Early Childhood Educators' Declarative Knowledge of the Next Generation Science Standards

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Introduction

More than half of US states have either adopted the Next Generation Science Standards (NGSS) whole cloth or developed similar standards that include the three-dimensional framework (disciplinary core ideas, science and engineering practices & crosscutting concepts).

What do teachers need to know to utilize the NGSS effectively? How accessible is the language of the NGSS? What ideas are readily understood and which are more challenging for teachers?

Purpose

In this study, we examine PreK-3rd grade teachers understanding of the NGSS three dimensions.

The focus was on **declarative knowledge** of the NGSS three dimensions. Declarative knowledge, is knowledge of facts, concepts and rules (i.e. knowing ***what*** something is). This is distinguished from *procedural* knowledge (knowing how) and *conditional* knowledge (knowing when or in what circumstance).

Our aim was to gather data to inform and help shape effective three-dimensionally infused teacher PD for early-childhood.

Methods

- 26 PreK-3rd grade teachers
- Pre/post 10 item multiple choice measure
- Taken 1 month prior to and directly after a 2-week NURTURES Summer Institute
- Item content validity reviewed by scientist and science teacher educator
- The measure focused on declarative knowledge of the NGSS three dimensions, with questions such as:

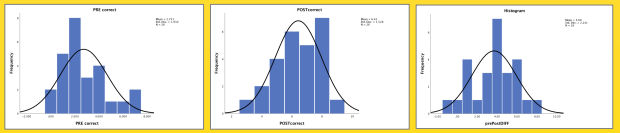
> *Structure and function*, *stability and change*, and *cause and effect* are examples of:
>
> - disciplinary core ideas
> - scientific and engineering practices
> - foundational forces
> - crosscutting concepts
> - inquiry stances

- All responses entered into a database
- Items scored (1 point for each correct answer)
- Descriptive analysis (i.e., frequencies of various answers pre/post Summer Institute) and statistical analysis – paired sample t-test of pre/post results

Scan this QR code and try the questions yourself!

Results

- **There was a statistically significant increase in declarative knowledge of NGSS from pre to post Summer Institute:** Paired sample t-test of pre/post total scores found a significant difference: pre (M= 2.73, SD=1.93) and post (M=6.42, SD=1.53); t(25)= -8.40, p= .000

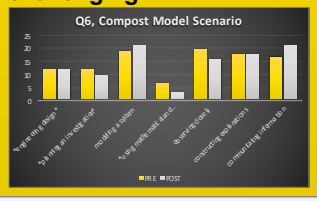


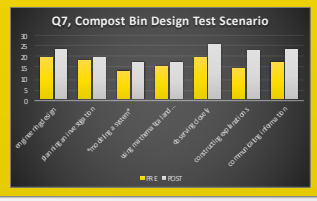
- **The greatest percentage gain was for a question regarding the names of the NGSS three dimensions.** (from 27% correct, n=7 at pretest to 100%, n=26, at posttest)
- **More than half the teachers (65%, n=17) understood at pretest that the main purpose of engineering design work is to find good solutions to problems**. This increased at posttest to 92% (n=24).
- **"*Crosscutting concepts*" was the least identifiable of the three dimensions at pretest**; pretest 23% (n=6); posttest, 85% (n=22)
- **Teachers had difficulty identifying the three-dimensional elements that form a NGSS *performance expectation.***

K-PS3-1. Make observations to determine the effect of sunlight on Earth's surface.

Section of ***performance expectation*** identified	***SEP*** "Make observation"	***CC*** "determine the effect"	***DCI*** "the effect of sunlight on Earth's surface"
PRE	n = 6 (23%)	n = 1 (4%)	n = 6 (23%)
POST	n = 14 (54%)	n = 16 (62%)	n = 17 (65%)

- **Discerning SEPs for a classroom scenario proved challenging.**





Discussion

Teachers' recognition of DCIs, SEPs, and CCs became more accurate when presented in isolation. While improvement was exhibited, it remained a challenge to discern the three-dimensional elements within a performance expectation.

In response to a classroom scenario, teachers tended to over-identify SEPs.

Three-dimensional learning is essential to incorporate in PD efforts supporting application of the NGSS in classroom contexts.

We are curious to see the results from the repeat measure, to be administered post-academic year NURTURES programming (Spring 2020).

Conclusion

Declarative knowledge of the NGSS, particularly of the three dimensions, can be increased through professional development.

Conceptually dense, the NGSS standards take time and effort for teachers to dissect, digest, and ultimately learn.

Future analyses will examine these teachers' planning and enactment of science and engineering instruction during the 2019-2020 school year to examine how their declarative knowledge of the NGSS, and its three-dimensional elements, correlates with their instructional practices.

Selected References

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