**Brief Summary/ Relevant Notes of all Videos on all CDs**

**CD #1, Video #1, 1:25:00 (Day 1)**

Focus is on Bobby, Michelle, Magda, and Amy (Amy Lynn?)… Table at right side of classroom

4:30- lecture starts, reminder of Guess My Rule (boxes/ first column, triangles/ second column), mentioning inverse operations (until 8:00): + and -, \* and /, square and square root. Main lecturer is “Dr. Dan”? (female lecturer)

9:00- students start solving a specific example, +2 -2 +2 -2 (off camera) but asked to find a universal rule ~11:00

11:20 new GMR example (off camera again), boxes and triangles still. Apparently the rule is “times 4”, as Angela comes up and writes it on overhead (can’t see what she writes though). Bobby does it backwards using inverses… 60 in second column means 15 is in first column (*dividing* by 4).

13:20- Michael comes up to overhead and explains another inverse GMR answer. More grinding out answers and GMR problems. Given triangles and boxes, find rules. Given triangles and rules, find boxes. Given boxes and rules, find triangles.

22:00- After more work, Amy (Amy Lynn? sp?) comes up and writes another rule on the overhead again. Other students answer other problems.

Next ~20+ minutes: Multiple conversations regarding validity of answers, writing corrects answers more than one way, or debating different answers.

Next ~20+ minutes: Focus solely on Bobby’s group working on calculations.

1:02:20- Ankur at overhead, writing and explaining a problem.

1:06:30- Back to Bobby’s group, talking about answers.

1:13:45- Dr. Maher at overhead, talking, announces visitor (Lindsay, third grader). Lindsay explains her Rule.

1:15:45- Lindsay explains more interesting rules, flabbergasts the class.

**CD #1, Video #2, 1:34:02 (Day 1)**

Focus is on Jeff’s table… table at left side of classroom (also includes Michael, Angela, and Sarah)

10:25- sound starts; 14:10- lecture starts (same day as Video #1, but from different angle)

Next hour: All conversations that are being had at the overhead or by the main lecturer are still out of sight/ off camera vision. Focus on Jeff’s table only includes some mumbling, some working on problems, and some goofing off (as to be expected). Comparable amount of information to Bobby’s video.

1:03:30 – Group writes solutions on transparencies for overhead. Explains answers to Dr. Maher.

Rest of video is the same.

**CD #1, Video #3, 1:30:00 (Day 1) \*\*\***

Focus is on the front of the room (finally!)

1:00- lecture starts

1:40- first GMR example shown on overhead… box + 3 = triangle… if box = 0, triangle = what, then box = 1 and 2, etc. (kids know easily). Box = -1 and -2 is solved easily too. 10 in triangle, so box is 7 (inverse: 10-7, even though rule was +3).

3:52- “What if you square a number? What is 5 squared?” (easy). More talk of inverses.

5:00- New two columns filled with numbers (including fractions) shown on overhead- kids need to figure out the rule. Rule is “box divided by 3 = triangle”. Shows Ankur/ Brian/ Stephanie (that table) thinking about problem. Not solved, lecturer (Dr. Dan? sp? Female…) moves on to new problem.

8:05- New two columns filled with numbers. Rule is “box times 4 = triangle”. Inverse with Bobby: 60 as triangle means box is 15.

10:08- They try the previous fraction GMR example again- Michael gets it as “box times 1/3 = triangle”.

11:58- Lecturer brings up she had a “different” rule from Michael’s: “box divided by 3 = triangle”.

13:44- New two columns filled with numbers. Rule is “box times 4, then add 1 = triangle”. Finally solved at 19:10. Also Michelle solves inverse (-1, /4) when triangle = 49, so box = 12.

22:30- New two columns filled with numbers. Rule is “box times 2, then add 6 = triangle”. Solved at 25:00. When triangle is 56, box is 25… inverse is -6, /2.

26:30- Lecturer claims she had a different rule than “box times 2, then add 6 = triangle”. She writes: “2 times (box + 3) = triangle”. Discussion over whether or not they’re the same (distributive property).

29:00- New two columns filled with numbers. Rule is “box squared = triangle” or “box times box = triangle”. If triangle is 25, box is 5. If triangle is -36 (at 32:20), then …??? Students confused! The eventual agreement among students is that -36 \*shouldn’t be used\*, and then the class moves on.

34:00- New two columns filled with numbers. Obvious rule is “box plus 2 = triangle”. Lecturer writes her rule as: “(3 times box + 6) divided by 3 = triangle”. Still equivalent, but students are unsure at first and find it unnecessary anyway (“why so complicated?”). They set off to prove/ check to see if the rule works and why, and then generate their own similar GMR patterns that have multiple short and long matching rules (given assignment at 44:13).

55:27- “Ankur Smells”. Hahahaha.

58:15- Ankur presents his/ his table’s GMR short/ long matching rules:   
1. box + 7 = triangle;   
2. box + (5\*2)-3 = triangle;   
3. (100 times box + 700) / 100 = triangle;   
4. (8\*box + 56) /8 = triangle.

1:10:10- Dr. Maher has been talking about why clarity is important in arguments and proofs, and here we see more equivalent rules from the GMR topic.

1:10:35- Visitor Lindsay arrives!

1:12:00- Lindsay’s first rule: 5 times an even number is half that even number with a zero at the end.

1:13:00- Lindsay’s second rule: 5 times an odd number… lower the odd by one (to make even), then divide by two and then put a 5 at the end.

1:16:50- Back to the equivalent rules from 1:10:10… explaining why they give matching answers (equivalent fractions that simplify/ reduce to the same numbers). Class ends at 1:19:50.

**CD #2, Video #1, 52:00 (Day 2) \*\*\***

Focus is on the front of the room/ overhead projector/ lecturer (mainly)

9:15- lecture starts, importance of explaining Why (example: asking mom for $5- she asks Why- you explain for movie ticket).

10:55- Multiplicative identity (of 1) and definition of multiplication. Introduction to axioms.

16:00- Explanation of commutative property, distributive property, associative property, additive property

22:00- Bobby and then Ankur generate multiplication patterns for 5 times tables.

28:40- Two-column paper is passed out so the students can work out future problems.

29:15- New GMR problem on the overhead. Asks for rule \*and inverse rule\* (first time for second question). Box column = 0, 1, 2, …; Triangle column = fractions: Box/(Box+1). Ankur’s table figures out pattern quickly and then there’s a lot of down time/ small talk/ boredom.

45:00- Michelle presents her table’s answer (correct).

46:50- Angela and Michael present their table’s answer (also correct, elaborate). Michael writes “denominator” in the equation instead of actual numbers/ shapes though, which is interesting.

50:50- Class is over.

**CD #2, Video #2, 52:00 (Day 2)**

Focus is on Bobby’s table

9:15- lecture starts

Video is same as #1, just focusing on Bobby’s table.

21:50- Bobby explains the third grader Lindsay’s patterns from yesterday. Bobby comes up to overhead to demonstrate this.

28:50- Focusing on Bobby’s table working on problems, occasional close-up of the two-column paper (can’t really make out what it says, but does show a lot of work).

Rest of video is identical (presentations at end). Not as good quality as Video #1.

**CD #2, Video #3, 50:00 (Day 2)**

Focus is on Jeff’s table.

5:20- lecture starts

Up until 25:00- Close-ups of Michael actually answering, Jeff writing on his nametag and being bored.

25:00- Jeff’s table starts to complete problems on their two-column papers (working together). Stop working at 41:00, then presentations.

42:50- Michael and Angela present together.

**CD #2, Video #4, 1:22:49 (Day 3) \*\*\***

No central focus (camera shifts around the room/ tables/ overhead)

0:00- lecture starts

0:42- Starting with more GMR questions. Camera panning to students working.

7:20- Close-up of a rule on the overhead. \*tough\*. triangle = -(box) + 1. Another close-up at 11:40.

23:00- Students present answers to a problem. Written in multiple ways but simplify the same. (Also, one equation = triangle, another = square.)

36:33- Lecturer talks about re-writing one of the correct equations in terms of another (using properties like commutative and distributive).

40:00- Asking to change equations from one variable to another… “triangle =” to “square =”. Specific problem is: square/ (square + 1) = triangle. Plugging in numbers to understand the rule as well.

1:07:00- Students finally present answers to their inverses of aforementioned problem. Arguments over which groups have better answers. Real answer: square = -triangle/ (triangle-1), or (after factoring out the negative): square = triangle/ (1- triangle). At 1:11:50, the correct inverse answer is revealed.

**Dissertation pdf:**

* **4.2 Data, p. 56: names of students, other generic information**
* **Chapter 5 Results \*\*\* starts on page 61 (most important area); Chapter 6 Conclusions important too.**
* **3 important questions:**
* **1.** What evidence, if any, exists that students understand the idea of function?
* **2.** How do students build the idea of inverse function?
* - What obstacles, if any, do they encounter?
* - If obstacles are encountered, how are they overcome?
* **3.** What evidence exists, if any, that students understand the idea of inverse function?

**Relevant Clips so far:**

**CD #1, Video #3**

(Relevant to Q1)-

1:40- 3:20- Showing functions as inputs and outputs, with students understanding how they work using a basic function (square + 3 = triangle). Students easily can come up with the output given the input, or the input given the output.

(Relevant to Q2)-

3:21- 4:47- They also understand the idea of inverse functions when the lecturer uses the term to talk about using the output to derive the input. Understanding inverse operations and being able to name them (+ and -, \* and /, square and square root).

**CD #2, Video #4**

(Relevant to obstacles- problems/ solutions)

1:07:00 onwards? Student overhead answers + actual answer (shown afterwards)? Because…   
Nearly every math problem given- except for the last question- across all videos were solved with relative ease by the students… last question shows most difficulty. Focus here? Pick out certain parts/ topics of dissertation that show evolution of understanding and explanation for functions and inverses…   
Also: step-by-step going backwards two operations to undo a function (e.g. subtract constant from both sides and then divide coefficient to obtain variable in equation in two-step equation); are there multiple inverses for one function (or are they equivalent through manipulation), etc.