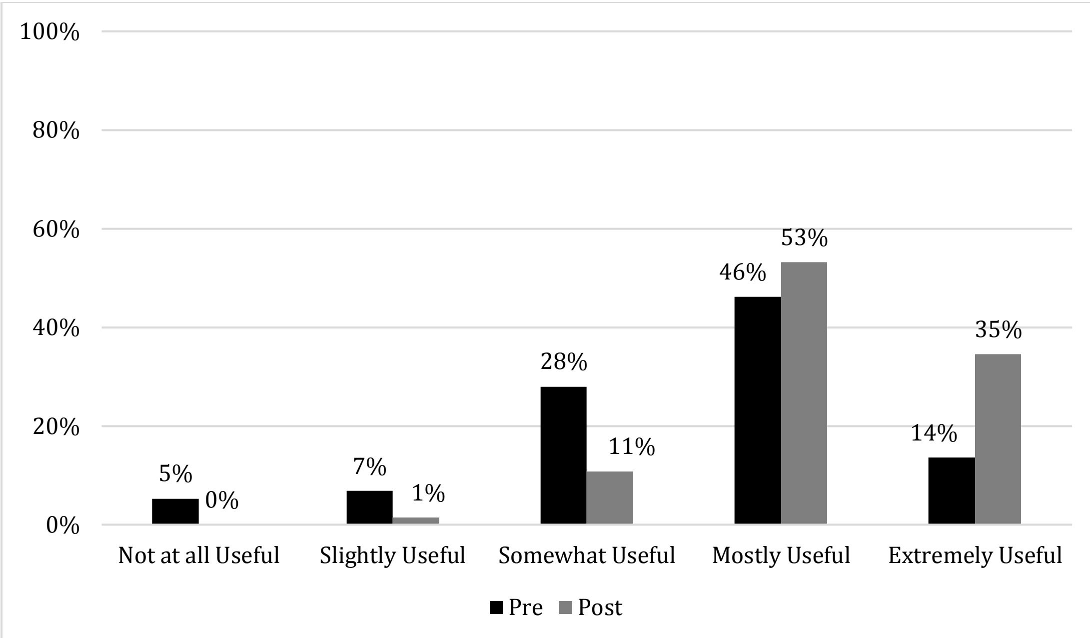
FIGURE 11. TEACHERS' RATINGS, PRE- AND POST-WORKSHOP, OF THEIR CONFIDENCE IN DESIGNING ASSESSMENT ALIGNED WITH 3-D APPROACH



Teachers' ratings on the utility of the 3-D approach for their science teaching

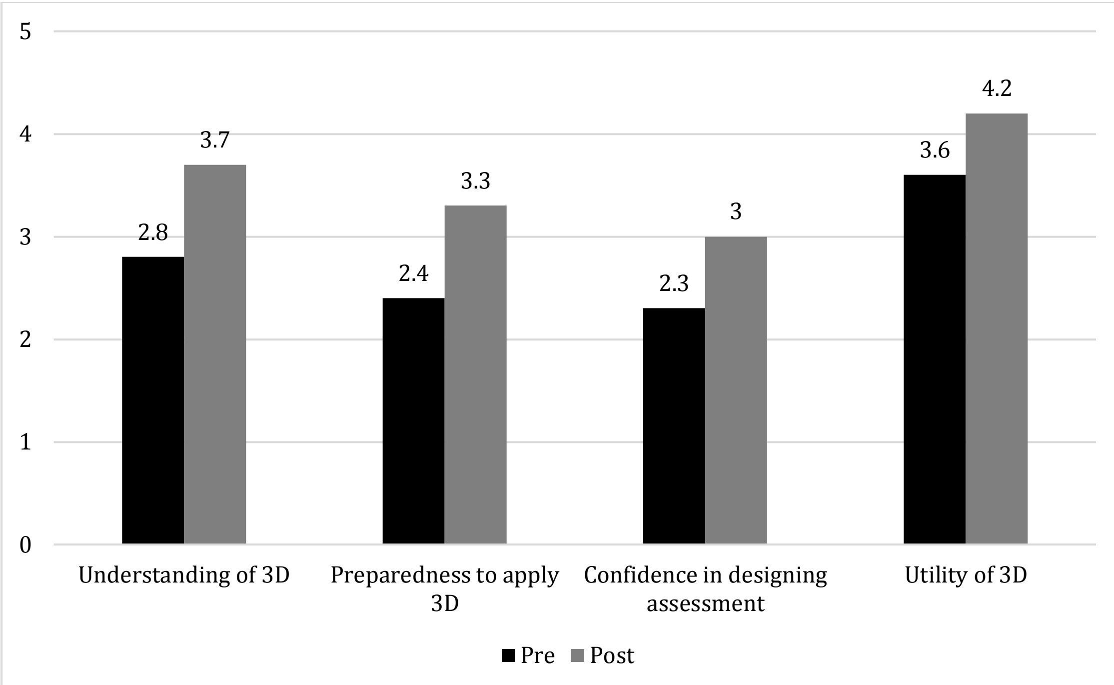
Prior to the workshop, teachers rated the utility of the 3-D approach as relatively high, with 60% indicating they thought it was "mostly" or "extremely useful." By the end of the workshop, even more of the teachers saw the usefulness and applicability of the vision, with 88% rating the utility of the 3-D approach as "mostly" or "extremely useful" (see Figure 12).

FIGURE 12. TEACHERS' RATINGS, PRE- AND POST-WORKSHOP, OF UTILITY OF 3-D INSTRUCTIONAL APPROACH



Looking at these ratings as mean scores, Figure 13 shows the change from pre-workshop to post-workshop on each of these measures, where 1=none or not at all, and 5=extremely, expert or very well. Using paired sample t-tests based on these responses, participation in the workshop significantly increased teachers' confidence in understanding the 3-D approach ($t(138) = -12.85$, $p<.0001$), and their preparedness to apply it in their classrooms ($t(137) = -10.99$, $p<.0001$). They were also significantly more confident in being able to design assessment aligned with the 3-D approach ($t(138) = -7.87$, $p<.0001$), and rated it as significantly more useful for their science teaching as a result of the workshop ($t(131) = -7.09$, $p<.0001$).

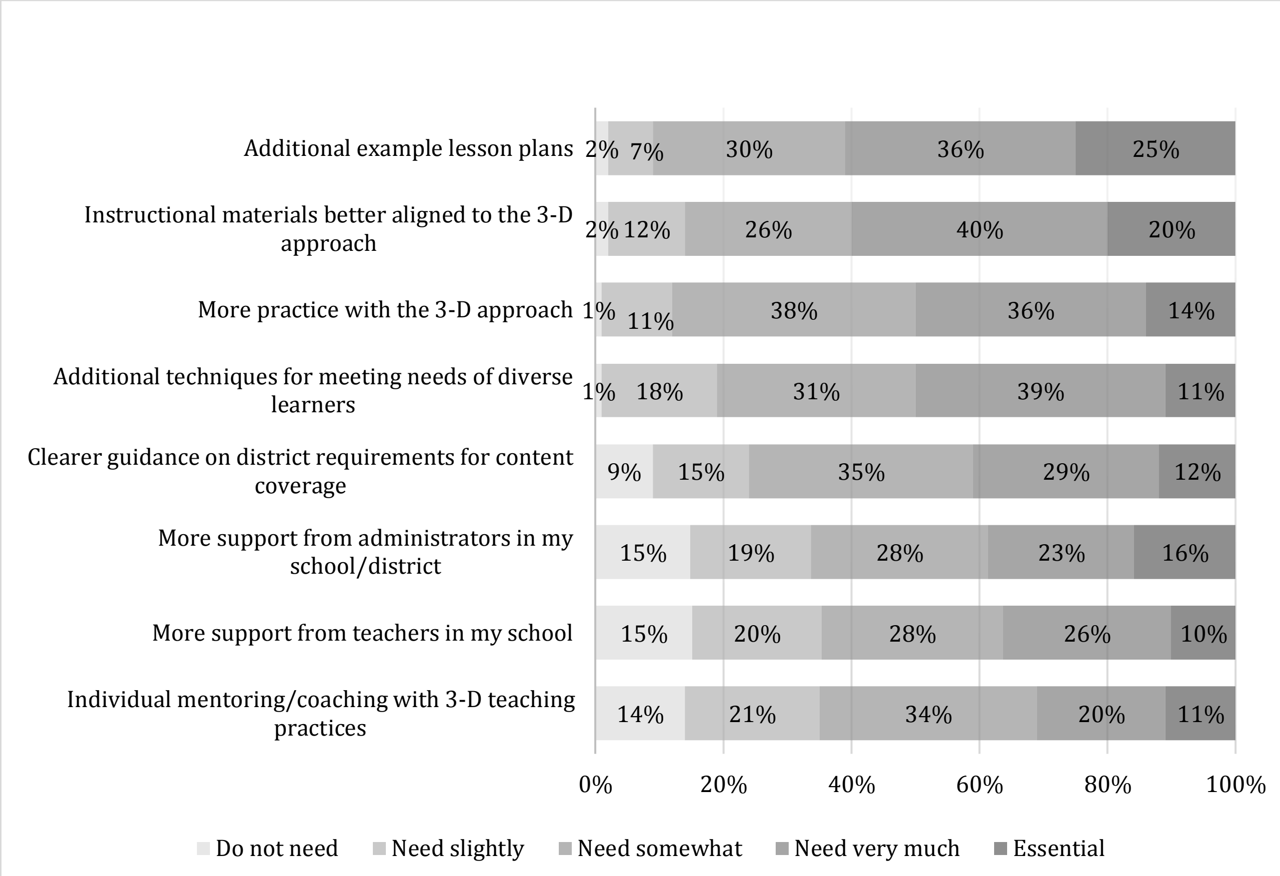
FIGURE 13. TEACHERS' MEAN RATINGS, PRE- AND POST-WORKSHOP, ABOUT 3-D INSTRUCTIONAL APPROACH



Teacher needs to implement 3-D instructional approach

Based on prior teacher responses about perceived needs to successfully implement the 3-D approach, we created a list of supports and resources, and asked teachers to rate them from "do not need" to "essential." Figure 14 shows their ratings, ranked from most needed to least. The two most requested kinds of resources were "additional example lesson plans" (61% felt this was needed very much or was essential) and "instructional materials better aligned to the 3-D approach" (60% rated this as needed very much or essential). This was followed by "more practice with the 3-D approach" and "additional techniques for meeting the needs of diverse learners (both rated by 50% as needed "very much" or "essential"). Although the other types of supports listed were not rated as being needed as much, all were rated as being needed very much to essential 31%-41% of the respondents. These included "clearer guidance on district requirements for content coverage," more support from administrators and colleagues, and "individual mentoring/ coaching with 3-D teaching practices."

FIGURE 14. TEACHERS RATINGS ON LEVEL OF NEED FOR DIFFERENT SUPPORTS AND RESOURCES



How teachers think students will respond to 3-D approach

When asked the open-ended question, "How do you think your students will respond to the 3-D approach to teaching and learning?" an overwhelming majority (95%) of teachers felt that students would respond positively, with comments including,

> *I think they will enjoy it.*
>
> *They will be excited to be doing science!*
>
> *They will love it. Hands-on and inquiry lessons are their favorite!*
>
> *I think it will make them enjoy the class more.*
>
> *They will benefit.*
>
> *They will prosper with the 3-D approach.*
>
> *I believe they will thrive with this model.*
>
> *Anything besides hearing me lecture they will enjoy.*
>
> *I think it will be great & my students will love it.*

Many respondents felt that the method would increase students' engagement with and excitement about the content, by promoting their curiosity and providing them more opportunity to really "explore science," and giving them "ownership of the learning." Comments reflecting these predicted student responses include,

> *I think my students are hungry for this approach. I prefer to engage quickly, let them gather and reason. Then take time to explain.*
>
> *They will be excited and engaged.*
>
> *Very well because most of them are very curious & like to figure things out.*
>
> *Students will engage well with the 3-D approach due to how much they can learn from a single lesson.*
>
> *I think my students will be more engaged and excited about learning. I feel this approach will help my students to maintain their curiosity about learning.*
>
> *I think will increase engagement & retention.*
>
> *They would love this approach - it allows them to think creatively and use their imagination.*
>
> *From my experiences 3-D = curiosity, engagement & ownership of knowledge. That is success from my students!*
>
> *I think that when students have ownership, it becomes important to them. The 3-D approach exemplifies that.*
>
> *I feel my students would take more ownership for their learning and feel like a partner in the learning process!!*

The teachers also expressed the importance of their own role in creating a different culture and the need to implement it in the right way. Some expressed concern about being able to do that. Comments included,

> *Once the routine has been established I think that they will love the 3-D approach.*
>
> *I am confident my students will come to find the 3-D approach useful. I am not as confident in my planning/lessons to align with 3-D.*
>
> *If done consistently and regularly the feedback and response will be positive because they will have more ownership of the learning.*
>
> *If done well I think it could provide them the opportunity to become real thinkers.*
>
> *I think getting them started with the terminology right away is the key and it should be easy going from there.*
>
> *I think [my students will respond] well, but like me will need much guidance.*
>
> *They will buy in if I do.*

Many teachers not only felt that students would enjoy this approach more, but also learn and think more, and develop a better understanding of the concepts presented.

> *Very well -hands-on-discussion, crosscutting concepts - utilizing vocabulary ongoing will increase understanding for all students.*
>
> *I think they will respond well, it's a great way to get students to both think on their own & collaborate with others.*

More engagement; better understanding.

I think the students would enjoy this as they will be more involved and could gain better understanding.

The structure will help develop a routine that encourages scientific reasoning skills.

They will learn w/ more depth.

I think they would be very engaged and it should impact test scores.

Higher level of thinking

I think kids will like it but it may require them to think :)

Some teachers, however, thought that their students might be hesitant at first or even negative, and that it would take some time for them to adjust. A few thought they would see a range of responses from students. All but a handful predicted that most students would eventually embrace the 3-D approach.

I think they would enjoy it once they bought into it.

I think it will work well once implemented and both teachers & students are a few years in.

I imagine they will be hesitant at first, but slowly come round & like the idea.

They will be frustrated at the start but I think they will want this form of learning in all classes.

Engagement, curiosity, and balking at writing (communicating)

Too detailed for 7th graders.

I expect a broad spectrum of reactions but most will find it an improvement.

They will probably resist providing evidence and explanations. But will be more motivated and engaged by providing phenomena to prompt learning.

Some will enjoy it right away, but many will not like it for awhile. They will want the answer & the grade, not the thinking.

They will find it challenging because they don't like to think as a general rule. After a while, I think they will enjoy it.

I think the students would love it if they have an established core of info. Those that don't - won't like it.

I think they will be excited and more engaged. I worry about lower students who come to class and expect the teacher to do it all!

Hesitant at first until I become more fluent in the process. It will overall help them in science class.

I think in the beginning there will be a push against just because it's different than what they are used to. But once implemented and used continually students will adjust & appreciate

Initially I think it is going to be very difficult because of the way they expect to obtain info. But in the long run I think they will respond positively.

A few teachers indicated that they already have used this approach to some degree, and responded that they had seen how well it had worked,

> *In the one time I have used this model, students were successful and exceeding expectations in understanding the concept more thoroughly than any other means.*

A few teachers also felt that their students would be better able to apply science to their own lives outside the classroom, and that they would enjoy sharing and discussing ideas together. A few teachers felt this method would promote more inclusion.

> *I think they will enjoy & apply it in their thinking & life lessons.*
>
> *Positively - give them more of a chance to question & explain*
>
> *It's very engaging & helps to create ownership of learning as well as inclusion of all learners*

Outside resources teachers currently use to enhance teaching

When asked to "name three outside resources you access to enhance your teaching," teachers provided a large variety of different places they turn to for support. Some listed very general categories of resources, such as "books," "colleagues," or "the internet," others identified organizations that provide resources such as different teaching associations or governmental organizations, and others listed specific websites or curricula. We have categorized these by type to create the following tables (see Table 2 and Table 3). There is some overlap as well as uncertainty about exactly what the teachers were referring to, so the categories are not definitive, but do provide a general picture of types of resources and how many teachers listed them. Overall, many teachers turn to the internet and their peers as their primary outside resources. More specifically, they most frequently listed websites and resources available through their professional discipline and teaching organizations and also through governmental agencies and university funded projects. Some teachers also listed local resources, including UNL and the ESU's. To a lesser degree, commercial and nonprofit websites were named.

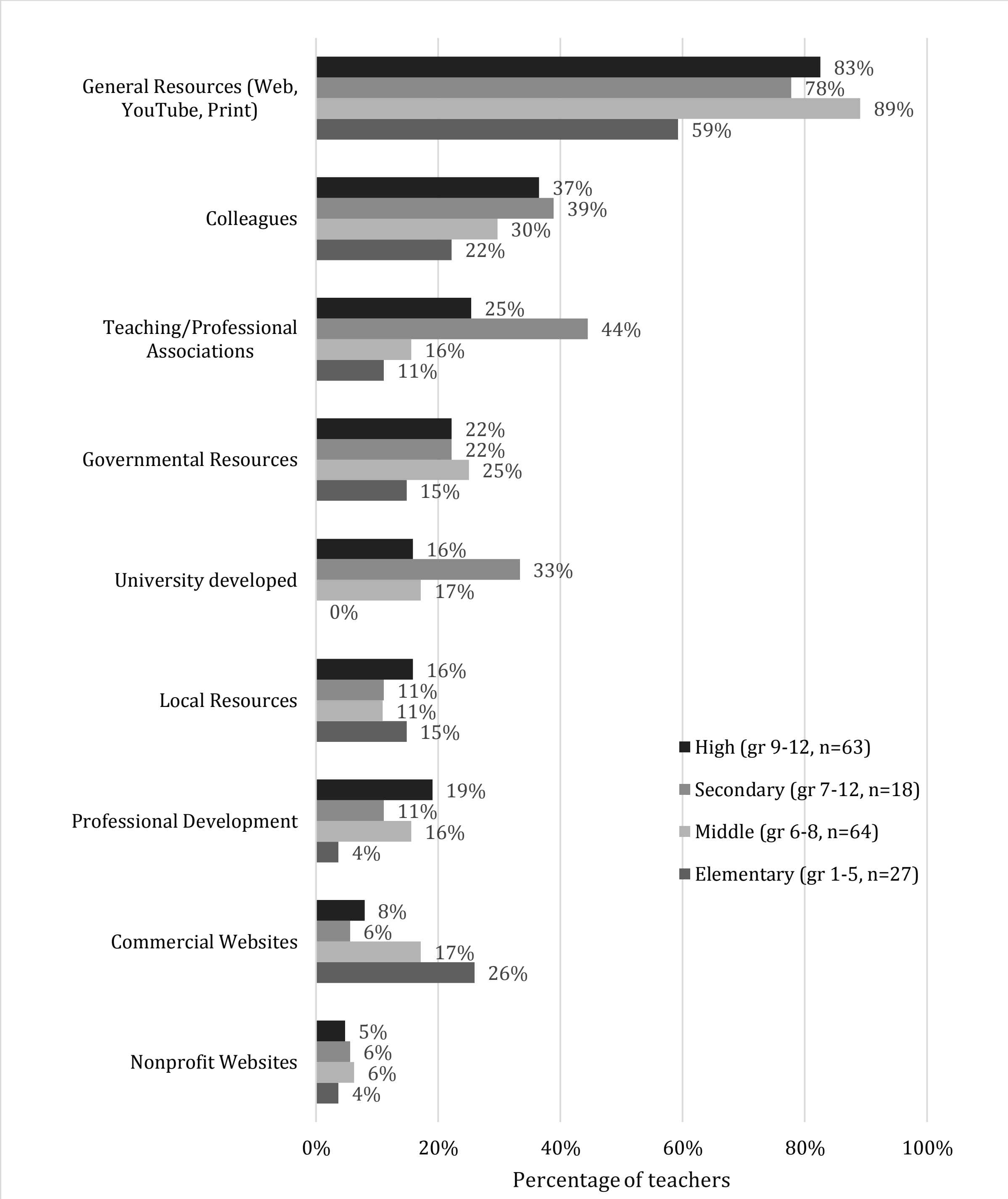
TABLE 2. TYPES OF OUTSIDE RESOURCES LISTED BY TEACHERS

Type/Name of Resource	***N***
General Resources	***147 (77%)***
Internet	84
YouTube	25
Books	24
current events/ magazines/ Periodicals	14
Peers/ Colleagues	***59 (31%)***
Peers/ Colleagues	48
Teaching blogs	5
Teachers pay Teachers	4
Teaching Channel	2

Teaching/ Professional Associations	***40 (21%)***
NSTA (National Science Teachers Association)	22
NATS (Nebraska Association of Teachers of Science)	7
NETA (Nebraska Educational Technology Association)	3
ACS (American Chemical Society)	2
Other (NAPTA - North American Process Technology Alliance; ACSD - Association for Supervision and Curriculum Development; NCSS - National Council for the Social Studies; NCTM - National Council of Teachers of Mathematics; AACT - American Association of Chemistry Teachers; AAPT - American Association of Physics Teachers)	6
Government Resources	**38 (20%)**
NGSS (Next Generation Science Standards)	9
KICKS (Nebraska Science Keep Improving Content Knowledge and Skills)	7
NASA (National Aeronautics and Space Administration)	5
NRD (Nebraska Natural Resources District)	5
NOAA (National Oceanic and Atmospheric Adminstration)	3
NIH (National Institutes of Health)	3
Nebraska Department of Education	3
USGS (United States Geological Survey)	2
Nebraska Game and Parks	1
University-developed Resources	**29 (15%)**
PhET Labs / simulations (University of Colorado - Bolder)	20
HHMI (Howard Hughes Medical Institute)	5
Utah Genetics (University of Utah - Salt Lake City)	2
Medical Mysteries	1
National Center for Case Study Teaching in Science (Buffalo)	1
Local Resources *(University of Nebraska-Lincoln, Educational Service Units, Henry Doorly Zoo, Virtual Fieldtrips, Museums)*	**26 (14%)**
Professional Development *(Workshops, Field Experts, Research journals, Graduate courses)*	**27 (14%)**
Commercial Web-based Resources (.com) *(Learn 360, Brainpop, Vernier Labs, FOSS, STEMscopes, Quizlet, Power Knowledge Life Sciences, Loose in the Lab, Clinch, Actively Learn, Spongelab, Marzelo Instructional Model)*	**24 (13%)**
Nonprofit Web-based Resources (.org) *(Modeling Physics, Concord Christian Science, STEM (Advocacy group), Understanding by Design, Read Works, Khan Academy)*	**9 (5%)**

Table 3 shows the variation by teaching level in types of outside resources that teachers identified.

TABLE 3. TYPES OF RESOURCES ACCESSED BY RESPONDING TEACHERS BY LEVEL TEACHING



How teachers could integrate ideas about viruses and infectious disease in science teaching

Because the Biology of Human grant centers around viruses and infectious disease, we included one item on the survey inquiring specifically about this topic: "How could you integrate ideas about viruses and infectious disease in your science teaching?" Not surprisingly, how teachers responded to this item was dependent on grade level and courses they were teaching.

One hundred forty-nine (78%)[3] of teachers responded to this item, however, 20 (11%) of these indicated that they would not integrate viruses and infectious disease into their science teaching (see Table 4). Most of these teachers are high school teachers who are not teaching a life science course and indicated it did not fit within their subject areas. Others, mostly middle school teachers, indicated the topic was no longer part of the curriculum, and a couple elementary teachers felt it was not appropriate to their students' grade level.

TABLE 4. TEACHERS INDICATING WHY THEY WOULD NOT INTEGRATE VIRUSES INTO THEIR TEACHING

3-D Approach Area	*Total*	*Elem (K-5)*	*Middle (6-8)*	*7-12*	*High (9-12)*	*Teaching Life Sciences*	*Not Teaching Life Sciences*
Not Integrating into Class (total)	**20**	**2**	**4**	**0**	**13**	**3**	**16**
Not Topical To Subject Area	13	0	1	0	11	0	12
Removed / Not part of the Curriculum	5	0	3	0	2	2	3
Not Appropriate for Grade Level	2	2	0	0	0	1	1

We looked at the remaining responses through the lens of the 3-D disciplinary core ideas (in life sciences, in particular), scientific and engineering practices, and cross-cutting concepts, when the topics listed fit within those categories. Overall, about 64% of these responses fit generally into these areas, including 43% that specifically fit within the disciplinary core ideas listed in the Life Science area. Nearly all the teachers citing these topics are currently teaching a life science course. Seven (5%) identified core ideas from the Earth and Space Science area, 11 (9%) cited specific scientific and engineering practices, 10 (8%) identified a cross-cutting concept that would enable them to integrate these topics.

TABLE 5. TEACHER RESPONSES ABOUT INTEGRATING VIRUSES FALLING WITHIN 3-D APPROACH BY LEVEL AND COURSE TYPE

3-D Approach Area	*Total*	*Elem (K-5)*	*Middle (6-8)*	*7-12*	*High (9-12)*	*Teaching Life Sciences*	*Not Teaching Life Sciences*
Life Sciences	**55**	**4**	**27**	**7**	**15**	**51**	**2**
LS1: From Molecules to Organisms: Structures and Processes ("cells" "structure and function" "DNA")	27	2	17	2	5	25	2
LS2: Ecosystems: Interactions, Energy, and Dynamics ("food web" "ecosystems" "impact of virus on body system")	7	2	4	0	1	7	0

[3] numbers in the tables corresponding to this question do not sum to totals because teachers often had multiple responses, and some teachers did not indicate grade level teaching or whether teaching a life science course.

LS3: Heredity: inheritance and Variation of Traits("cells and heredity" "genetics" "mutations")	9	0	5	2	3	9	0
LS4: Biological Evolution: Unity and Diversity("natural selection" "evolution")	12	0	1	3	6	10	0
Earth and Space Sciences *("environmental science" "related to history of earth")*	**7**	**1**	**2**	**0**	**4**	**3**	**3**
Scientific and Engineering Practices *("mathematical model" "research projects")*	**11**	**1**	**5**	**0**	**3**	**4**	**4**
Cross Cutting Concepts *("Cause and effect" "cross cutting concept")*	**10**	**1**	**0**	**4**	**5**	**6**	**4**

Some teachers indicated that viruses and infectious diseases could be integrated within the existing curricular framework, either within a specific curriculum unit or topic (44%) or brought in through a discussion of current events or via specific medium, such as comics or videos (26%) (see Table 6).

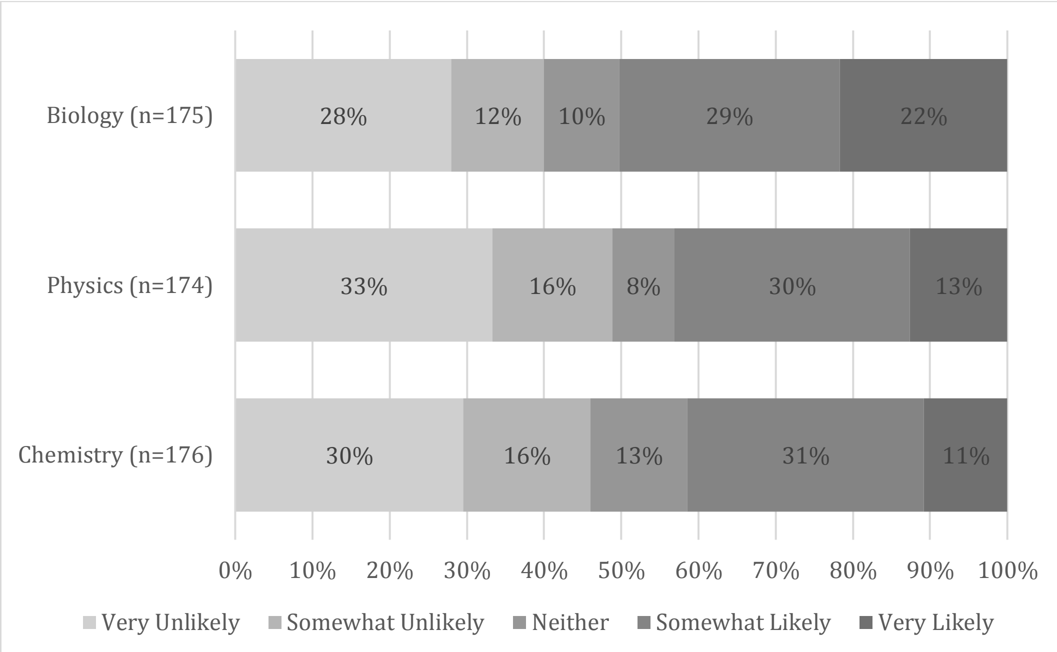
TABLE 6. TEACHERS RESPONSES ABOUT INTEGRATING VIRUSES WITHIN CURRENT CURRICULUM FRAMEWORK

Current Curriculum Framework	***Total***	***Elem (K-5)***	***Middle (6-8)***	***7-12***	***High (9-12)***	***Teaching Life Sciences***	***Not Teaching Life Sciences***
Already Do / Part of Curriculum Unit/ Could Integrate into Curriculum Unit (teachers listed: health/hygiene/ medications, biology, virus, chemical changes, & physiology/pathology units)	57	11	18	12	18	43	13
Current Events/Media ("current events" "graphic novels" "videos")	34	4	18	4	6	17	15

Likelihood of Accessing EPSCoR Mobile Labs

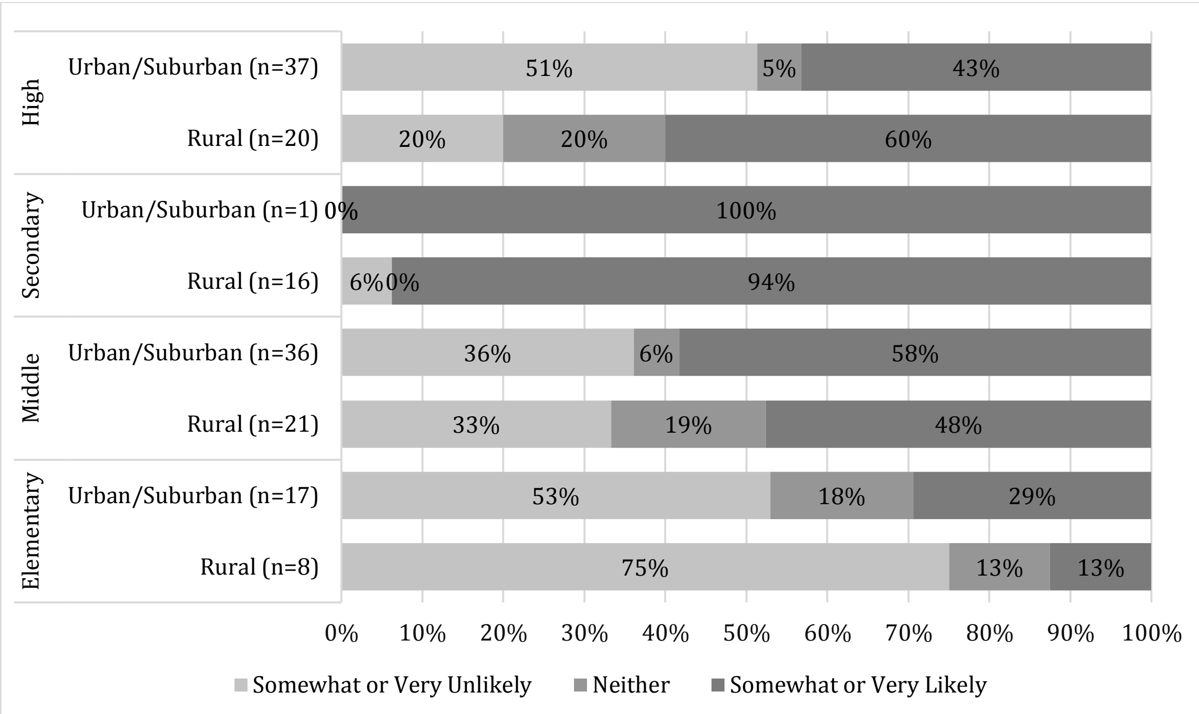
Teachers were asked to rate how likely they were to access the existing or planned EPSCoR mobile equipment labs in Physics, Biology and Chemistry, and were also asked to list, if relevant, other types of lab they would be likely to access. Just over 50% of teachers indicated they would be somewhat or very likely to access the biology lab (see Figure 15). A little over 40% of teachers indicated they would be somewhat or very likely to access the physics and chemistry labs.

FIGURE 15. TEACHERS' AVERAGE RATINGS ON LIKELIHOOD OF ACCESSING EPSCOR LABS OVERALL



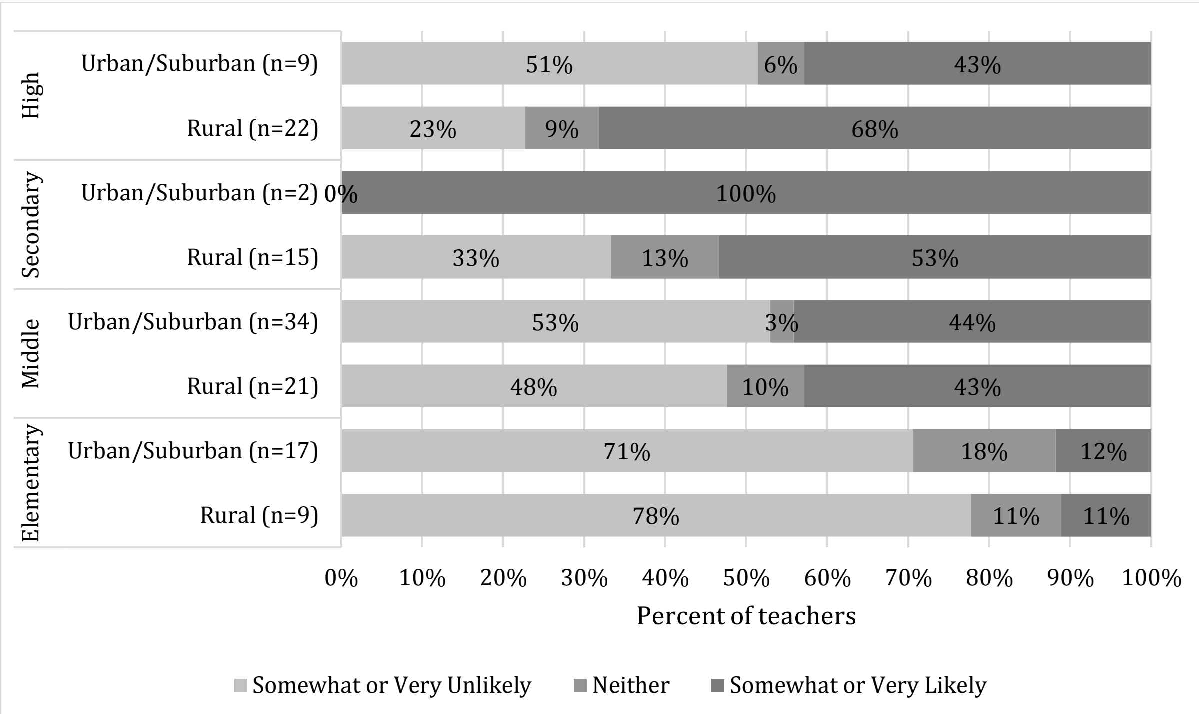
To better understand the types of teachers who envision using these kits, the following figures indicate the proportion of teachers who indicated they would be likely to access these kits by grade level teaching and by district type (urban/ suburban vs. rural). Nearly all the secondary (teaching at 7-12 grade schools) rated themselves as likely to access the biology lab (see Figure 17). Between 40% and 60% of both middle level and high school teachers indicated they would likely access this lab. About 30% of urban elementary teachers indicated they would be likely to use this lab, but only 13% of rural elementary teachers.

FIGURE 16. TEACHERS' AVERAGE RATINGS OF ACCESSING EPSCOR BIOLOGY LAB BY GRADE LEVEL TAUGHT AND DISTRICT SETTING



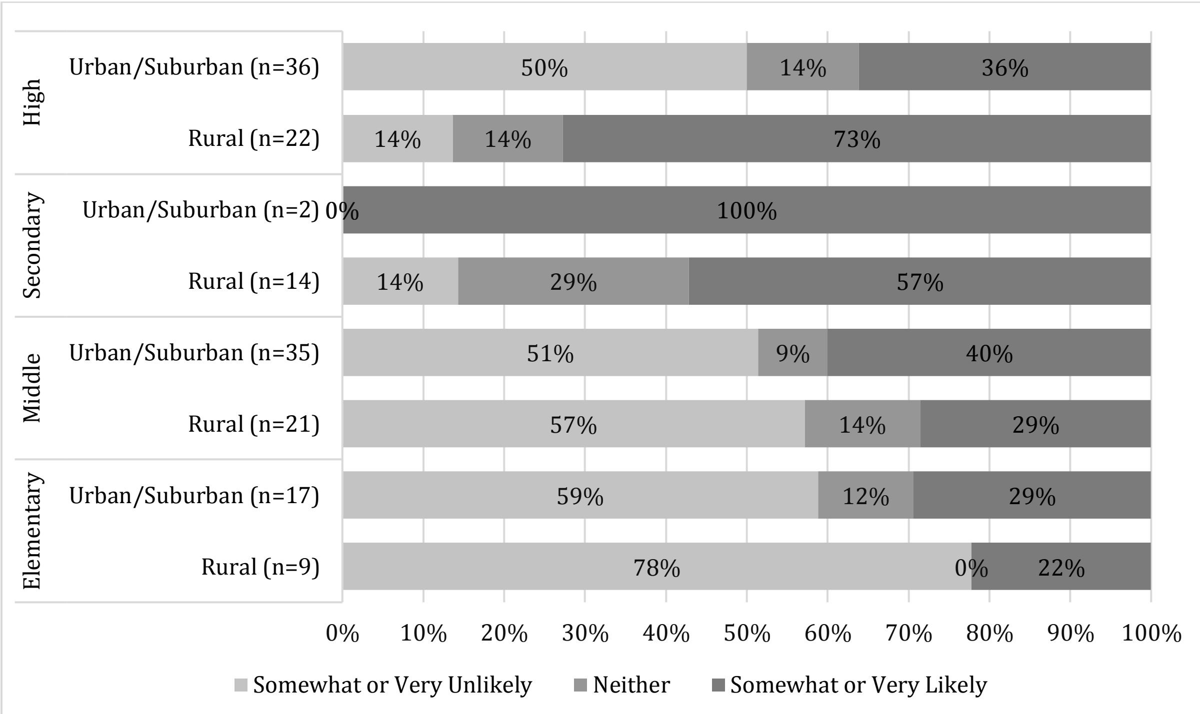
The Physics lab (see Figure 16) was rated as likely to be accessed by the majority of secondary and high school teachers, although only 43% of teachers from the Omaha and Lincoln areas indicated they would be likely to access them, which is about the same rate as middle school teachers overall. Only a little over 10% of elementary teachers indicated they would be likely to access these labs.

FIGURE 17. TEACHERS' AVERAGE RATINGS OF ACCESSING EPSCOR PHYSICS LAB BY GRADE LEVEL TAUGHT AND DISTRICT SETTING



Both of the responding urban secondary teachers, 73% of the rural high school teachers and 57% of rural secondary teachers indicated they would be likely to access the Chemistry lab kit (see Figure18). Urban high school teachers and middle level teachers were somewhat less likely, with about 30%-40% indicating interest. Although still low, interest by elementary teachers in the chemistry kit was the highest among the topics, around 25% overall.

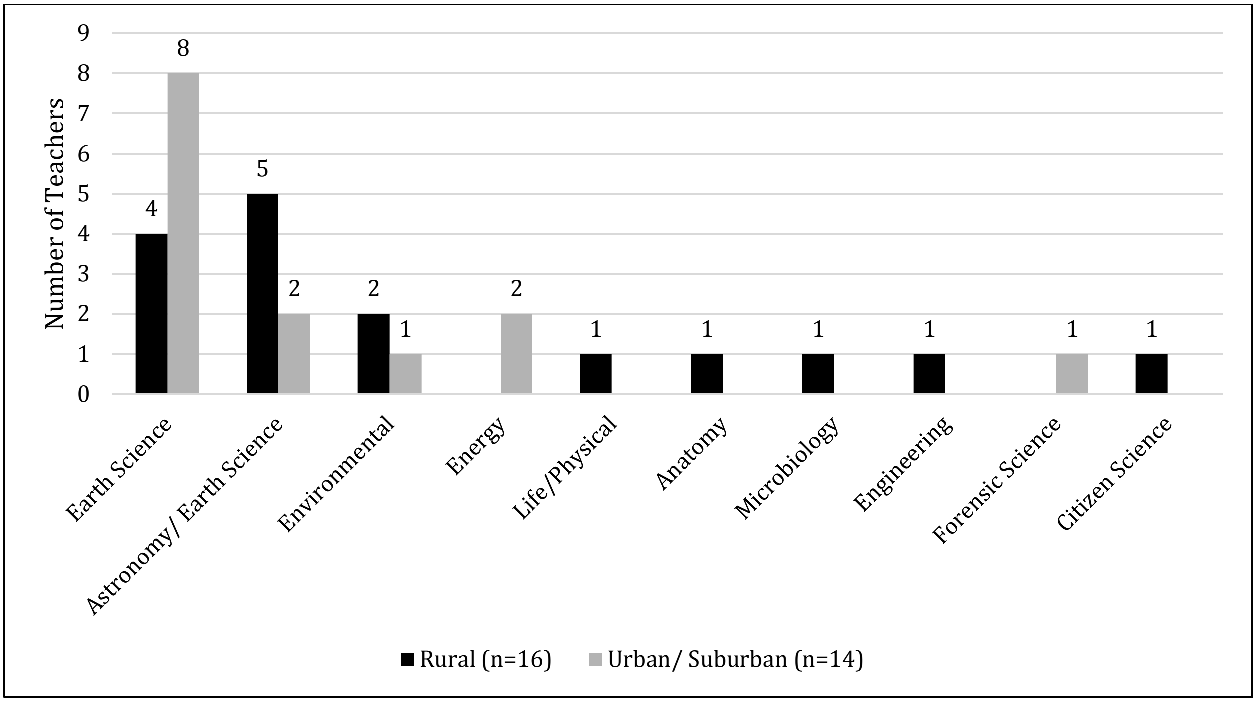
FIGURE 18. TEACHERS' AVERAGE RATINGS OF ACCESSING EPSCOR CHEMISTRY LAB BY GRADE LEVEL TAUGHT AND DISTRICT SETTING



Suggested EPSCoR kit topics

When asked what other topics would be useful for these portable equipment labs, 25 teachers, all at the middle through high school level, had suggestions. Earth science and astronomy/space science were the most frequently listed (see Figure 19), by both rural and urban teachers. Environmental science was also identified by a few teachers, both rural and urban. Each of the other topics were listed by just one or two teachers. Rural teachers had the widest array of suggestions, asking for life/physical, anatomy, microbiology, engineering and citizen science.

FIGURE 19. NUMBER OF TEACHERS SUGGESTING EPSCOR KIT TOPICS BY DISTRICT TYPE*



* some teachers had multiple suggested topics

Other comments

Of the 50% of teachers who had additional comments, over a third were positive comments. The most frequent were those indicating that they had learned some new skills or gained knowledge, including, "This gave me some great ideas about teaching with phenomena," "[this] changed my thinking on how to engage and increase my students' reasoning skills," and "[I now have] greater understanding of 3-D dimensions." Many teachers also remarked on the "professional presenters," who were "engaging and informative," and provided "a great way to see the 3D instruction model in both concept and action." Teachers appreciated being able to network with their colleagues and to see the techniques modeled in the different sessions. A few teachers felt inspired by the workshop and a few indicated that it reinforced what they already do. A small number also mentioned that this workshop was a "great beginning for supporting teachers in the state-- moving towards standards revision." There were, however, several suggestions for change. Some teachers felt that the breakout sessions could have been shorter, and that this would have allowed them to attend more, different sessions. In addition, a few teachers wanted the sessions separated by grade level (elementary vs. secondary) or by content area. With respect to technical issues, one teacher pointed out how crowded the breakout rooms were and thought those could have been bigger. Another person couldn't hear the teacher comments in the large plenary room and suggested getting a microphone or paraphrasing those comments. In addition, there were these following comments,

> *Awesome! need to bring administrators with us next time.*
>
> *Maybe have a panel-or "edcamp" set up for a portion of the conference. Allow some of the brilliant minds in the room to share resources.*

> *Would like to have lesson design ideas and practice--collaborate with teachers to design 3D & 5Elessons*
>
> *"There are no wrong answers" Not sure how I feel about this one; there are correct answers.*

About 7% of the comments were critical of the workshop. More than half of these were critical of particular presenters, indicating some were "unorganized" or not very engaging. A couple comments expressed general disappointment, saying "not impressed." One other comment focused on the lack of providing a research base, saying, "[this was] opposite of the two day training provided by Anita Archer & the importance of explicit instruction. She provided a lot of empirical evidence to support her approach which was very engaging." The "explicit instruction" method cited here is not well-aligned with the proposed 3-D approach.

Summary and Discussion

Overall, the one-day workshop was very well received by the diverse group of teachers attending. The purpose of the workshop to help familiarize Nebraska science teachers with the 3-D instructional approach, and based on the responses to the post-survey at the end of the day, this was goal was achieved. Teachers rated themselves as understanding the 3-D approach to a greater degree and the overwhelming majority felt at least somewhat prepared to implement the approach in their classroom as a result of the workshop. They increased in their confidence in their own ability to develop assessments aligned with this approach, and by the end of the workshop, nearly 90% rated the utility of the 3-D approach as mostly or extremely useful.

Although teachers still feel they need more time to learn about and to implement this approach in their classrooms, most indicated they were enthusiastic about it. They thought this method would benefit their students in a variety of ways, increasing their enjoyment of science, and helping them develop a better understanding of the concepts presented. Although a handful of teachers remain skeptical about this method, this comment may best sum up how many teachers felt, "I learned a lot of valuable information that helped me not view NGSS as negatively. It really helped me understand how to move forward in my classroom with these ideas."

The evaluation survey also helped illuminate the many resources and supports that teachers feel they still need to be successful in implementing the 3-D approach, including more example lesson plans, instructional materials aligned with the 3-D approach, more practice, additional techniques for meeting the needs of diverse learners, clearer guidance and more support from administrators, more support from colleagues and individual mentoring. Research and guidelines on professional development to adopt and implement this vision of science instruction indicates the importance of sustained, ongoing and in-depth experiences (Achieve & U.S. EDI, 2013; National Research Council, 2015;Wilson, 2013). This workshop was an important step toward teachers embracing the collective vision for Nebraska science education.

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