Title II, Part A
Update 2002
North Carolina Department of Public Instruction
Research-based Professional Development
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Horizon Research, Inc.
Logic Model of Professional Development

Quality of PD Program
↓
Increased Teacher Knowledge/Skills
↓
Improved Classroom Practice
↓
Improved Student Performance
Logic Model of Professional Development

CONTEXT

Quality of PD Program
↓
Increased Teacher Knowledge/ Skills
↓
Improved Classroom Practice
↓
Improved Student Performance
Two key questions about Professional Development

- What knowledge and skills do teachers need for effective classroom practice?
- What types of professional development meet teachers’ learning needs to create the necessary knowledge and skills, facilitate their transfer to classroom instruction, and result in improved student learning?
Put simply

What is effective professional development?
Writing about reform professional development: “These principles and beliefs seem reasonable. Yet we know as little about what teachers learn in these kinds of forums as we do about what teachers learn in traditional staff development and in-service. Our readiness to embrace these new principles may, in fact, be rooted in a desire to escape collective bad memories of drab professional development workshops rather than in sound empirical work. But replacing our old conceptions of professional development with new makes sense only if the new ideas are held up for rigorous discussion and evaluation. New is not always right.” (Wilson and Berne, 1999)
Four ‘Truisms’ or ‘Mantras’ about Effective Professional Development

- Teachers should be treated as active learners who construct their own understanding.

- Teachers should be empowered and treated as professionals.

- Teacher education should be situated in classroom practice.

- Teacher educators should treat teachers as they expect teachers to treat students.

(Putnam and Borko, 1997)
Professional Development: The Consensus View (Elmore, 2002)

- 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
- 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 (Elmore, 2002)

- 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
Professional Development: The Consensus View (Elmore, 2002)

- Models of 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
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: 4.39
- Active participation of all was encouraged and valued: 4.34
- Facilitator(s) displayed understanding of concepts: 4.27
Relative Strengths of the LSC Professional Development

Facilitator(s)' background, experience, and/or expertise enhanced the quality of the session: 4.21

Content appropriate for purposes of session and participants' background: 4.2

Encouraged a collaborative approach to learning: 4.16
Relative Strengths of the LSC Professional Development

- Facilitator(s)' contributions enhanced the quality of session: 4.08
- Provided opportunities for teachers to consider classroom applications of resources, strategies, and techniques: 4.07
- Incorporated tasks, roles, and interactions consistent with a spirit of investigation: 4.04
Relative Weaknesses of the LSC Professional Development

- Participants were intellectually engaged with important ideas relevant to classroom practice (3.88)
- Included "framing" the activity to help participants understand the session purpose (3.83)
- Intellectual rigor, constructive criticism, and challenging of ideas were evident (3.82)

Mean 3.82
Relative Weaknesses of the LSC Professional Development

- Attention to student thinking/learning was appropriate for the session’s purpose and participants’ needs: Mean 3.75
- Adequate time and structure provided for ‘sense-making’: Mean 3.68
- Extent of ‘sense-making’ about classroom practice was appropriate for session’s purpose and adult learners’ needs: Mean 3.58
Relative Weaknesses of the LSC Professional Development

- Adequate time and structure were provided for wrap-up: 3.54
- Facilitator(s) effectively modeled questioning strategies: 3.56
- Extent of "sense-making" of content was appropriate for session purpose and adult learners’ needs: 3.57
When we go into classrooms: how deep are changes in practice?

- Lessons taught by teachers using standards-based instructional materials, with PD on those materials, incorporated some specific strategies from PD.

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

(Pasley, 2002)
“In all three lessons observed, teachers did not demonstrate that they understood the content or how the concepts in the lessons they were teaching fit into the concepts in the unit. They tended to zero in on the minutiae of a particular lesson and apparently did not recognize how the lessons fit into the bigger picture of the unit.

The issues demonstrated in the observations are difficult to address within the format of the professional development program. Teachers need to change their perceptions of themselves as teachers, their own ideas of learning, and their understanding of how students learn mathematics.”
Mechanical Use

Creative Use

Purposeful Use
When we go into classrooms: how deep are changes in practice?

- 25 mathematics teachers who reported reform-oriented practice on TIMSS teacher items were observed, with some evidence of reform-oriented observed practices in all 25 classrooms.
When we go into classrooms: how deep are changes in practice?

- Only 4 of 25 teachers observed were judged to be implementing reform-oriented practices consistent with the current mathematics reform vision, where “mathematical tasks were set up to help students grasp and grapple with principled mathematical knowledge that represented doing mathematics as conjecturing, problem solving, and justifying ideas (and where discourse norms) supported attention to principled mathematical knowledge and represented mathematical work as more than computation.”

(Spillane and Zeuli, 1999)
When we go into classrooms: how deep are changes in practice?

- Many classrooms reflect a balance between traditional and standards-based practices.
- Most instruction “remained more familiar than new, more ordinary than challenging;” teachers appeared to layer new practices onto traditional lessons.

(Wilson and Floden, 2001)
How do we decide where to focus our efforts?

Supply-driven Professional Development

Demand-driven Professional Development

Need-driven Professional Development
Main Categories of Teacher Learning Needs

- Developing a vision and commitment to school mathematics/science reform
- Strengthening one’s knowledge of mathematics/science content
- Understanding the pedagogical theories that underlie school mathematics/science reform
- Understanding students’ mathematics/science thinking
- Learning to use effective teaching and assessment strategies
Main Categories of Teacher Learning Needs

- Becoming familiar with exemplary instructional materials and resources
- Understanding equity issues and their implications for the classroom
- Coping with the emotional aspects of engaging in reform
- Developing an attitude of inquiry toward one’s practice

(Borasi and Fonzi, 2002)
Evidence of Need

- Teacher self report
- Classroom observations
- Teacher assessments
- Student assessments
2000 National Survey of Science and Mathematics Education
Elementary Teachers Considering Themselves Very Well Qualified to Teach Each Subject

<table>
<thead>
<tr>
<th>Subject</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reading/Language Arts</td>
<td>76</td>
</tr>
<tr>
<td>Mathematics</td>
<td>60</td>
</tr>
<tr>
<td>Social Studies</td>
<td>52</td>
</tr>
<tr>
<td>Life Science</td>
<td>29</td>
</tr>
<tr>
<td>Earth Science</td>
<td>25</td>
</tr>
<tr>
<td>Physical Science</td>
<td>18</td>
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</table>
Middle School Science Teachers Considering Themselves Very Well Qualified to Teach Each Subject

<table>
<thead>
<tr>
<th>Subject</th>
<th>Mean Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Process Skills</td>
<td>51</td>
</tr>
<tr>
<td>Biology</td>
<td>44</td>
</tr>
<tr>
<td>Environmental Issues</td>
<td>42</td>
</tr>
<tr>
<td>Earth Science</td>
<td>36</td>
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<tr>
<td>Chemistry</td>
<td>32</td>
</tr>
<tr>
<td>Physics</td>
<td>20</td>
</tr>
</tbody>
</table>
Content Preparedness Composite Scores of High School Science Teachers Who Teach Each Subject

Mean Score

Chemistry: 90
Biology/Life science: 84
Physics: 82
Earth Science: 81
Environmental science: 73
Physical science: 66
Integrated/general science: 64
Middle School Mathematics Teachers Considering Themselves Very Well Qualified to Teach Each Topic

- Computation: 90%
- Estimation: 83%
- Measurement: 81%
- Pre-algebra: 75%
- Geometry: 57%
- Algebra: 49%
- Probability: 46%
- Functions: 19%
- Statistics: 18%
- Calculus: 4%
High School Mathematics Teachers Considering Themselves Very Well Qualified to Teach Each Topic

- Algebra: 94%
- Pre-Algebra: 94%
- Computation: 88%
- Estimation: 85%
- Measurement: 85%
- Geometry: 70%
- Functions: 61%
- Probability: 42%
- Statistics: 26%
- Calculus: 24%
Composite Scores of Science and Mathematics Teachers’ Preparedness to Use Standards-Based Teaching Practices

Mean Score

<table>
<thead>
<tr>
<th></th>
<th>K - 4</th>
<th>5 - 8</th>
<th>9 - 12</th>
</tr>
</thead>
<tbody>
<tr>
<td>Science</td>
<td>66</td>
<td>73</td>
<td>76</td>
</tr>
<tr>
<td>Mathematics</td>
<td>73</td>
<td>73</td>
<td>68</td>
</tr>
</tbody>
</table>
Science Teachers Reporting They Perceived a Moderate or Substantial Need for Science Professional Development Three Years Ago

Technology in Instruction
- K-4: 85%
- 5-8: 78%
- 9-12: 71%

Deepen Content Knowledge
- K-4: 71%
- 5-8: 67%
- 9-12: 38%

Inquiry/Investigation-Oriented Strategies
- K-4: 66%
- 5-8: 61%
- 9-12: 52%

Understand Student Thinking
- K-4: 62%
- 5-8: 58%
- 9-12: 47%

Legend:
- K-4
- 5-8
- 9-12
Mathematics Teachers Reporting They Perceived a Moderate or Substantial Need for Mathematics Professional Development Three Years Ago

- **Technology in Instruction**: K - 4: 80%, 5 - 8: 83%, 9 - 12: 67%
- **Deepen Content Knowledge**: K - 4: 45%, 5 - 8: 40%, 9 - 12: 32%
- **Inquiry/Investigation-Oriented Strategies**: K - 4: 62%, 5 - 8: 62%, 9 - 12: 53%
- **Understand Student Thinking**: K - 4: 46%, 5 - 8: 51%, 9 - 12: 40%
Science Teachers’ Participation in Professional Development in the Last 3 Years

- K-4: 24% 0 hours, 26% <6 hours, 26% 6-15 hours, 14% 16-34 hours, 10% ≥35 hours
- 5-8: 27% 0 hours, 15% <6 hours, 25% 6-15 hours, 15% 16-34 hours, 18% ≥35 hours
- 9-12: 23% 0 hours, 16% <6 hours, 23% 6-15 hours, 16% 16-34 hours, 45% ≥35 hours

Legend:
- 0 hours
- <6 hours
- 6-15 hours
- 16-34 hours
- ≥35 hours
Mathematics Teachers’ Participation in Professional Development in Last 3 Years

- K - 4:
  - 0 hours: 14
  - > 6 hours: 32
  - 5 - 15 hours: 18
  - 16 - 34 hours: 14
  - ≥ 35 hours: 14

- 5 - 8:
  - 0 hours: 14
  - > 6 hours: 29
  - 5 - 15 hours: 15
  - 16 - 34 hours: 19
  - ≥ 35 hours: 23

- 9 - 12:
  - 0 hours: 7
  - > 6 hours: 8
  - 5 - 15 hours: 17
  - 16 - 34 hours: 25
  - ≥ 35 hours: 43

Legend:
- 0 hours
- > 6 hours
- 5 - 15 hours
- 16 - 34 hours
- ≥ 35 hours
Inside the Classroom
National Observation Study

- Content was significant and worthwhile: 68%
- Teacher appeared confident: 63%
- Teacher-provided content information was accurate: 56%
- Active participation was encouraged: 55%
- Climate of respect for students' ideas, questions, and contributions: 50%
- Content was appropriate for development needs: 50%
Inside the Classroom
National Observation Study

- Pace of lesson appropriate for students' developmental levels: 27%
- Climate of lesson encouraged students to generate ideas and questions: 24%
- Students intellectually engaged with relevant, important ideas: 22%
- Mathematics/science portrayed as dynamic body of knowledge: 21%
- Teacher's questioning strategies enhanced development of student understanding: 17%
- Degree of 'sense-making' of content was appropriate: 15%
- Intellectual rigor, constructive criticism, and the challenging of ideas was evident: 15%
Mathematics Task 1: Growing Dots 1

At the beginning

At 1 minute

At 2 minutes

What is growing/changing in this sequence? If the pattern continues in the same way, what will it look like at 3 minutes? 100 minutes? “t” minutes?
Solve the problem by your preferred method. Be sure to show how you arrived at your solution.

Are there other ways that you think your students might approach this problem that would likely lead them to a correct solution? If so, please describe them.

Are there ways that you think your students might approach this problem that would not likely lead them to a correct solution? If so, please describe them.
Assume that each side of the Superstar has a length of 1 unit. Assume that the Superstar continues to change in the same way every minute.

1. What will be the perimeter of the Superstar at 4 minutes?
2. What will be the perimeter of the Superstar at 30 minutes?
3. What will be the perimeter of the Superstar at N minutes?
You have given the “Superstar” problem to a group of 25 students in your class to work. You have collected the students’ work (sample of four attached) and you are planning for the next lesson on linear functions.

Your objectives for the next lesson are:

- To have students be able to determine a general equation for the Superstar problem.
- To have students understand that the general equation represents a linear pattern of growth, and be able to identify what the parts of the equation represent in relation to the superstar diagrams.
Assume that this sample of work is representative of the work of students in the class. Briefly, give your assessment of the class’s current level of accomplishment of your objectives.

Assume that you will continue to address the same objectives in the next lesson. Based on your assessment of the student work on the Superstar problem, describe what you would do, what you would have the class do, and what questions you would ask in the next lesson. Be sure to describe why you would approach the next lesson in this way.
For each of the examples of student work below, identify whether or not each student’s answer choices to the two questions are correct. Then comment on what each student’s responses to the two questions tells you about what the student does AND does not understand about the topic.

The diagram below shows the position of two cars at one second intervals.

C1: 0 1 2 3 4 5 6 7

C2: 0 1 2 3 4 5 6 7

**Student 1**
At what time(s) were the cars traveling equally fast?

A. at t = 2 and t = 5.
B. at t = 7

**C. at about 3.5**

What reasoning about motion would best justify the answer you chose?

A. The two cars are equally far from where they were when the clock started.
B. The two cars are going equally far in the same short bit of time.

**C. The two cars are side by side at those times.**
<table>
<thead>
<tr>
<th>Task</th>
<th>Goal</th>
<th>A. To assess teachers’ ability to distinguish big ideas from supporting detail</th>
<th>B. To assess teachers’ understanding of fundamental concepts</th>
<th>C. To assess teachers’ ability to understand student thinking/identify common misconceptions</th>
<th>D. To assess teachers’ ability to plan strategies in guiding student learning</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Analysis of activity description or curriculum overview paragraph for identification of major concepts</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Answer the question OR Identify correct and incorrect responses to a question</td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Prediction of ways their students would answer a question OR Select the wrong answer(s) their students would likely make</td>
<td></td>
<td></td>
<td></td>
<td>*</td>
<td>X</td>
</tr>
<tr>
<td>4. Analysis of what students do/don’t understand based upon their answers</td>
<td></td>
<td>*</td>
<td></td>
<td>*</td>
<td>X</td>
</tr>
<tr>
<td>5. Possible explanations for students’ thinking</td>
<td></td>
<td></td>
<td></td>
<td>*</td>
<td>X</td>
</tr>
<tr>
<td>6. Identification of questions to clarify extent of student understanding</td>
<td></td>
<td></td>
<td></td>
<td>*</td>
<td>X</td>
</tr>
<tr>
<td>7. Description or selection of teaching strategies to develop further understanding of concepts</td>
<td></td>
<td></td>
<td></td>
<td>*</td>
<td>*</td>
</tr>
</tbody>
</table>
We got skinned alive in the first meetings. Principals did a lot of venting. They have a load, they’re overburdened. Anything they wanted we gave them the first year. We didn’t start with our issues, like here are some good science/math/technology programs and you guys get with it. We started with their issues. What do they need to be successful? What kinds of resources do you need? What strategies do we need to give them a hand?

(PI, elementary mathematics/science LSC)
Importance of Involving Principals

“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.”
<table>
<thead>
<tr>
<th>Old View of PD</th>
<th>New View of PD</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Individual teachers attend summer workshops on college campuses</td>
<td>• More emphasis on working with all or critical masses of teachers, at district sites, during academic year</td>
</tr>
<tr>
<td>• Generic PD (e.g. “cooperative learning”)</td>
<td>• Content-based PD</td>
</tr>
<tr>
<td>• Content taught separately from pedagogy</td>
<td>• Integration of content and pedagogy in the context of “cases” and other practice based materials</td>
</tr>
<tr>
<td>• Evaluation of how much teachers “like” the PD</td>
<td>• Evaluation of impact on teachers and students</td>
</tr>
</tbody>
</table>
(Loucks-Horsley et al., 1998)
Teacher Education Materials Project
WWW.TE-MAT.ORG

An online database of reviews of materials for K-12 mathematics and science professional development providers

National Science Foundation   Grant
#: ESI 9619139
OBJECTIVES

of TE-MAT Project

• To increase accessibility of K-12 science and mathematics professional development materials
• To describe the content and quality of these materials
• To encourage the sound use of professional development materials
What’s In TE-MAT

• materials explicitly designed to support the work of K-12 mathematics and science professional development providers

• materials framed in such a way that they are useful for the professional development of K-12 mathematics and science teachers
Two professional development providers with experience and expertise in the topic area
A third reviewer writes the final review in standard format.
Identified TE-MAT Materials

- 14 in review process
- 44 to be posted soon
- 435 currently on the website
The TE-MAT Conceptual Framework:

Highlights key elements critical to effective professional development

- design process
- target audience
- purposes
- strategies and materials
The TE-MAT Conceptual Framework:

- Briefly frames issues to consider
- Links users to selected materials reviewed in the database
- References important resources that are not included in the database, e.g. standards documents
The Conceptual Framework Outline

1. Understanding needs of target audience
2. Deciding on purposes
3. Building on current knowledge
4. Adapting program to context
5. Selecting appropriate strategies
6. Preparing providers
7. Implementing effective professional development
8. Evaluating the quality and impact of professional development
www.te-mat.org
Professional development needs to be designed to achieve a particular purpose or set of purposes.
Coherence doesn’t happen by accident

- Need to help teachers understand the mathematics and science big ideas AND how the student activities relate to those ideas

- Need to provide incentives for teachers to engage in long-term professional development aligned with their needs

- Need to make sure principals understand and support your vision of effective mathematics/science teaching
References


References

Putnam & Borko, 1997, as cited in Wilson & Berne


