The STEM Supplement to the Youth Program Quality Assessment:

Development and Early Validation Evidence for an Observational Measure of High Quality Instructional Practice for Science, Technology, Engineering and Mathematics in Out-of-School Time Settings

Overview

During the summer of 2011, the Providence After School Alliance (PASA) sponsored The AfterZone Summer Scholars Program – a program in which nine community-based organizations partnered with Providence School District teachers and PASA to develop and deliver nine different summer courses from the fields of environmental science, technology, engineering, and mathematics ("STEM") to 250 Providence Middle School youth. Ten student cohorts, each consisting of 25 students, spent two days per week on site at a school focusing on intense math instruction and two days per week in the field with one of the nine partner organizations. Two instructors moved with them at all times from the classroom to the field and back to make connections between the two settings.

In order to understand the quality of the Summer Scholars program and build upon its already successful quality improvement system for school year after school programs, PASA contracted with the David P. Weikart Center for Youth Program Quality (Weikart Center) at the Forum for Youth Investment to develop an observation-based measure of instructional practices to support continuous improvement during STEM programming and conduct a preliminary analysis of its reliability and validity based on data collected during AfterZone Summer Scholars program.

Data Collection and Sample

Expert raters, trained to reliability by the Weikart Center, were paired to visit each of the ten courses twice, resulting in a total of forty observations, or four observations per course. Observers took notes and fit their notes into numeric rubrics to produce scores for program quality. Raters were intentionally "crossed" (e.g., rater pairs were different in most observations) to support estimates of rater bias in future analyses.

Summary of Findings

The findings from this study must be interpreted with caution due to the small sample size and the early stage of measures development. Findings were as follows:

1. Expert reviewers agreed that the items on the STEM supplement reflect high quality practice as described in the existing scientific literature on informal STEM programming.
2. Many of the items developed to measure STEM instructional practices in the Summer Scholars program demonstrated acceptable levels of inter-rater reliability. Others did not. More work is necessary to improve both the clarity of descriptors in each item as well as the observation-based data collection method.
3. At this early stage we do not recommend deletion of any items from the STEM supplement because all items describe important practices according to both the literature and expert review – and these items may serve a useful purpose as a source of individual level performance feedback to practitioners who are observed. A STEM practices total score was positively associated with child reports that they could envision a "future self" that included membership in a STEM profession. Further, this association remained substantively large and statistically significant, even when controlling for student baseline responses, suggesting an association between STEM instructional quality and change in student beliefs.

Recommendations for Usage

At this time, the STEM supplement is not appropriate for high stakes uses. Scores on the STEM supplement should not trigger consequences that observed staff experience in a negative way. However, it is suitable for purposes of performance feedback to staff in low stakes conditions. This tool can serve a positive educational purpose and support continuous improvement planning and action. The STEM supplement to the Youth PQA is available to other practitioners, system administrators and researchers at no charge.

SAMPLE SCALE FROM STEM SUPPLEMENT

STEM Skill Building

Representation

V. Staff support skills for representing STEM ideas, actions and objects

Practice does NOT occur	*Practice occurs, but NOT ALL youth/teams engaged*	*Staff enacts practice AND all youth/teams engaged*		**Supporting Evidence/Anecdotes**
1	**3**	**5** Staff **model use of STEM vocabulary terms** *(e.g., SCIENCE - chlorophyll, density, atomic, nuclear, geologic, light year, H_20; COMPUTERS - hard drive, random access memory (RAM), gigabytes; ENGINEERING -,torque, currents force; MATH - spreadsheet; graph, variable, rate of change, slope, percent).*	☐	
1	**3**	**5** Staff support and **encourage youth in use of STEM vocabulary** *(e.g. expand upon youth comments with correct terminology; explain meaning of STEM vocabulary in ways youth can understand, ask "do you know the correct term for that?; " that 'tall bird' is a Great Blue Heron"; "saline means it has salt in it.").*	☐	
1	**3**	**5** Staff support youth in using **classification or abstraction,** linking concrete examples to principles, laws, categories, or formulas *(e.g. "Mice, porcupines, and squirrels are all rodents, rodents are all mammals." "The pool ball moved because 'for every action, there is an equal and opposite reaction'.").*	☐	
1	**3**	**5** Staff support youth in conveying STEM concepts through **symbols, models**, or other nonverbal language (*e.g., youth use diagrams, equations, flowcharts, idea webs, outlines, photographs, mock-ups, draft drawings, use of design software to create blueprints, displays, dioramas, physical models, prototypes, graphs, charts, tables, equations, etc*.).	☐	