Digital Observation of Educational Practice

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"Closing the Gap: Highly Qualified to Highly Effective"

Tuesday, June 17, 2008

Motivation: the Parent Project

- Project: "Professional Development Partnership for Improving Understanding in Algebra"
  - Foundation: the *Framework for Procedural Understanding*

- Project components:
  - One-week institute (13 teachers)
    - 8 algebra, 2 geometry, 1 AP calculus, 1 physical science, 1 special education
  - Academic year follow-up:
    - **<u>Classroom observations</u>**
    - Weekend meetings
    - Online component

Our *Framework for Procedural Understanding*

<u>Objective</u>: To help students develop deep connected knowledge of procedures.

<u>To that end, we ask students:</u>
1a)What is the goal of the procedure?
1b)What sort of answer should I expect?
2a)Can I execute the procedure?
2b)What other procedures could I use to compete the task?
3)Why does the procedure work?
4)How can I verify my answer?
5)When is this the "best" procedure to use?
    6)What else can I use this procedure to do?

Adapted from NCTM's Navigating through Algebra in Grades 9-12
(Burke, Lott, Erickson, & Obert, 2001)

Connecting the Framework:
WMAS for Mathematics

Framework Question	*WMAS for Mathematics*
1a. What is the goal of the procedure?	"Students need to <u>know…why [skills and knowledge] are being applied</u>."
1b. What sort of answer should I expect?	"Students must be able to <u>communicate their thinking</u> to others."
2a. How do I execute the procedure?	"Students need to know…<u>how to apply skills</u> and knowledge…"
2b. What are some other procedures I could use instead?	"Learning is easier when students <u>see the connections</u> between various concepts and procedures…"
3. Why is the procedure effective and valid?	"Students should be able to <u>provide a reason… why [a] skill works</u> the way it does."
4. What connections or contextual features could I use to verify my answer?	"Students should habitually check their results and conclusions for their reasonableness; <u>that is, 'does this make sense?'</u>"
5. When is this the "best" procedure to use?	"Students should be able to provide a reason <u>why they have chosen to apply a particular skill</u> or concept…"
6. What can I use this procedure to do?	"Important goals for students are… to master specific knowledge necessary for its <u>application to real problems</u>…"

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Observing Teacher Practice – Pilot

- Pilot study (college algebra, 2005)
  - Study goal: Improve understanding without declines in skill
  - Need: assess fidelity of implementation
  - Observation methods:
    - Pairs of observers
    - Tally marks of desired classroom events
    - Holistic perception on 0 to 6 scale.

Observing Teacher Practice – Pilot

Brief Instructions: An *event* refers to a classroom episode in which a Framework Objective is addressed. As you observe the lesson, place a tick mark in the appropriate box for each event that you observe.
- An event in which a majority of students are engaged (either through dialog, discussion, or writing) should be marked under the *Active* heading.
- An event in which the instructor is lecturing, having a dialog with just one or two students, or answering his or her own question, should be marked under the *Passive* heading.

Framework Objective	Related Questions	Passive (Q&A / Monolog / Lecture) Emphasis (focus of instructor's lecture / monolog; esp. when written on the board)	Aside
1a. The **Overall Goal** of the procedure.	1a. "What are we trying to accomplish?"	I	II
1b. **Predicting & Estimating**.	1b. "What sort of answer should we expect?"	I	IIII
2a. **Performing** the procedure.	2a. "How do we carry out this procedure? What are the steps?"	NU NU NU III	
2b. **Alternate Methods / Representations.**	2b. "How else could we have done this?"	I	II
3. Why the procedure is **Effective & Valid**.	3. "Why does this work? Why is it valid?"		
4. **Evaluate Results** by using context, other procedures, etc.	4. "How can we verify the answer? Does it make sense?"	IIII	
5. Assess relative **Efficiency & Accuracy**.	5. "What is the most efficient method to use?"		
6. **Empowerment** as a problem solver.	6. "What types of problems can we solve with this?"		

Classroom Observations – Overall Emphasis on Procedural Understanding

Your Initials: ____

Week Number? (circle one)   2   6   (10)

Class Observed? (circle one)
McGoff8   Katz9   Erlich10
(Lauriski10)   Hayes11   Sporleder12

Brief Instructions:
- Complete this section immediately after you have observed the lesson.
- Base your responses on your overall impression of the lesson, guided by the events you recorded on the checklist.
- Remember that "infrequent" and "frequent" should also reflect the duration of the events you observed.
- See the sample below to note how to mark your response. Please use whole numbers (0 – 6) only.

Sample

	Absent 0 1	Infrequent 2 3	Frequent 4 5	Pervasive 6
0a. SAMPLE – This is marked a "2 - Infrequent" (Use an "x" to mark the spot)		X		
0b. SAMPLE – This is marked a "5 - Frequent to Pervasive" (Use an "x" to mark the spot)			X	

Mark the locations on each of the 8 continua below that correspond to your independent evaluation of the extent to which each Framework Objective was addressed during the lesson.

	Absent 0 1	Infrequent 2 3	Frequent 4 5	Pervasive 6
1a. Overall Goal of Procedure ("What are we trying to accomplish?")				
1b. Predicting & Estimating ("What sort of answer should we expect?")				
2a. Performing the Procedure ("How do we carry out this procedure?")				
2b. Alternate Methods & Representations. ("How else could we have done this?")				
3. Why the procedure is Effective & Valid ("Why does this work? Why is it valid?")				
4. Evaluating the Results using context, etc. ("How can we verify our answer? Does it make sense?")				
5. Efficiency & Accuracy ("What is the most efficient method to use?")				
6. Empowerment as a problem solver ("What types of problems can we solve with this?")				

0 = "Absent"
2 = "Infrequent"
4 = "Frequent"
6 = "Pervasive"

Observing Teacher Practice – Pilot

- Primary Limitations:
  - No record of *sequencing* of events
  - No record of *time* spent in each category
    - (Cannot say, "Instructors devoted 15% of class time to…")

- Additional limitations
  - Holistic score was subjective
 - Holistic score could mask disagreements between observers about specific events

Observing Teacher Practice – Round 2

- Vision:
  - Digital checklist would keep track of sequencing and duration of desired events.
  - Observer selects category (with optional notes); computer keeps record of the changes.

- Benefits:
  - Record of sequencing of events.
  - Precisely measures time spent in each category.

Observing Teacher Practice – Round 2
(format similar to Praxis III checklist)

Observing Teacher Practice – Round 2

- Revised instrument provides more precise information and greater detail.

Lesson A

Lesson B

Lesson Progression

Lesson Distribution
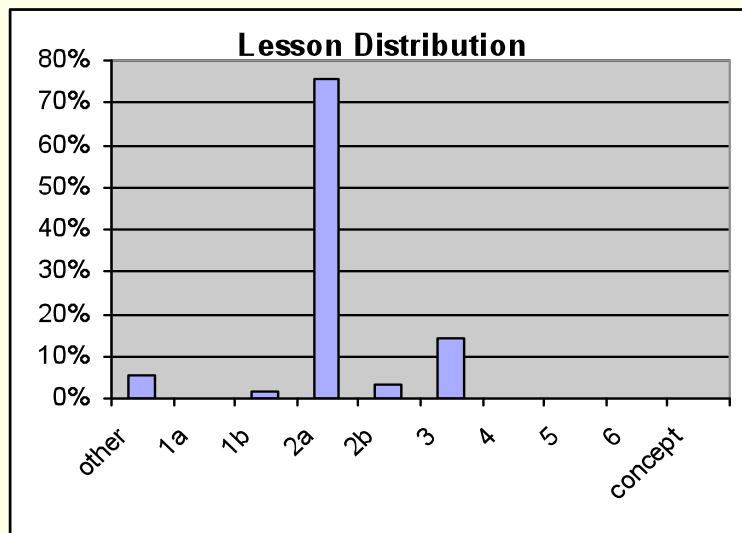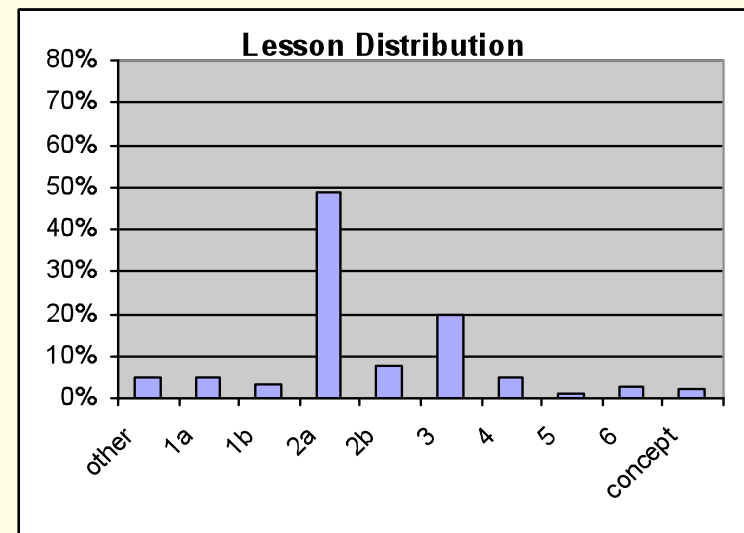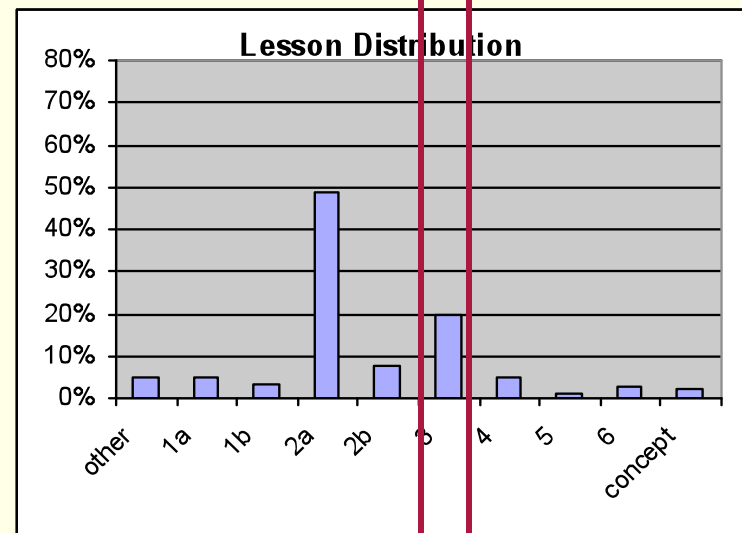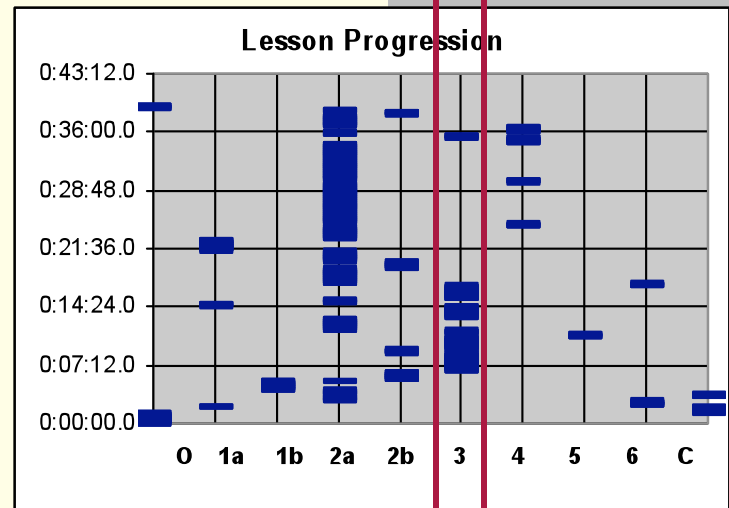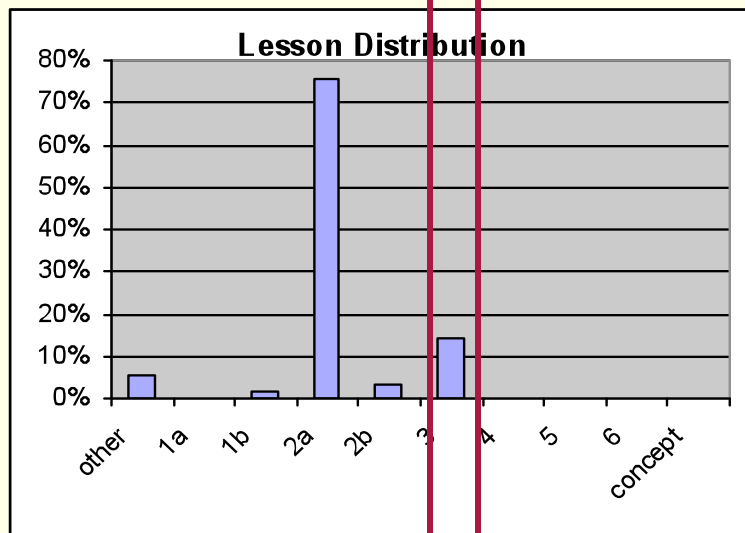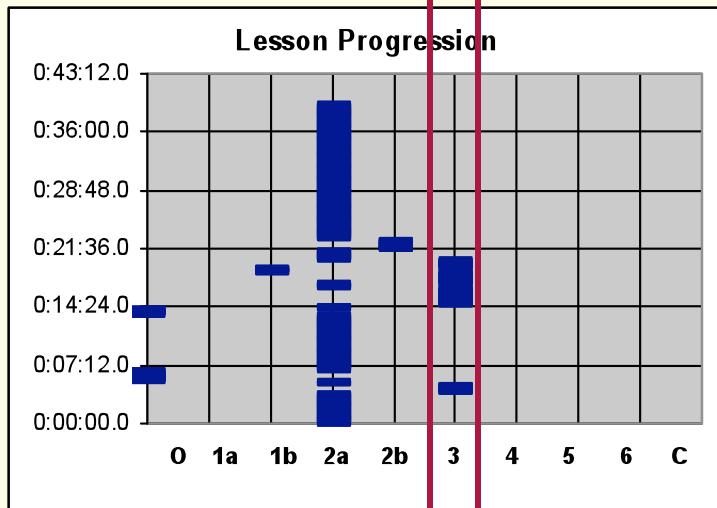
Inter-rater Reliability

■ Comparing independent observations is possible by merging the graphs:
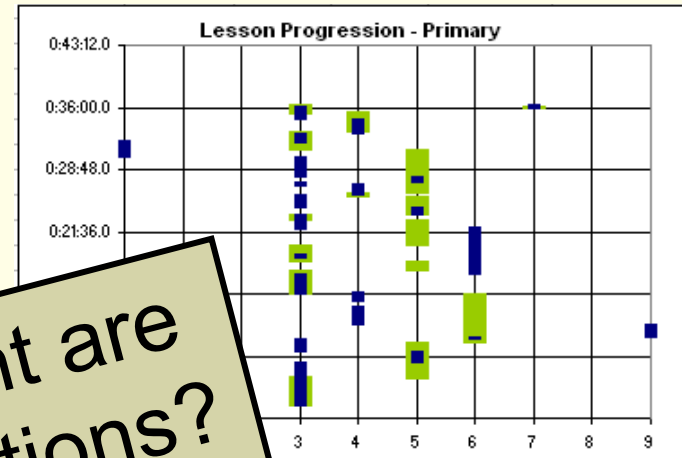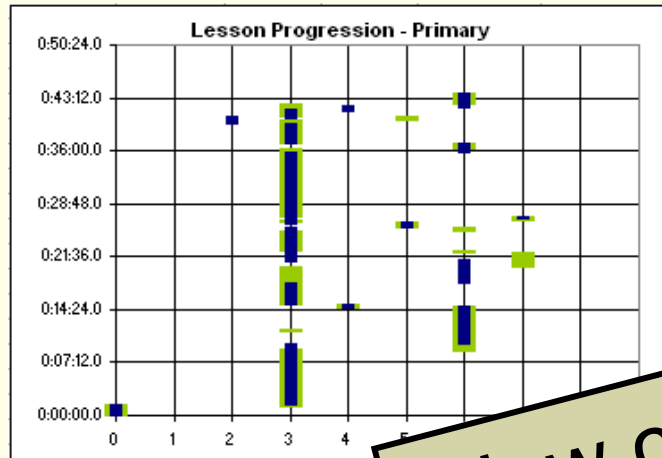
How consistent are these observations?
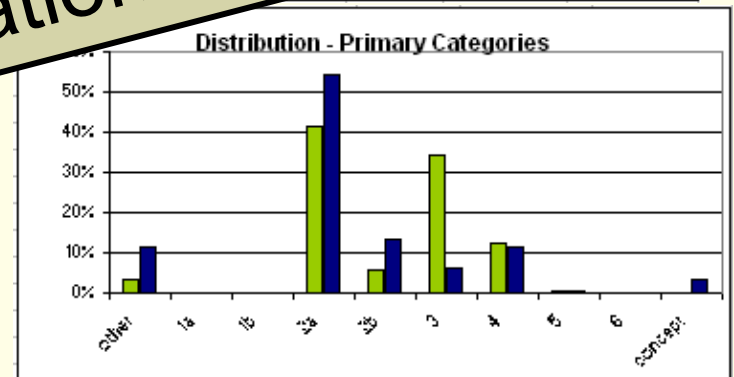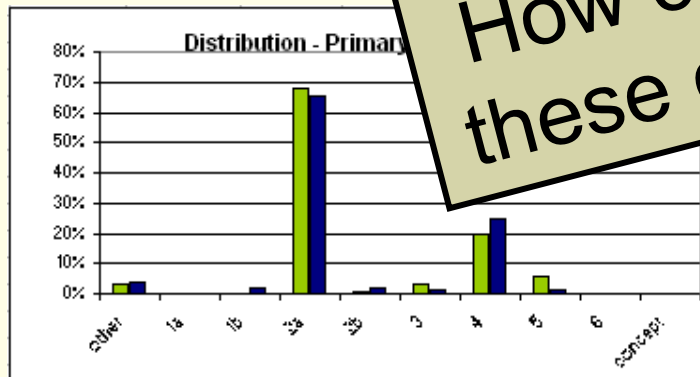
Inter-rater Reliability - Options

- Options for assessing inter-rater reliability:
  - Association
    - Linear correlation (R or R^2), using *aggregate* data (overall frequency per category, per observer)

  - Agreement
    - Raw agreement (%), moment by moment
    - Cohen's *kappa* (Agresti, 1990, p. 366), moment by moment agreement beyond that expected by chance.

Inter-rater Reliability – Correlation

- Simple correlations are not appropriate.
  - High-leverage points skew regression.
  - Clustering near (0,0) inflates R^2.
  - Strong correlation does not guarantee high agreement.
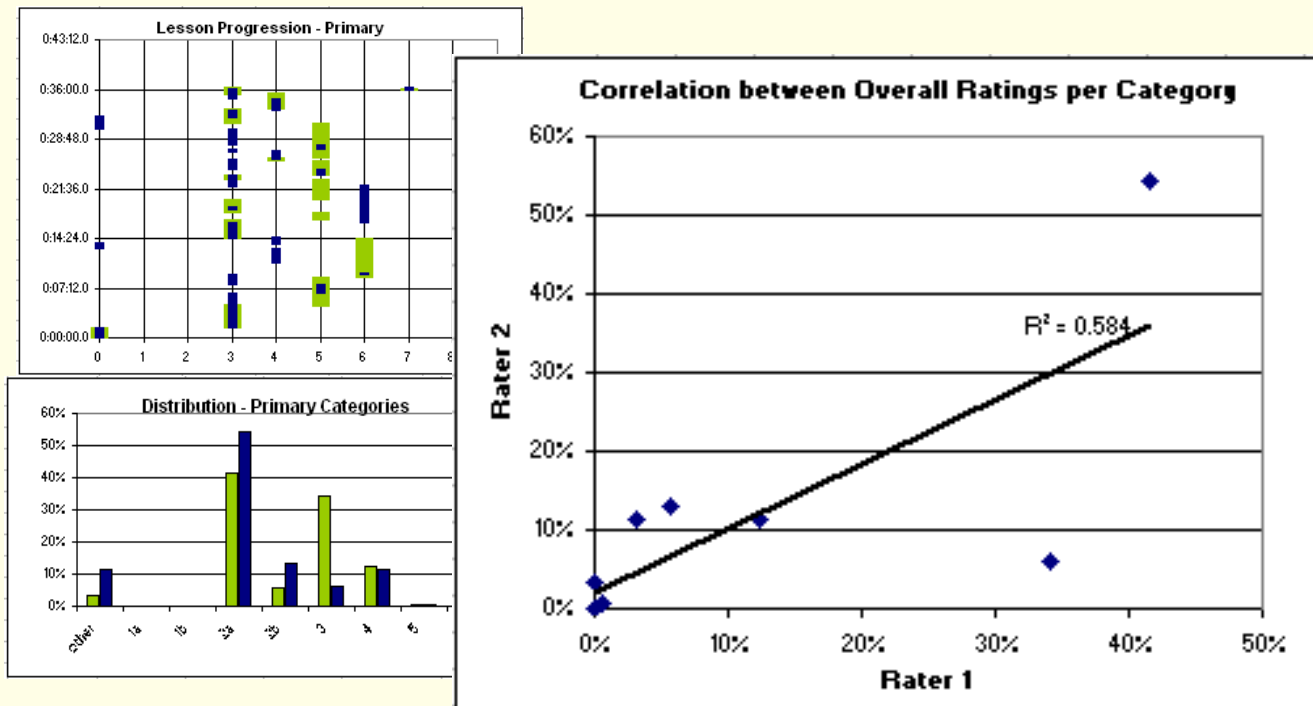
Inter-rater Reliability – % Agree

- % Agreement (moment to moment) is easy to calculate from our data…
  - Triangulate with plots to see *where* we differed.
- % Agreement for all joint observations:
  - 3|9
  - 4|
  - 5|91
  - 6|6
  - 7|9522
  - 8|861
  - 9|2
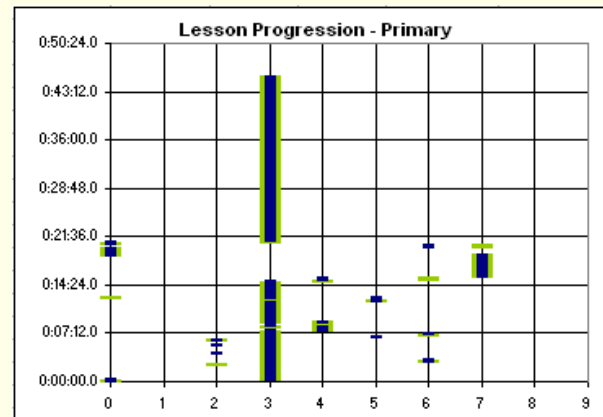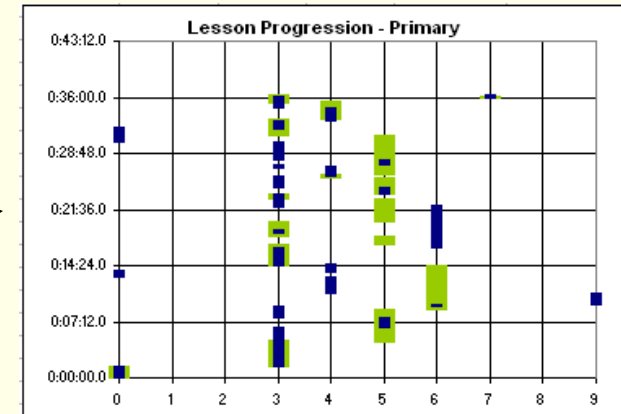
Inter-rater Reliability – % Agree

- When necessary, we can drill down to explore the areas of disagreement.

Lesson Progression - Primary

Frequency of primary code pairs (Jon, Jenn)

	-1	0	1	2	3	4	5	6	7	8	9	Jon:
-1	-	-	-	-	-	-	-	-	-	-	-	0%
0	-	4%	-	-	3%		2%	2%	-	-	-	11%
1	-	-	-	-	-	-	-	-	-	-	-	0%
2	-	-	-	-	-	-	-	-	-	-	-	0%
3	-	-	-		22%	2%	21%	1%	-	-	-	46%
4	-	-	-	-	1%	5%	3%	8%	-	-	-	16%
5	-	-	-	-	-	-	7%	-	-	-	-	7%
6	-	-	-	-	6%	-	8%	0%	-	-	-	14%
7	-	-	-	-	0%	-	-	-	0%	-	-	1%
8	-	-	-	-	-	-	-	-	-	-	-	0%
9	-	-	-	-	-	-	4%	-	-	-	-	4%
Jenn:	0%	4%	0%	0%	31%	7%	42%	16%	0%	0%	0%	
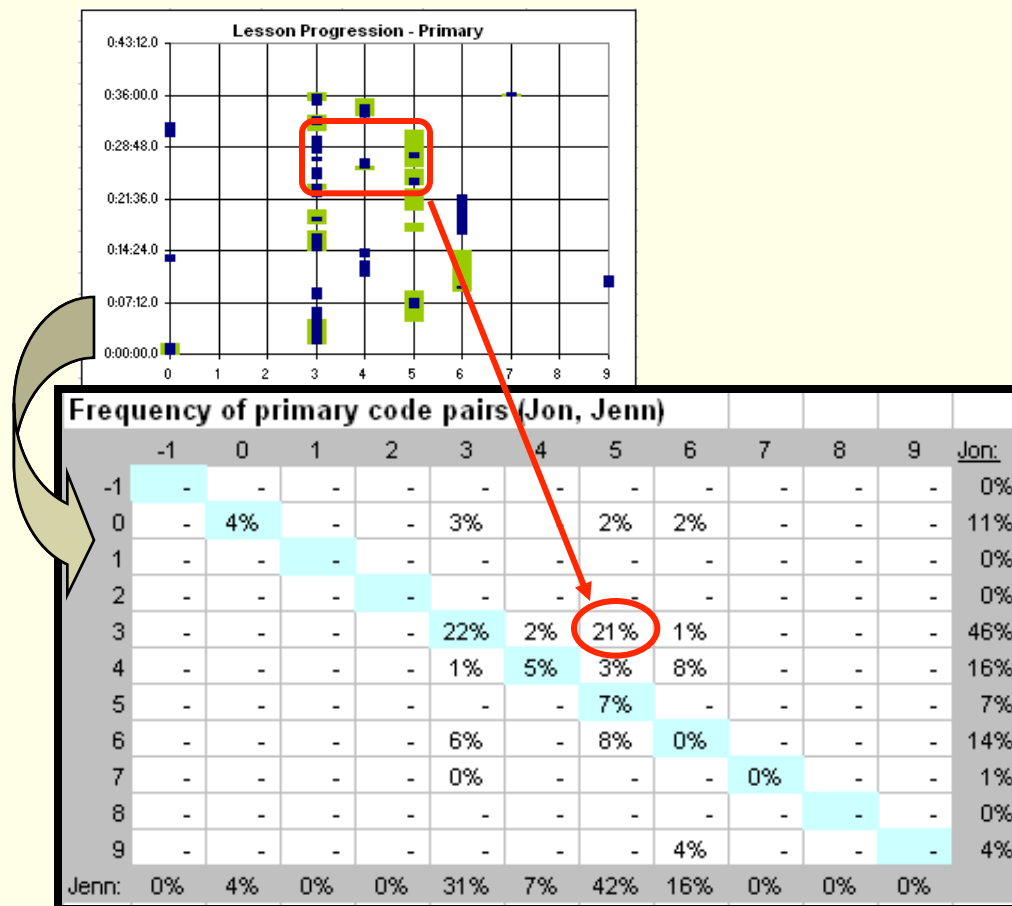
Inter-rater Reliability - *kappa*

- Cohen's *kappa* is a measure of agreement beyond what is expected by chance.

- <u>Range of *kappa* for our joint-observations:</u>
  - <0.0 (worse than chance)   -
  - 0.0-0.2 (slight agreement)   -
  - 0.2-0.4 (fair)   .22, .24
  - 0.4-0.6 (moderate)   .42, .45, .48, .48
  - 0.6-0.8 (substantial)   .60, .61, .70, .74, .75, .79
  - 0.8-1.0 (almost perfect)   -

Inter-rater Reliability - Remarks

- Remarks about reliability:
  - Categories should be mutually exclusive…
    - …our *Framework* items may not be.

  - "% agreement" and *kappa* are influenced by long unbroken periods in a single category (e.g. homework time at end of period.)
    - Next steps include trimming data to explore only teacher-centered time.

Preliminary Results – The Nature of Algebra Instruction

- We observed 14 *algebra* lessons (11 hr. 45 min.) using the instrument (7 jointly).

- Teachers were told to "sprinkle in" Framework-related items. How well did they do?

Algebra Results – ES and AE

ES
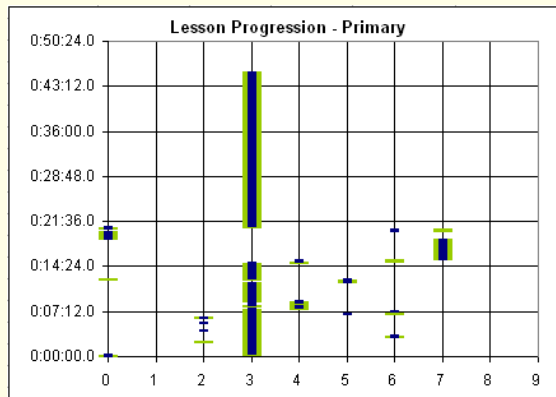
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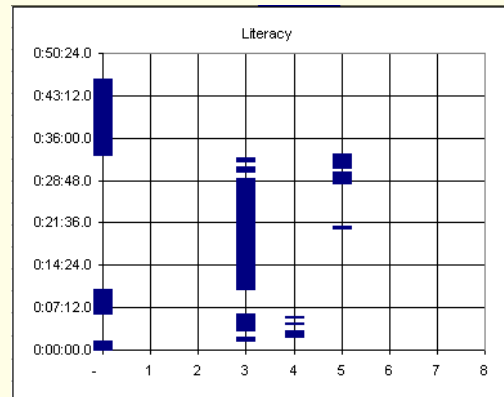
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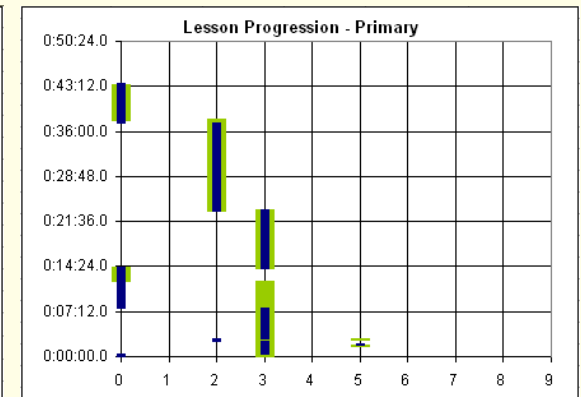
Feb. 2008

AE
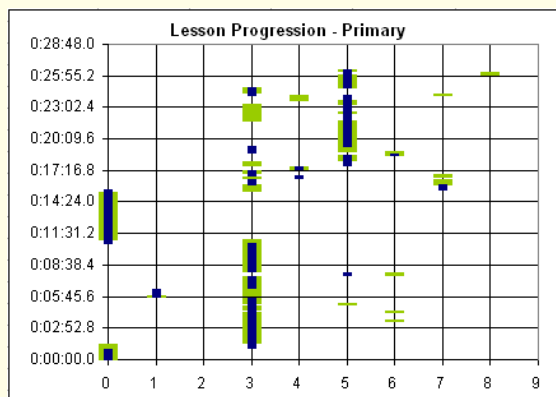
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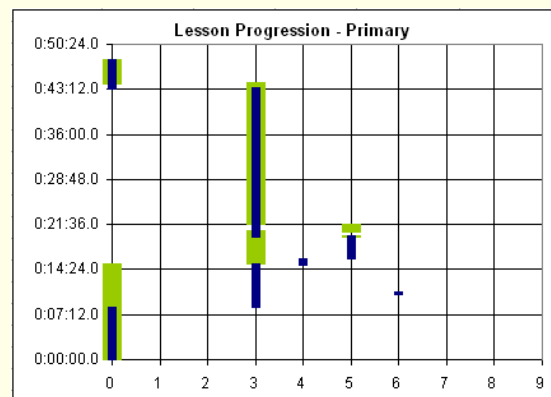
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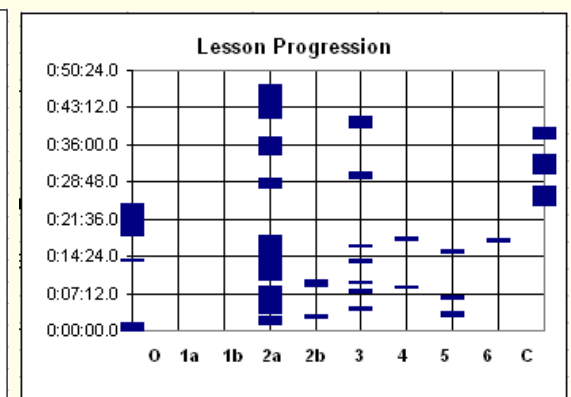
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Algebra Results – KE and BE

KE
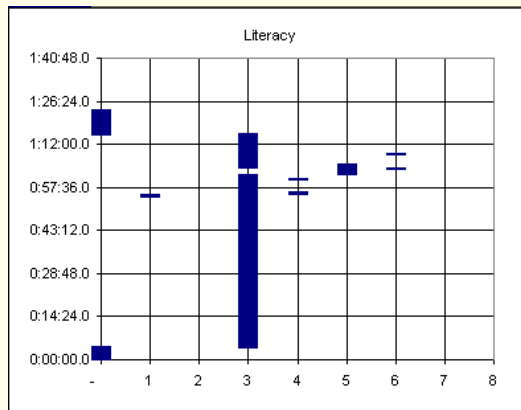
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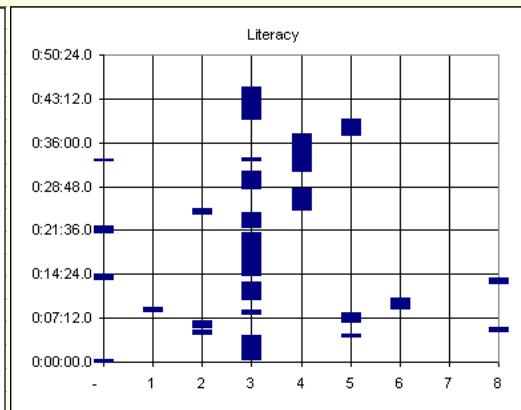
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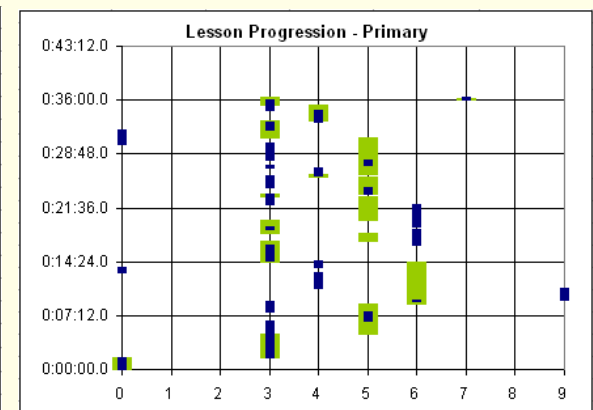
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BE
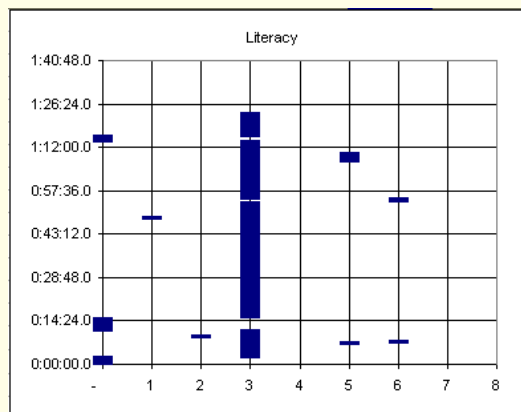
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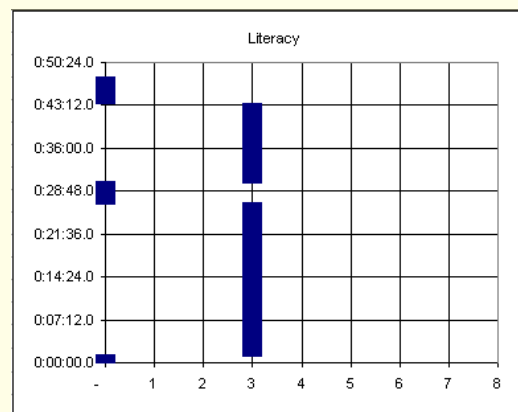
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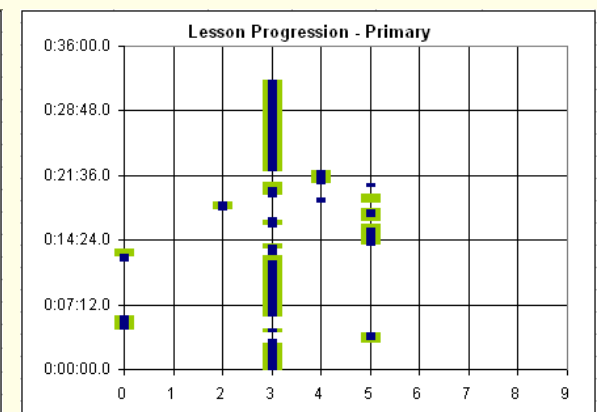
Feb. 2008

Algebra Results – EZ

EZ
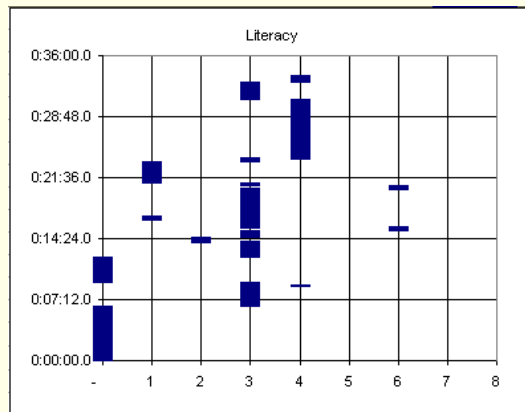
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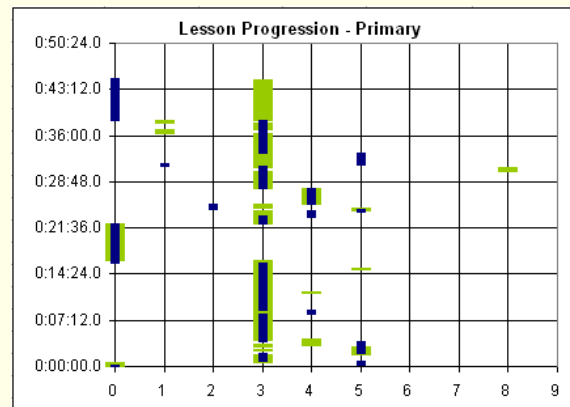
Nov. 2007

Preliminary Results – The Nature of Algebra Instruction

- **Allocation of time in 14 algebra periods:**
  - 64% "How do we do it? What are the steps?"
  - 18% Other *Framework* questions.
  - 17% "Other activities (taking attendance, etc.)"

Time Devoted to *Framework* Dimensions (14 Observed Algebra Lessons)
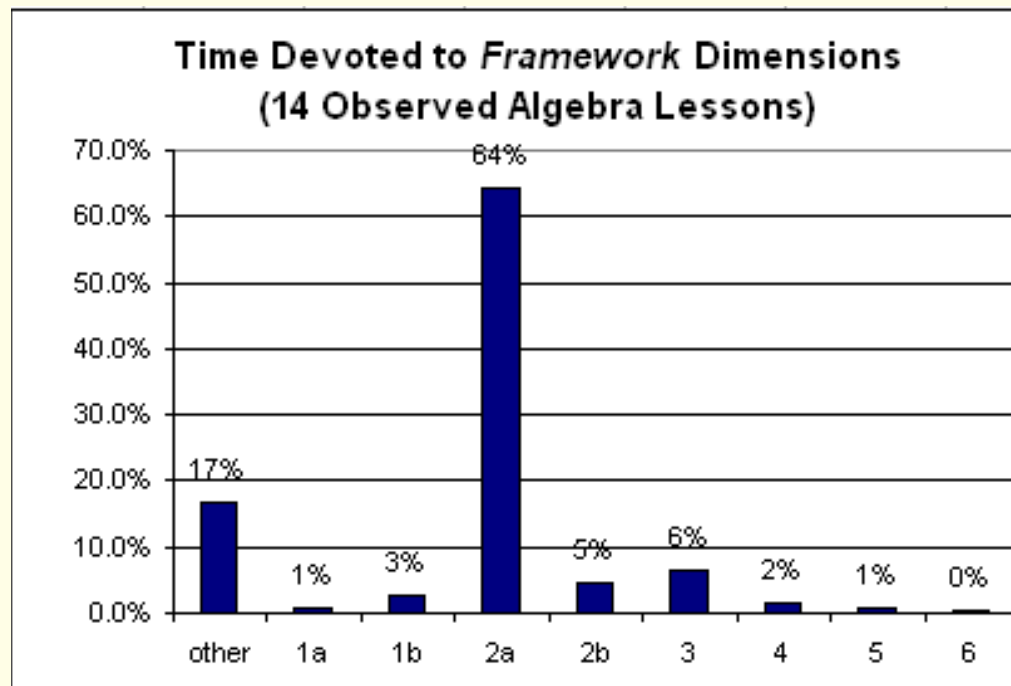
Connections to Other Projects

- Praxis III: "Classroom Performance Assessments" instrument uses an observation sheet with:
  - Time, Comment, Evaluation Code

- "Instructional Skills Observation Instrument" based on Hunter's Lesson Design Model with:
  - Categorical codes: Set/Focus, Instruction, Guided Practice, and Independent Practice

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