

Linking Science and Literacy in the Classroom: The National Context

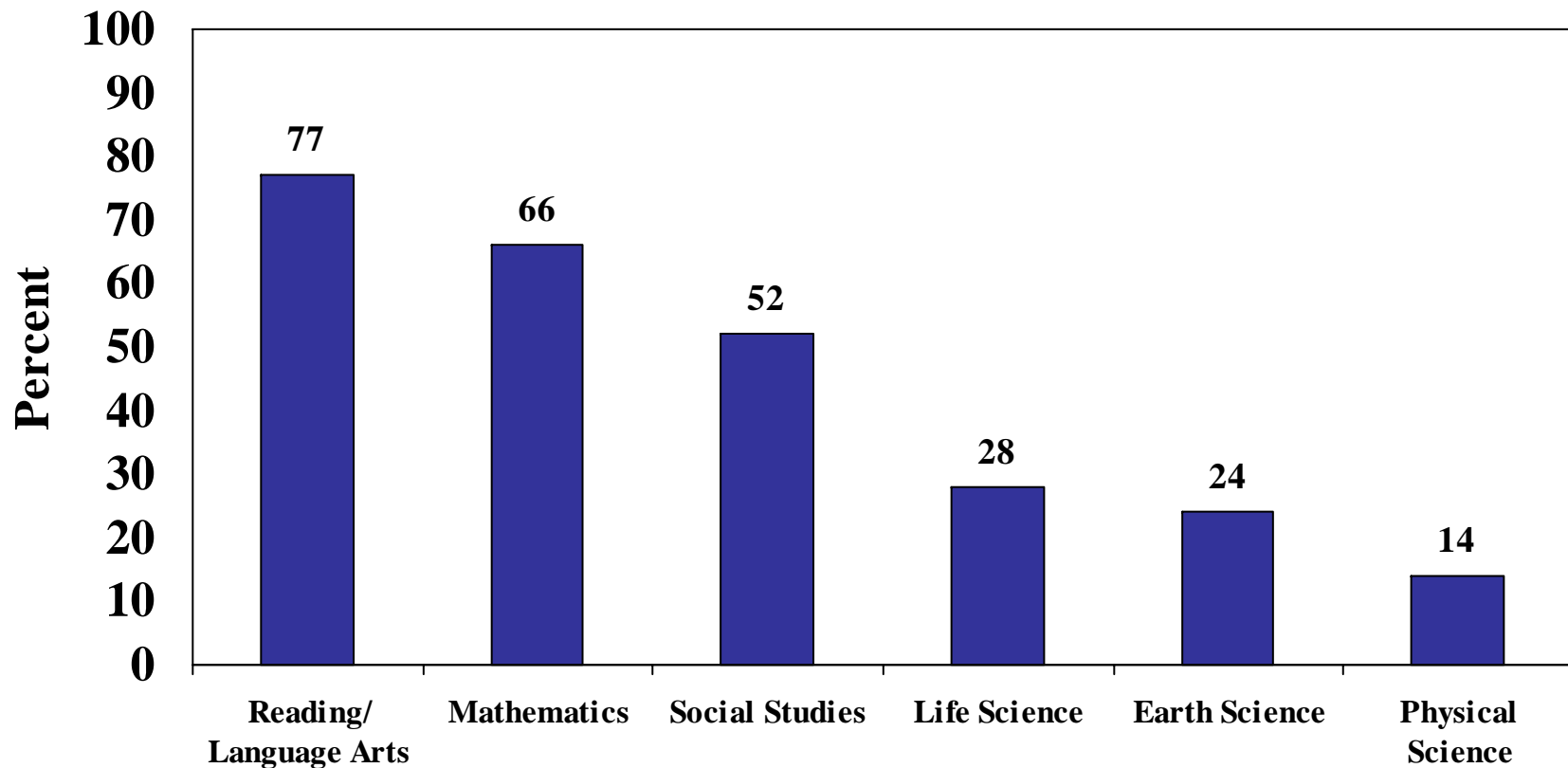
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Horizon Research, Inc.

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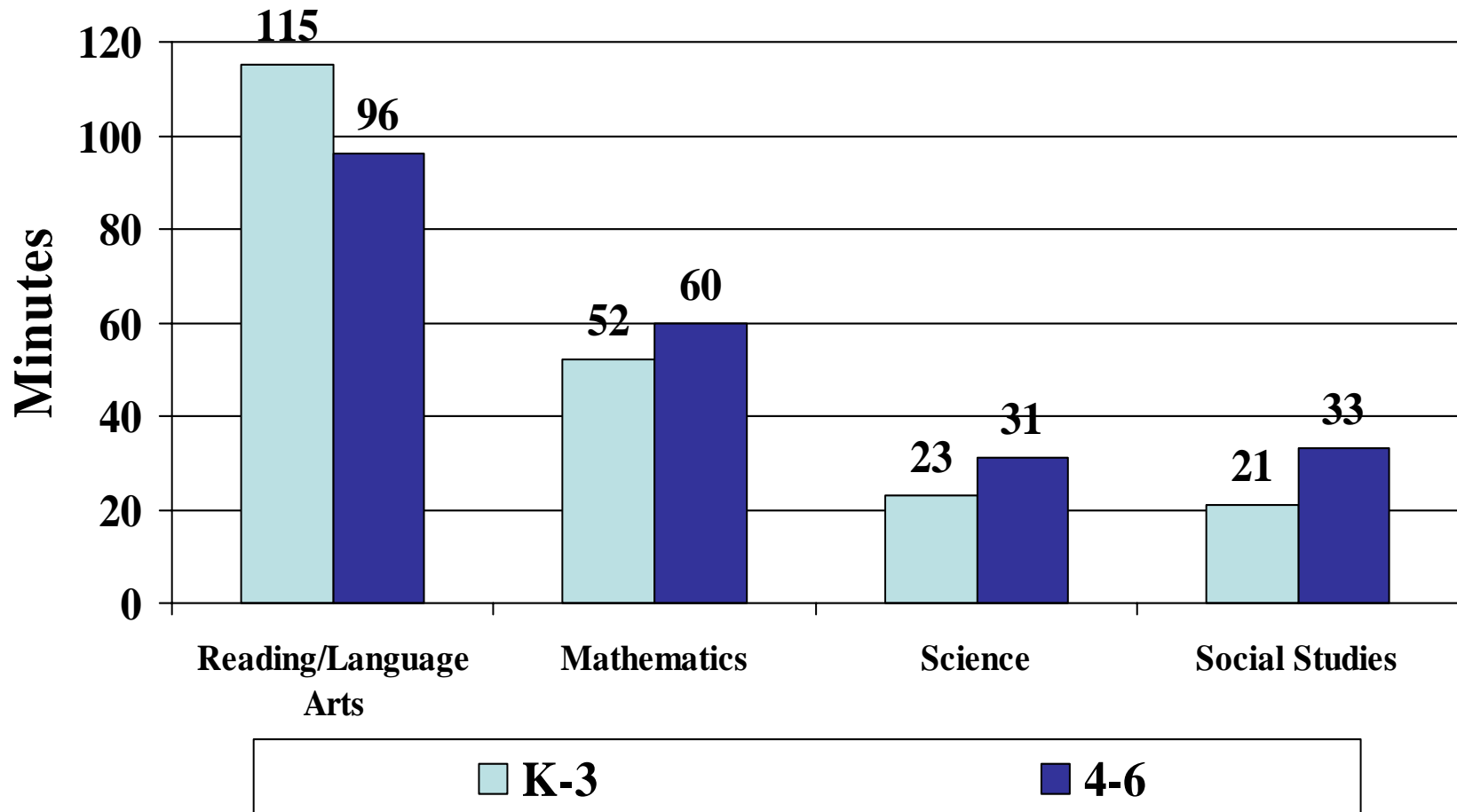
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Elementary Teachers Considering Themselves “very well qualified” to Teach the Subject



(Fulp, 2002)


Average Number of Minutes Per Day Spent Teaching Each Subject in Self-Contained Classes



(Weiss, 2001)

Time teachers spent on inservice education in science in the previous three years

	Percent of Teachers	
	Grades K-5	Grades 6-8
None	24	10
< 6 hours	25	10
6-16 hours	26	25
16-35 hours	16	25
> 35 hours	10	30




What do we know about
the strengths and
weaknesses of “typical”
science instruction?




Looking *Inside the* *Classroom*

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Nationally representative
sample of lessons
observed by trained
researchers

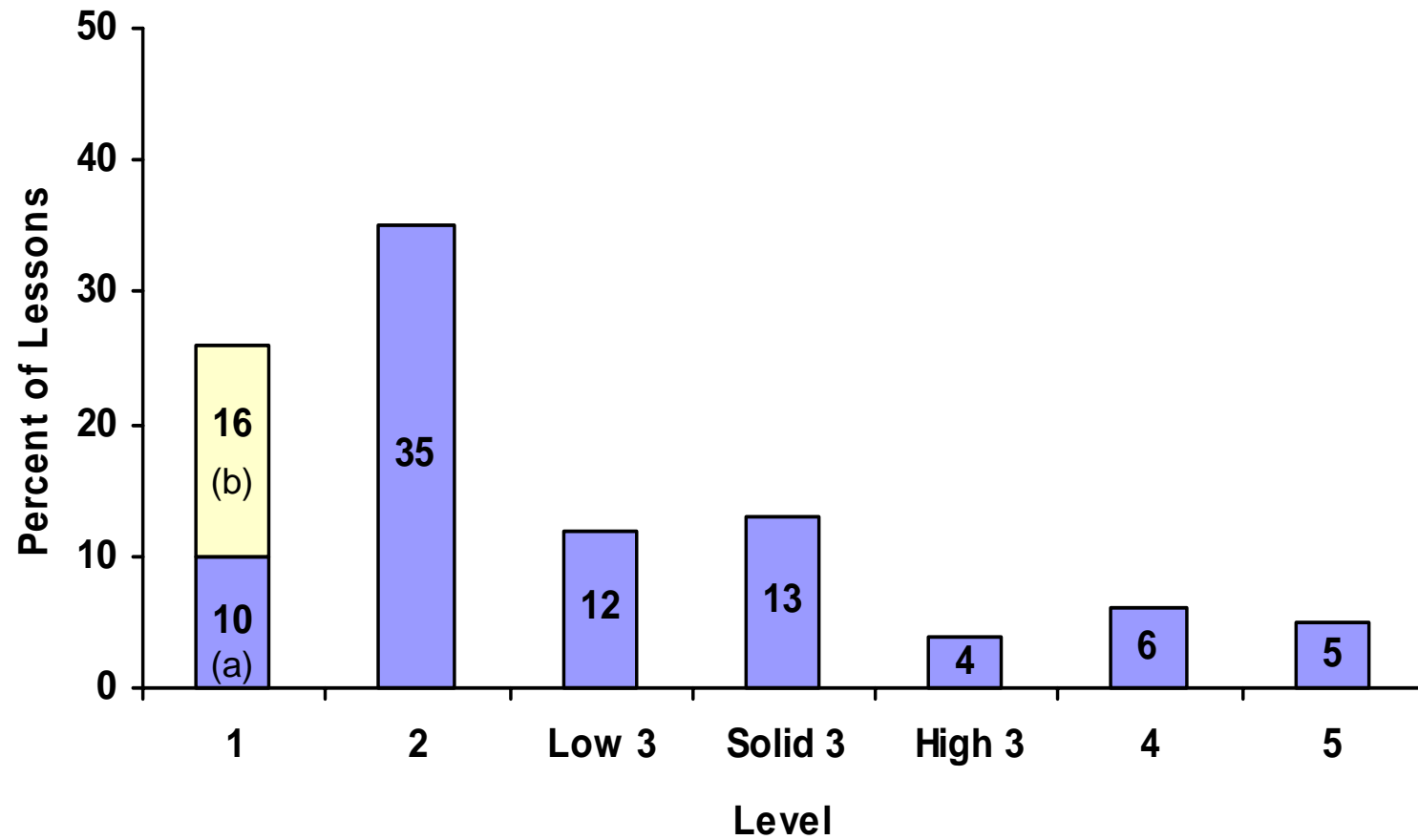


What percent of K-8
science lessons nationally
are “high quality”?

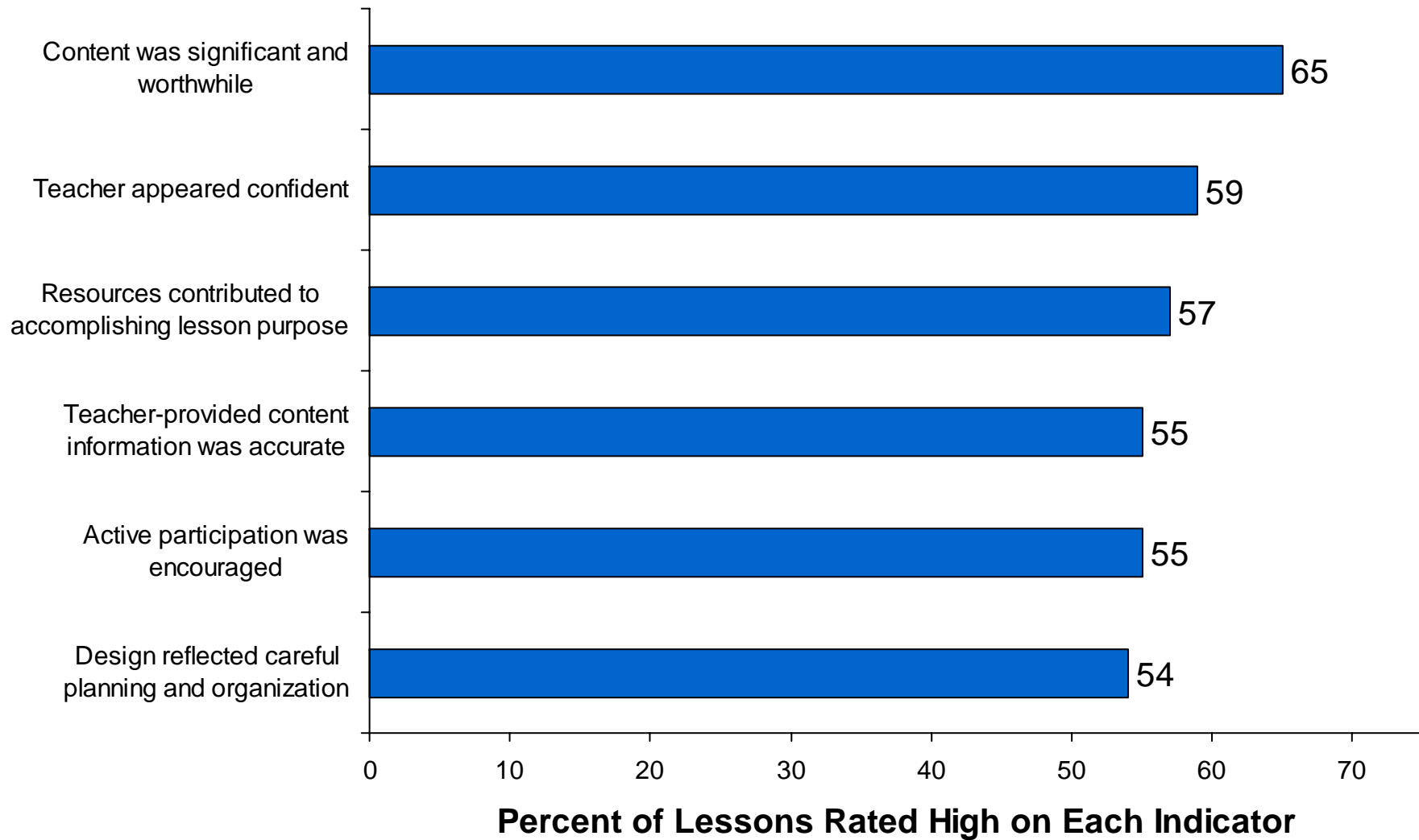
“Capsule” Rating Scale

- Level 1: Ineffective instruction
 - a. “passive learning”
 - b. “activity for activity’s sake”
- Level 2: Elements of effective instruction
- Level 3: Beginning stages of effective instruction (low, solid, high)
- Level 4: Accomplished, effective instruction
- Level 5: Exemplary instruction

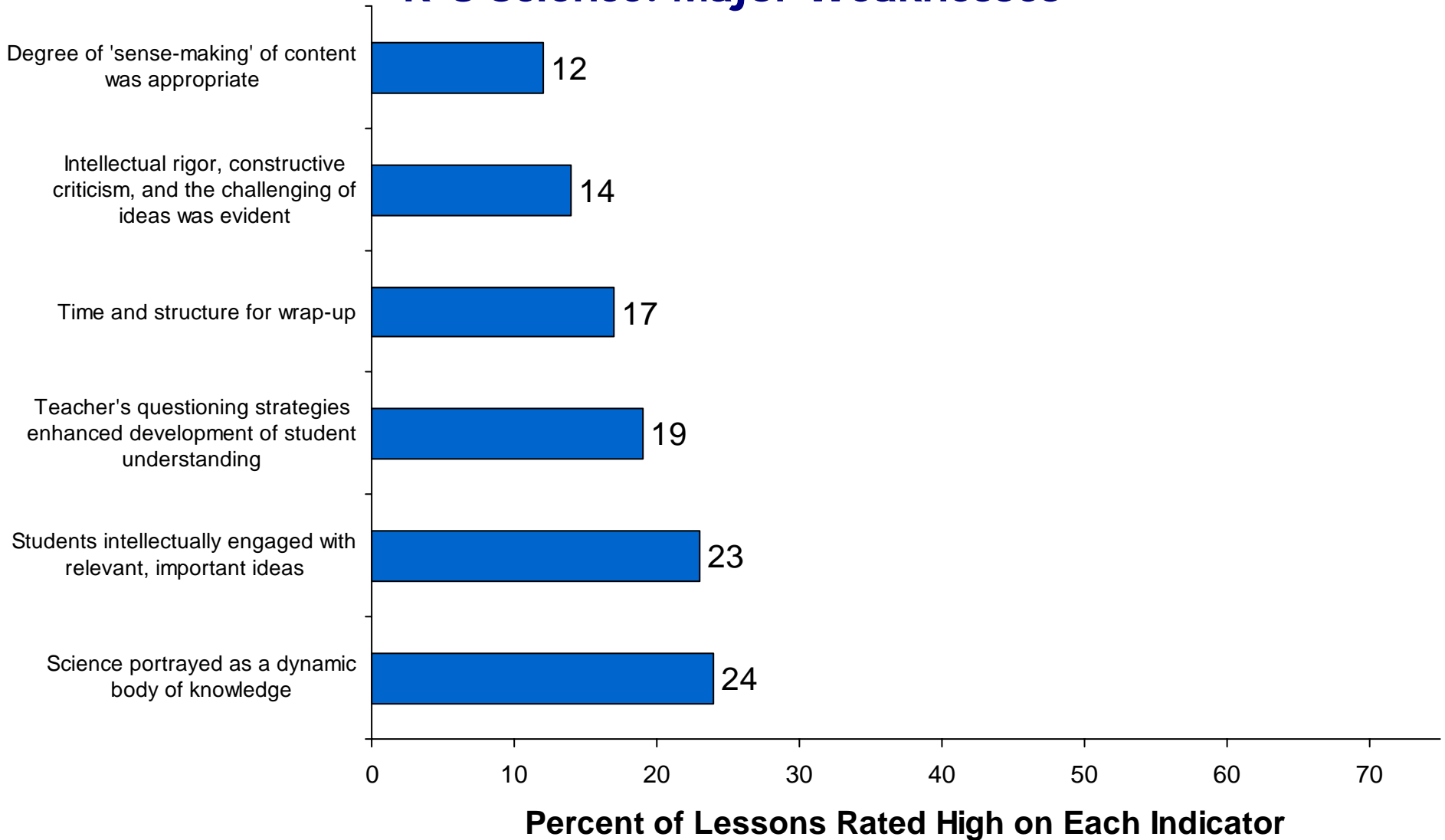
Capsule Ratings: K-8 Science Lessons



Inside the Classroom National Observation Study K-8 Science: Relative Strengths




Inside the Classroom National Observation Study K-8 Science: Major Weaknesses



Key Elements of High Quality Instruction

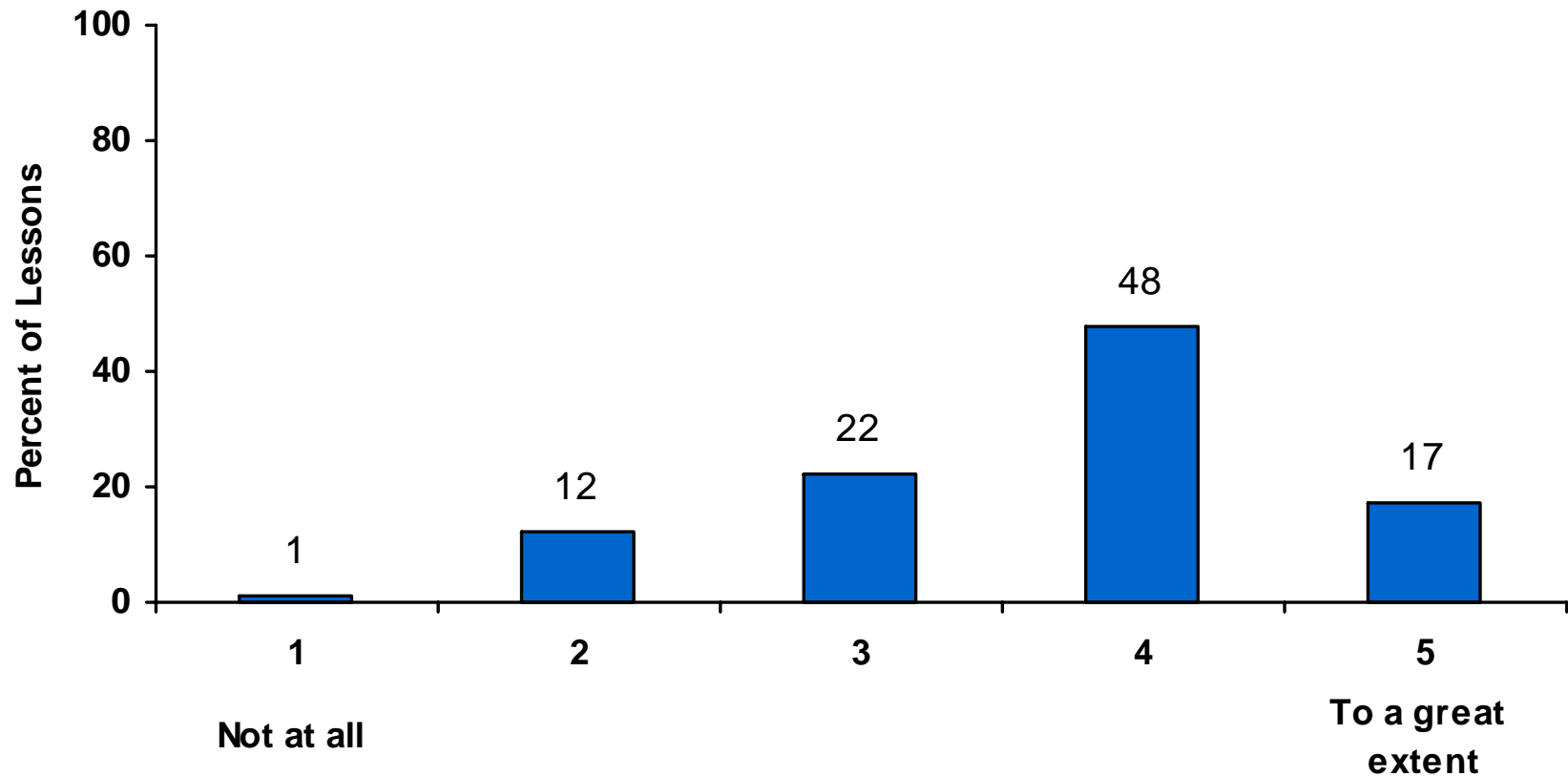
- Engage students with the science content;
- Create an environment conducive to learning;
- Ensure access for all students;
- Use questioning to monitor and promote understanding; and
- Help students make sense of the science content.



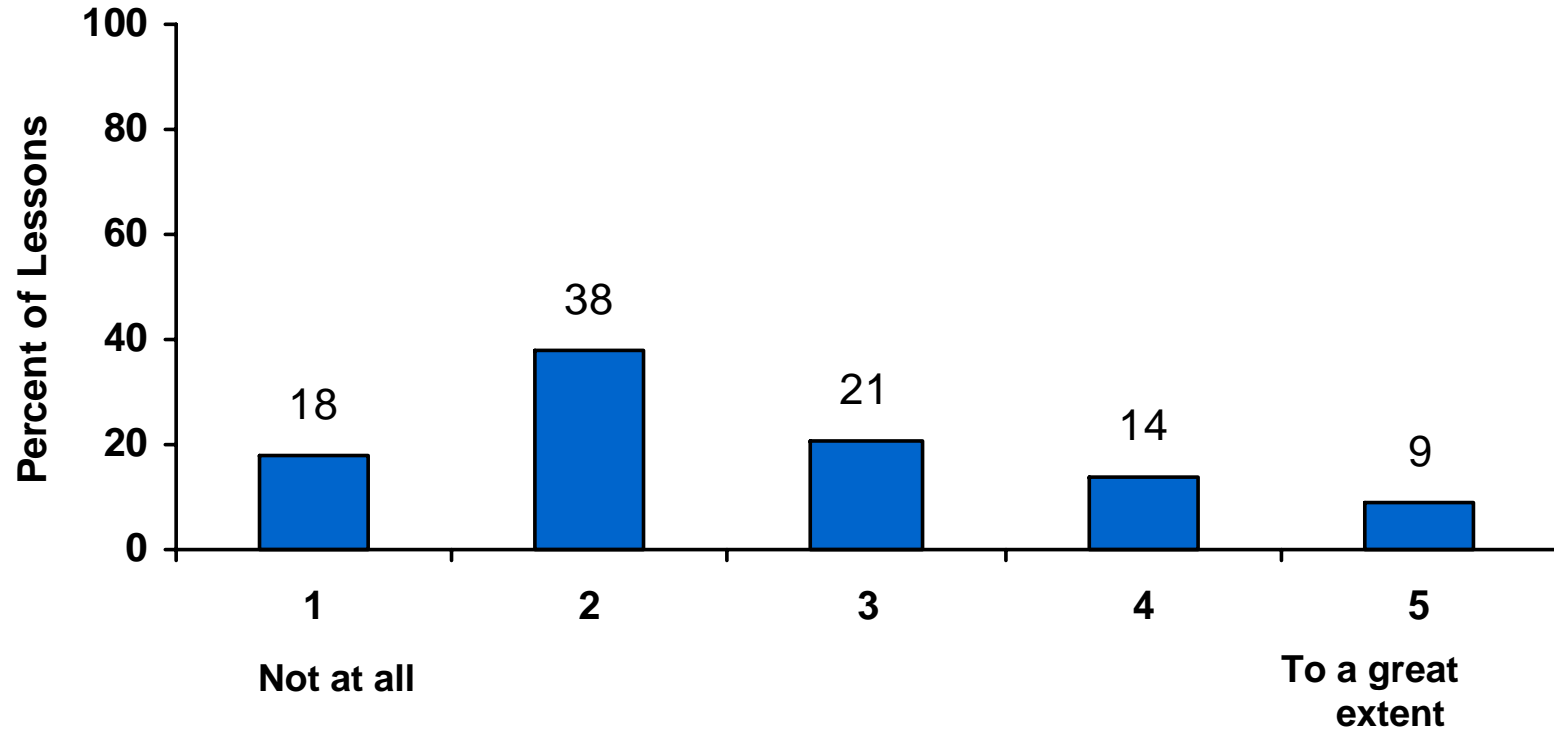
Engaging Students With Mathematics/Science Content

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Mathematics/Science Content Is Significant and Worthwhile: K-8 Science



Students Are Intellectually Engaged with Important Ideas Relevant to the Focus of the Lesson: K-8 Science



Many Lessons “Just Started”

- Turn to page 117 in your textbook
- We’re at IV.B. 2a in your lecture notes outline
- Today we’re doing activity 12; get your materials and begin working in your table groups.

In Contrast:

- As an introduction to the relationship between form and function in living things, the teacher in a 4th grade science class handed out a tail feather and a magnifying glass to each pair of students, and asked them to examine the feather, pull the barbs apart, and look for the hooks. They then pulled the feather between their fingers, making the barbs stick back together. The teacher then handed out a down feather and they repeated their investigations.


Portraying Science as a Dynamic Body of Knowledge

Not!!

An 8th grade science lesson was designed to give the students a great deal of factual information on Newton's Third Law of Motion. The students copied notes from the blackboard for half of the lesson, and the next half of the lesson was spent with the teacher asking them to recall information from the notes.

In Contrast:

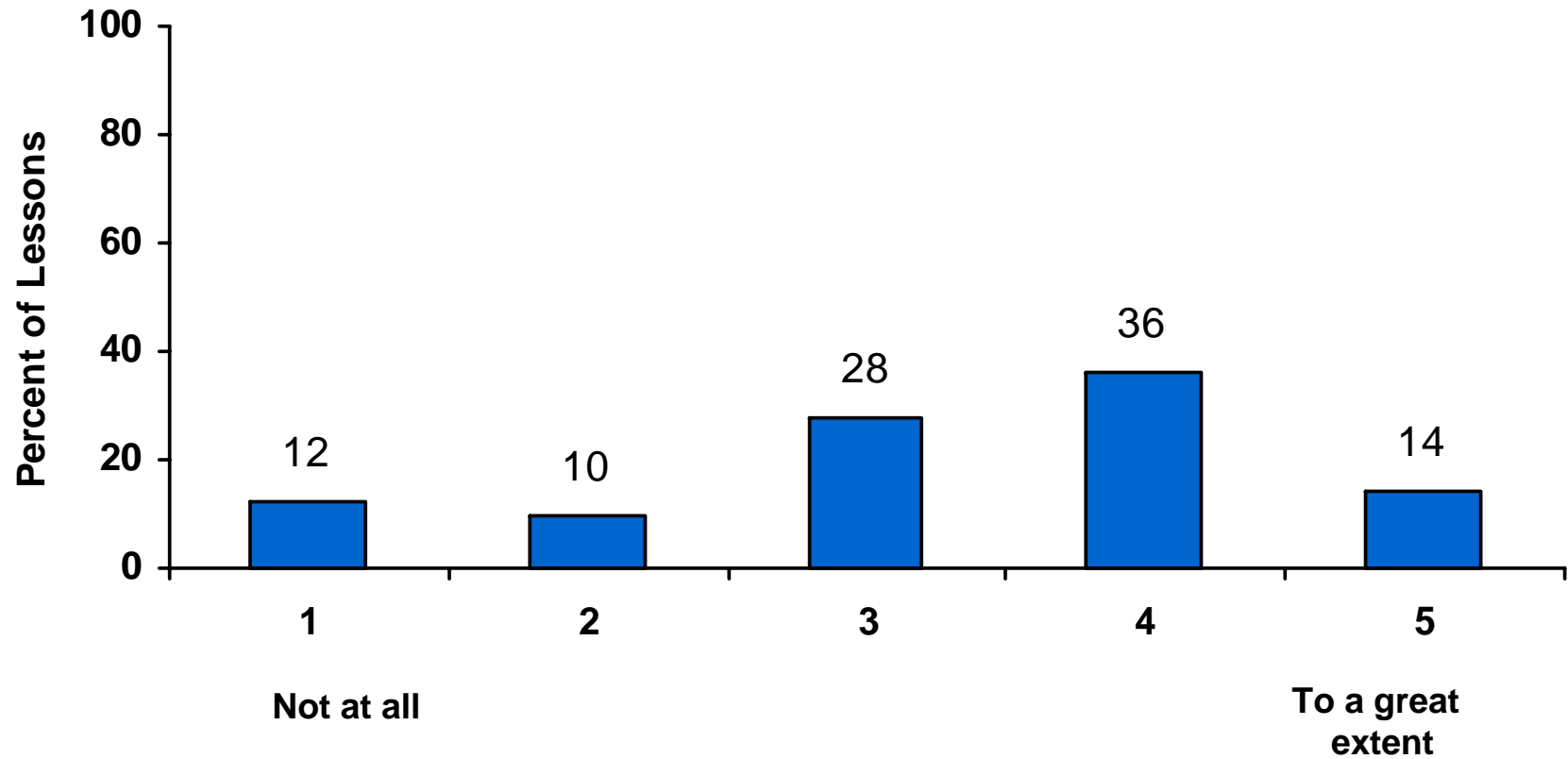
A 6th grade science lesson consisted of a teacher-led discussion of the process of sedimentary rock formation. By drawing upon the experiences and prior knowledge of the students, the teacher helped the students devise a model of how sedimentary rock is formed. For example, the teacher asked students, if they broke a vase, what they would need to fix it. The students decided that not only would they need glue, they would also need something to push the pieces together. The teacher then asked the students, "Where might the force come from [to push sand together to make sandstone]?" The teacher probed students until they considered possible sources of the pressure. This lesson emulated the scientific process of using observable data and knowledge of basic scientific principles to create a model of an unobservable process.



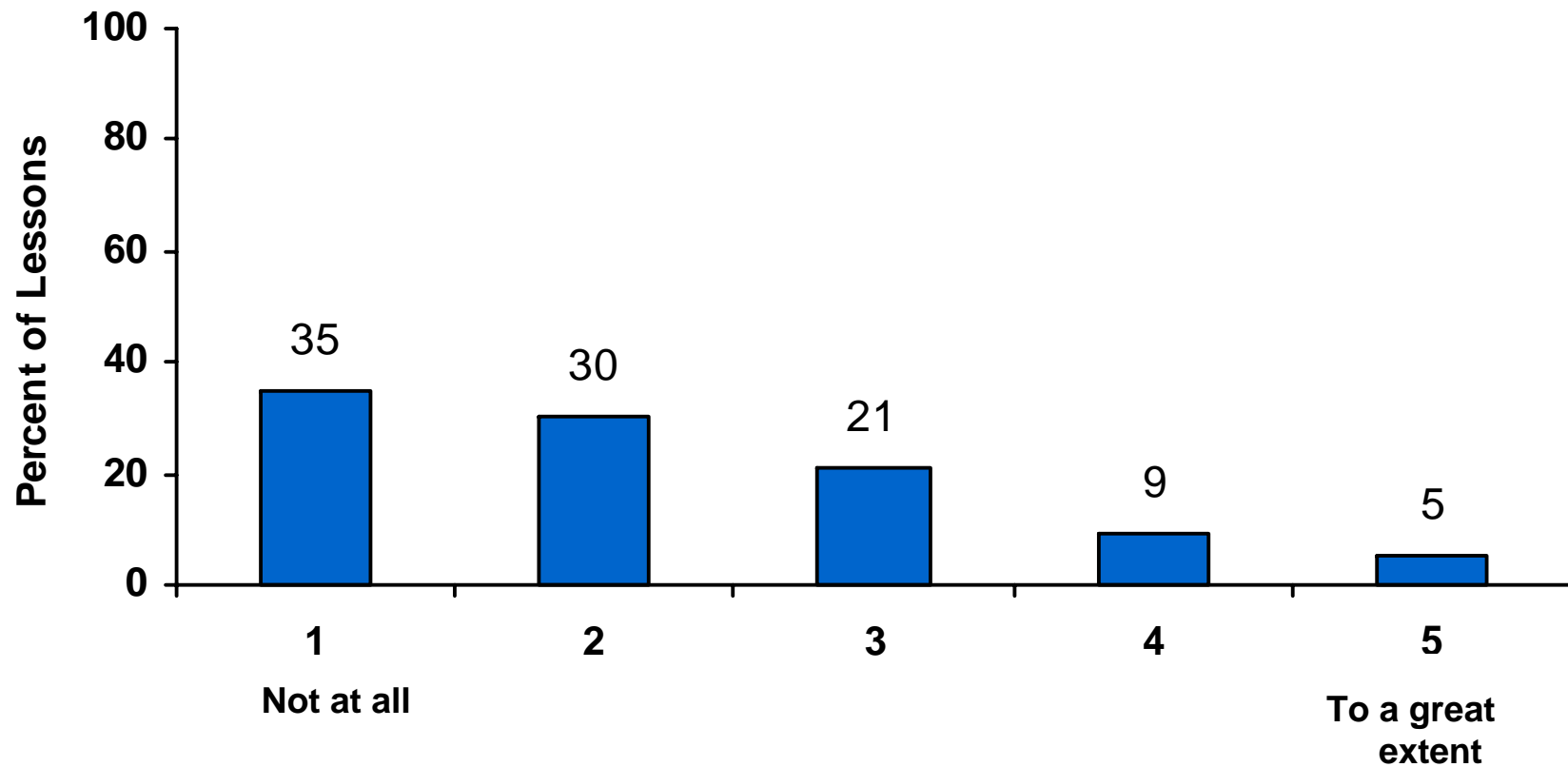
Creating an Environment Conducive to Learning


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Climate of Respect for Students' Ideas, Questions, and Contributions: K-8 Science



Intellectual Rigor, Constructive Criticism, and Challenging of Ideas Are Evident: K-8 Science





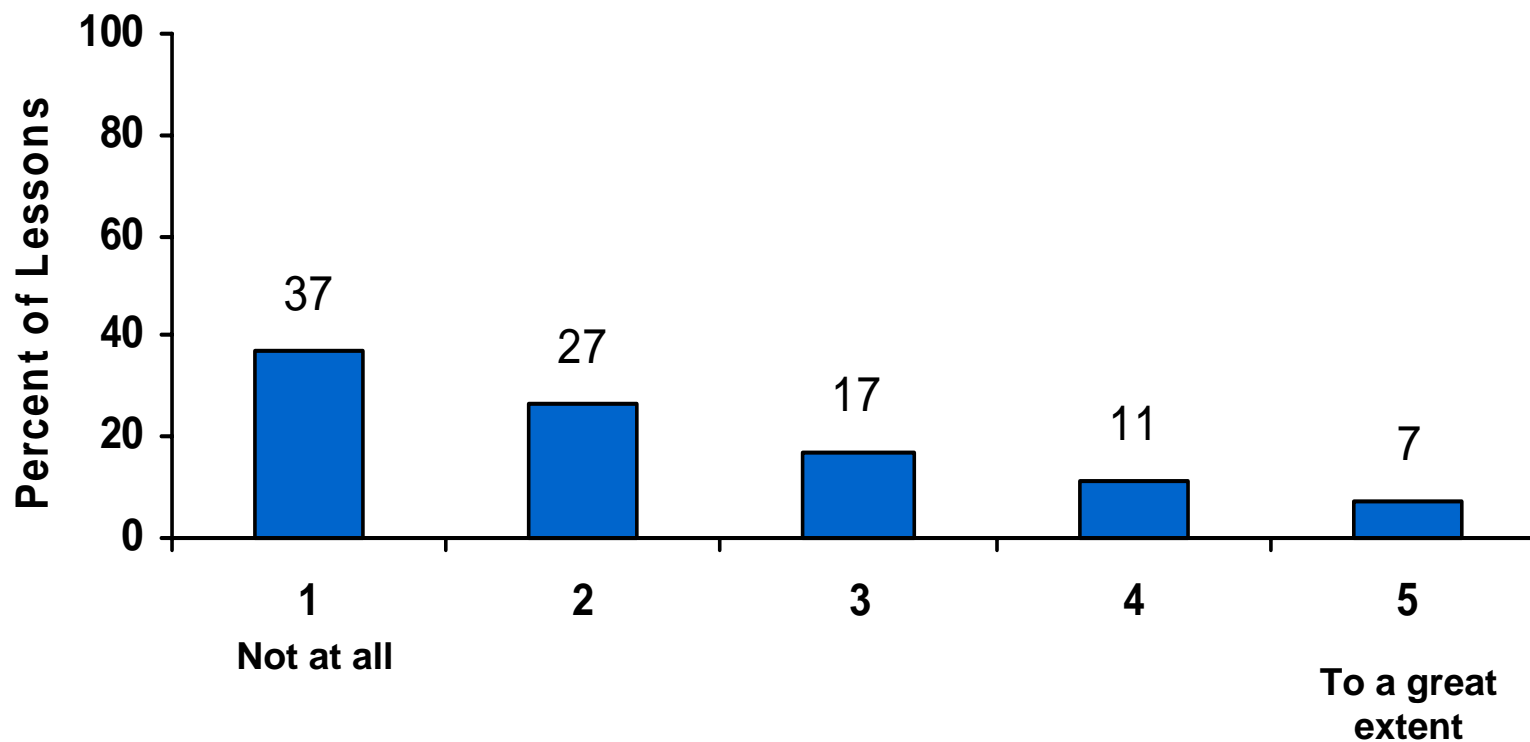
Helping Students Make Sense of the Science Content

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Questioning to Encourage Students to Think More Deeply

Teacher's Questioning Enhanced Development of Student Understanding/Problem Solving: K-8 Science



How would you rate the following question and answer session that took place in a 6th grade science lesson on weather and the atmosphere?


- Teacher: "The first layer is the what?"
- Students: "Troposphere"
- Teacher: "How many layers are there?"
- Students: "Four"
- Teacher: "What happens in the troposphere?"
- Student: "It rains"
- Teacher: "What happens in that layer?"
- [Students unsure]
- Teacher: "w, w, w..."
- Student: "Water?"
- Teacher: "What have we been studying?"
- Student: "Weather."
- Teacher: "What are four forms of precipitation?"
- Students: "Rain, snow, sleet, hail"



Sometimes teachers
answer their own
questions

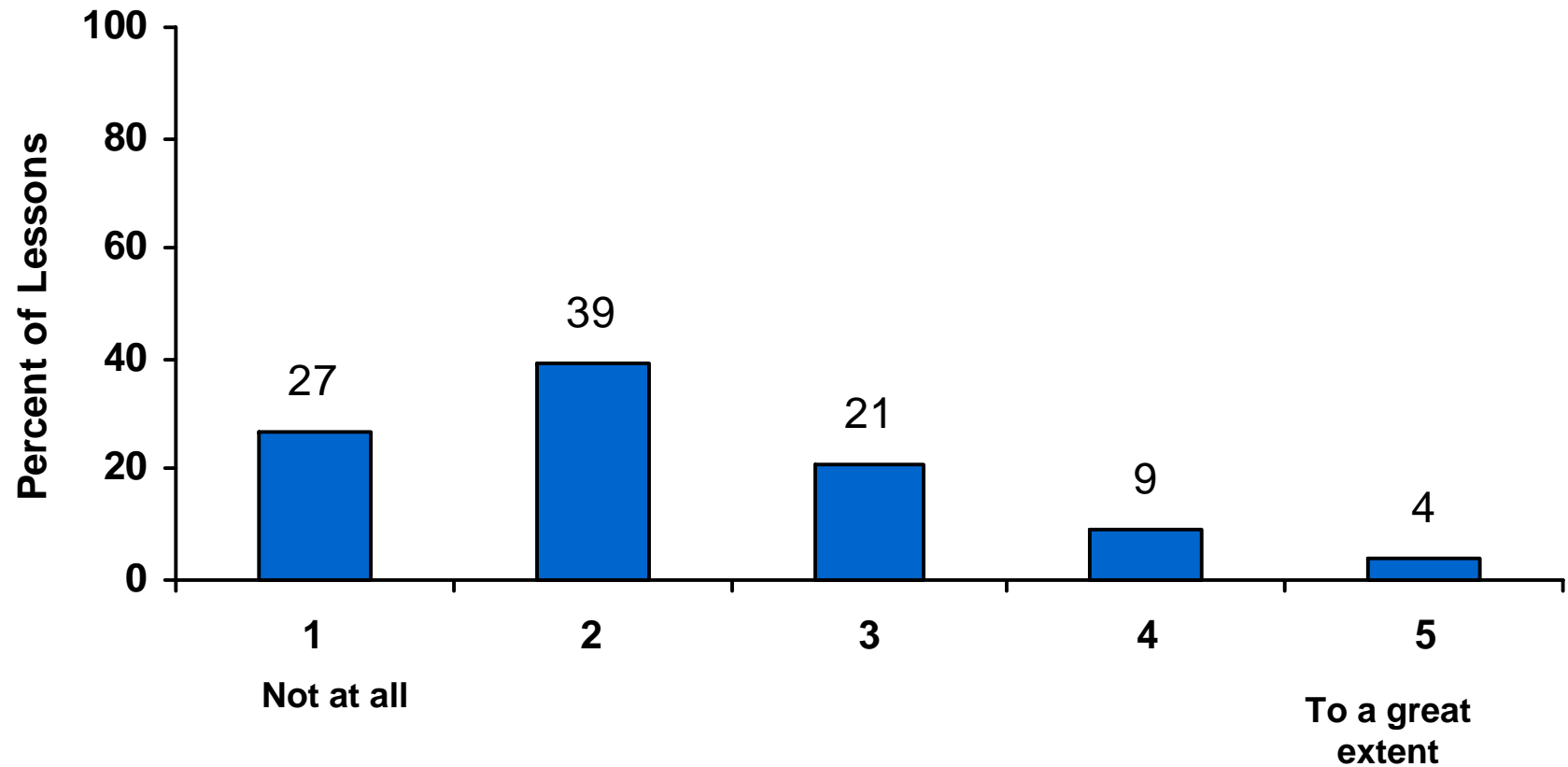
In Contrast:

As the students in a 10th grade science class were examining the results of their experiment, the teacher asked questions that pushed them to examine their results further and to provide evidence for their conclusions. Examples of questions asked by the teacher are: “How could we test if there is still sugar in the reservoir?” “Why didn’t it [the iodine indicator] reach equilibrium?” and “How do you know?”



Inadequate
attention to “sense-
making”

Degree of Sense-Making Is Appropriate for This Lesson: K-8 Science



The bottom line:

- Choice of instructional strategy doesn't appear to be as important as some have suggested.
- The key appears to be first providing students an opportunity to engage with important science concepts and then ensuring that they in fact make sense of these concepts.



Strategy:

Integrating literacy and science to capitalize on teachers' strong suit in strengthening an area of need.



Goal:

Improved education for all students, not just volunteers.

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Scaling Up \neq Going to Scale

(Elmore, 1996)

Start with promising interventions

- Understand the nature and extent of needs in your context
- Select effective, promising intervention approaches for linking science and literacy
- Pilot the interventions to get the “kinks” out and demonstrate their effectiveness in your context



What do we know
about effective
professional
development?

Professional Development: The Consensus View

- Focuses on a well-articulated mission or purpose anchored in student learning of core disciplines and skills
- Derives from analysis of student learning of specific content in a specific setting

Professional Development: The Consensus View

- Focuses on specific issues of curriculum and pedagogy
 - Derived from research and exemplary practice
 - Connected with specific issues of instruction and student learning of academic disciplines and skills in the context of actual classrooms

Professional Development: The Consensus View

- Embodies a clearly articulated theory or model of adult learning
- Develops, reinforces, and sustains group work
 - Collaborative practice within schools
 - Networks across schools
- Involves active participation of school leaders and staff
- Sustains focus over time—continuous improvement

(Elmore, 2002)

Professional Development: The Consensus View

- Models effective practice
 - Delivered in schools and classrooms
 - Practice is consistent with message
- Uses assessment and evaluation
 - Active monitoring of student learning
 - Feedback on teacher learning and practice

(Elmore, 2002)

Local Systemic Change (LSC) Projects

- Designated instructional materials
- 130 hours of professional development
- Target all teachers, not just volunteers
- Address the “system” constraints and incentives

Relative Strengths of the LSC Professional Development

- Climate of respect for participants' experiences, ideas, and contributions
- Active participation of all was encouraged and valued
- Facilitator(s) displayed an understanding of concepts
- Facilitator(s)' background, experience, and/or expertise enhanced the quality of the session

Relative Strengths of the LSC Professional Development


- Content appropriate for purposes of session and participants' background
- Encouraged a collaborative approach to learning
- Facilitator(s) contributions enhanced the quality of the session
- Provided opportunities for teachers to consider classroom applications of resources, strategies, and techniques
- Incorporated tasks, roles, and interactions consistent with the spirit of investigation

Relative Weaknesses of the LSC Professional Development


- Participants were intellectually engaged with important ideas relevant to classroom practice
- Including “framing” the activity to help participants understand the session purpose
- Intellectual rigor, constructive criticism, and challenging of ideas were evident
- Attention to student thinking/learning was appropriate for the session’s purpose and participants’ needs

Relative Weaknesses of the LSC Professional Development


- Adequate time and structure provided for 'sense-making'
- Extent of 'sense-making' about classroom practice was appropriate for session purpose and adult learners' needs
- Extent of 'sense-making' of content was appropriate for session purpose and adult learner needs
- Facilitator effectively modeled questioning strategies
- Adequate time and structure were provided for wrap-up



Note the similarities in strengths and weaknesses of professional development and classroom instruction

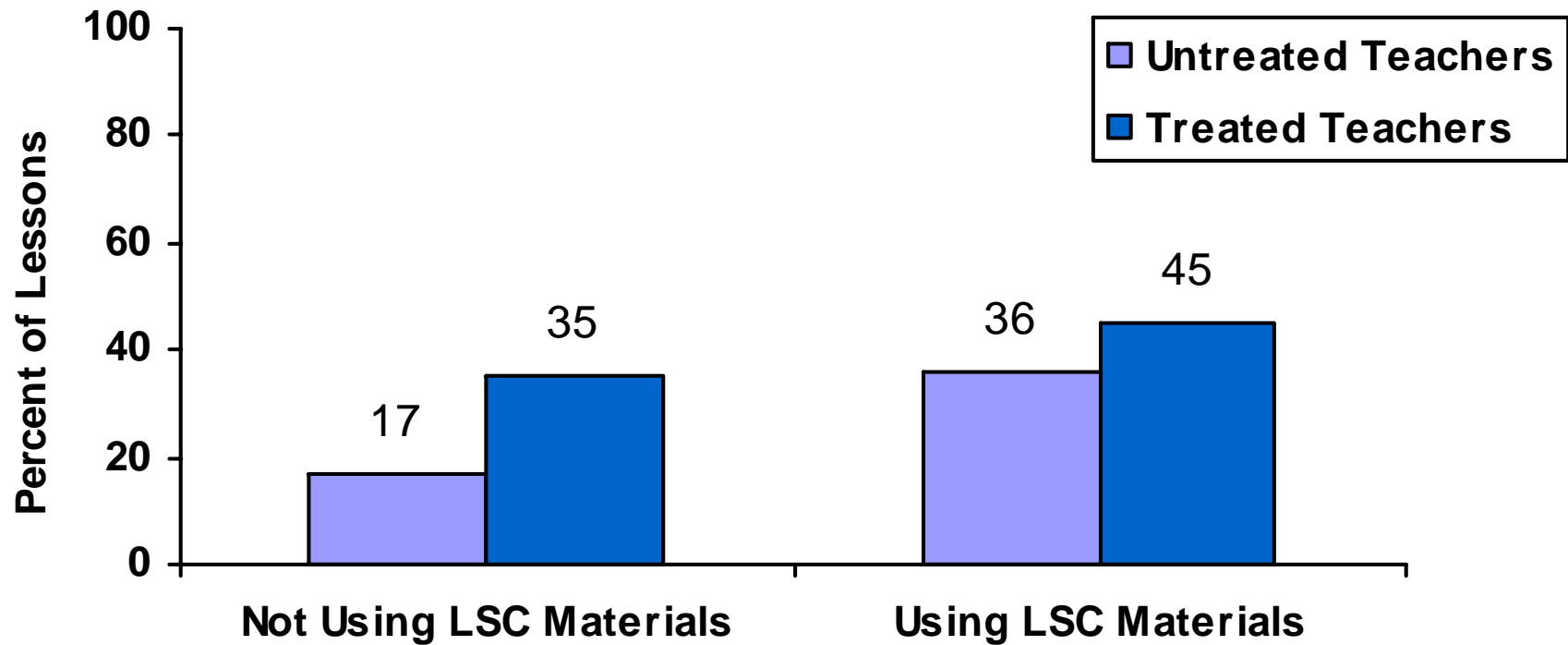


Based on teacher self report, LSC professional development leads to improvements in teacher preparedness and classroom practice.



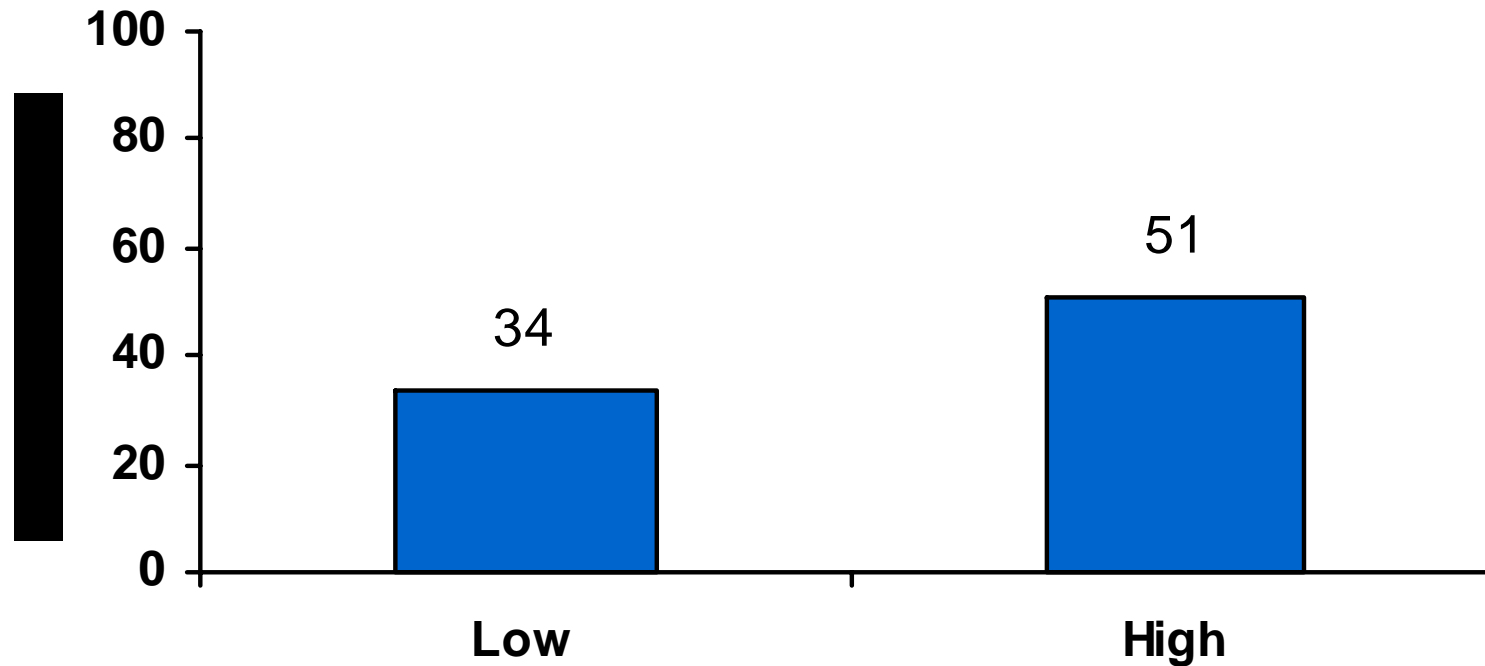
Based on classroom observations, LSC professional development and use of LSC materials leads to improvements in classroom practice.

Highly-Rated Lessons, by Use of LSC-Designated Materials and Treatment




(Weiss et al., 2004)

Highly-Rated Lessons, by Adherence to LSC-Designated Materials



(Weiss et al., 2004)



But PIs reported that the lessons they observed typically fell short of current vision on areas such as the use of higher order questioning, and making sense of data.

(Pasley, 2002)

“In each classroom visited for this study, pieces of the professional development workshops were incorporated in the lesson, such as graphic organizers, word lists, question folders, or use of predictions. There was also room for improvement in every classroom. It was not always clear that teachers were really seeing the underlying reasons for some of the activities. Because most of those I observed were somewhat new to the module, their use seemed to be fairly mechanical.”



Mechanical Use

Creative Use

Purposeful Use

Old View of PD

- Individual teachers attend summer workshops on college campuses
- Generic PD (e.g. “cooperative learning”)
- Content taught separately from pedagogy
- Evaluation of how much teachers “like” the PD

New View of PD

- More emphasis on working with all or critical masses of teachers, at district sites, during academic year
- Content-based PD
- Integration of content and pedagogy in the context of “cases” and other practice based materials
- Evaluation of impact on teachers and students



Effective interventions are necessary but not sufficient for going to scale.

Need to garner support from key stakeholders

- Identify the key stakeholders
- Build support for the reform vision
- Leverage the support of influential stakeholders

Principals are particularly important stakeholders

"We realized that if principals are not behind you, if they're not supporting you, then you're not going to get a lot of the teachers out. If principals are not behind it, there's very little opportunity for change."

"What we found, it was really a function of the principals as to whether [the LSC] stayed as a priority for the five years."

"The vision of the principal is a key determinant of how well standards-based science is implemented within a school."

"Never stop working with principals. You can never do enough to get them to understand what this kind of science is all about, what it looks like in the classroom, what it means in terms how it enhances their vision of literacy acquisition. The most important cog in the wheel is the building principal."

Need to align policy with the reform vision

- Identify the most influential policies and have a plan for dealing with them
- Leverage aligned policies to move forward
- Seek and create opportunities to align policies with reform vision

Need to scale up interventions with quality

- Develop human resources
- Develop infrastructure
- Create a system for maintaining quality during scale up.

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