At the intersection of Professional Development Schools and Professional Learning Communities:

JUGYOKENKYUU (LESSON STUDY)

Steven Rogg, Ph.D.
March 13, 2010

Abstract

Is there synergy at the intersection of Professional Development Schools (PDS) and Professional Learning Communities (PLC)? Experiences of the *Chicago Lesson Study Group* (CLSG) suggest that the Japanese practice "*jugyokenkyuu,*" commonly translated as "Lesson Study" or "Lesson Research", might tap this potential. Described as teacher-led and student-focused professional development, *jugyokenkyuu* establishes a direct link between professional goals and classroom practice. This, in turn, creates a strategic focus for Professional Learning Communities in Professional Development Schools. This session will: (1) introduce key characteristics of *jugyokenkyuu*; (2) illustrate the alignment of *jugyokenkyuu* with core features of exemplary professional development; (3) report examples of *jugyokenkyuu* in the professional education of pre-service teachers, in-service teachers, and teacher educators; and (4) propose ideas for strengthening Professional Development Schools by establishing Professional Learning Communities skilled in the practice of *jugyokenkyuu*.

edweek.org

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COMMENTARY

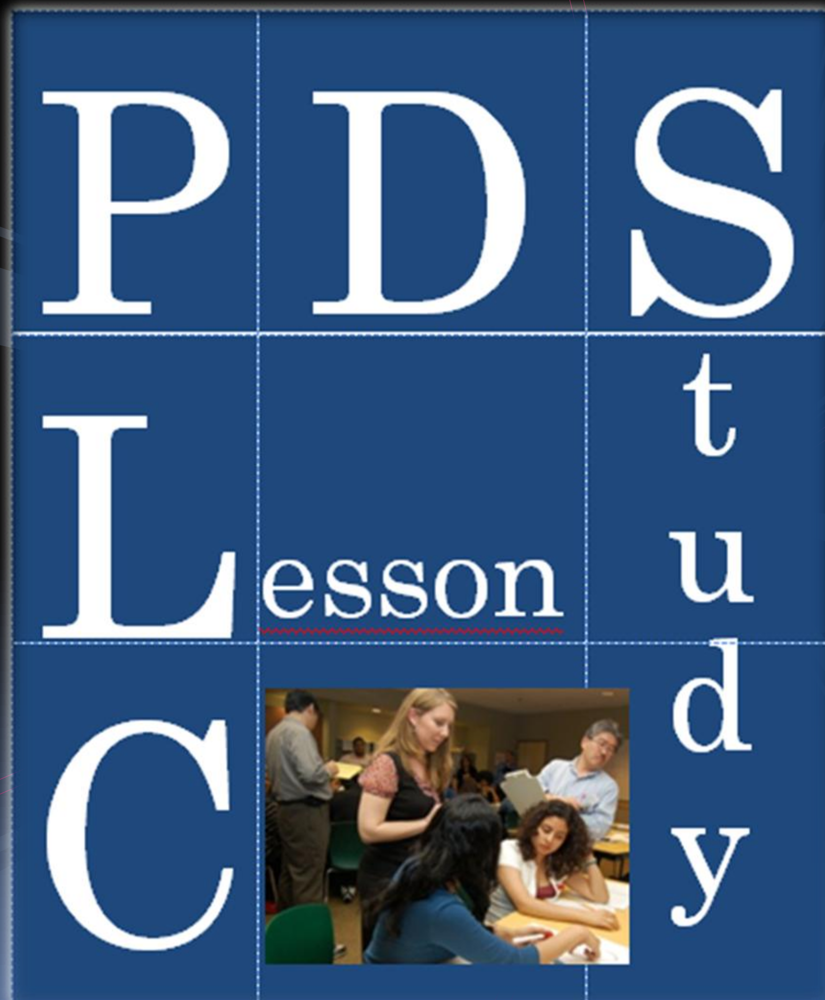
Teacher Learning: Sine Qua Non of School Innovation

By Stephanie Hirsh

You wouldn't know it from current discussions about teacher effectiveness, but the talent and expertise needed to raise student achievement already exist in many, if not most, schools. Unfortunately, too few of them have a culture that encourages teachers and administrators to work together on a regular basis, to consult each other more often on matters of teaching and learning, to share responsibilities for instructional improvement, and to implement professional-learning opportunities that address both their needs and their students'.

At the intersection of Professional Development Schools and Professional Learning Communities:

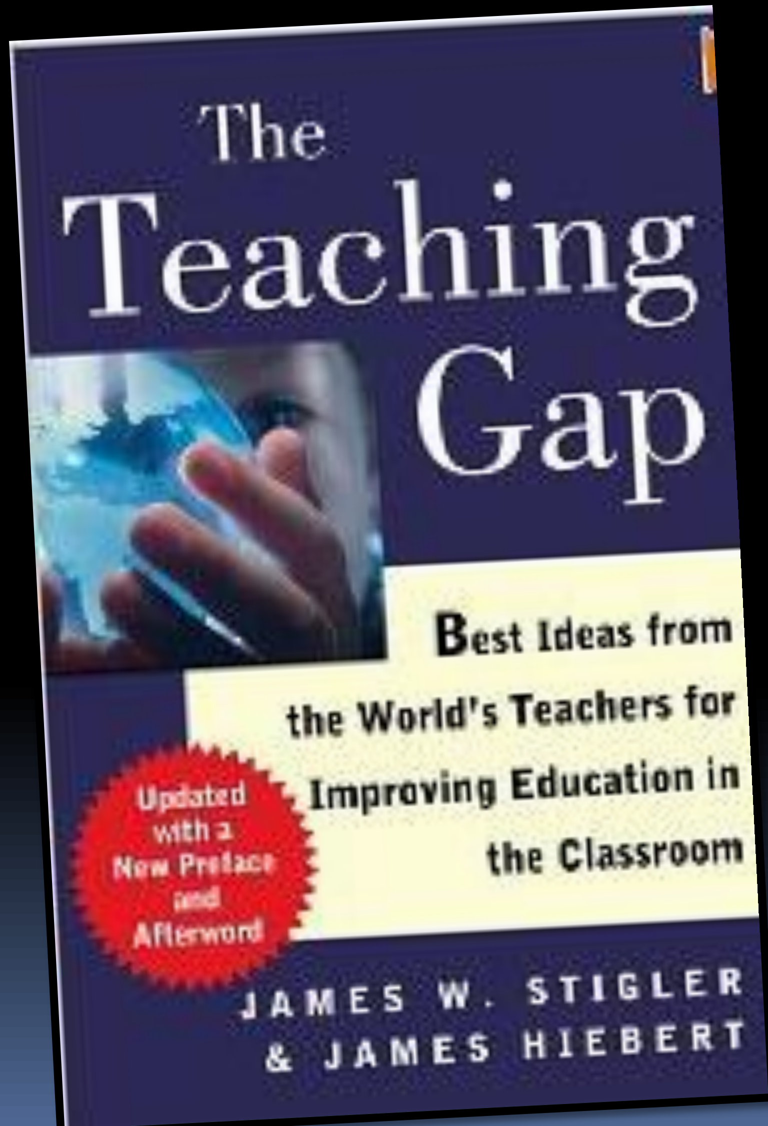
Jugyokenkyuu (Lesson Study)

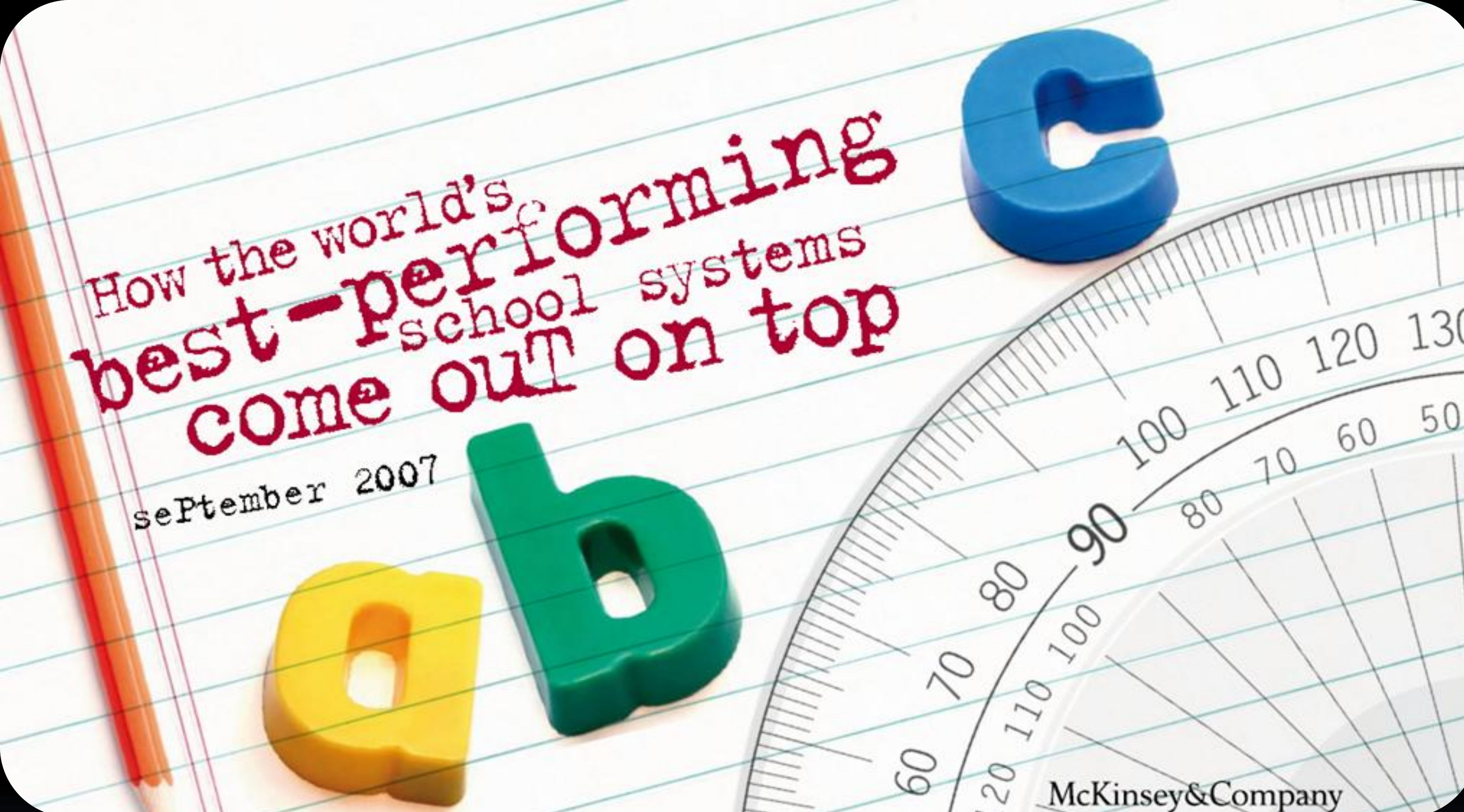


Agenda

- key characteristics of *jugyokenkyuu*
- alignment of *jugyokenkyuu* with core features of exemplary professional development
- *jugyokenkyuu* in the professional education of pre-service teachers, in-service teachers, and teacher educators
- strengthening PDSs by establishing PLCs skilled in the practice of *jugyokenkyuu*.

Stigler, J. W., & Hiebert, J. (1999). *The teaching gap: Best ideas from the world's teachers for improving education in the classroom. New York: Free Press.*





1. "The quality of an education system cannot exceed the quality of its teachers"
2. "The only way to improve outcomes is to improve instruction"
3. "High performance requires every child to succeed"

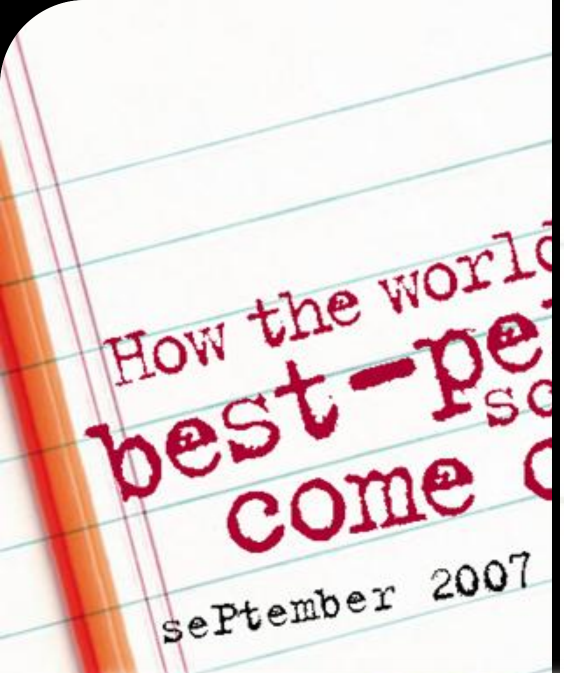


Exhibit 21: Japan: Learning communities

Enabling teachers to share best practice, learn from each others strengths and weaknesses, and jointly develop and disseminate excellent practice

Lesson study	Demonstration lessons
Teachers work in teams to analyse and develop model lessons. The study requires each teacher to reflect in depth on their own practice, with the assistance of their peers. The final sample lessons are recorded and distributed.	Teachers demonstrate excellent practice to a wider group of instructors, followed by discussion and feedback sessions. The lessons are used to give each teacher access to examples of excellent practice, to recognise development, and to hold teachers accountable for the quality of their instruction

- **Japan:** The learning culture in its schools is centred on 'lesson study' (kenkyuu jugyou). Groups of teachers work together to refine individual lessons, jointly planning, executing and then evaluating different instructional strategies for achieving a specific learning objective. Groups of teachers visit each others classrooms to observe and understand the practice of other teachers (Exhibit 21). There is a strong emphasis on making sure that best practices are shared throughout the school: "When a brilliant American teacher retires, almost all of the lesson plans and practices that she has developed also retire. When a Japanese teacher retires, she leaves a legacy."[55]

McKinsey&Company

Lesson Study Overview

- Set Team Learning Goals
  - School Improvement, Teacher Learning & Student Learning
- Lesson Design (~5-weeks)
- Research Lesson (Internal or Public)
  - Briefing → Teaching → Observing → Debriefing
- Revising and Re-teaching (optional)
- Reflecting and Sharing Insights

Some Key Processes

Term	Meaning
kyozaikenkyu	instructional material research
kenkyu jugyo	research lesson
hatsumon	posing key questions
bansho	blackboard writing
kikanshidoi	in-between desk instruction
neriage	extensive whole-class discussion

http://hrd.apecwiki.org/index.php/Glossary_of_Lesson_Study_Terms

Three Major Forms of Lesson Study

Example of Lesson Study Groups	Description	Main Purpose
School-Based Lesson Study	•Usually all teachers from a school participate •Establish a school Lesson •Form several subgroups that engage in a lesson study cycle	•Achieving systematic and consistent instructional and learning improvement in the school as a whole •Developing a common vision of education at the school through teacher collaboration
Cross-School Lesson Study (District-wide)	•Organized as an intra-school Lesson Study group •Usually subject-oriented groups (e.g., math teachers from each school in the district gather to conduct lesson study) •Meet once or twice a month	•Developing communication among the schools in the district •Exchanging ideas between the schools •Improving instruction and learning in the district as a whole
Cross-Districts Lesson Study (Regional or Nation-wide)	•Usually a voluntarily organized group •Group of enthusiastic practitioners with purpose of improving teaching and learning or curriculum in a certain subject •Meet once or twice after school on off-school days	•Developing new ideas for teaching chosen topics •Investigating curriculum sequences and contents •Developing curriculum

http://hrd.apecwiki.org/index.php/Lesson_Study_Overview

Anticipating Student Responses

Why this is so essential…

How can we anticipate student responses?

- Familiarity/Empathy
  - with your prior cohorts of students
  - with your current cohort of students
- Extrapolation
  - from your own experiences/ideas of schooling
- Grounding
  - base in generalized systematic research
- Others?

Teaching → Learning?

Agenda

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- *jugyokenkyuu* in the professional education of pre-service teachers, in-service teachers, and teacher educators
- strengthening PDSs by establishing PLCs skilled in the practice of *jugyokenkyuu*.

Three characteristics set Lesson Study apart from typical professional development programs:

- Lesson Study provides teachers an opportunity to see teaching and learning in the classroom in a concrete form. Teachers focus their discussions on planning, implementation, observation, and reflection on classroom practice. By looking at actual practice in the classroom, teachers are able to develop a common understanding or image of what good teaching practice entails. This in turn helps students understand what they are learning.
- Lesson Study keeps students at the heart of the professional development activity. It provides an opportunity for teachers to carefully examine the student learning and understanding process by observing and discussing actual classroom practice.
- Lesson Study is teacher-led. Through it teachers can be actively involved in the process of instructional change and curriculum development.

http://hrd.apecwiki.org/index.php/Lesson_Study_Overview#Lesson_Study_in_Japan

High-Quality PD

"Research on teacher learning shows that fruitful opportunities to learn new teaching methods share several core features:

- ongoing (measured in years) collaboration of teachers for purposes of planning with
- the explicit goal of improving students' achievement of clear learning goals,
- anchored by attention to students' thinking, the curriculum, and pedagogy, with
- access to alternative ideas and methods and opportunities to observe these in action and to reflect on the reasons for their effectiveness . . ."

Hiebert, J. (1999). Relationships between Research and the NCTM Standards. *Journal for Research in Mathematics Education, 30*(1), 3-19.

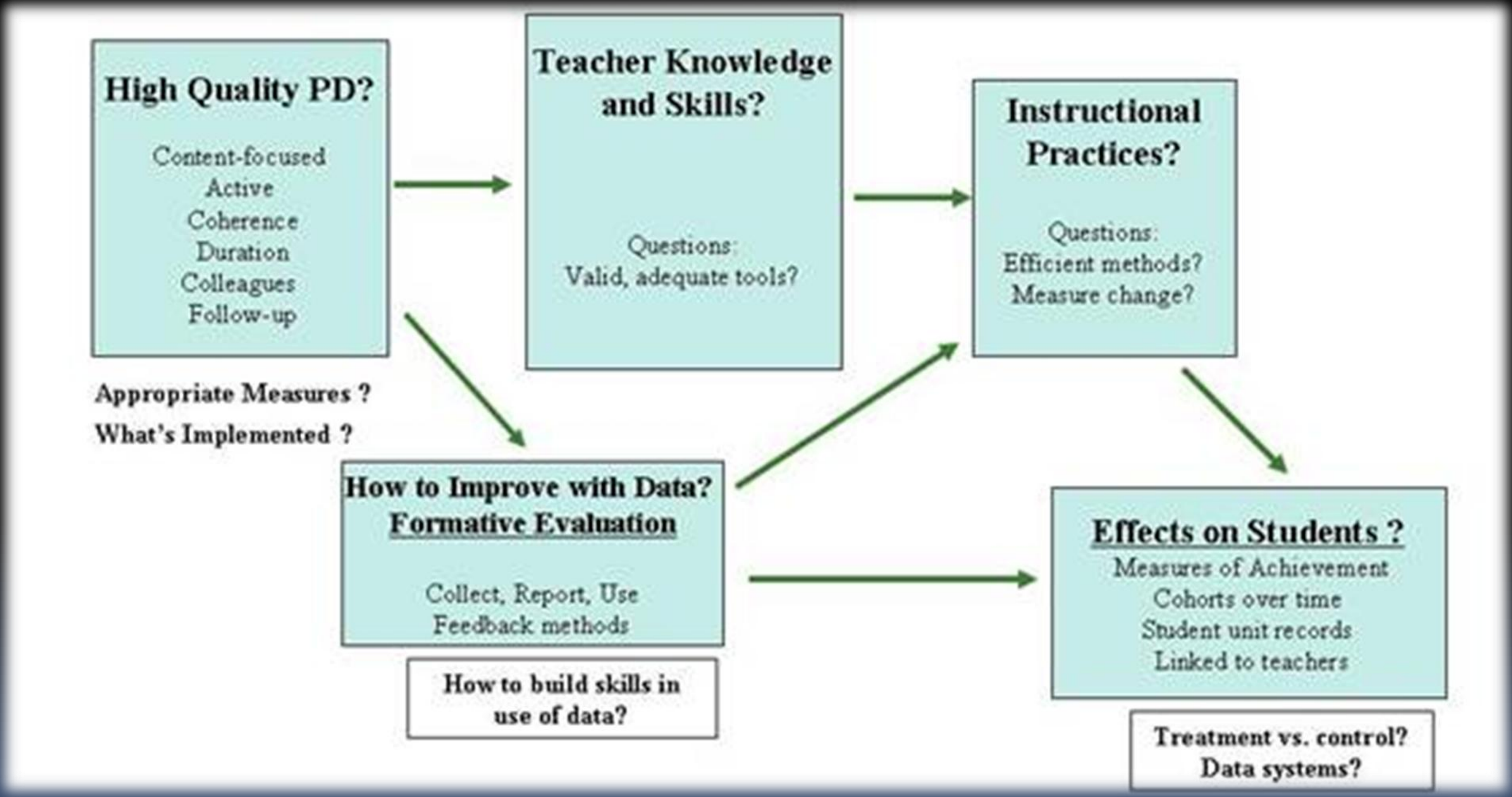
CHANGING EMPHASES

The *National Science Education Standards* envision change throughout the system. The professional development standards encompass the following changes in emphases:

LESS EMPHASIS ON	MORE EMPHASIS ON
Transmission of teaching knowledge and skills by lectures	Inquiry into teaching and learning
Learning science by lecture and reading	Learning science through investigation and inquiry
Separation of science and teaching knowledge	Integration of science and teaching knowledge
Separation of theory and practice	Integration of theory and practice in school settings
Individual learning	Collegial and collaborative learning
Fragmented, one-shot sessions	Long-term coherent plans
Courses and workshops	A variety of professional development activities
Reliance on external expertise	Mix of internal and external expertise
Staff developers as educators	Staff developers as facilitators, consultants, and planners
Teacher as technician	Teacher as intellectual, reflective practitioner
Teacher as consumer of knowledge about teaching	Teacher as producer of knowledge about teaching
Teacher as follower	Teacher as leader
Teacher as an individual based in a classroom	Teacher as a member of a collegial professional community
Teacher as target of change	Teacher as source and facilitator of change

NRC. (1996). *National Science Education Standards : observe, interact, change, learn*. Washington, DC: National Academy Press.

CCSSO



Blank, Rolf. (2007). *Improving Evaluation of Professional Development in Math & Science Ed.* NSF REC Grant (2005 to 07). Council of Chief State School Officers. http://www.ccsso.org/projects/Improving_Evaluation_of_Professional_Development/

"How Students Learn…"

A community-centered classroom that relies extensively on classroom discussion, for example, can facilitate learning for several reasons…

- It allows students' thinking to be made transparent—an outcome that is critical to a learner-centered classroom. Teachers can become familiar with student ideas... Teachers can also monitor the change in those ideas with learning opportunities, the pace at which students are prepared to move, and the ideas that require further work—key features of an assessment-centered classroom.
- It requires that students explain their thinking to others. In the course of explanation, students develop a disposition toward productive interchange with others (community-centered) and develop their thinking more fully (learner-centered)...
- Conceptual change can be supported when students' thinking is challenged, as when one group points out a phenomenon that another group's model cannot explain (knowledge-centered).

National Research Council. (2005). *How students learn: science in the classroom. Washington, D.C.: National Academies Press.*

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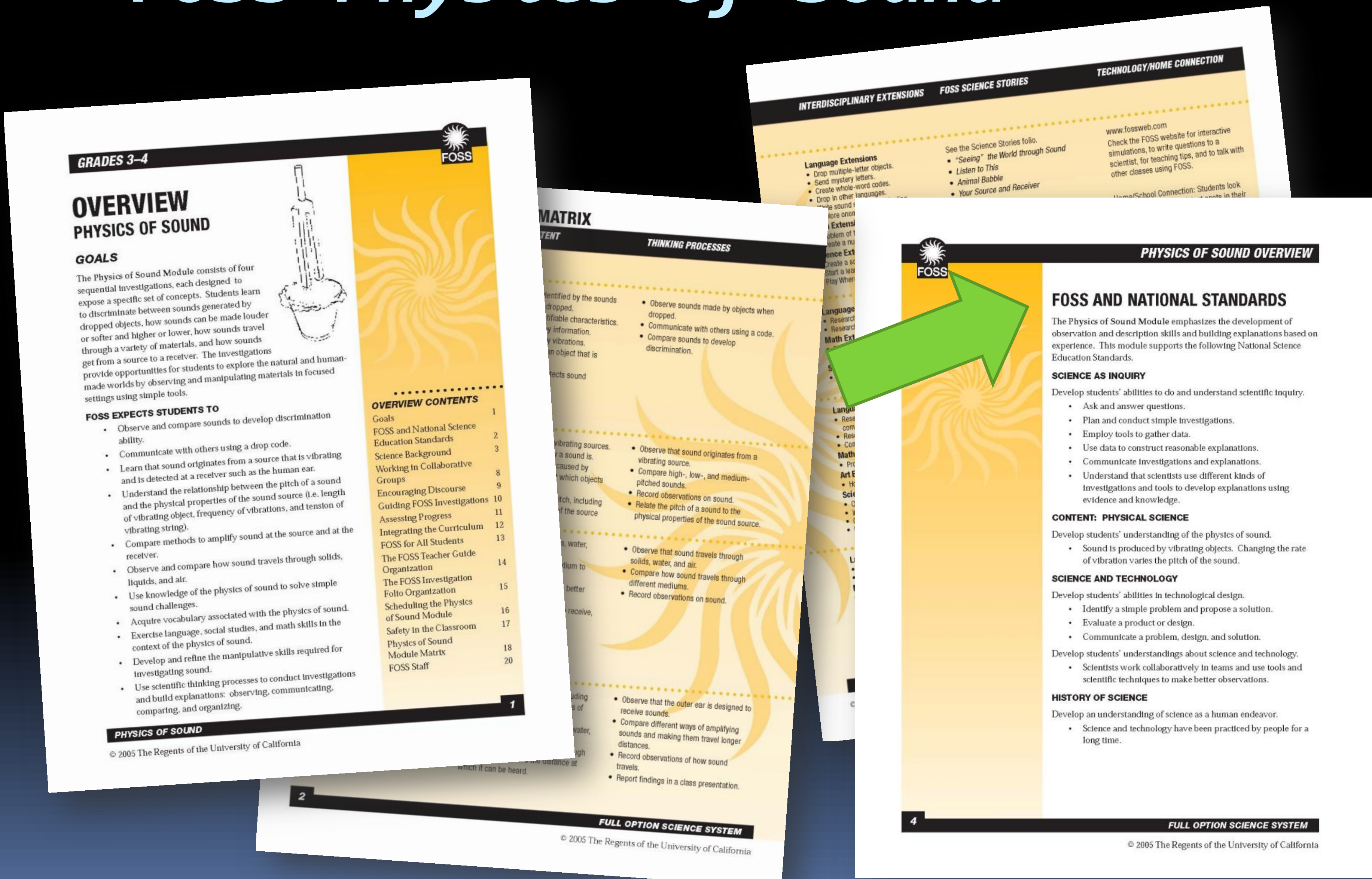
Example 1: Physics of Sound

Our team's first science research lesson…

“Physics of Sound” Research Lesson

FOSS *Physics of Sound*



GRADES 3–4

FOSS

OVERVIEW
PHYSICS OF SOUND

GOALS

The Physics of Sound Module consists of four sequential investigations, each designed to expose a specific set of concepts. Students learn to discriminate between sounds generated by dropped objects, how sounds can be made louder or softer and higher or lower, how sounds travel through a variety of materials, and how sounds get from a source to a receiver. The investigations provide opportunities for students to explore the natural and human-made worlds by observing and manipulating materials in focused settings using simple tools.

FOSS EXPECTS STUDENTS TO

- Observe and compare sounds to develop discrimination ability.
- Communicate with others using a drop code.
- Learn that sound originates from a source that is vibrating and is detected at a receiver such as the human ear.
- Understand the relationship between the pitch of a sound and the physical properties of the sound source (i.e. length of vibrating object, frequency of vibrations, and tension of vibrating string).
- Compare methods to amplify sound at the source and at the receiver.
- Observe and compare how sound travels through solids, liquids, and air.
- Use knowledge of the physics of sound to solve simple sound challenges.
- Acquire vocabulary associated with the physics of sound.
- Exercise language, social studies, and math skills in the context of the physics of sound.
- Develop and refine the manipulative skills required for investigating sound.
- Use scientific thinking processes to conduct investigations and build explanations: observing, communicating, comparing, and organizing.

OVERVIEW CONTENTS

MATRIX

THINKING PROCESSES

INTERDISCIPLINARY EXTENSIONS — FOSS SCIENCE STORIES — TECHNOLOGY/HOME CONNECTION

FOSS AND NATIONAL STANDARDS

The Physics of Sound Module emphasizes the development of observation and description skills and building explanations based on experience. This module supports the following National Science Education Standards.

SCIENCE AS INQUIRY

Develop students' abilities to do and understand scientific inquiry.

- Ask and answer questions.
- Plan and conduct simple investigations.
- Employ tools to gather data.
- Use data to construct reasonable explanations.
- Communicate investigations and explanations.
- Understand that scientists use different kinds of investigations and tools to develop explanations using evidence and knowledge.

CONTENT: PHYSICAL SCIENCE

Develop students' understanding of the physics of sound.

- Sound is produced by vibrating objects. Changing the rate of vibration varies the pitch of the sound.

SCIENCE AND TECHNOLOGY

Develop students' abilities in technological design.

- Identify a simple problem and propose a solution.
- Evaluate a product or design.
- Communicate a problem, design, and solution.

Develop students' understandings about science and technology.

- Scientists work collaboratively in teams and use tools and scientific techniques to make better observations.

HISTORY OF SCIENCE

Develop an understanding of science as a human endeavor.

- Science and technology have been practiced by people for a long time.

c(m+s)i
Chicago Math & Science Initiative

Science Scope and Sequence, K-8

Grade	First Quarter	Second Quarter	Third Quarter	Fourth Quarter
K	Characteristics of Living Things **Animals Two By Two (FOSS) and Weather (STC)***		Properties That Make Materials Useful **Fabric (FOSS) and Weather (STC)***	
	Weather* **Weather (STC)**			
1	Plants and How They Grow **New Plants (FOSS)**	Solids and Liquids **Solids & Liquids (FOSS)**	Rocks, Soil, and Dirt **Pebbles, Sand, Silt (FOSS)**	Organisms and their Environment **Organisms (STC)**
2	Weather **Weather (FOSS)**	Forces and Motion **Balance & Motion (FOSS)**	Making Measurements **STC Balancing & Weighing**	Animals and How They Live **Insects (FOSS)**
3	Water and the Water Cycle **Water (FOSS)**	Earth Materials and their Uses **Earth Materials (FOSS)**	Sound **Physics of Sound (FOSS)**	Cycles Of Living Things **Structures of Life (FOSS)**
4	Human Body: Form and Function **Human Body (FOSS)**	Chemical Testing **Chemical Tests (STC)**	Electricity and Magnetism **Magnetism & Electricity (FOSS)**	Earth Features and Changes **Land and Water (STC)**
5	Microorganisms and other Small Things **Microworlds (STC)**	Time and Motion **Measuring Time (STC)**	Levers, Pulleys and Machines **Lever & Pulleys (FOSS)**	Solar Energy **Solar Energy (FOSS)**
6	The Changing Earth **IES Dynamic Planet** The Earth in the Solar System **IES Solar Systems**	Rocks and Geological Time **IES Fossils**	Climate and Weather **IES Climate & Weather**	Energy Resources **IES Energy Resources**
7	Human Biology and Organ Systems **My Body & Me (SALI)**	Cell Structure and Function **Micro-life (SALI)**	Genetics **Our Genes, Our Selves (SALI)**	Ecology and Evolution **Ecology & Evolution (SALI)**
8	Water **Water (IEY)**	Materials Science **Material Science (IEY)**	Work, Energy, and Efficiency **Energy (IEY)**	Environmental Impact **Environmental Impact (IEY)**

(FOSS) – Full Option Science System; (STC) – Science, Technology and Children; (IES) - Investigating Earth Systems; (SALI) - Science & Life Science; (IEY) – Issues, Evidence & You

* Full day Kindergarten - STC Weather will be taught across entire school year

What it looked like…

What we looked for…

1. Was there sufficient discussion among the students within each group?
2. Were the instruments (cup and string) adequate to show difference in pitch?
3. Did students correctly identify relation between tension and pitch, i.e. tighter = higher?
4. Did all of the students get a chance to work with the instruments? If not, was this important?
5. Do students realize that there are two variables and only one at a time should be varied?
6. Should the length of the string be specified, since the goal of the lesson was to see the effect of varying the tension?
7. How specific should the directions of the teacher be to ensure the goal of the lesson is achieved?

A Glimpse at the Post-Lesson Discussion…

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8	Water **Water (IEY)**	Materials Science **Material Science (IEY)**	Work, Energy, and Efficiency **Energy (IEY)**	Environmental Impact **Environmental Impact (IEY)**

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* Full day Kindergarten - STC Weather will be taught across entire school year

SEC Content Topics

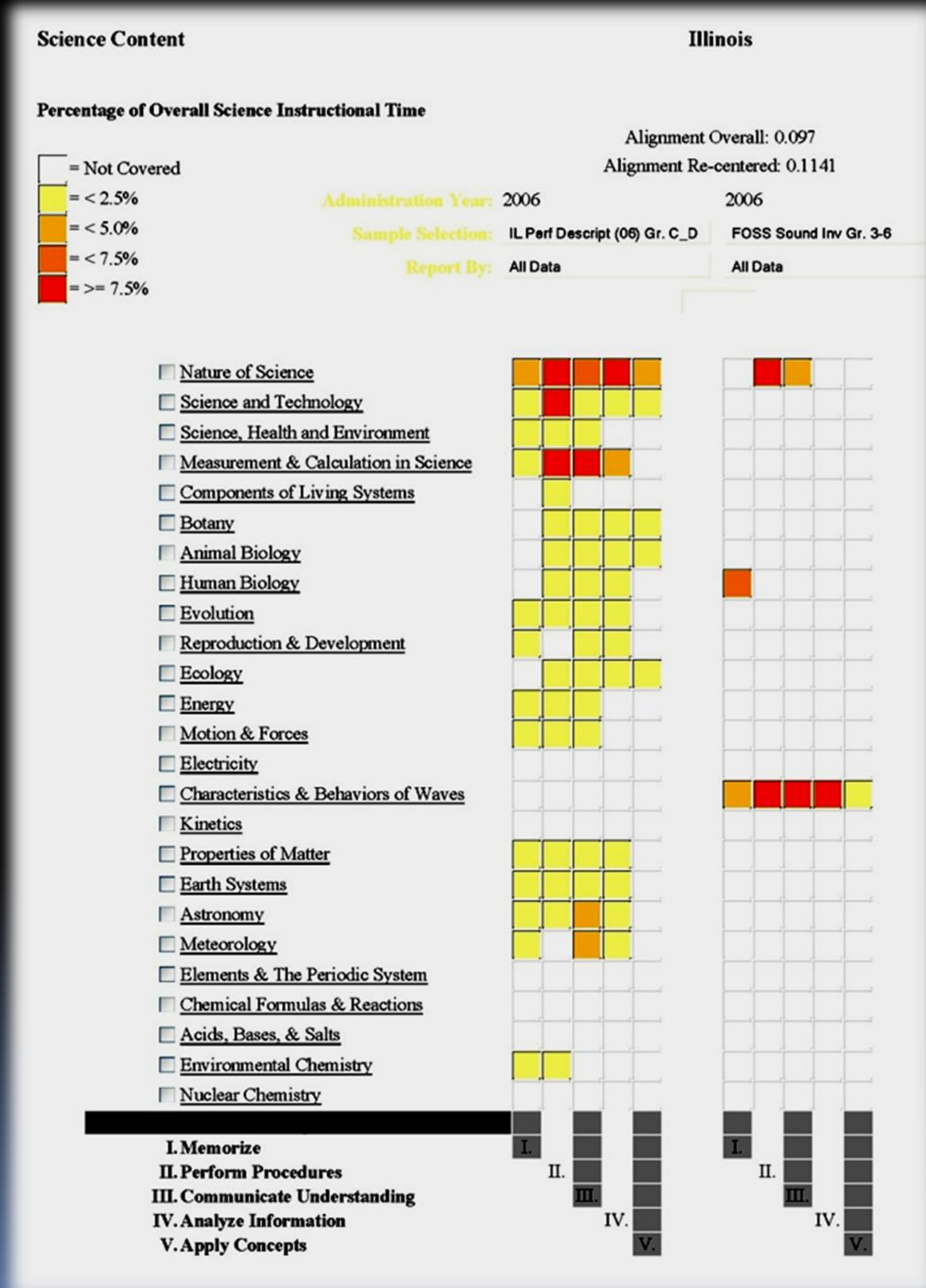
Mathematics, Science, English Language Arts

The SEC provides a neutral, research-based language to describe content of English language arts, mathematics, and science.

NCLB anyone?

Time on Topic					*Elementary Mathematics Topics*
<none>				1	**Number sense / Properties / Relationships**
●	①	②	③	101	Place value
●	①	②	③	102	Patterns
⓪	●	②	③	103	Decimals
⓪	①	●	③	104	Percent
⓪	①	②	●	105	Real numbers
⓪	①	②	●	106	Exponents, scientific notation
⓪	●	②	③	107	Factors, multiples, divisibility
⓪	①	●	③	108	Odds, evens, primes, composites
⓪	①	②	●	109	Estimation
⓪	●	②	③	110	Order of operations
⓪	●	②	③	111	Relationships between operations
<none>				2	**Operations**
⓪	①	②	③	201	Add, subtract whole numbers
⓪	①	②	③	202	Multiplication whole numbers
⓪	①	②	③	203	Division whole numbers

FOSS Physics of Sound



Example 2: Electrical Circuits

Teacher Candidates and Faculty Peer Review

7-Es: Experience the 5-E Instructional Model with Electrical Circuits

- **E**ngage: Set up the challenge "Make Light"
- **E**xplore: Alternative ways to "Make Light"
  - or ~~*not*~~
  - or *heat*
- **E**xplain: Construct Meaning from Solutions
  - seeing the "circuit" as *path*
- **E**laborate: The Circuit Inside
- **E**valuate: The "Post Lesson Discussion"

“Make Light”

Electrical Circuits (1/3)

Project 2061 took a close look at the topic of electrical circuits. This happens to have been the subject of considerable research on students' learning difficulties, in terms of both the necessary input of learning effort and the likely output of fruitful knowledge. On the input side, how learnable are circuit ideas? Some researchers have spent their careers trying to understand why students—from elementary school to college—have so much difficulty in understanding not just the differences in behavior of series and parallel circuits, but even the very notion of what a circuit is. Even when researchers have thought they understood the nature of students' difficulties and misconceptions, they still have had trouble figuring out how to overcome them. So, at best, a great deal of extra classroom time would have to be spent on getting students to understand electrical circuits.

Electrical Circuits (2/3)

On the outcome side, how important is it to science literacy for students to understand electrical circuits? The judgment has to be made on the basis of the importance of that knowledge itself, the prior knowledge required to learn it, and what other knowledge it will lead to or support. By itself, electrical circuitry does not have much to offer science literacy. Practical knowledge of electrical circuits may be required for students who will specialize in physics or engineering, and it would also be of value to do-it-yourselfers to understand what is happening in, say, a three-way switch arrangement, but even they would be well advised to follow standard wiring diagrams rather than figure it out on their own. On the other hand, the idea of an electric current plays an important role in science literacy because of its relationship to magnetic fields in electric motors, power generators, Earth's magnetic field, and more. For those links, however, less need be known about currents than is necessary for making sense of series and parallel circuits.

Electrical Circuits (3/3)

Project 2061 concluded, therefore, that series and parallel electrical circuits as a subject was best left out of the goals for the core science curriculum on the grounds that it would require a high instructional cost and provide a low payoff. Paradoxically, one of the most popular instructional units among elementary- and middle-school science educators is the hands-on science activity “batteries and bulbs,” in which students investigate series and parallel circuits. It may be that this engaging activity can be adequately justified by its contribution to understanding scientific reasoning— hypotheses, evidence, modeling, observation, and so on—even if students are not likely to retain knowledge about series and parallel electrical circuits. And of course any student with an interest in electrical or electronics technology ought to have some opportunity outside of the common core to study circuits. In any case, the point here is not to single out conclusions about the topic of electrical circuits for special attention but to illustrate the kind of analysis that is needed in deciding which topics ought to be included and which left out.

For more about electrical circuits…

1. Search for the term "electric" in Chapter 7 of Designs for Science Literacy at: http://www.project2061.org/publications/designs/ch7.pdf
2. Check the research base (albeit not up-to-date) in Resources for Science Literacy. Simply search for "electric" (or "electric circuit") in the search field on this page: http://www.project2061.org/publications/rsl/online/RESEARCH/COG_TOC.HTM
3. The Illinois Learning Standards for Science do not speak to electric circuits explicitly. The only goal found for electricity at the elementary level was: "12.C.2a Describe and compare types of energy including light, heat, sound, electrical and mechanical." Of course, we can look to *Benchmarks for Science Literacy* and the *National Science Education Standards*, too. http://www.isbe.net/ils/science/pdf/goal12.pdf
4. The new *Handbook of Research on Science Education* has a relevant chapter. It turns out that there are at least **444 published studies about electric circuits** (Duit, Neidderer, & Schecker, 2007, p606). Reference: Duit, R., Neidderer, H., & Schecker, H. (2007). Teaching Physics. In S. K. Abell & N. G. Lederman (Eds.), Handbook of research on science education (pp. 599-629). Mahwah, N.J.: Lawrence Erlbaum Associates.

7E Conclusions

- Did the teacher candidates learn something about electricity?
  - Yes, and this was very limited.
  - This is forgivable since T&L415 is decisively ***not*** a physics or physical science class.
  - Mostly the teacher candidates were confronted with how terribly little they had learned in elementary school, high school, and college! (Which is, of course, disturbing enough.)
- Did the teacher candidates experience a reasonable representation of a 5-E learning cycle model?
  - We are confident that they did.
  - It was striking how naturally the 5-E model mapped into the lesson study template.
- Did the teacher candidates consider the utility of the 5-E instructional model?
  - Feedback from students at the subsequent meeting was very positive.
  - Consensus was that the experience was far more effective that simply reading and discussing.

Topic 3: F=MA

Remember this?

TEACHING & LEARNING NEWTON'S SECOND LAW: MASS HYSTERIA

- Engage:
  - Observe and describe the static system
  - Predict what will happen in the dynamic system
- Explore:
  - Qualitative Observations – Run the cart
  - Quantitative Data Collection – Produce graphs.
- Explain: Compare achieved and predicted graphs
- Elaborate:
- Evaluate: The "Post Lesson Discussion"

GOAL OF THIS RESEARCH LESSON

- Chicago Lesson Study Group general goal for 2008-09 :
  - ***Increase student self-efficacy***.
- Specific goal for the science team:
  - ***Increase student self-efficacy in science through success in a challenging experience requiring analytical thinking about natural phenomena***.

LESSON GOALS (CONTINUED)

- **Teaching-** Experience teaching a common concept (F=MA) in an uncommon way: The Learning Cycle as framed by the BSCS 5-E model (Bybee et al., 2006).
- **Learning** – See the learning experience from the perspective of high school students. Anticipate student responses to each step of the 5-E BSCS Learning Cycle. This will be embedded in the activity sequence and made explicit during the research lesson panel discussion.
- **Curriculum** – Recognize probable strengths and weaknesses in published curriculum materials. This lesson was based on the Active Physics™ *Predictions* module Activity 6: "*The modern cart and book experiment*". During lesson design, the team discovered a discrepancy (p. 166, paragraph 4) that could lead to confusion. During the Panel Discussion, the lesson design team will discuss how they revised the lesson accordingly.
- **Technology** – Experience using computer-based motion detector to capture and analyze (make sense of) data. Use of the Vernier™ system is a means to readily collect sufficient numbers of data points for multiple trials.
- **Professionalism** – introduce preservice teachers to Lesson Study as a viable form of professional development. The lesson was prepared during lesson study, will be experienced as a research lesson, and will be discussed with participants during the post-lesson panel. Since participants are preservice educators, they will be invited to participate in the post lesson panel as participant-observers.

Mass Hysteria Conclusions

"Mutationem motus proportionalem esse vi motrici impressae, et fieri secundum lineam rectam qua vis illa imprimitur."

-OR-

$$A_{expected} = g_{m/s^2}\left(\frac{m_g}{m_g + m_c}\right)_g = 9.8_{m/s^2}\left(\frac{50g}{50g + 900g}\right) = 0.52_{m/s^2}$$

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PLCs and *Jugyokenkyuu*

7E References

- Bybee, R. W., Taylor, J. A., Gardner, A., Van Scotter, P., Carlson Powell, J., Westbrook, A., et al. (2006). *The BSCS 5E Instructional Model: Origins and Effectiveness*. Colorado Springs, CO: BSCS.
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Resource Links

http://lessonstudygroup.net/

http://www.project2061.org/

http://www.house.gov/science/hot/Competitiveness/aci06-booklet.pdf

http://www.ed.gov/about/inits/ed/competitiveness/

http://www.ed.gov/about/inits/ed/competitiveness/strengthening/strengthening.pdf

http://seconline.wceruw.org/secWebHome.htm