Deborah Loewenberg Ball

VI SIPEM - Seminário Internacional de Pesquisa em Educação Matemática

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PREPARING TEACHERS FOR THE MATHEMATICAL WORK OF TEACHING

SCHOOL OF EDUCATION
UNIVERSITY OF MICHIGAN

WHAT ARE THE RESPONSIBILITIES OF MATHEMATICS TEACHING?

- To create and scaffold access to mathematical tools, knowledge, and ways of thinking for students
- To do this with every student
- To make mathematics a societal resource for democracy and political and social change

WHAT DOES THIS MEAN FOR THE WORK OF TEACHING?

- Knowing mathematics in special ways suited for helping others learn

- Being able to build connections with and among students

- Using mathematics teaching to disrupt the structures that reproduce political and social inequality

WATCHING A VIDEO OF TEACHING

What evidence can you see related to:

1. Knowing mathematics in special ways suited for helping others learn

2. Building connections with and among students

3. Using mathematics teaching to disrupt the structures that reproduce social inequality

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CONTEXT FOR THE VIDEO

- Grade 3 students

- Middle of U.S. school year (January)

- Multicultural class: Children from different cultures and who speak different languages

- Mathematics content being studied: Even and odd numbers (definitions), mathematical structures of number, mathematical reasoning

EDUCATION

VIEW VIDEO

DISCUSSION

What evidence can you see related to:

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THE MATHEMATICAL WORK OF TEACHING

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FOUR DEFINITIONS OF EVEN NUMBER IN USE BY DIFFERENT CHILDREN

1. If you can divide a set of things in two equal parts without breaking any, that set is an even number. (class "working definition")

2. If you count alternating whole numbers on the number line starting with 0, those are the even numbers. (Cassandra)

3. If you divide a set of things into groups of 2, and the number of groups is an odd number, the set is both an even and odd number. (Sean)

4. If you divide a set of things into groups of 2 and don't have any left over, then the set is an even number. (Ofala)

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KNOWING MATHEMATICS IN SPECIAL WAYS SUITED FOR HELPING OTHERS LEARN

- Let's consider what it means to "know" even and odd numbers, mathematical structure, and mathematical reasoning.

- We will examine possible definitions for even and odd numbers and ways to reason about them.

- Then we will examine the work of **hearing students** mathematically.

TEACHING REQUIRES HEARING LEARNERS MATHEMATICALLY

- What are learners saying and thinking? (Sean, Cassandra, Mei, Ofala, Betsy)

- How do their ideas relate to standard mathematics in the discipline? (Ofala)

- How are their ideas mathematical and novel although not part of accepted contemporary mathematics?

STANDARD DEFINITION

An even number is an integer multiple of 2.

Examples:

0 is even because $0 = 0 \cdot 2$

-2 is even because $-2 = -1 \cdot 2$

5 is not even because $5 \neq \text{(integer)} \cdot 2$

KNOWING HOW TO TALK MATHEMATICS BOTH PRECISELY <u>AND</u> ACCESSIBLY

a) An even number is a number that can be divided into two equal parts.

b) An even number is any multiple of 2.

c) An even number is any integer multiple of 2.

d) An even number is any number whose unit digit is 0, 2, 4, 6, or 8.

e) A whole number is even if it is the sum of a whole number with itself.

a)   An even number is a number that can be divided into two equal parts.

b)   An even number is any multiple of 2.

All numbers, for example 7, 3/5, √2, π, are even!

c)   An even number is any integer multiple of 2.

This is a correct definition of even number.

d)   An even number is any number whose unit digit is 0, 2, 4, 6, or 8.

In this case, 36.7 is an even number!

e)   A whole number is even if it is the sum of a whole number with itself.

This is a correct definition of evenness for whole numbers, and is consistent with the general definition for integers that will arrive later.

Are these definitions okay? What are the consequences of any of these?

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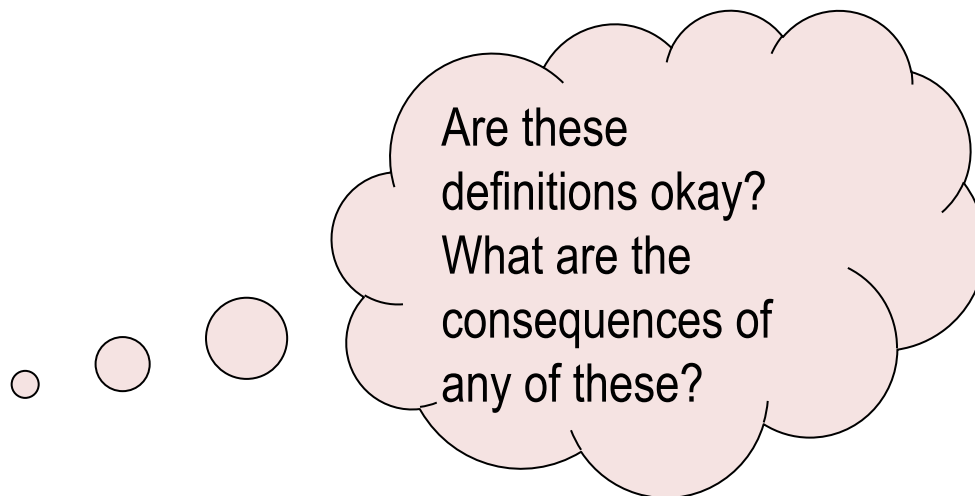
MATHEMATICAL KNOWLEDGE FOR TEACHING (MKT)
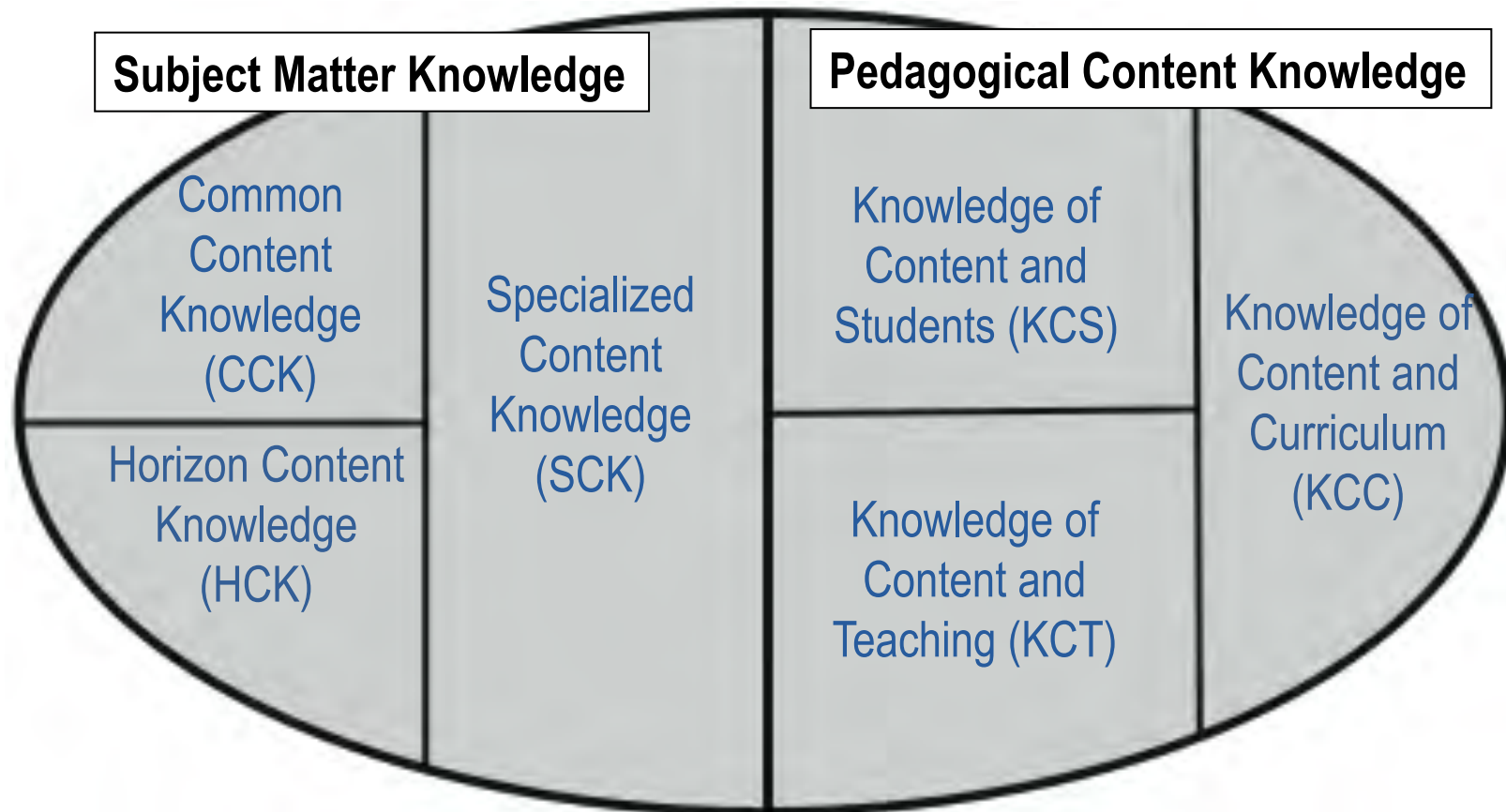
# TEACHING REQUIRES HEARING STUDENTS MATHEMATICALLY

- What are students saying and thinking? (Sean, Cassandra, Mei, Ofala, Betsy)

- How do students' ideas relate to standard mathematics in the discipline? (Ofala)

- How are students' ideas mathematical and novel although not part of accepted contemporary mathematics? (Sean)

THE MATHEMATICAL WORK OF TEACHING

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HOW ARE THE STUDENTS LEARNING TO HEAR AND TO INTERACT WITH AND DISAGREE RESPECTFULLY WITH OTHERS?

- Cassandra, to Sean: "Zero is not an even number" *(challenging with evidence)*

- Tembe: "Prove it to us, Sean" *(asking for argument)*

- Mei: "I think I know what he is saying" *(listening closely)*

- Ofala: "Odd numbers are things like this – with something left" *(listening and connecting)*
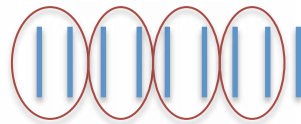
Teaching practices:

- Asking students to respond to others' ideas

- Positioning children as sense-makers

- Modeling respectful questioning and challenging

- Making rules of argument transparent and explicit

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HOW DOES MATHEMATICS TEACHING OFFER OPPORTUNITIES FOR SOCIAL AND POLITICAL CHANGE?

What did we see in this one video segment?

HOW DOES MATHEMATICS TEACHING OFFER OPPORTUNITIES FOR SOCIAL AND POLITICAL CHANGE?

What did we see in this one video segment?

- Children making (not just reproducing) mathematics. (Sean, Ofala)

- Children challenging others, with respect. (Cassandra, Mei, Ofala).

- Children debating and determining "truth" following shared explicit rules of argumentation that have been developed together, not based on power, race, social class, gender, other social identities.

- Being "smart" at mathematics comprises a broad range of capabilities.

- Children have opportunities to "try out ways of being" relative to mathematics and other people.

- Mathematics as a human context for invention, imagination, reasoning, puzzling, interacting.

- Mathematics as a context for developing agency for the production of knowledge.

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ENTAILMENTS OF TEACHING RESPONSIBLY

- Being able to consider learners' ideas and to connect them to established mathematics requires knowing mathematics in special ways for teaching. *(Sean, Cassandra, Ofala)*

- Being able to use mathematics for social and political change requires reconstructing power relationships between teachers and students, among students, and with what is called "mathematics." *(Sean, Betsy, Ofala)*

- This also requires special ways of knowing mathematics and seeing children, as well as appreciating the power that mathematics holds in society. *(Sean, Mei, Ofala)*