Making the Most of Flipped In-Class Time

Samuel Otten, Zandra de Araujo, Wenmin Zhao, JP Han, Erica Mason, & Jessica Kamuru
University of Missouri at Columbia

This study is funded by the National Science Foundation grant no. DRL-1721025. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.

www.FlippedMathStudy.net
Agenda

1. Lesson Activity Structures
2. Personal Introductions
3. Criteria for Lesson Observations
   a. Sample Video 1
   b. Sample Video 2
4. Two Profiles of Flipped Instruction
5. Conclusion and Q&A
Lesson Activity Structures

WHOLE-CLASS DISCOURSE

SMALL-GROUP WORK

INDIVIDUAL WORK

HOMEWORK

*CLASSROOM BUSINESS
Lesson Activity Structures - Flipped Instruction

- **HOMEWORK**
- **WHOLE-CLASS DISCOURSE**
- **SMALL-GROUP WORK**
- **INDIVIDUAL WORK**
- **CLASSROOM BUSINESS**
Flipped Lesson Flow - Example

HOMEWORK

WHOLE-CLASS DISCOURSE

INDIVIDUAL WORK
Introductions

Introduce yourself to your neighbor and then discuss the following questions:

● In terms of the main activity structures, what is your typical lesson flow?
● Have you ever flipped a lesson? Was the lesson flow the same or different?
Our Study - www.FlippedMathStudy.net

- **Algebra 1 Classes:** 20 flipped and 20 non-flipped
- **Research Questions**
  - What are salient factors entailed in teachers’ implementation of flipped instruction in Algebra 1?
  - To what extent do these factors* predict students’ learning of algebra as measured on a procedural inventory and on a concept-of-variable inventory?

*We’re interested in instructional factors in flipped AND non-flipped classes*
Framework

At Home
- Video/Multimedia
  - Lecture
    - Multimedia Design
    - Mathematical Quality
    - Interactivity
  - Set-Up or Motivation
    - Connection (explicit, implicit, or not discernible) to Learning
- Problems/Exercises
- No Homework

In Class
- Whole-Class Format
  - Univocal Discourse
    - Mathematical idea
    - Mathematical justification
    - Attention to receivers
    - Other features (motivation, connections)
  - Dialogic Discourse
    - Mathematical question/goal
    - Mathematical justification
    - Other features
- Non-Whole-Class Format
  - Groups
    - High Cognitive Demand
    - Low Cognitive Demand
  - Independent (Voluntary Grps.)
    - High Cognitive Demand
    - Low Cognitive Demand

Factors mediating at-home influence on in-class
- Availability of resources, Student behaviors (e.g., watching or not watching, pausing or skipping ahead), Teacher and Parental Expectations, Accountability, etc.

Factors mediating in-class influence on student outcomes
- Teacher expectations, Student behaviors, Norms, Time, Resources, Physical arrangement, etc.

Student Outcomes

Students' Knowledge, Skills, and Other Outcomes
Framework
Framework: In-Class Time

- Individual Work, Small-Group Work
  - High cognitive demand tasks
  - Low cognitive demand tasks
  - On-task behavior (low, moderate, high)
Framework: In-Class Time

- **Individual Work, Small-Group Work**
  - High cognitive demand tasks
  - Low cognitive demand tasks
  - On-task behavior (low, moderate, high)

- **Whole-Class Discourse**
  - Clear mathematical **idea**
  - **Motivation** for the mathematical idea
  - Conceptual development and **coherence** to the flow of ideas
  - Mathematical **justifications** provided
  - Visual/tangible **representation** accompanying verbal discourse
  - Explicit **connections** to prior knowledge
  - Locus of authority (teacher/textbook …… shared/student-led)
  - Nature of interactions (sharing …………… collaborating) [Staples & Colonis, 2007]
Flipped Instruction: Ms. Schaefer

- Consider the following in the lesson excerpt (recognizing that we aren’t watching the whole lesson):
  - Idea
  - Justification(s)
  - Representation(s)
  - Connection(s)
  - Locus of authority
Flipped Instruction: Mr. Forrest

- Consider the following in the lesson excerpt (recognizing that we aren’t watching the whole lesson):
  - Idea
  - Justification(s)
  - Representation(s)
  - Connection(s)
  - Locus of authority

Exploring the graph of \( y = \sqrt{-x} \)
Forrest: Tony had a question about [problem] 2B. He said, “Why is that even possible?” Tony, can you explain why you think it’s a problem?
Tony: I don’t know, I just noticed it’s \[y = \sqrt{-x}\] undefined.
Forrest: Why would you say that it’s undefined?
Tony: Because it’s imaginary numbers.
Forrest: Okay, so Tony says, “Why is that possible,” because you think it’s imaginary. Square root of a negative should be imaginary. Can anybody explain why you still got a graph there? What do you think, Matt?
Matt: Because all the x-values are negative, it’s gonna make it positive.
Forrest: So, “Because all the x-values are negative, it’s gonna make them…”
Matt: Like, the x-values in the graph, whenever you plug them in, it’s gonna invert them into a positive number.
F: Alright, so can you give me an example? Because we got (writes on board) \(y = \sqrt{-x}\), right?
Matt: So \(x\) is negative three.
Forrest: So if we made an xy-table (writes a table on the board with \(x = -3\) as the first entry), plugged in negative three?
Matt: Yeah.
Forrest: We get the square root of…
Matt: Three.
Forrest: Three, right? (writes \(\sqrt{3}\) in the y-column) Because, if you think of it another way, wouldn’t that be the square root of negative negative three?
Female Student: Uh huh.
Forrest: Which is the square root of negative negative 3. This is why it’s still possible. Because even though it’s the square root of negative \(x\), what kind of values can we plug in for \(x\)? We can plug in negative values for \(x\) to give the square root of \(x\). Does that make sense?
Lesson Profiles
Sample Lesson Profiles - Flipped Instruction
Sample Lesson Profiles - Flipped Instruction

Time
Concluding Thoughts

- Videos are the defining feature of flipped instruction but we suspect they are not the primary predictor of student learning.
- In our view, benefits are more likely to come from in-class time. For example...
  - Offload lower-level processes to the HW, emphasize higher-level processes in class.
  - Offload teacher authority to the HW, emphasize shared/student authority in class.
  - Use the extra in-class time to have more collaborative discussions or implement more open-ended tasks. (*Time is often the #1 barrier cited by teachers*)
- Think about the kind of lesson profile you want and, if you are flipping instruction, make sure that it’s supporting you in achieving that profile.
Questions?

Interested in participating our study? Email ottensa@missouri.edu or visit FlippedMathStudy.net