Teacher’s Voices: How Educative Curriculum Materials Help Me Teach for Understanding

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The slides in this presentation will be available at www.bscs.org/sessions by Monday, March 14
Project PRIME

• **Promoting Reform through Instructional Materials that Educate**

• Collaborative project with the Center for Research and Evaluation at BSCS and the Center for Science Teaching and Learning at NAU

• Funded by NSF in 2004 through the Teacher Professional Continuum (TPC) program

• Goal: Study impact of educative curriculum materials on teacher understanding and practice
Focus of this Session

Describe the project while highlighting the experience of the teachers in their own words.
### Flow of the Project

<table>
<thead>
<tr>
<th>Year</th>
<th>Dates</th>
<th>Major Activities</th>
</tr>
</thead>
</table>
| 1    | Apr 05-06 | Curriculum review by University of Michigan team  
|      |         | Recruit Cohort A  
|      |         | Using AIM process to choose between  
|      |         | EDC Insights on Biology or BSCS Biology: A Human Approach                       |
| 2    | Apr 06-07 | Cohort A  
|      |         | • Summer 1 PD (2 weeks)  
|      |         | • 1st year of implementation  
|      |         | • ASTA meeting  
|      |         | • 2 Collaborative Lesson Studies                                                 |
|      |         | Recruit Cohort B  
|      |         | Using AIM process                                                               |
| 3    | Apr 07-08 | Cohort A  
|      |         | • Summer 2 PD (3 weeks)  
|      |         | • 2nd year of implementation  
|      |         | • ASTA meeting  
|      |         | • 3 Collaborative Lesson Studies                                                 |
|      |         | Cohort B  
|      |         | • Summer 1 PD (2 weeks)  
|      |         | • 1st year of implementation  
|      |         | • ASTA meeting  
|      |         | • 2 Collaborative Lesson Studies                                                 |
| 4    | Apr 08-09 | Optional 3rd year of participation                                               |
|      |         | Cohort B  
|      |         | • Summer 2 PD (3 weeks)  
|      |         | • 2nd year of implementation  
|      |         | • ASTA meeting  
|      |         | • 3 Collaborative Lesson Studies                                                 |
| 5    | Apr 09-10 | Optional 3rd year of participation                                               |
PRIME Time Line

Time line for Cohort 1

Spring 05  Summer 05 (2 wks)  School Year 05-06  Summer 06 (3 wks)  School Year 06-07

Time line for Cohort 2

Spring 06  Summer 06 (2 wks)  School Year 06-07  Summer 07 (3 wks)  School Year 07-08

40 HS biology teachers in Arizona

Insights into Biology

BS CS Biology

Northern Arizona University
Major Components of the Project from a Participant Perspective

1. Curriculum selection process
2. Emphasis on educative curriculum materials
3. Extensive summer professional development program
4. Collaborative lesson study sessions
5. Research on Pedagogical Content Knowledge (PCK)
Component 1: Curriculum Selection Process

- Teachers participated in a 2-day professional development experience to choose between two biology programs rated as “highly educative” by an external group.

- Teachers from the same school had to reach consensus.
Selection process included looking for evidence of Coherence and Focus

1. Coherence
   - An organizational structure that deliberately promotes student understanding,
   - Explicit links between facts and concepts that will facilitate the retrieval and application of those facts
   - Builds from and extends concepts previously developed
   - Explicit connections between the key concepts and an overarching framework about biology

2. Focus
   - Inclusion of a limited number of key concepts
   - Development of concepts in-depth at an appropriate level for an introductory college course
   - Intellectual requirement that the reader apply and demonstrate their understanding in multiple ways
   - Articulated text that helps the reader build from and extend concepts that were developed previously
Teachers' Voices

How did choosing a curriculum using the AIM process differ from what you had experienced before?

• Donna:
  – Before: matched curriculum with state standards
  – AIM: careful examination for relevance & rigor
  – Recently applied AIM process in new district project

• Erin:
  – Before: selected curriculum with the best ancillaries
  – AIM: careful examination for coherence & focus
Component 2: 
Educative Curriculum Materials

Educative curriculum materials are those that promote *teacher learning* as well as student learning.

(Ball & Cohen, 1996; Davis & Krajcik, 2005)

See this link: [http://www.bscs.org/pdf/prensentationhighschoolbiotext06.pdf](http://www.bscs.org/pdf/prensentationhighschoolbiotext06.pdf) for a summary of the review of biology curriculum materials.
We hypothesize that thoughtfully designed instructional materials can help teachers develop:

*Content Knowledge* – e.g., content information in the teacher materials

*Pedagogical Knowledge* – e.g., support materials for using the instructional model

*Contextual Knowledge* – e.g., information on common student misconceptions and related strategies
As you learned more about BSCS Biology: A Human Approach during professional development and used it to teach all year, how do you think it was the same or different from other textbooks you had used?
Teachers’ Voices

Erin:
• AHA scaffolds experimental skills and the curriculum for students
• AHA includes student-led activities

Donna:
• Previous textbooks were used as a resource only, AHA is our guide to learning
• AHA interconnects concepts so it all flows together
• AHA emphasizes problem solving, critical thinking, relevance
Teachers’ Voices

What educative features would you look for the next time you get to select a program?

Erin:
• Would prefer a more accessible teacher manual

Donna:
• Look for parts to join together to create a whole
• progressive building on concepts
• building on prior knowledge
• Look for a good fit to our students (relevance)
Component 3:
Extensive Summer Professional Development Program

Program Selection

1 week

Curriculum Analysis

2 weeks

Analyze Units a,b
Teach a

ASTA and 2 Lesson Study Cycles

Fall
Analyze Student Work
Plan y

ASTA
Teach b

Spring
Analyze Student Work

Curriculum Analysis

Y1

Analyze Units c,d,e
Teach c

ASTA and 3 Lesson Study Cycles

Fall
Analyze Student Work
Plan d

ASTA
Teach d

Winter
Analyze Student Work
Plan e

ASTA
Teach e

Spring
Analyze Student Work

Y2
Some PD Features

- Participants switched between a teacher hat and a student hat.
- There was an emphasis on understanding the curriculum features that supported student understanding of concepts as well as an emphasis on the educative features of the curriculum and teacher craft knowledge.
- Participants taught selected activities to their colleagues.
- There was one content deepening experience per unit – usually a university researcher describing his/her research; later participants work to make connections between the lecture and the curriculum.
Understanding Concept Development in Curriculum

1. On a sticky note, write a sentence for the *one* big idea or concept addressed in each of your activities. It should be a *complete sentence* that describes a relationship between/among ideas.

2. Compare your big idea sentences with the other members of your **Expert** group and come to consensus on one sentence that best expresses the concept addressed in each of your activities.

3. Each member of the **Expert** group should write the consensus sentence on a sticky note to take back to his/her **Home** group.
4. Return to your Home group.
5. Share the major concept in each activity of the chapter.
6. Work together to write a sentence that conveys the overarching concept of the chapter. Write this sentence on a sticky note.
7. Talk with each other about:
   a) How the concepts in your section build from those in previous sections
   b) How concepts in your section are extended in subsequent sections
   c) How the concepts in your section connect to the overarching concept of the chapter
   d) The context in which the concepts are presented
What was your reaction to the development of Conceptual Flow Graphics? What were your colleagues’ reactions?

• Donna:
  – First reaction: not fun! Colleagues’ reactions about the same
  – Second year: recognized that CFGs helped see program as a whole & how chapters flow together
  – More recently: used CFGs in PD with new teachers
Teachers’ Voices

What was your reaction to the development of Conceptual Flow Graphics? What were your colleagues’ reactions?

• Erin:
  – Made sense of the curriculum progression
  – Helped me determine what lessons could be skipped if necessary
  – Helped me see links between big ideas in science
  – Got to hear viewpoints of other teachers and could hear about their experiences related to the material
Teachers’ Voices

What do you remember most about the summer PD experiences?

• Donna:
  – Process of selecting the textbook
  – Working collaboratively with colleagues
  – Experiencing the activities in the program
  – Completing PCK reflections
  – PD providers were more patient & professional
Teachers’ Voices

What do you remember most about the summer PD experiences?

• Erin:
  – Collaboration with colleagues
  – Better understanding of curriculum during each summer as we completed CFGs and PCKs
  – Learning how colleagues completed the activities
Component 4: Collaborative Lesson Study Sessions

- Participants worked in small groups to choose one lesson that they agreed to teach in a similar way, video record, and collect student work from.
- Planning was done during the summer.
- CLS sessions were held twice during each school year.
<table>
<thead>
<tr>
<th>Program Name: AHA</th>
<th>Unit Name and Number: Ecology: Interaction and Interdependence in Living Systems Unit 6</th>
<th>Activity Name: Critters and Interdependence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Focus Question: What will student work based on their critters in the form of a story suggest about their understanding of resources, carrying capacity, growth rate, and limiting factors?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Expected Student Learning Outcomes</td>
<td>Ways that students can communicate understanding of the concept(s)…</td>
<td>Students will demonstrate their understanding of the concepts of resources, carrying capacity, growth rate, and limiting factors by writing a story that includes illustrations about their critters and the interactions between their critters and that of others in the same environment.</td>
</tr>
<tr>
<td>Description of a High Quality Student Work Product</td>
<td>Description of a Medium Quality Student Work Product</td>
<td>Description of a Low Quality Student Work Product</td>
</tr>
<tr>
<td>Connecting to the Conceptual Flow Graphic: How should this activity contribute to students’ understanding of the overarching concept of the unit? In this chapter students where engaged in an activity where they directly observed organisms interacting in their natural environment, then explored the interactions between these organisms. Next students explained how limited resources and the carrying capacity of a simulated commons pasture affected cattle populations and financial profit. Then students elaborated on these concepts by studying a case study about the population changes that occurred historically on Easter Island. Finally students write a story based on their critters interacting in a particular environment with other critters to show their understanding about the concepts of resources, carrying capacity, growth rate, and limiting factors. This story serves as a way to evaluate student understanding of the concepts previously stated.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Criteria</td>
<td>Excellent</td>
<td>Could Be Improved</td>
</tr>
<tr>
<td>----------</td>
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</tr>
<tr>
<td><strong>Concept:</strong> Showing understanding of the big picture in this chapter</td>
<td>Story describes the interdependence and interactions between the organisms that inhabit this ecosystem, using specific examples that clearly show the author’s understanding that those interactions are complex and essential.</td>
<td>Story generally describes the interdependence and interactions between the organisms that inhabit this ecosystem, showing the author has a general understanding that those interactions are important.</td>
</tr>
<tr>
<td><strong>Explanation:</strong> Explanation for population growth trends, including specific evidence to support ideas</td>
<td>Description of the critter’s population growth includes an explanation of what type of growth it is, using correct terminology and a specific example for comparison. Story gives 4 or more specific examples that explain how the populations of organisms are likely to change as a result of their interactions with the environment in their habitat.</td>
<td>Description of the critter’s population growth includes a general explanation of what type of growth it is, using some terminology and examples. Story gives 2 or 3 examples that explain how the populations of organisms are likely to change as a result of their interactions with the environment in their habitat.</td>
</tr>
<tr>
<td><strong>Explanation:</strong> Explanation for how limiting factors and carrying capacity affect population size, including specific evidence to support ideas</td>
<td>Story correctly identifies at least 5 limiting factors present in the environment and explains their impact clearly and accurately. Story provides specific information about the carrying capacity of the environment and how it might change in response to changes in the environment, for example, in response to limiting factors.</td>
<td>Story generally identifies 3 or 4 limiting factors present in the environment and explains their impact. Story provides general information about the carrying capacity of the environment and how it might change in response to changes in the environment. Some descriptions of limiting factors or the influence of carrying capacity are incorrect.</td>
</tr>
<tr>
<td><strong>Creativity</strong></td>
<td>Story includes interesting, appropriate, and engaging information about author’s critter as well as classmates’ critters that are living in the same ecosystem.</td>
<td>Story includes basic information about author’s critter and classmates’ critters that are living in the same ecosystem.</td>
</tr>
<tr>
<td><strong>Presentation</strong></td>
<td>Drawings, diagrams, and descriptions make it easy for any reader to imagine how this critter experiences interactions and interdependence in its habitat. Grammar and punctuation are used correctly, making it easy to understand what was meant.</td>
<td>Drawings, diagrams, and/or descriptions give the reader a general idea of how this critter experiences interactions and interdependence in its habitat. Grammar and punctuation are generally used correctly. Sometimes it is difficult to be sure what was meant.</td>
</tr>
</tbody>
</table>
CLS Discussion Protocol

I. Whole Group Preparation
   – Review process for the day to include team assignments, room locations, equipment access
   – Review norms of participation
   – Questions

II. Small Group Discussions

<table>
<thead>
<tr>
<th>Time</th>
<th>Focus</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 min</td>
<td>Small Group Preparation</td>
</tr>
<tr>
<td>15 min</td>
<td>Lesson Overview</td>
</tr>
<tr>
<td>5 min</td>
<td>Clarifying Questions</td>
</tr>
<tr>
<td>10 min</td>
<td>Read Student Work</td>
</tr>
<tr>
<td>10 min</td>
<td>Probing Questions</td>
</tr>
</tbody>
</table>
II. Small Group Discussions, continued

<table>
<thead>
<tr>
<th>Time</th>
<th>Focus</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 min</td>
<td>Pause to Reflect</td>
</tr>
<tr>
<td>10 min</td>
<td>Share Feedback</td>
</tr>
<tr>
<td>15 min</td>
<td>Presenter’s Response to Feedback</td>
</tr>
<tr>
<td>10 min</td>
<td>Summary and Next Steps</td>
</tr>
<tr>
<td></td>
<td><strong>Total time = 83 minutes</strong></td>
</tr>
</tbody>
</table>

III. Whole Group Debrief

– What did you learn from this experience?
– General discussion of the tuning protocol may develop.
– Discuss frustrations, misunderstandings, positive reactions participants may have experienced.
What was the value of the school year sessions when you shared video and student work with other teachers?

Erin:

• Sharing video and student work with other teachers (Summer 2) was great—I saw:
  • other methods of teaching to try
  • questioning techniques different than mine
  • classroom arrangements that were successful for the assignments
What was the value of the school year sessions when you shared video and student work with other teachers?

Donna:

• School is very secluded from others & in a different culture, so great to compare student work with others
• helped me see my teaching style
• I gained a PLC—I was able to discuss teaching with others in my group via email & phone calls
Teachers’ Voices

What was the value of jointly planning that lesson during the summer PD?

Erin:

• It was great because two or three amazing teachers could put their brains together and develop a great lesson.
How could this experience have been richer and more rewarding?

Donna:

• Having more time to develop on work on this lesson

Erin:

• Initially I was unsure of how to generate & collect student data. A portfolio with distinct categories would have been helpful.
Component 5: Research on PCK

Research Questions
1. How does a teacher’s Pedagogical Content Knowledge change
   – With the use of highly educative curriculum materials?
   – With or without professional development?

2. How does teacher knowledge correlate to student achievement?

3. What is the relationship between PCK and fidelity of use of highly educative materials?
Measurements

1. PCK Reflections (CK, PK, CxK, PCK)
2. Structured Interviews (CK, PK, CxK, PCK)
3. Videotapes of Classroom Instruction (CK, PK, CxK, PCK, Fidelity of Implementation)
4. Major Field Test for Biology (ETS) (CK)
5. Reform Teaching Observation Protocol (CK, PK, CxK)
6. Student Achievement
7. Student Work
Data Collection Schedule

- **BL**: Baseline, prior to program start
- **PD**: Following summer professional development
- **PDT**: Following professional development and teaching the topic once
- **T**: Following teaching without professional development
- **TPD**: Teaching followed by professional development
- **PDTT**: Following professional development and teaching the topic twice
- **TPDT**: Teaching in year 1, followed by professional development and teaching in year 2.
What do you remember most about the research component of the project?

Erin:

- Became easier as we completed additional PD hours in the summer and processed what we had done that year.
- Discussing data collection procedures with PD leaders and other teachers helped.
What do you remember most about the research component of the project?

Donna:

• Videotaping classes
• Student achievement on state tests after AHA was much higher
How did participating in Project PRIME change you as a teacher?

Donna:

• Before: stand & deliver
• Now: a facilitator
• Before: students expected to get it “right or wrong”
• Now, students create labs, think critically & learn the process of science
Teachers’ Voices

How did participating in Project PRIME change you as a teacher?

Erin:

• Learning about metacognition helped me plan better and ask better questions
• Hearing other teachers’ ideas increased my efficiency as a teacher
• Seeing the CFGs helped me understand how the lessons are related
What We’ve Learned

The Researchers’ Perspective
• Teachers matter!
• We need more classroom-based research.
• We need districts who are willing to commit to longer-term projects.

The Participants’ Perspective
• Students matter!
• We need PD for new teachers coming into the program.
• We need administration to understand the importance of this program and how it transfers to other studies.
Thank you!

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