Summary of Articles Related to CER

The goal of this document is to familiarize the reader with pertinent research for implementing an inquiry-based Claim-Evidence-Reasoning (CER) approach in the classroom. Each article is broken down, with the pertinent findings of each article summarized. The full citation is at the end of each summary, should the reader wish to locate the full article.

Potential uses:

-Identifying key components for implementing an inquiry driven CER approach in the classroom.

-Providing evidence of a research-based foundation for curricular choices to show a CSS or school admin.

-For an administration or CSS wishing to develop or enhance an inquiry-driven CER program to support math and science achievement and interest, as well as critical thinking skills, for their school site.

Title of Article/Chapter	Conducting Talk in Secondary Science Classrooms: Investigating Instructional Moves and Teaching Beliefs
Source Title (journal, book, etc.)	Science Education
Author(s)	Diane Silva Pimentel and Katherine L. McNeill
Year	2013
Setting for Study (grades, subjects, etc.)	Urban school in New England, pilot year for an ecology curriculum designed to engage students who are traditionally underrepresented in science fields.
Participant Focus (teachers/students/etc.)	15 teachers with a bachelor's in science and a master's in education.
Research Question(s)	How do teachers' approaches to whole-class discussions provide some explanation for the type of science talk that is prevalent? How do teachers' beliefs help to explain their approach to talk during whole talk discussions?
Study Design	Video recordings and teacher interviews were analyzed to understand patters of science talk that occurred in the classroom during whole class instruction and how teachers viewed science talk. <u>For Video Recordings</u> There were two lessons of interest-one about developing researchable questions, and one about arguing regarding climate change. Teacher moves were coded into categories and evaluated. Student responses were also used to characterize the talk in the classroom. Teachers were provided with professional development that highlighted strategies teachers could use to support productive student talk. <u>For interviews</u> Interviews were transcribed and analyzed using thematic analysis.
Main Findings	-Student responses were predominately single words/short phrases

	-Student responses that were categorized as extended reasoning made up less than 5% of total responses. -More than three-quarters of verbal exchanges were between the teacher and a student, not student to student. -Teachers often had a tendency to cut off or stifle student responses by elaborating on short student responses. -Observed probing questions infrequently, but when probing was used it allowed students to provide the elaboration. -The least used talk move was the toss back – asking the students to comment on another student response.
Implications for Practice	-Establish the type of knowledge that is expected in discussion. -Probing students during discussion is crucial to extend responses. -Use the toss back approach to encourage students to provide feedback on each other's thoughts. -Teachers struggle with passing on content versus developing students' ability to participate and contribute to discussions. Engaging other students in the discussion and using probing and/or toss back will assist in developing student understanding of content.
Citation (APA format)	Pimentel, D.S. & McNeill, K.L. (2013). Conducting talk in secondary science classrooms: Investigating instructional moves and teacher beliefs. *Science Education, 97* (3), 367-394.

Title of Article/Chapter	Talking Science: Argument-Based Inquiry, Teachers' Talk Moves and Critical Thinking in the Classroom
Source Title (journal, book, etc.)	Science & Education
Author(s)	Yilmaz Soysal
Year	2021
Setting for Study (grades, subjects, etc.)	4 middle school science teachers and 92 7th grade students. The author did not provide relevant information about the demographics of the student test group or the training/education level of the teachers.
Participant Focus (teachers/students/etc.)	Teacher talk moves were evaluated to understand implementation quality and the ability to improve student-higher ordered thinking. Student critical thinking levels were then compared across teacher classrooms, and compared with the teacher implementation quality to understand how implementation quality enhances critical thinking.
Research Question(s)	-What is the relationship between implementation of argument-based inquiry and teacher led talk moves? -How does ABI and teacher-led talk impact students' critical thinking about scientific questions?

Study Design	RTOP (Reformed Teaching Observation Protocol) was used to examine teacher capabilities.
Main Findings	Literature review: -There is an assumption that there is an interaction between scientific reasoning and critical thinking. Core components of critical thinking overlap with the skills used in scientific inquiry. -Implementation quality is how effectively the teacher implements in-class inquiry, and is closely related to the quality for classroom discourse/discussions. -Talk moves that improve student voice are most important for improving critical thinking. Study: **Teachers with higher implementation quality scores had students with higher critical thinking.**
Implications for Practice	The talk moves teachers make during the argument-based inquiry process is crucial for improving student critical thinking. Talk moves that focus on student voice should be the focus of teacher talk.
Citation (APA format)	Soysal, Y. (2021). Talking science: Argument-based inquiry, teachers' talk moves, and students' critical thinking in the classroom. *Science and Education, 30*, 33-65.

Title of Article/Chapter	The Relative Effects and Equity of Inquiry-Based and Commonplace Science Teaching on Students' Knowledge, Reasoning, and Argumentation
Source Title (journal, book, etc.)	Journal of Research in Science Teaching
Author(s)	Christopher D. Wilson, Joseph A. Taylor, Susan M. Kowalski and Janet Carlson
Year	2010
Setting for Study (grades, subjects, etc.)	58 children ages 14-16 who were recruited to take place in a 14 hour, 2 week course in science.
Participant Focus (teachers/students/etc.)	The study compared student achievement based on the delivery model (inquiry-based instruction compared to commonplace teaching).
Research Question(s)	What is the effect of inquiry-based materials on student achievement as compared to commonplace materials? -To what extent can differences in student achievement between the inquiry-based and commonplace groups be attributed to randomized group assignment? -Does student race/ethnicity, gender, or socioeconomic status account for variation in posttest scores above and beyond the variation accounted for by the pretest scores and group assignment?

	-What differences in achievement by treatment group exist specific to the learning goals of knowledge, reasoning and argumentation?
Study Design	A laboratory-based randomized control design was used. 58 students ages 14-16 were randomized to receive either inquiry-based instruction or commonplace teaching during 14 hours of instruction in a 2-week summer course. There were no differences in the make-up of the two groups in terms of age, race, SES, etc. All students completed an identical pre-test and posttest before and immediately after the 2-week course. A 30 minute interview were also conducted four weeks following the course. Reformed Teaching Observation Protocol (RTOP) was used as an index for the teacher moves during the course.
Main Findings	-RTOP Index was higher for the inquiry based unit. -There was a significant increase in achievement in the post-test results for inquiry-based instruction compared to the post-test results for common-place instruction. -Comparison of pre-test and post-test results indicated that a higher achievement gap was present at the end of the common-place unit compared to the inquiry-based instruction unit.
Implications for Practice	-Inquiry driven instruction lends itself to more productive teacher moves that increase student learning. -Data supports that using inquiry-based instruction will facilitate ameliorating the achievement gap.
Citation (APA format)	Wilson, C.D., Taylor, J.A., Kowalski, S.M., Carlson, J. (2010). The relative effects and equity of inquiry=based and commonplace science teaching on students' knowledge, reasoning, and argumentation. *Journal of Research in Science Teaching, 47* (3), 276-301.