Using Curriculum Topic Study to Enhance Achievement in K-12 Science: Preliminary Outcomes

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Goals

- Increase the academic achievement of students in math and science by enhancing the content knowledge and pedagogical content knowledge through increased understanding and use of the New Jersey Core Curriculum Content Standards (NJCCCS) by classroom teachers
- Progression of science & mathematics topics through three years
- Preliminary outcomes for K-12 science teacher and student performance from the first year (life sciences) are presented here

Hypothesis

- A rigorous examination of the NJCCCS using the Curriculum Topic Study (CTS) process will result in an increase in teacher and student content knowledge and an increase in teacher pedagogical knowledge…or, in other words…
- A process-oriented professional development model will enhance content knowledge if the process is adopted and practiced by the attendees

Left: children testing hypotheses about the number of seeds in a pumpkin versus exterior appearance. **Right:** children making measurements of gas volume in a 5th grade/ 2nd grade vertical teacher and student exchange

Method: Curriculum Topic Study (CTS)

- CTS is a method and index for linking curriculum topics to recognized authorities on curriculum content and pedagogy
- Developed by Page Keeley, Maine Math and Science Alliance
- Much of the substance of CTS takes the form of tables of references to the authoritative resources (e.g., AAAS *Benchmarks in Science Literacy, Atlas of Science Literacy, Science for All Americans*)

Professional Development (PD) Program

- 124 hrs PD for each of 33 participants from 18 partner districts (up to 9 grad credits)
- 2 wk summer institute plus 4 PD workshops during school year (3 f2f & 1 online) and monthly classroom visits
- Cross-grade Teacher Exchange Program
- Professional Learning Communities & online support

Teacher and Student Evaluation: Quasi-experimental Study

Teachers

- Pre-/post-assessments of content knowledge in treatment & comparison groups
- Approx. 25 questions taken from TIMSS, NAEP, and state assessments (validated)
- Survey of Enacted Curriculum for PCK (validated)
- Self-report surveys

Students

- Pre-/post-assessments of student content knowledge for MS treatment & comparison teachers
- Approx. 25 questions taken from TIMSS, NAEP, and state assessments (validated)
- Student state assessment data (NJ ASK, HSPA) for grade 3-12 Treatment students

Outcomes: Teacher Content Knowledge

Group (N)	Pre-Test[1] (mean±SD)	Post-Test[2] (mean±SD)	% Change	*p* value
Treatment teachers (30)[3]	14.3±3.6	15.3±2.7	7.0	< 0.01
Comparison teachers (12)	13.7±4.5	14.1±5.6	2.9	0.66

[1] Treatment and Comparison teacher scores on the pre-test were not significantly different
[2]Treatment and Comparison teacher scores on the post-test were not significantly different
[3]Includes only Treatment teachers who completed both the pre- and post-assessment tests

Outcomes: Student Content Knowledge

Group (N)[1]	Pre-Test[2] (mean±SD)	Post-Test[2] (mean±SD)	Paired diff.[3] (mean±SD)	*p* value
Treatment students (459)[4]				
6th grade	8.6±2.6	9.8±3.0	1.2	< 0.001
7th grade	10.3±3.2	12.1±3.1	1.8	< 0.001
8th grade	14.4±2.5	15.4±2.5	1.0	< 0.02
Comparison students (285)[4,5]				
6th grade	9.2±2.7	10.6±2.8	1.3	<0.001
7th grade	10.5±3.1	12.1±3.4	1.6	< 0.001

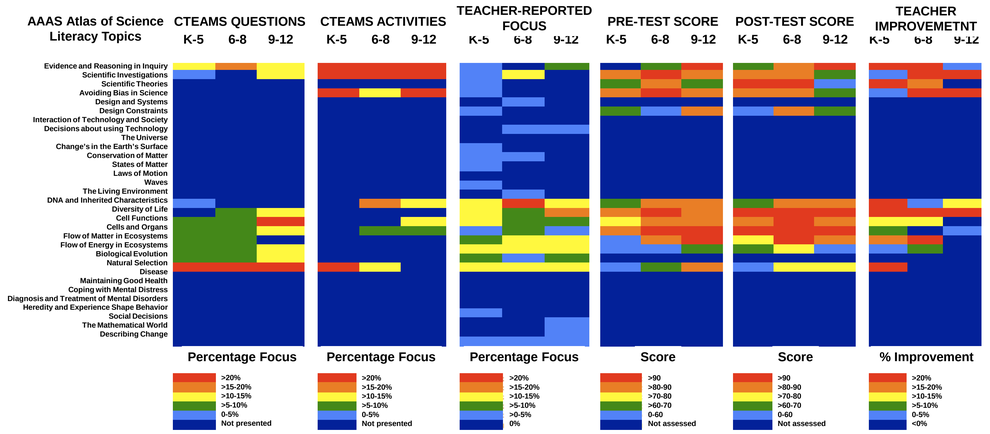
[1] Pre- and post-assessments were conducted with middle school students only
[2] Treatment and Comparison students' scores on the post-test were not significantly different in 7th grade but were significantly different in favor of the comparison students in 6th grade; this result may have been due, in part, to prior knowledge (comparison6th grade students had a higher mean on the pre-test although not significant [p=0.075]
[3] Difference in post vs. pre-test score per item (paired items pre vs. post)
[4] # students who completed pre- and post-tests; no 8th grade Comp. students were recruited

Outcomes: 7th Grade Students[1] by Content Area

Content area[2]	Treatment[3] Paired diff./ Total items	Treatment[3] *p* value	Comparison[3] Paired diff./ Total items	Comparison[3] *p* value
Science Practices[4]	0.08/2	0.096	0.15	0.013
Organization & Development	0.42/4	<0.001	0.48	<0.001
Matter & Energy Transformations	0.27/4	<0.001	0.55	<0.001
Interdependence	0.46/4	<0.001	0.27	0.002
Heredity & Reproduction	0.32/4	<0.001	0.20	0.038
Evolution & Diversity	0.32/3	<0 0.001	0.03	0.745

[1] Most partner districts teach life science topics in 7th grade
[2] Content areas as aligned with the New Jersey Core Curriculum Content Standards
[3] Study population included 276 Treatment students and 178 Comparison students
[4]A significant increase in pre- vs. post-test scores were observed for 6th graders (both Treatment and Control groups) for Science Practices

Workshop Content and Teacher Performance: AAAS Atlas Use



Other Accomplishments

- 9 of 10 vertical teams had at least 1 workshop participant serve on curriculum development committees at the district level
- 1 participant designated to develop ELL science curriculum in grades 5 to 8
- 2 presentations at the NJ Science Convention; 1 presentation at the NSTA STEM Expo May '12; oral presentation at USDOE STEM Regional Meeting 2011

Summary & Conclusions

- While overall achievement of students could not be correlated with workshop participation, achievement of the 7th grade cohort of treatment students (aligned with life science focus) appeared to show a positive trend in gains in content knowledge
- Elementary treatment teachers showed a significant increase in post-test scores
- Presentation of a limited scope of content in the context of CTS training led to broader investigation of NJCCCS and Atlas topics by participants