

# **Professional Development Strategies for Mathematics Improvement**

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# AGENDA

- Current state of affairs in mathematics teaching
- What have we learned from 10 years of LSC research?
- Looking inside the classroom

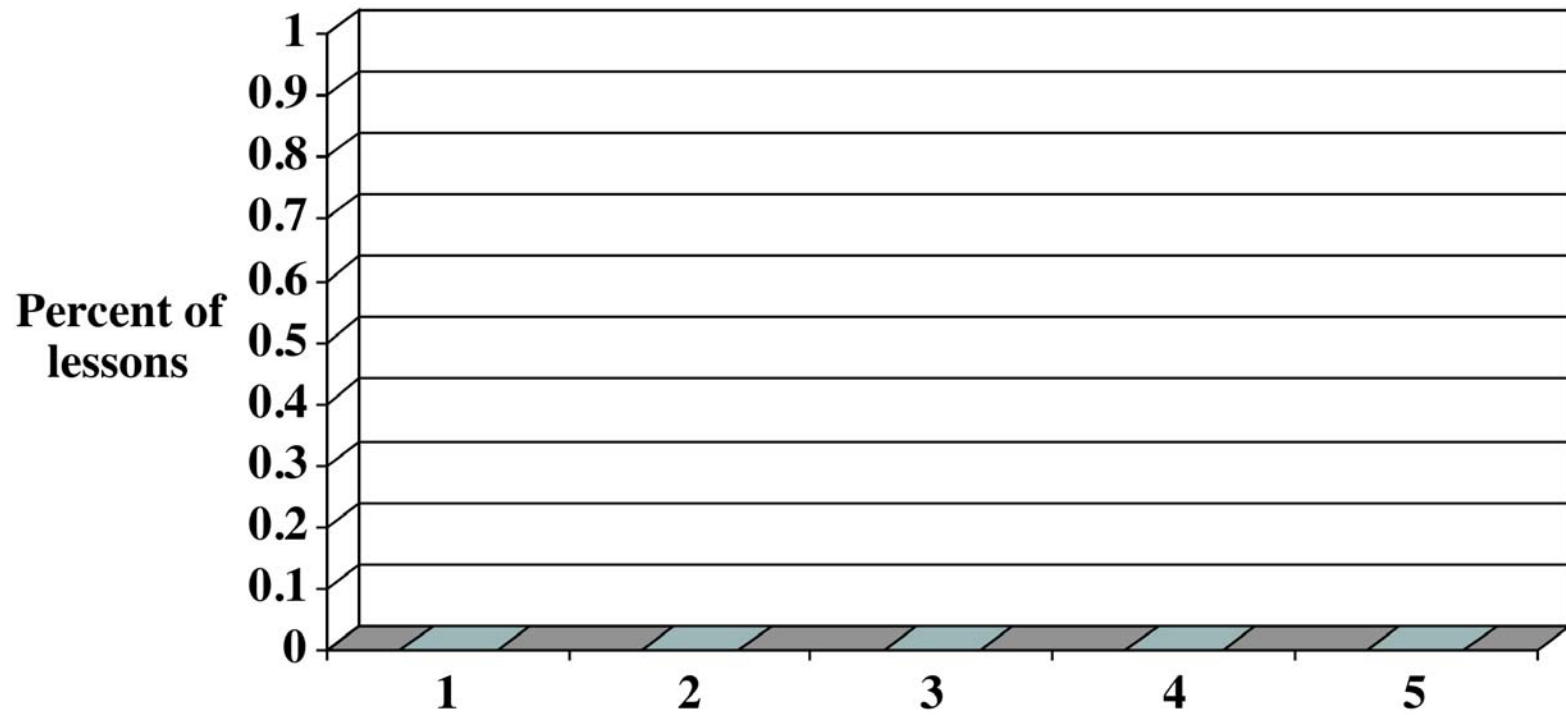
If you could visit a sample  
of K-12 classrooms across  
the nation...

what percent of  
mathematics and science  
lessons would you expect  
to see that are “high  
quality”?

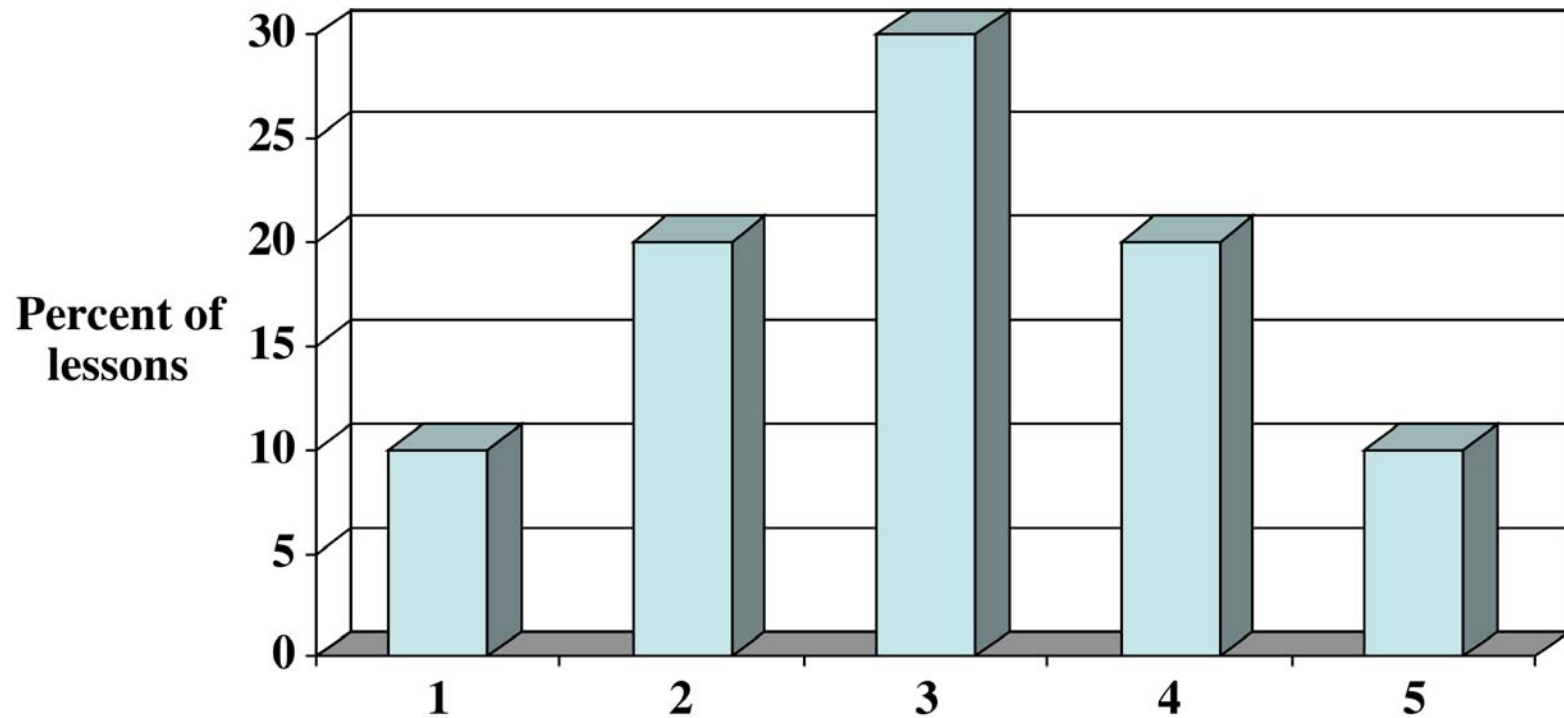
# “Capsule” Rating Scale

- 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

# What Do You Think?



# What Do You Think? Will It Look Like This?

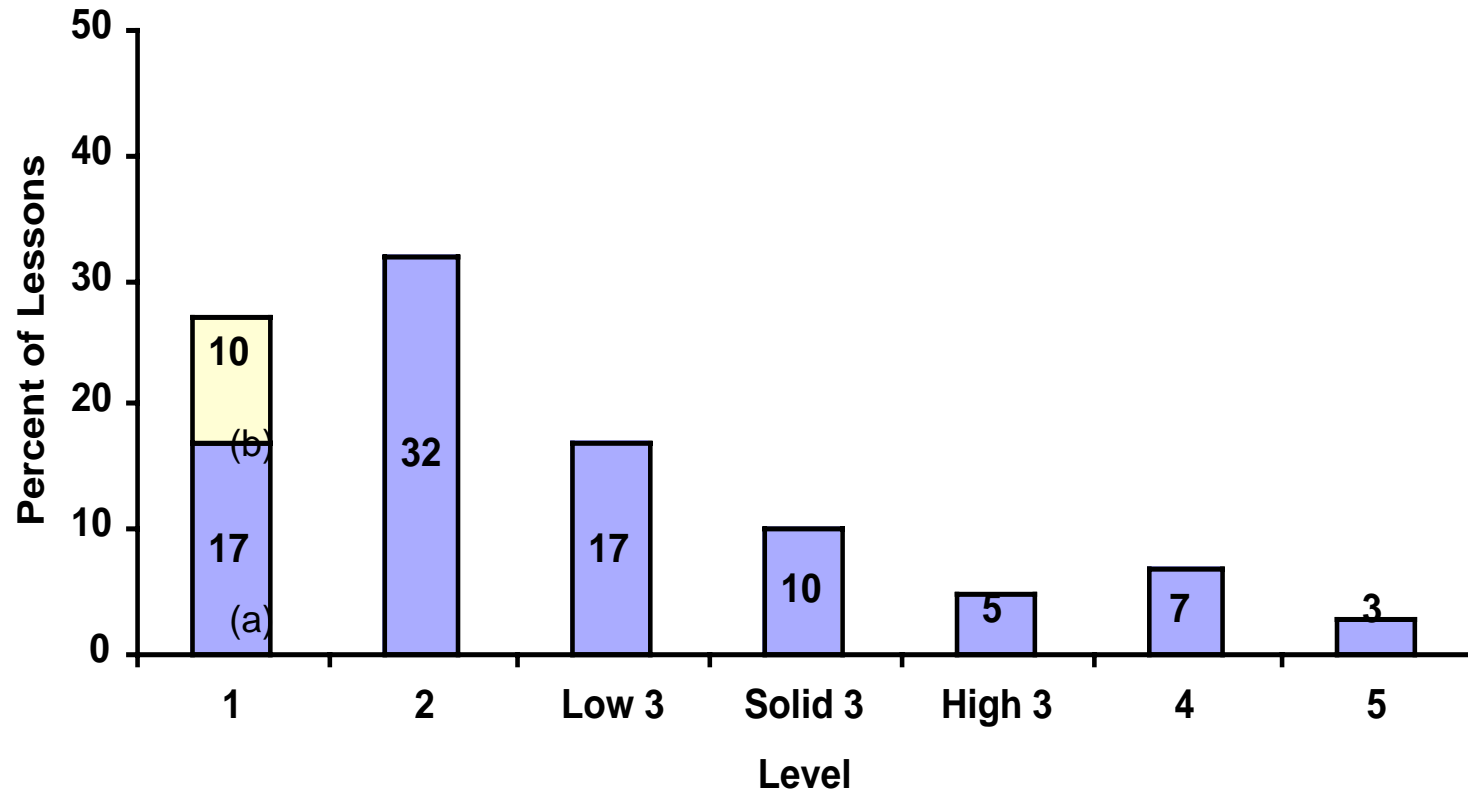


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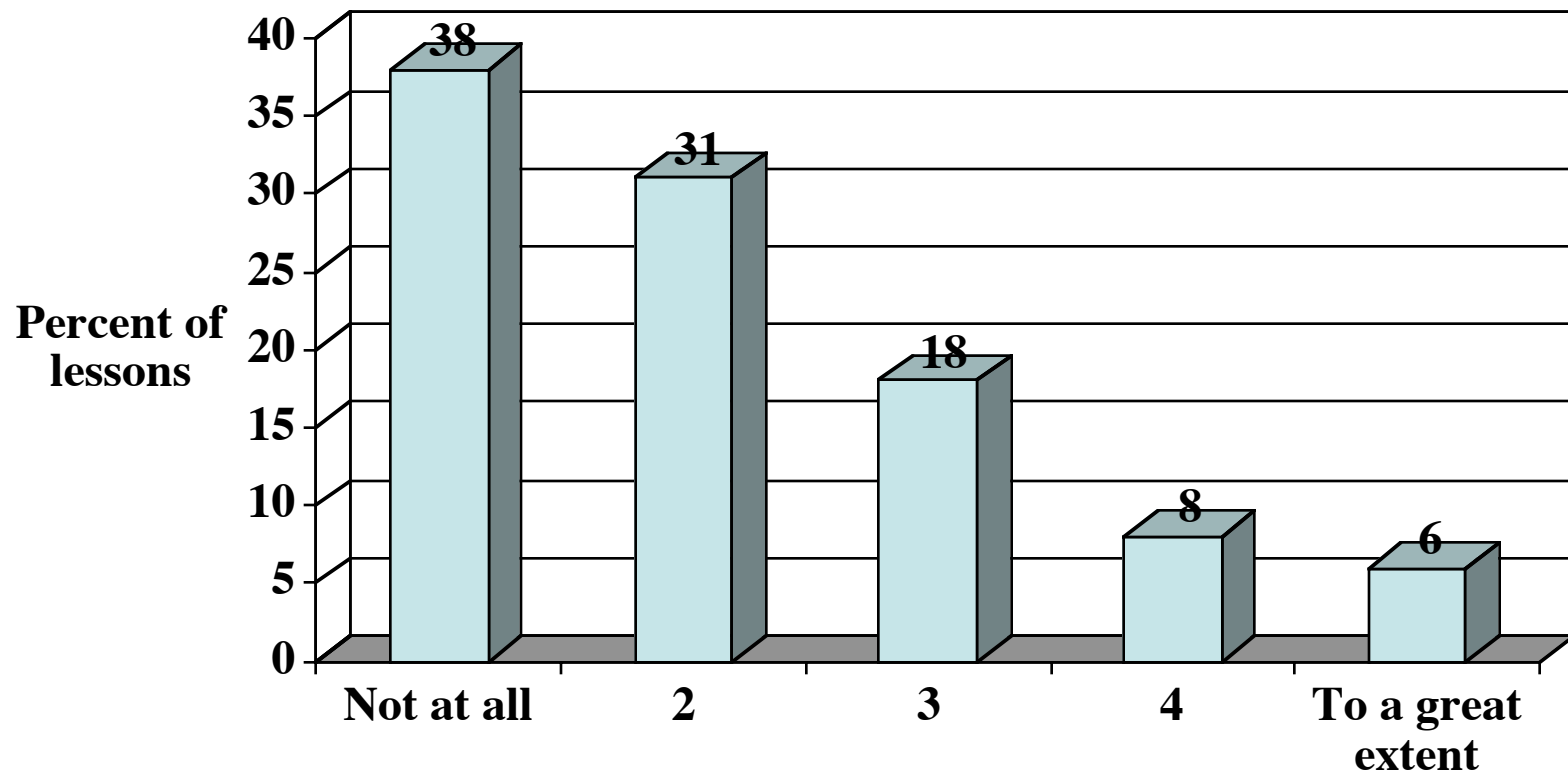


# Capsule Ratings: K-12 Mathematics and Science Lessons

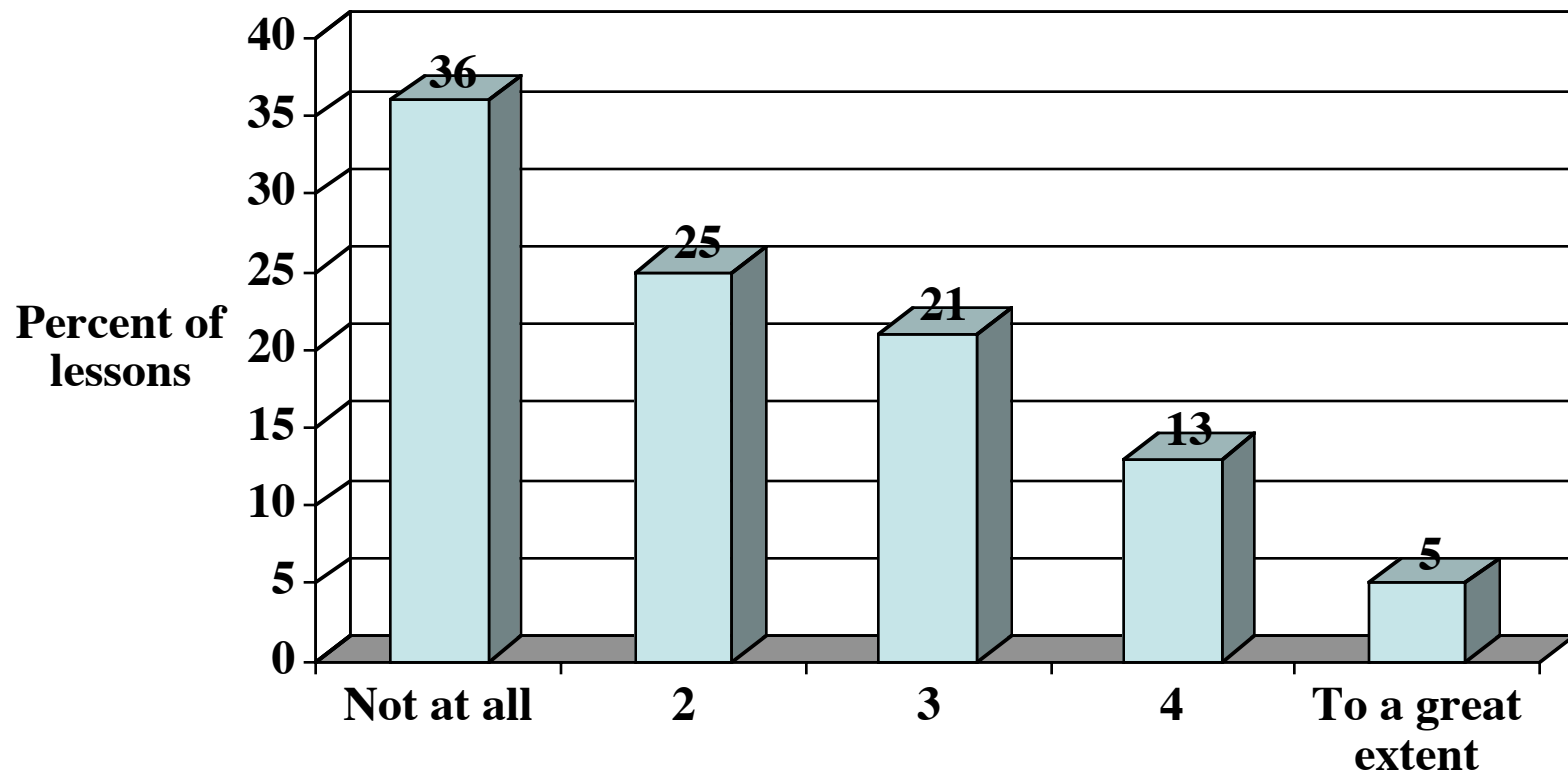


Looking Inside the Classroom, Horizon Research 2003

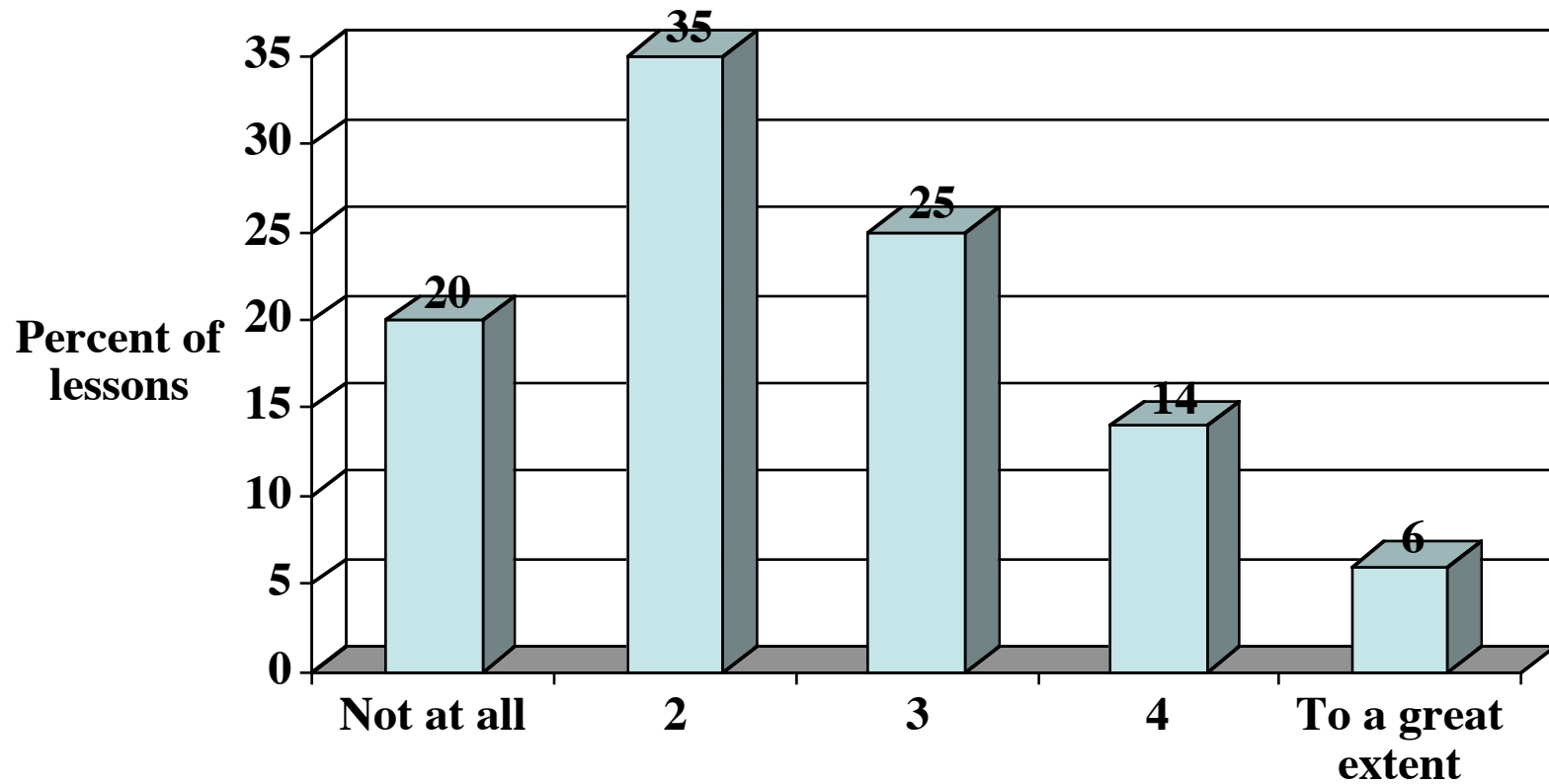
# Intellectual rigor, constructive criticism & challenging of ideas



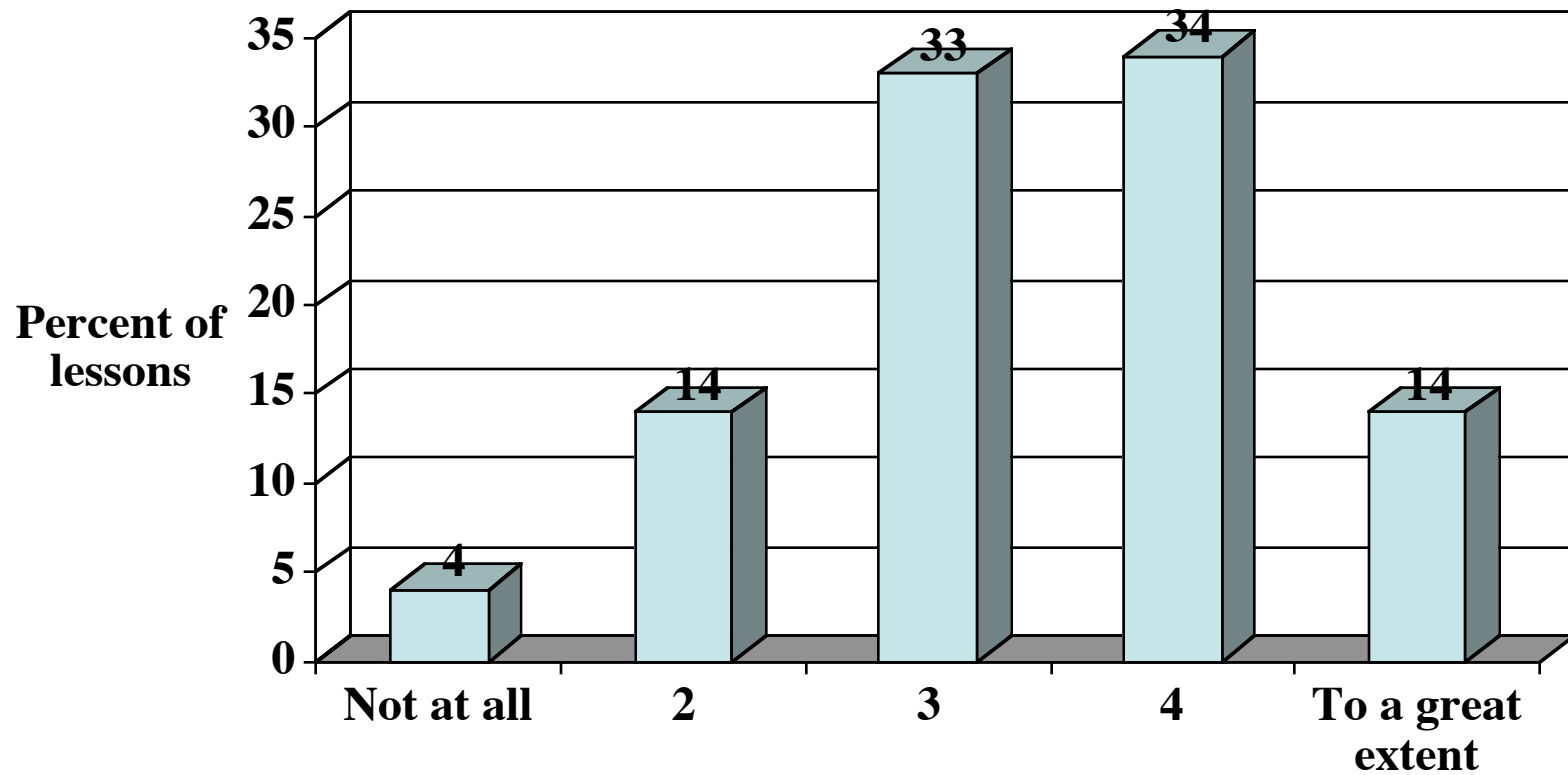
# Math/science portrayed as dynamic body of knowledge



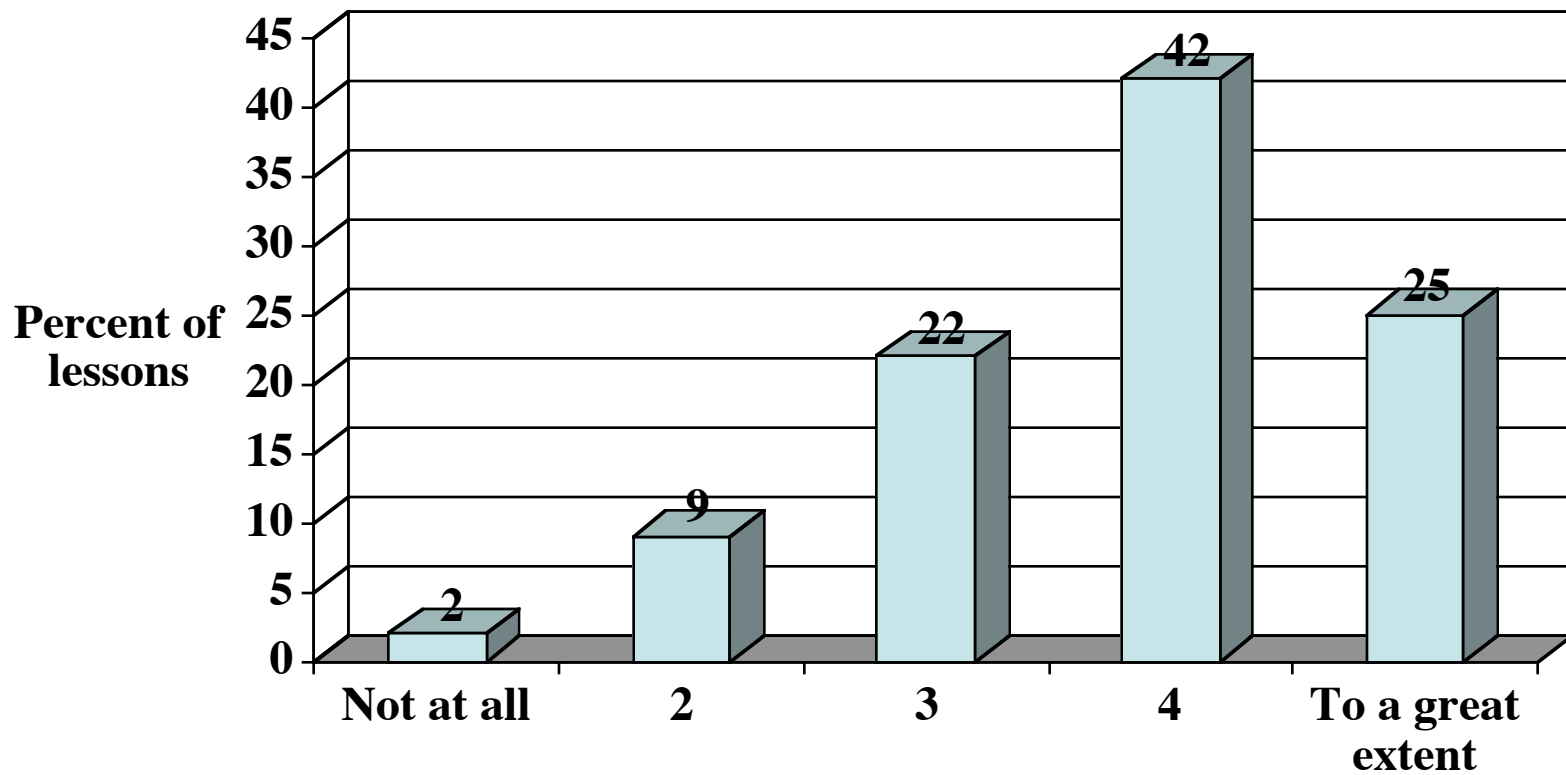
# Students intellectually engaged with important ideas



# Content is developmentally appropriate



# Content is significant and worthwhile



Given this state of affairs,  
what are the leverage  
points to improve the  
quality of classroom  
lessons?

# LSC Principles

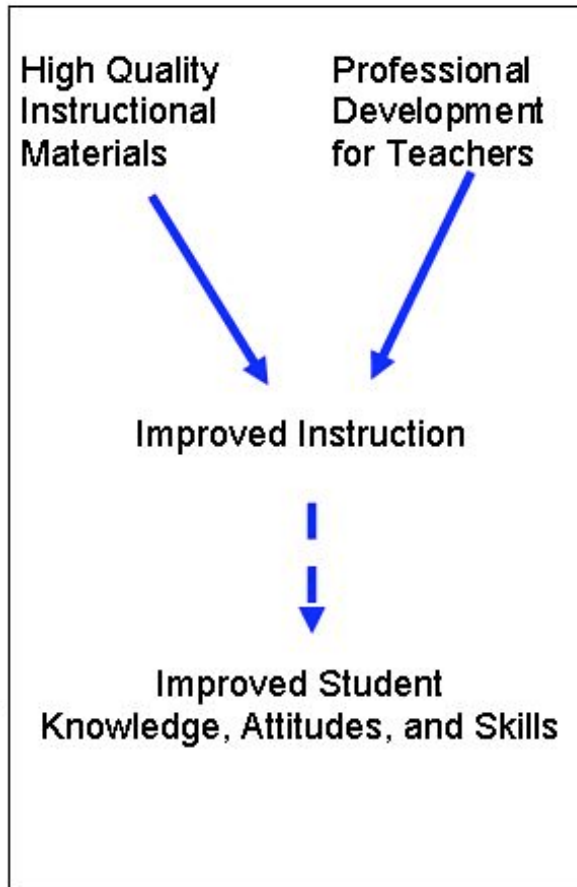
- Well-prepared professional development providers
- Supportive professional development culture
- Experiences to deepen teachers' content knowledge
- Opportunities to become familiar with:
  - Instructional materials
  - Appropriate pedagogy
- Implementation support



# LSC Theory of Action

## Supportive Context for Teaching

- Appropriate curriculum, assessment, materials management
- Time for teachers to plan, collaborate
- Support from administrators
- Support from parents and community



## Sustained Professional Development System

- Capacity
- Structures
- Resources

# Core Evaluation Activities

## *Teacher-level*

- Teacher Questionnaires
- Teacher Interviews
- Classroom Observations

# Core Evaluation Activities

## *Teacher Questionnaires*

As of 2003, nearly **75,000 teacher questionnaires** were returned to HRI:

- 36,828 from K–8 science teachers
- 24,903 from K–8 mathematics teachers
- 11,206 from 6–12 mathematics teachers
- 2,021 from 6–12 science teachers

# Core Evaluation Activities

## *Teacher Interviews*

- A total of **1,782 interviews** in 76 projects were used for the capstone report analyses.

## *Principal Questionnaires*

- A total of **17,380 principal questionnaires** were used in the capstone report analyses.

# Core Evaluation Activities

## *Classroom Observations*

- The data set used in the capstone report analyses included **1,610 lesson observations**.

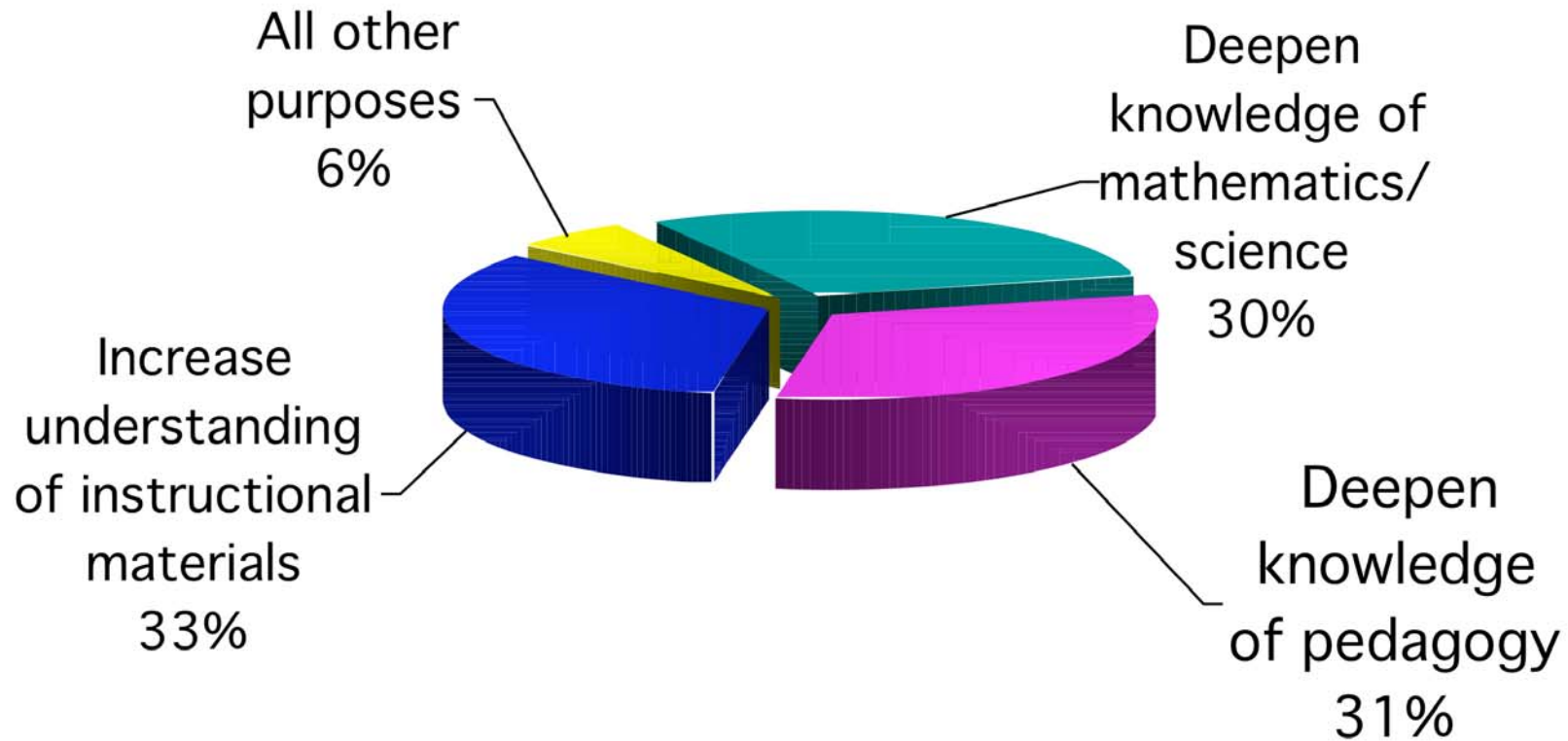
## *Observations of Professional Development Activities*

- The capstone report analyses utilized data from **2,185 observed sessions**.

What did ten years of  
research on the LSC  
program find?

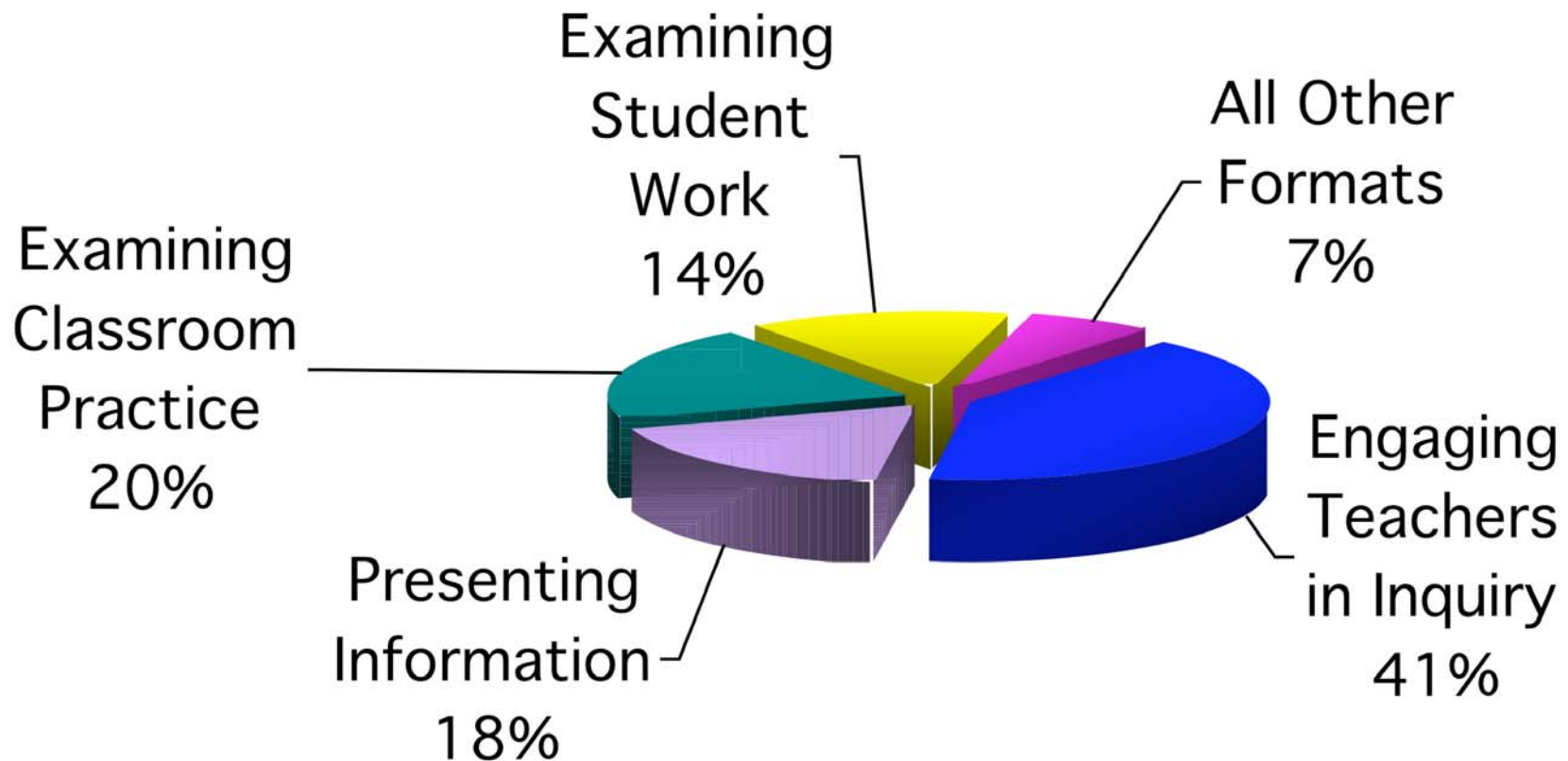
# Purpose of Professional Development

(Average Percent of Professional Development Hours)



# Format of Professional Development: Mathematics

(Average Percent of Professional Development Hours)





# Impact on Teachers and Teaching

Teachers' participation in LSC professional development is linked to a number of positive outcomes in their instruction, including:

- Overall improvement in the quality of mathematics /science lessons
- Enhanced quality of content presented to students
- More frequent use of investigative practices, questioning, and sense-making practices
- A greater likelihood that the classroom culture promotes intellectual rigor and student engagement

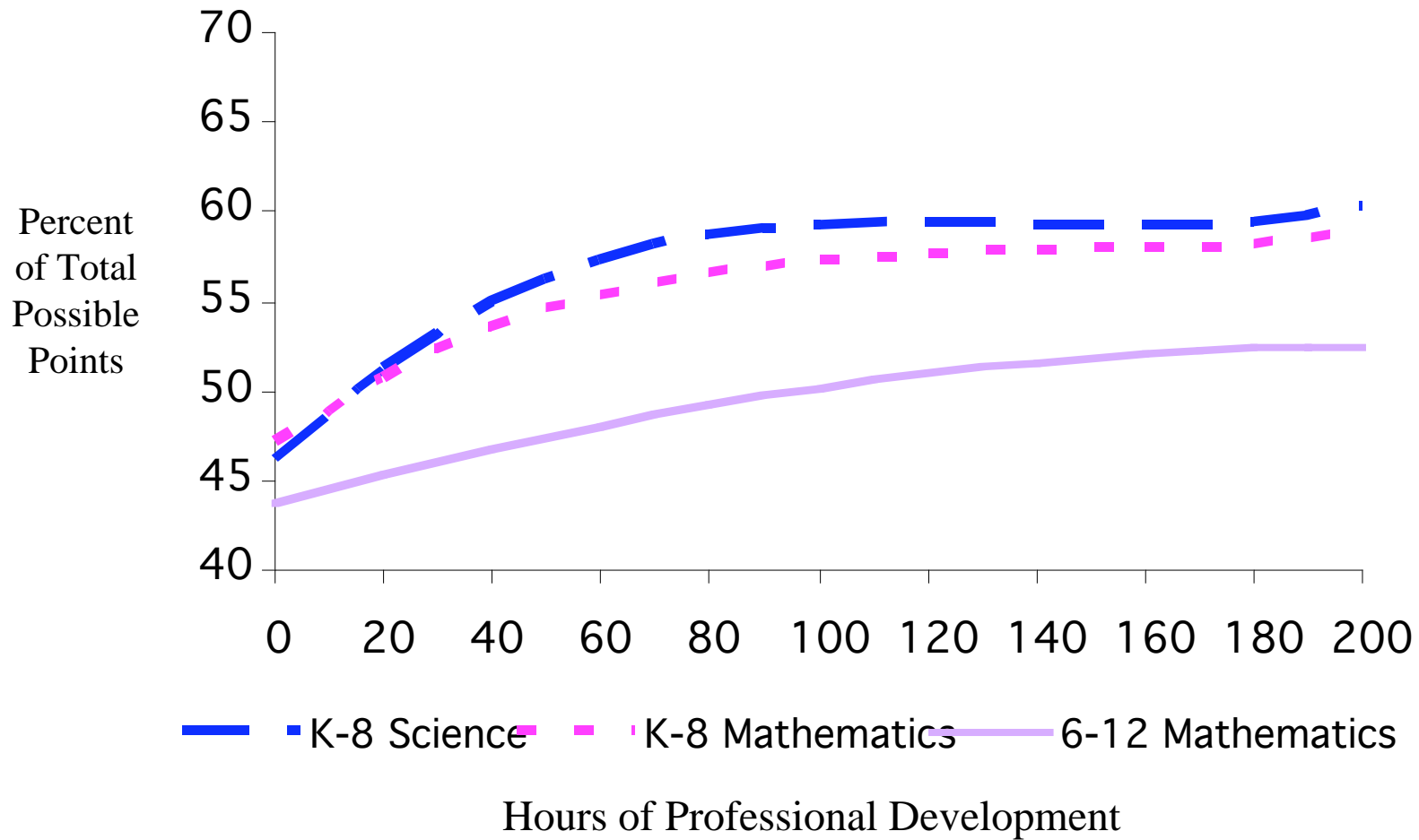
# Impact of LSC on Teachers

LSC professional development had a positive impact on:

- Teachers' attitudes toward reform-oriented teaching in mathematics and science
- Teachers' perceptions of their content and pedagogical preparedness to teach these subjects

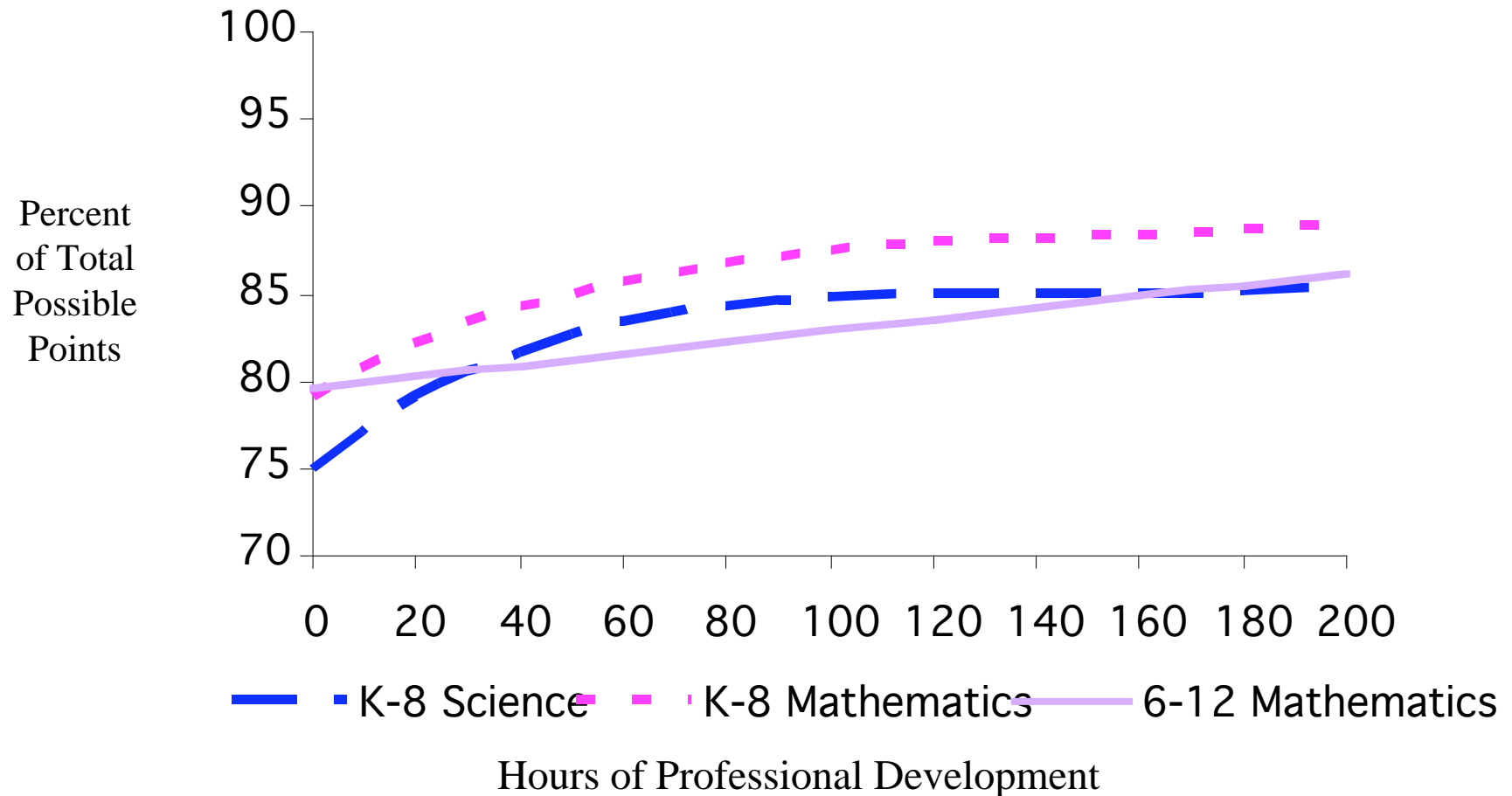
# Impact of LSC on Teachers

## Teacher Use of Investigative Teaching Practices, by Extent of Participation in Professional Development



# Impact of LSC on Teachers

## Classroom Investigative Culture, by Extent of Participation in Professional Development

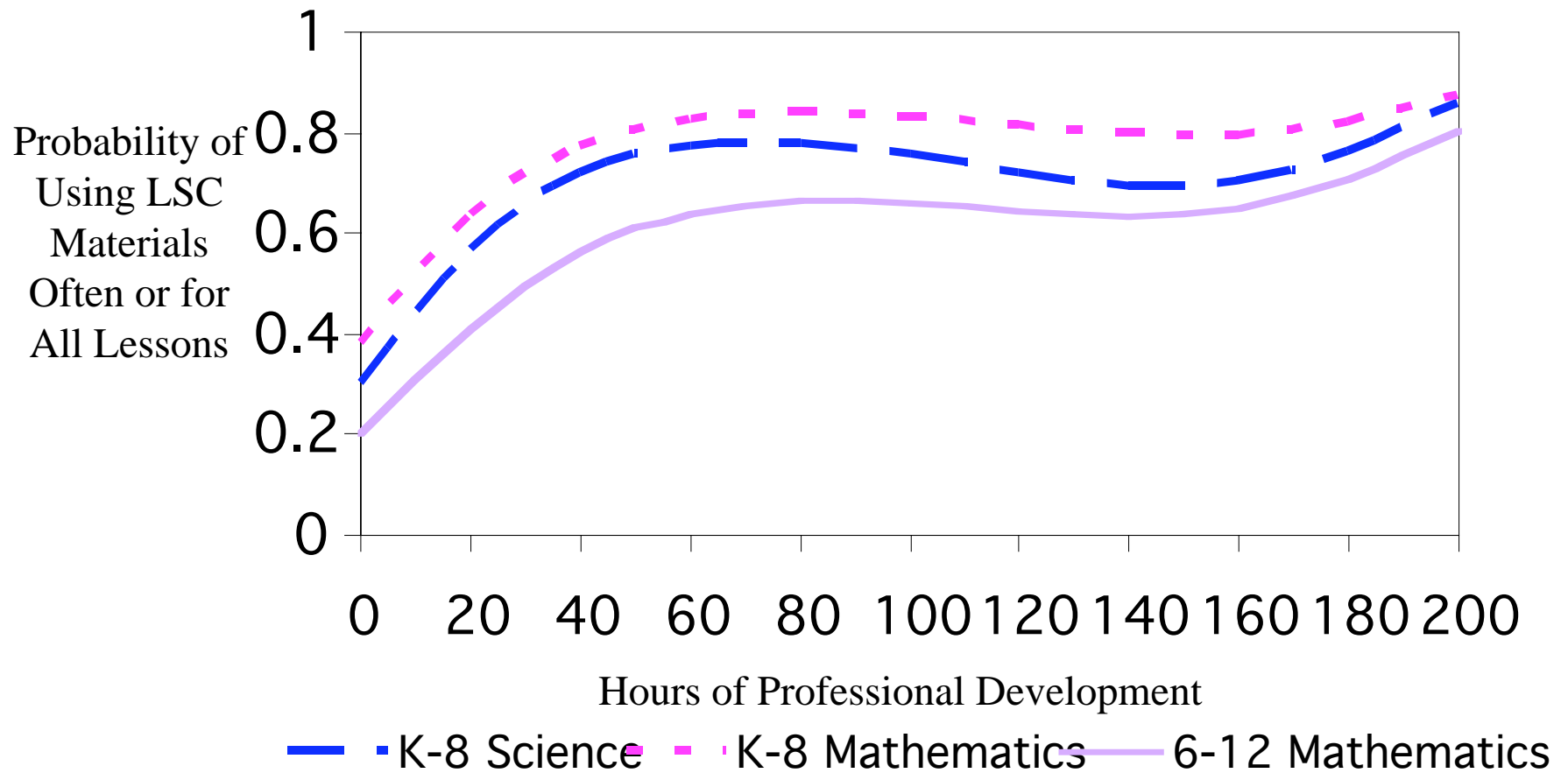


# Impact on Classroom Practices

Analyses of teacher questionnaires found that the LSC had an impact on teachers and their instruction, although there seemed to be a limited impact beyond 80 hours of professional development.

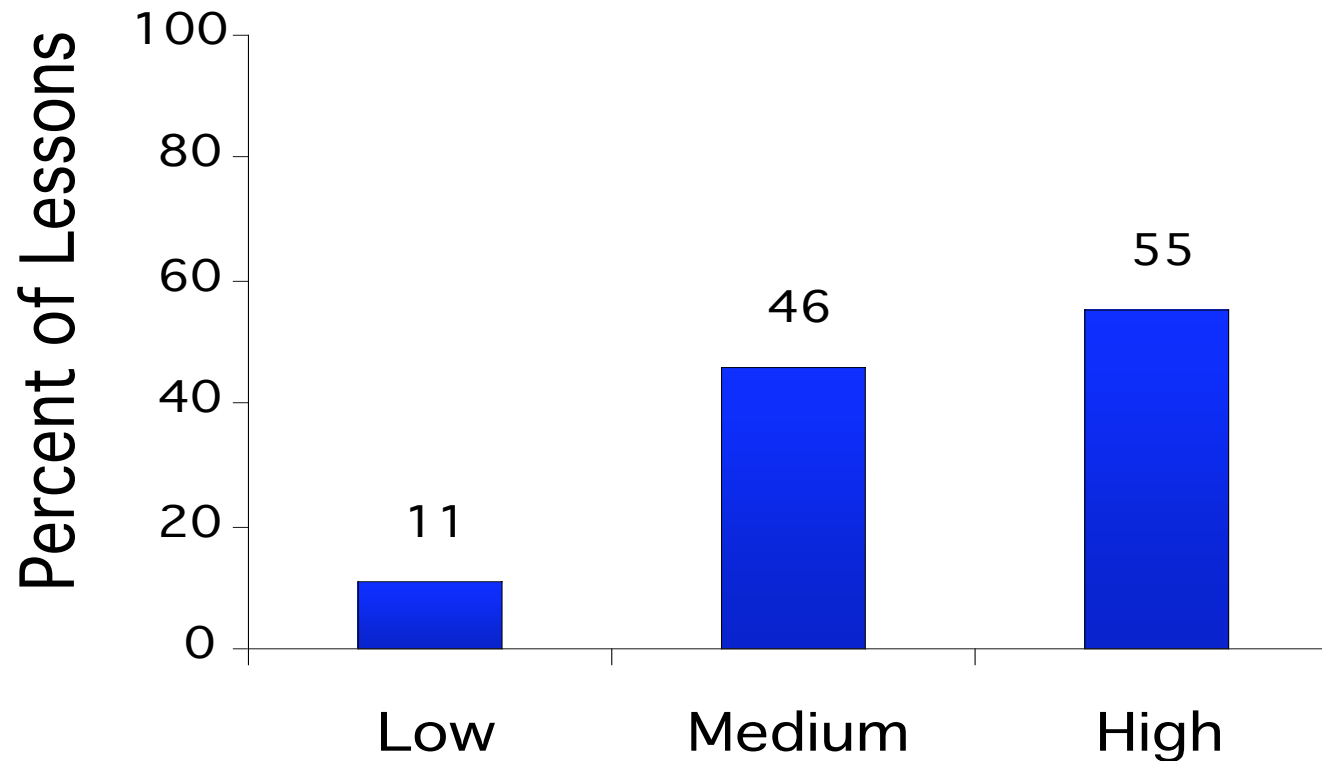
# Impact of LSC on Teachers

Probability of Using LSC Instructional Materials Often or for All Lessons, by Extent of Participation in LSC Professional Development



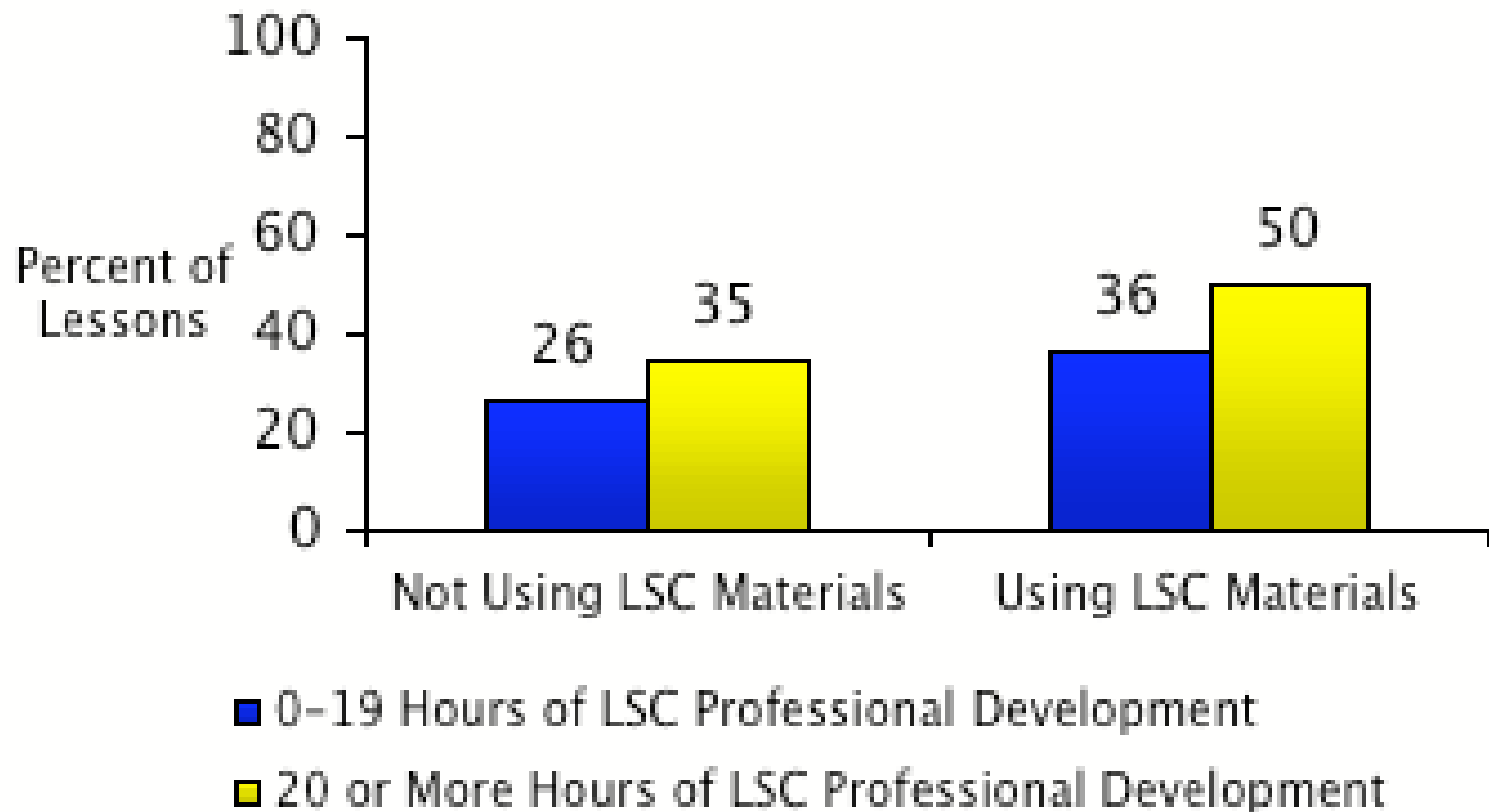
# Impact on Classroom Practices

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



# Impact on Classroom Practices

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





While teachers were using the materials more extensively in their classrooms, there was a wide variation in how well they were implementing these materials. Teachers were often content to omit rich activities, skip over steps and jump to higher level concepts, or leave little time for students to "make sense" of the lessons.

In fact, classroom observations indicated that the lessons taught as the developers intended were more likely to provide students learning opportunities than those that were “adapted.”

# **Looking into the Classroom: Observing a Math Lesson**

# **Task: Making Halves**

- Each person: Find at least three different ways to show halves on your geoboard.
- Record each of your halves on geoboard paper.
- Share your work with others in your group explaining how you know your ways show halves.

**Share methods with class**

# What's the Mathematics?

- What mathematical ideas are embedded in the task?
- What makes this worthwhile mathematics?

# Video “Making Halves” Background

- 4th graders in a 4-5 team-taught open classroom in Tucson, AZ.
- Fourth grade teacher Constance Richardson is shown initially introducing the investigation to the fourth grade class, then circulating among small groups of students as they do the activity.
- Students present their results to the class.

# Purpose of Video

- IS Not to critique the teaching.
- IS to stimulate thoughtful discussion about learning, teaching, and mathematics.



# Geoboard Fractions

- Read the abbreviated observation protocol.
- Watch the lesson:
  - What is the teacher doing?
  - What are the students doing?
- Complete the abbreviated observation protocol, including a capsule rating

# Abbreviated Classroom Observation Protocol

- The instructional strategies and activities of this lesson provided sufficient pathway(s) for students to build toward understanding of the intended content.
- Content information provided to students by teacher or instructional materials was accurate.
- Students were intellectually engaged with ideas relevant to the focus of the lesson.
- The teacher's questioning strategies likely enhanced the development of students understanding of key concepts connected to this lesson.
- The degree of "sense-making" of mathematics/science content within this lesson was appropriate for the developmental levels/needs of the students and the purposes of the lesson.
- Students were encouraged to use evidence to support their statements.
- Intellectual rigor, constructive criticism, and the challenging of ideas were evident between teacher and students.

# Geoboard Fractions

- After everyone has completed the abbreviated protocol, discuss your comments on the indicators and your overall rating of the quality of the lesson.

# Reflection

- What did you learn that you did not already know?
- What questions did the work raise for you?
- What implications does this have for work in your district to support standards-based mathematics and science instruction?

**What are your challenges in designing and implementing high quality professional development programs that support increased student achievement?**

# Top Ten Challenges

1. Addressing the extent of teacher needs for content and pedagogy professional development in a culture of "voluntary" participation
2. Striking a balance in professional development activities between theory and practice, content and pedagogy/materials, depth and breadth of coverage
3. Moving teachers beyond module-specific and logistics discussions to deeper conversations around conceptual learning and student understanding
4. Moving teachers beyond "surface changes" in practice to implementing high quality materials as intended
5. Providing adequate guidance and structure for teacher professional development choices

# Top Ten Challenges (Cont.)

6. Anticipating the turnover among the teaching staff and providing different levels of professional development targeted to teachers at different stages of experience
7. Identifying, training and supporting a sufficient number of qualified and skilled teacher-leaders, mentors, coaches and professional development providers
8. Establishing quality standards for professional development providers, especially their capacity to model and discuss effective instructional practices and address content in ways that are both rigorous and accessible
9. Establishing a school culture that values collaboration and provides adequate time and resources for collaboration to occur.
10. Maintaining momentum beyond the project, using available resources for on-going, high quality professional development