

Improving Science Education in International Schools Through Professional Development Targeting Next Generation Science Standards Assessment Design

Extended Abstract Prepared for Participating Institutions

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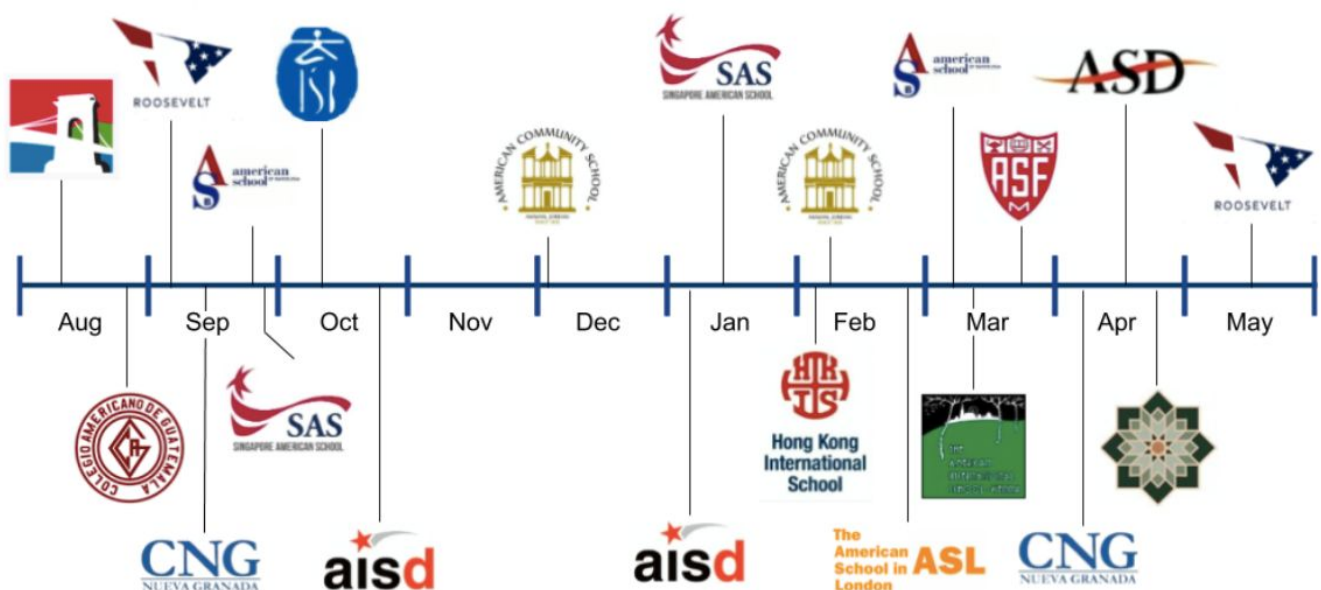
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Overview:

This study explored the impact of professional development (PD) activities conducted during the 2018-2019 school year for science teachers at 15 American-curriculum international schools in 13 countries. The PD activity utilized an assessment screening tool to evaluate the alignment of practitioner-designed assessments with the constructs of the Next Generation Science Standards (NGSS) and best practices in science instruction. Data from a survey instrument and interviews were analyzed and interpreted using the Refined Consensus Model of Pedagogical Content Knowledge. Findings strongly support the suggestion that PD activities focused on aligning assessments with NGSS constructs using an aid-guided process benefit teacher comprehension of the NGSS and elicit changes in teaching practices.

Participants and Timeline of the PD:

Eighty-five science teachers from 15 international schools participated in this study. The schools were: American International School Vienna, American International School Dhaka, International School of Beijing, Colegio Nueva Granada, American School in London, American School of Guatemala, Hong Kong International School, American International School of Budapest, American Community School of Amman, American School Foundation Monterrey, Colegio Franklin Delano Roosevelt, Singapore American School, American School of Barcelona, American School of Dubai, and American Community School of Abu Dhabi. Participating teachers had engaged in the PD activity on at least one occasion during the 18-19 academic year, but several had participated multiple times. The timeline below shows the participating schools and the approximate dates that the PD activity was presented at each school.



Professional Development Intervention:

Educators participated in a training session with science education consultant Paul Andersen. During the session, they were led through a process of assessment design and revision utilizing a three-dimensional assessment screening tool (image at right). The tool provided feedback to teachers regarding assessment alignment with the NGSS dimensions of science and engineering practices, disciplinary core ideas, crosscutting concepts, and other best practices in science instruction. Teachers were encouraged to additionally utilizing NGSS evidence statements, as well as other literature, to make revisions addressing issues revealed through use of the tool.

Performance Assessment Screening Tool

1. Read or take the entire assessment.
2. Apply the checklist in order (1-2).
3. Give feedback on missing elements.

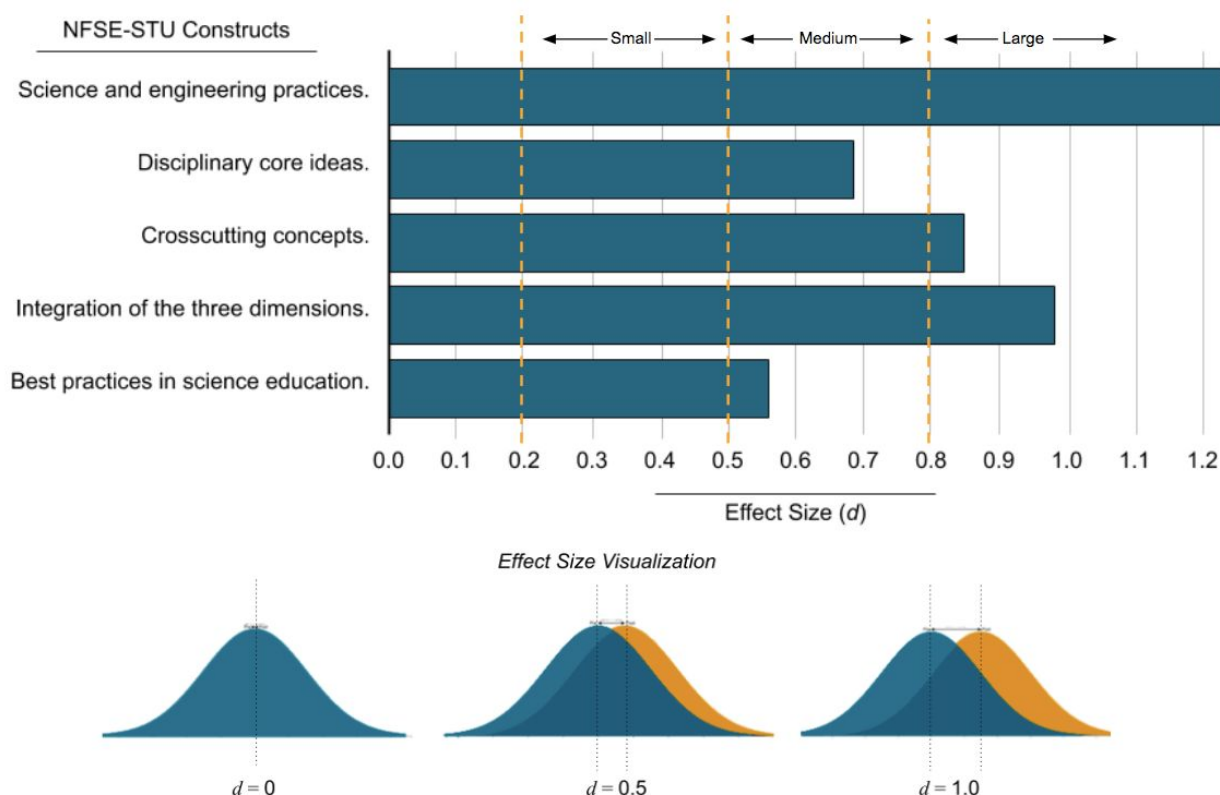
Performance Expectation (PE) - the entire standard.
Disciplinary Core Idea (DCI) - the content (e.g. F. Science and Engineering Practices (SEP) - science inquiry and engineering design (e.g. Modeling).
Crosscutting Concepts (CCC) - interdisciplinary (e.g. Patterns).

Phenomenon - fact or situation that is observed.
Problem - a need or desire that can be solved.
Stimulus - information (e.g. data, text, etc.) required.
Prompts - questions.

- ☐ 1. The prompts match the Science and Engineering Practices (SEP) and engage students in sense making.
- ☐ 2. The stimuli have the required information needed to utilize the SEP (e.g. data for analysis).
- ☐ 3. The stimuli have multiple and sufficient information needed open up the SEP (e.g. open text).
- ☐ 4. The prompts elicit observable understanding of the Disciplinary Core Ideas (DCI).
- ☐ 5. The prompts include the Crosscutting Concept (CCC).
- ☐ 6. The prompts include language (i.e., bullets) from grade appropriate progressions (DCI/CCC/SEP).
- ☐ 7. The prompts include graphic organizers.
- ☐ 8. The entire assessment contains information that is scientifically accurate and properly attributed.
- ☐ 9. The prompts point in the direction of explaining the phenomenon or designing a solution.
- ☐ 10. The phenomenon or problem is authentic, interesting, and requires students to figure something out.
- ☐ 11. The phenomenon or problem is novel to show the transfer of knowledge. (e.g., not in the unit)

Findings:

The PD activity was found to have medium to strong effect size on teacher understanding of the NGSS in each of the areas measured by the *New Framework of Science Education Survey of Teacher Understanding*¹. The effect sizes for each construct are shown below.



Interview data supported findings from the survey instrument and also provided insight that is relevant to international school administrators seeking to maximize the efficacy of teacher PD:

1. Teachers perceived the intervention to have elicited changes in their professional practice.
2. Use of the assessment screening tool was perceived to facilitate more effective collaborative practice.
3. Perceptions of PD effectiveness were strongly influenced by relationships with the intervention moderator.

¹ Nollmeyer, G. E., & Bangert, A. W. (2017). Measuring Elementary Teachers' Understanding of the NGSS Framework: An Instrument for Planning and Assessing Professional Development. *Electronic Journal of Science Education*, 21(8), 20-45.
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Teachers perceived the intervention to have elicited changes in their professional practice.

In addition to teachers indicating their knowledge of the NGSS had increased, teachers also indicated that lessons from the PD activity had elicited changes in their activities with students and also in the processes they used to prepare for lessons. In particular, teachers reported a significant increase in the use of scientific phenomena to lead instruction and modeling instruction practices. They also reported increased use of graphic organizers in instruction and assessments, and increased use of authentic data sets. Also reported was an increased use of backward-design thinking in lesson and unit planning guided by assessments deemed 'high quality' as per the assessment screening tool.

Use of the screening tool was perceived to facilitate more effective collaborative practice.

More than a third of interviewed teachers described professional conflicts that could be mediated by use of the screening tool. This sentiment was common among teachers who were tasked with working in a formalized Professional Learning Community structure. Teachers described how the use of an aid to guide professional conversations served, in a sense, as a 'third party expert' that could be referenced when disputes arose or direction was needed. The tool's function to alleviate professional conflict was especially salient in the close-knit communities of international schools.

Perceptions of PD effectiveness were strongly influenced by relationships with the intervention moderator.

A strong correlation was found between the way teachers perceived their own relationship with the intervention moderator and the extent to which they felt the PD activity was valuable and/or changed their professional practice as a result. Teachers with whom Andersen was found to have less rapport were less likely to perceive the PD activity to be valuable or translate learnings from the PD into new professional practices. However, the extended nature of Andersen's interaction with teachers (sometimes over multiple visits) most often led to strong interpersonal relationships which facilitated the assimilation of learnings and changes to professional practice.

Implications for Practice:

International school leaders seeking to maximize the impact of science teacher PD should (a) consider PD activities that train teachers in the use of aids that hold potential to increase teachers' pedagogical content knowledge while simultaneously guiding assessment design (b) seek to evaluate PD's effect on changes in professional practice and (c) give careful consideration to contextual components of PD that influence the extent and nature of the pedagogical content knowledge that is assimilated, transferred and enacted upon by teachers.

Further Information:

Full details of the research will be available via ProQuest in July 2020. Educators seeking additional information more immediately are welcome to request an unpublished manuscript or review the information available at:

<http://www.neuralvortex.com/doctoral-research.html>

Thank you for your support,

A handwritten signature in blue ink, appearing to read 'Wyatt Wilcox', with a stylized, cursive script.

Wyatt Wilcox, Ed.D.