Teacher Questioning as an Indicator of Change

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Changing Teaching; Changing Learning; Helping Students Become Knowledge-Able

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Presentation Goal

To report the findings of the analysis for the teacher questioning as an indicator of change.

Illinois Mathematics-Science Partnership Goals

- Increase teachers' content knowledge and thus improve student achievement
- Use expertise of STEM faculty; draw on best practices for teacher professional development
- Increase teachers' understanding and utility of research pertaining to the teaching and learning of mathematics and science

Aims of the research

- investigate how participation in a Master's degree program influences teachers' instructional practice
  - focus on teacher questioning as one indicator of change

Institutes for Integrating Content-Knowledge with Classroom-Instruction (IICC)

- 3-year Master's degree program in two tracks:
  - Master of Science in Mathematics (mathematics education)
  - Master of Science in Curriculum and Instruction (science education)
- Coursework for state endorsement in middle grades mathematics *or* science
- Graduate 25 teachers (22 graduates)

IICC Teachers

Mathematics Track

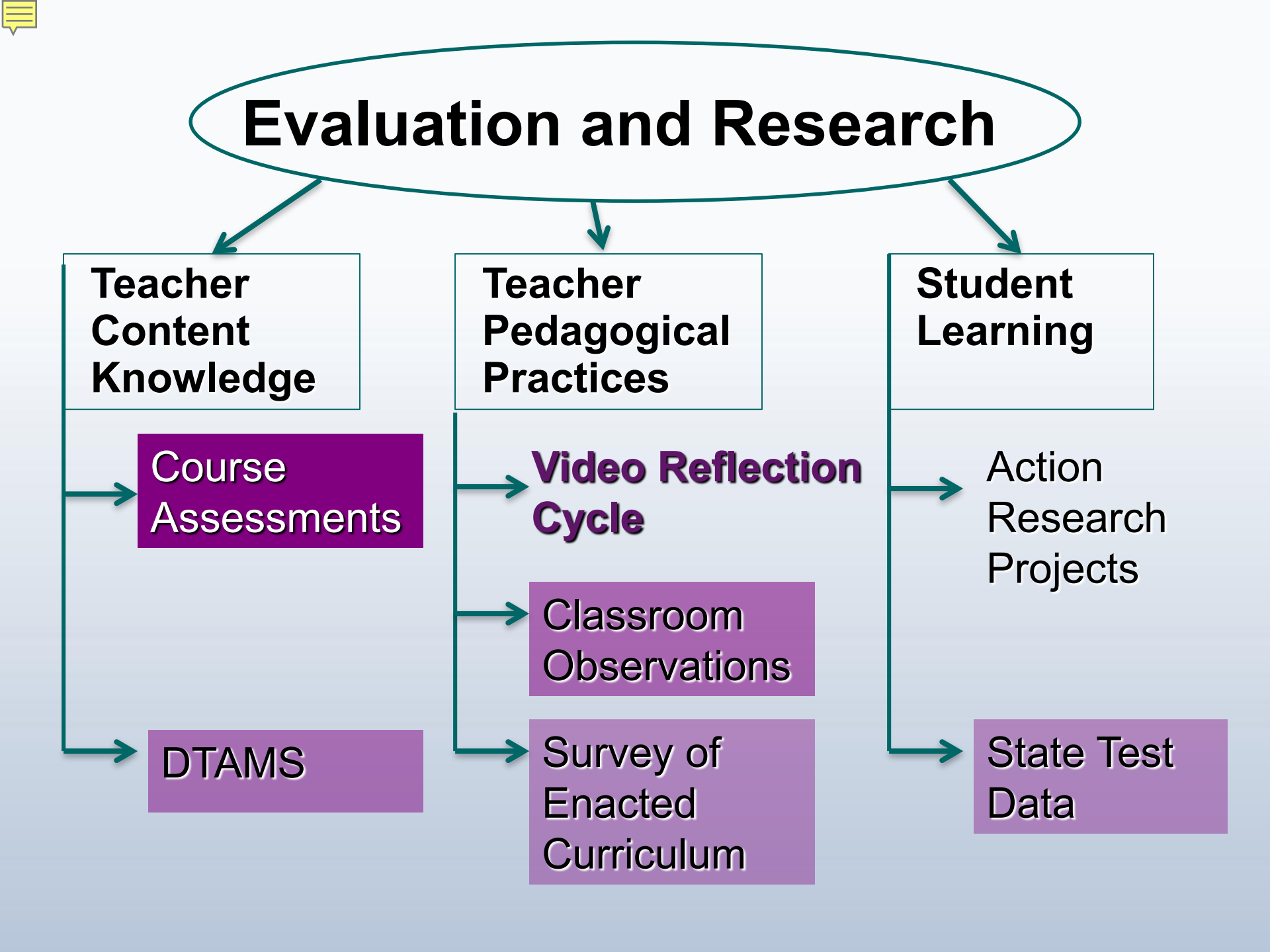
Middle school	10
High school	5
Special Education	3

Science Track

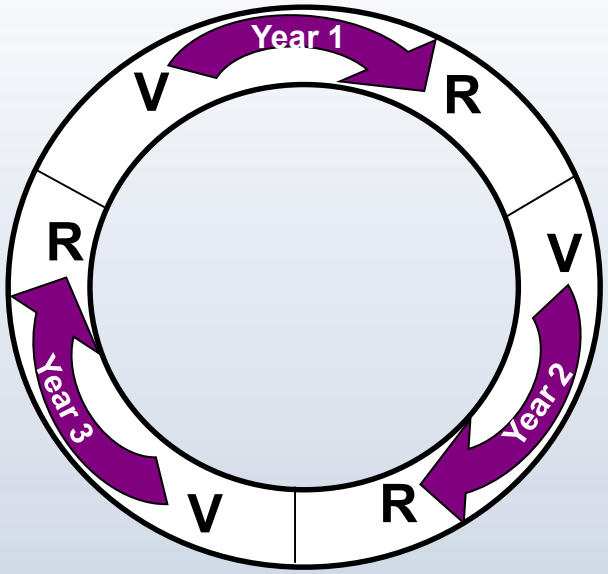
Elementary school	4
Middle school	3
Special Education	2

IICC Plan of Study (36+ credit hours)

	Mathematics Track	Science Track
Fall 2008	MAT 401/C&I 451: Research in Mathematics & Science Education	
Spring 2009	EAF 410: Statistics in Education	
Summer 2009	MAT 489: Teaching, Learning, Assessment of Rational Numbers	CHE 409: Physical Science for Middle School Teachers
	MAT 403/ C&I 407: Learning Theories in Mathematics & Science Education	
Fall 2009	MAT 304: Modern Geometry for Middle School Teachers	C&I 458: Life Science for K-8 Teachers
Spring 2010	C&I 453/MAT 402: Instructional Strategies in Science & Mathematics Ed.	
Summer 2010	MAT 421: Topics in Algebra for Teachers	GEO 306.16: Regional & Area Studies–The Geology of Central IL
	C&I 481: Professional Research	
Fall 2010	MAT 312: Probabilistic & Statistical Reasoning for K-8 Teachers	C&I 459: Principles of Ecology for K-8 Teachers
Spring 2011	MAT 309: Number Theory for K-8 Teachers	PHY 489.02: Astronomy for Middle School Teachers
Summer 2011	MAT 490/C&I 482: Professional Research II TEC 489.17: STEM Leadership	


Evaluation and Research
Teacher Content Knowledge
Teacher Pedagogical Practices
Student Learning
Course Assessments
DTAMS
Video Reflection Cycle
Classroom Observations
Survey of Enacted Curriculum
Action Research Projects
State Test Data

Video Reflection Cycle



- Beginning of the program: teachers planned, taught/recorded, and reflected on a lesson
- Middle of program: teachers watched, modified original lesson, retaught/recorded, and reflected on the lesson
- End of program: repeated video reflection process.

Analysis of the Data

As part of the research we are conducting, we are working on two different types of research

1. The use of the video reflection cycle for teacher improvement
   - *Teachers' written reflections*
   - *Focus group interviews (collaborative verbal reflections)*
   - *Pair group interviews (verbal reflections)*

2. Analysis of video-taped lessons –
   - *by using Modified Horizon protocols (focused on implementation, content, and classroom atmosphere)*
   - *by using questioning framework (focused on analysis of teacher questions as an indicator of change over time)*

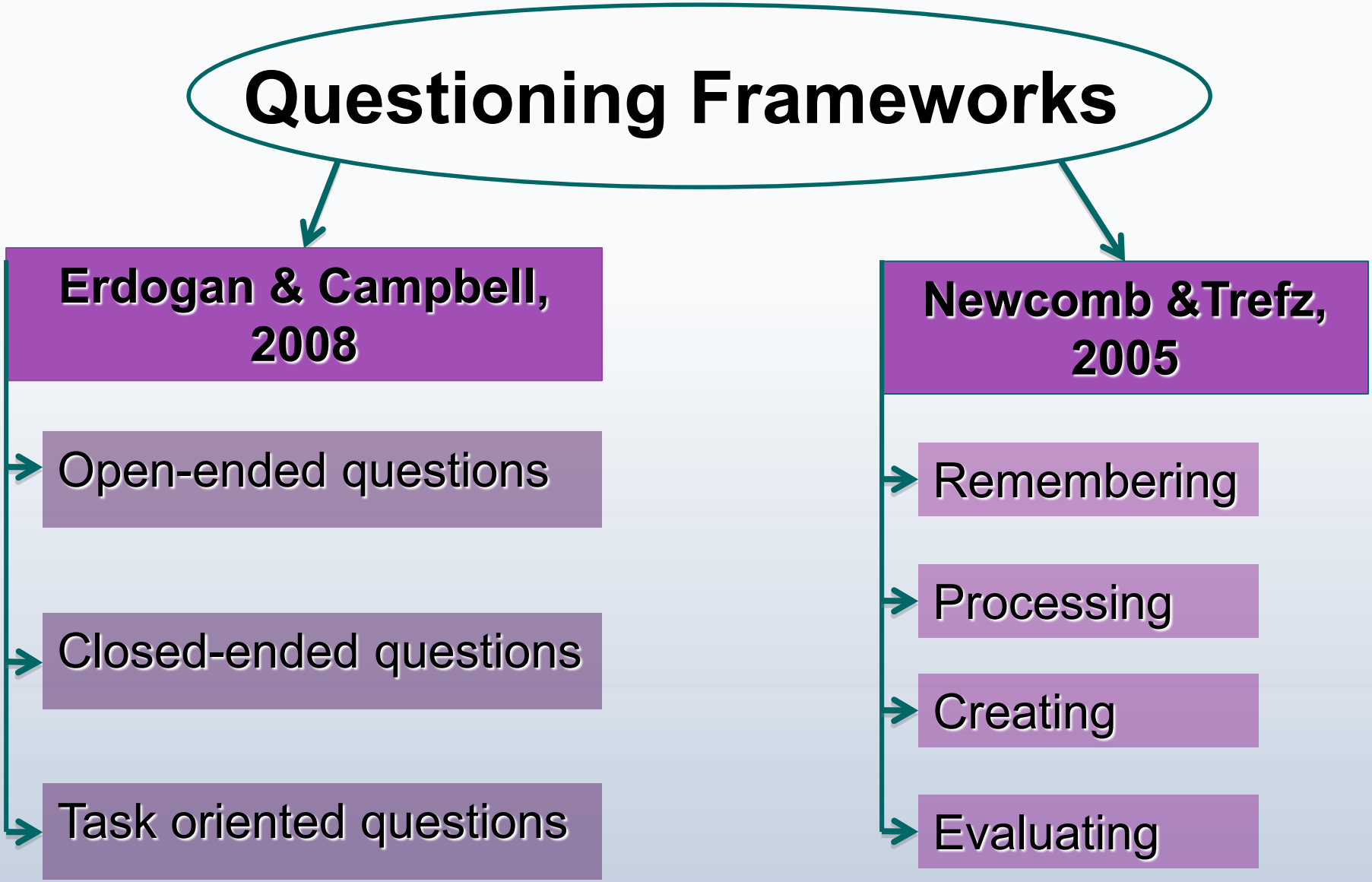
Why the Focus on Teacher Questions?

- Teachers identified questioning in their teaching/ reflection cycles, and interviews with researchers
- Types of questions teachers ask could be an indicator of teacher change
- In the first lessons, we observed that teachers' questions were at a low cognitive level (e.g., Walsh & Sattes, 2005)

Trying Not to Reinvent the Wheel!

- Practically, we sought a framework that would:
  - detect and characterize shifts in teachers' questioning,
  - assist teachers in critiquing and improving the questions they pose.
- Theoretically, we wanted a framework that would:
  - meet our theoretical demands in serving as a tool to conceptualize teacher change in both mathematics and science,
  - show potential to function at a practical level in the hands of teachers.
- We sought a framework that already exist in math and science literature.

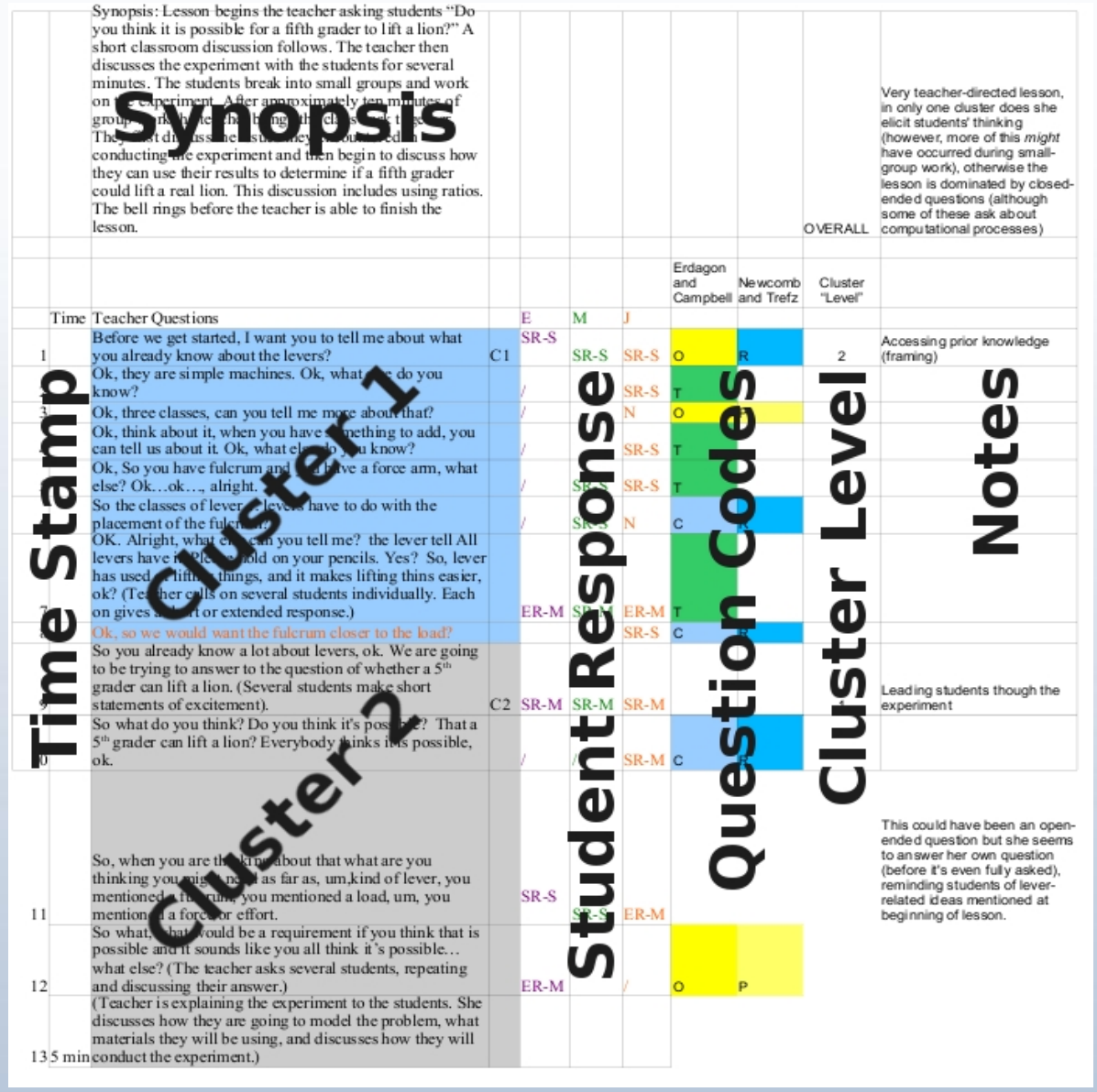
Questioning Frameworks



Analysis of Teacher Questions

- Transcribed the questions teachers posed, identified type of student response, wrote a synopsis for each lesson
- 3 researchers independently reviewed each transcript to identify clusters of questions (based on the shift in content or lesson focus); met to compare and agree upon cluster designations
- 3 researchers individually coded each cluster using a 5-point rubric and wrote a brief description of the overall lesson; cluster codes were compared and agreement was negotiated

Excerpt from Our Coding



Five-Point Cluster Rubric

Level	Description
1	(almost entirely) closed-ended, teacher-centered questions with limited correct responses, primarily recall and memorization, lacks a clear focus , loosely organized
2	primarily teacher-centered; may contain some student-centered segments, some open-ended questions are interspersed within the cluster; however, the teacher quickly switches over to closed-ended questions.
3	blend of teacher-centered and student-centered instruction, contain s a mix of open-ended (more frequent) and closed-ended questions, focus more on the use of known facts, theories, and principles and less on the recall or memorization.
4	primarily student-centered with limited teacher-centered instruction, open-ended questions are dominant with may be a few closed-ended questions, very little recall or memorization.
5	Entirely open-ended, student-centered questions. Predominance of questions that ask students to draw original conclusions /novel thinking, may require students to make a judgment or critical analysis.

Five-Point Cluster Rubric

Level	Description
1	
2	
3	blend of teacher-centered and student-centered instruction, contains a mix of open-ended (more frequent) and closed-ended questions, focus more on the use of known facts, theories, and principles and less on the recall or memorization.
4	
5	

Analysis of Teacher Questions

- For each lesson, 1 researcher constructed a narrative characterization of the overall lesson (based on the cluster codes and a synthesis of the researchers' short narrative descriptions of the lesson)
- Narratives were analyzed to construct a lesson rubric (similar to the 5-point cluster rubric) to describe each lesson.
- Changes in teachers' questioning were examined broadly according to shifts in lesson rubric designations and more specifically through qualitative analysis of the three narrative characterizations for each lesson.
- Lesson characterizations were analyzed and grouped according to subtle, moderate, and significant changes in each teacher's questioning and structure.

Results of Questioning Analysis

Lesson Structure	Questioning: No Change	Questioning: Subtle Change	Questioning: Significant Change
No Change	2 Teacher Teacher questioning focused on recalling facts/procedures throughout. Lesson structure dominated by teacher-directed instruction with limited student engagement.	2 Teachers Teacher questioning shifted to consider student strategies/explanation but still focused on recalling facts/procedures rather than mathematical/scientific concepts. Consistent lesson structure dominated by teacher-directed instruction with limited student engagement.	
Subtle Change	4 Teachers (T2) Teacher questioning focused on recalling facts/procedures throughout. Subtle shifts in lesson structure to increase student engagement through use of activities or group work.	7 Teachers (T3, T6, T17) Teacher questioning shifted toward more questions that required using facts/theories and applying procedures. Subtle shifts in lesson structure to increase student engagement through use of activities or group work, student sharing, and written reflections.	
Significant Change	3 Teachers (T20) Questioning of one teacher was consistently focused on recalling facts/procedures. Significant shift in lesson structure with the inclusion of activities intended to foster student engagement. Questioning of the other two teachers was consistently a mix of recall and application questions sometimes requiring inference. Significant shift in lesson structure with tasks designed to elicit student thinking.	1 Teacher (T5) Teacher questioning shifted toward more questions that required using facts/theories and applying procedures. Lesson structure changed to include substantive mathematical/scientific content and greater student engagement in activities/investigations.	4 Teachers (T9, T14) Teacher questioning shifte significantly to feature student justification, illustration, and deduction. Significant shift in lesson structure to feature substantive mathematical/scientific content and elicit student thinking and sharing of solutions/reasoning.

Change in Teacher Reflections

- Teachers became more reflective as they engage in the program and particularly as they do video reflections.
  - Most teachers related their reflections to the research and provided evidence from their video lessons.
- Teachers' comments shifted from the teacher to the students (as well as their questioning).
- Teachers' focused more on the process rather than the students right or wrong answers (this is a shift we see in their questioning).
- Teachers' focus shifted from evaluating to interpreting their performance.
- Teachers paid attention to the details of their teaching (not from what they remember but what they notice in their video lessons.)
- Teachers' focus shifted from general teaching practices to the specific aspects of their teaching (for example their questioning).

Change in Teacher Questioning

- We are seeing a shift from teacher-centered to student-centered questions
- 46% of our teachers improved their questioning (10/22) one or more levels.
  - Increased their use of more open-ended, student-centered questions.
  - 11 teachers' questioning changed but not enough to move to a higher level.
- We are seeing subtle changes in teacher questioning strategies
  - More focus on student prior knowledge
  - More attention paid to student responses
  - More focus on the process rather than the product
  - Improved follow up questions

Conclusions

- Teacher change is complex and multi-faceted.
  - Questions can be an indicator of change.
- This is a useful and sustainable model to investigate teachers' instructional practices but needs refinement (still in progress).
  - We found this model to be useful because of its reliable use.
  - It meets our theoretical demands on this study.
  - It is also feasible for teachers to use for investigating their own questioning.

References

Erdogan, I. & Campbell, T. (2008). Teacher questioning and interaction patterns in classroom facilitated with differing levels of constructivist teaching practices. International Jounal of Science Education, 30(14), 1891-1914.

Newcomb, L.H. & Trefz, M.K. (2005). Toward teaching at higher levels of cognition. NACTA Journal, June, 56-60.

Walsh, J. A. & Sattes, B. D. (2005). *Quality Questioning: Research-Based Practice to Engage Every Learner.* Thousand Oaks, CA: Corwin Press.

Thank you!

QUESTIONS???

SUGESTIONS???

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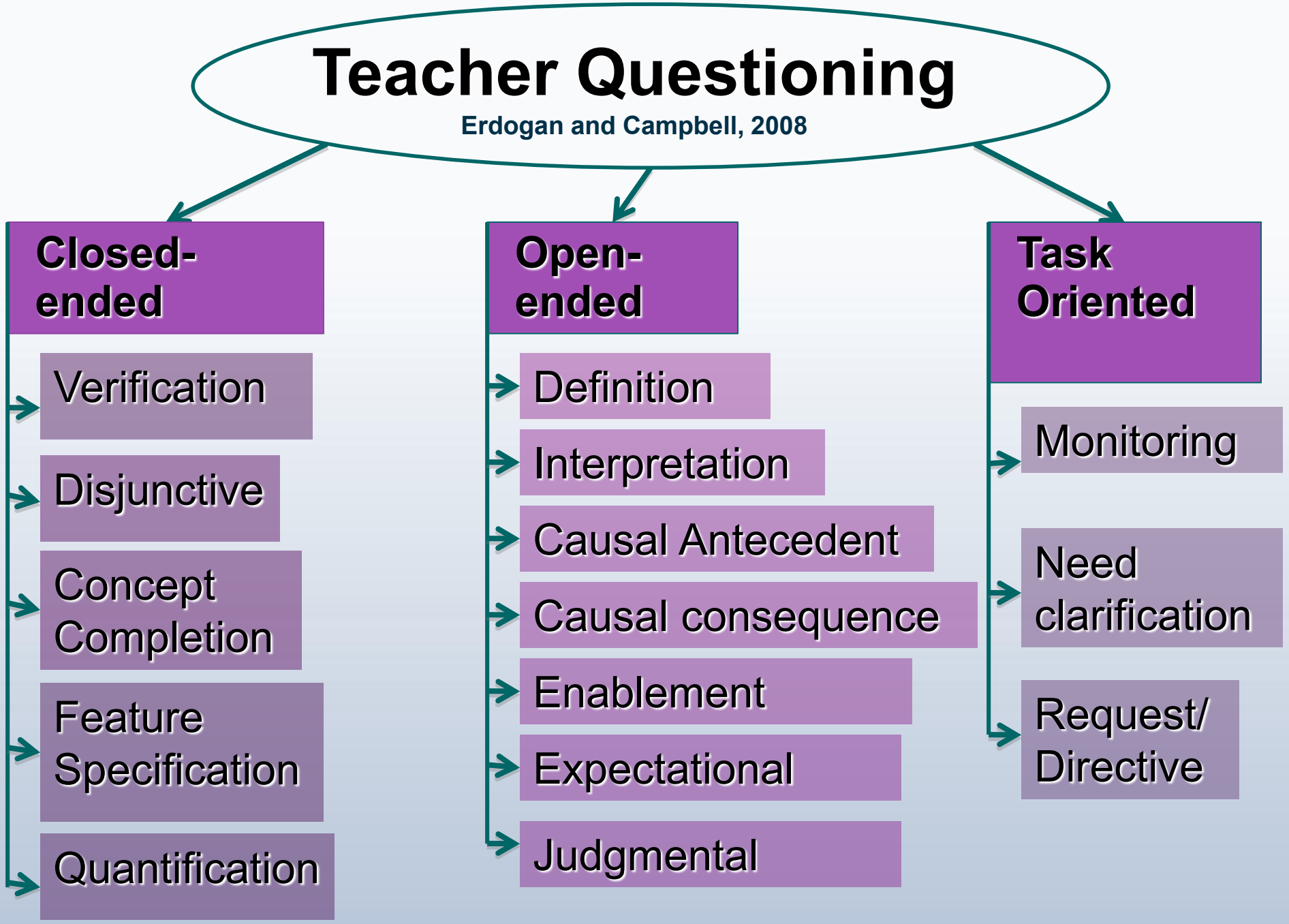
Teacher Questioning
Erdogan and Campbell, 2008
Closed-ended
Verification
Disjunctive
Concept Completion
Feature Specification
Quantification
Open-ended
Definition
Interpretation
Causal Antecedent
Causal consequence
Enablement
Expectational
Judgmental
Task Oriented
Monitoring
Need clarification
Request/ Directive

Teacher Questioning

Newcomb &Trefz,1988

Remembering	Memorizing, recall, identification of facts
Processing	Use of known facts, theories, and principles in a procedural manner
Creating	Novel thinking, making original conclusions, a student explaining their thinking about finding a solution to a non-routine problem
Evaluating	Making judgment or critical analysis

Five Point Lesson Scale

	1	2	3	4	5
Erdagon and Campbell	**Closed-ended**	**Closed-ended** Open-ended	Open-ended Closed-ended	**Open-ended** Closed-ended	**Open-ended**
Newcomb and Trefz (1988)	**Remembering**	**Remembering** Processing	**Processing** Remembering Creating	**Creating** Processing Evaluating	**Evaluating** Processing

Note: Bold indicates that this was present the most