Bridging Informal and Formal Knowledge in Numeracy Education to Support High Quality Instruction

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Outline

• Formal and informal mathematics

• Examples from out-of-school settings

• Implications for assessment, instruction, and training
Formal and Informal Mathematics

- **Formal Mathematics**
  - Historically-developed system taught explicitly through formal education
  - Abstract
  - Examples: algorithms, base-10 notation, written equations

- **Informal Mathematics**
  - Based on everyday activities
  - Concrete
  - Often referred to as workplace mathematics, preschool mathematics, out-of-school mathematics, everyday mathematics, street mathematics
  - Example: math used when shopping
Children interpret formal mathematics through their informal mathematics knowledge

- Linking concrete with abstract
- Everyday understandings give meaning to formal ones, and vice versa (Vygotsky, 1986)
Illustrations: India

Aged 8-14

Living in poverty

Infrequent to no formal schooling

Sold small items on trains and railway platforms in Mumbai
Illustrations: India

Seller:

Hairclip

5 rupees
Illustrations: India

Seller: 5 rupees

Customer: x 7
Illustrations: India

Seller: 

Customer: 

Seller: 

Illustrations: India

Seller: Hairclip
Customer: x 7

Seller: 5 rupees
Customer: 35 rupees
Illustrations: India

Seller: Hairclip

Customer: Hairclip

Seller: 5 rupees

Customer: x 7

Seller: 35 rupees

Customer:

Seller:
Illustrations: India

Seller: 5 rupees

Customer: x 7

Seller: 35 rupees

Customer: 11

Seller asks customer to buy one more to make it 40 rupees, because she does not have change
Illustrations: India

Math that this young seller used was:

- Quick
- Efficient
- Tied to the context
- Accurate
Pencils are 5 rupees each
A customer wants to buy 56.
What is the total price? How do you know?
Pencils are 5 rupees each
A customer wants to buy 56.
What is the total price? How do you know?

12 year-old seller:
He says:
If 5 rupees for 1 pencil, then
50 rupees for 10 pencils
100 rupees for 20 pencils
150 rupees for 30 pencils
200 rupees for 40 pencils
250 rupees for 50 pencils
Then
30 rupees for 6 pencils
250 and 30 is 280 rupees

12 year-old non-seller:
He writes 56 x 5 on paper, then uses a school-based algorithm to solve the equation
Illustrations: Mexico

Aged 5-15

Triqui Indigenous group

Living in poverty

Some schooling, though quality low

Sold artisanal goods in main plaza
Illustrations: Mexico

20p each
3 for 50 p
Why do you sell 3 shawls for 50 pesos?

8-year-old seller:

Yes, because look, it’s like, we give one for 20. And we have to lower [the price] by 10 or they won’t buy it from us. If we put [the price] at 60, they won’t buy it from me, that’s why we lower [the price] by 10.
Why do you sell 3 shawls for 50 pesos?

8-year-old seller:

Si, porque mira, es que como, lo damos una a 20. Y es que tenemos que bajar 10 así no nos compren. Si ponemos a 60, no me la compraría, le bajamos a 10 por eso.

Yes, because look, it’s like, we give one for 20. And we have to lower [the price] by 10 or they won’t buy it from us. If we put [the price] at 60, they won’t buy it from me, that’s why we lower [the price] by 10.
Implications: Assessments

- Formal mathematics assessments measure what children SHOULD know
- Informal mathematics assessments measure where children are starting from and reveal what children already know
- Examples from TEMA-3 (Ginsburg & Baroody, 2003)
  - Naming written numerals (formal)
  - Producing sets of given numbers (informal)
• Instruction can be designed to link abstract with concrete
  • Often instruction begins with concrete and then moves to abstract, but there should be EXPLICIT linking
Concrete
Kajol went to the market to buy cabbage. On Monday she bought 3 cabbages. On Tuesday she bought 2. How many cabbages did she buy all together?

Abstract
Abstract

3 + 2 = ?

Concrete
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Concrete

Abstract

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Concrete
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Abstract
3 + 2 = ?
Training

- Importance of informal mathematics for high-quality instruction
  - What mathematics looks like at the early grade
  - Awareness of rich mathematical knowledge that children develop out-of-school
  - Attitudes towards informal mathematics

- How to make the link between formal and informal explicit
Thank you!
Comments and Questions

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