Claims, Evidence, and Reasoning in Mi
School Science: A Mixed-Methods Study

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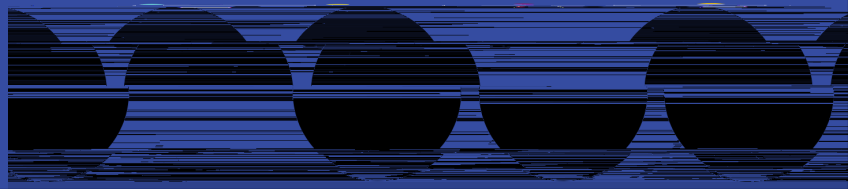
Background and Context: Ashley

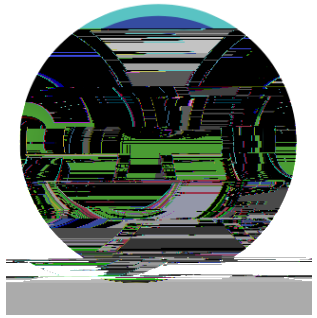
Prior science teaching experience in Washington D.C. and Thailand

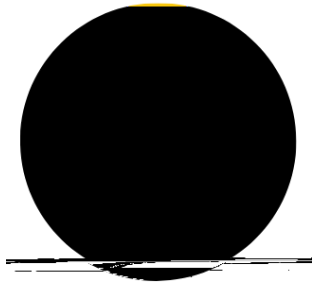
Now: 7th Grade Science Teacher at Hector P. Garcia Middle School

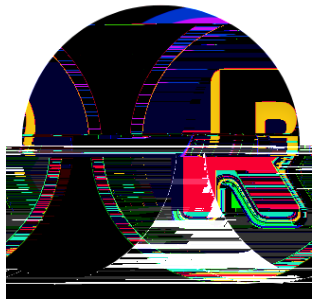
Instructional Goals:

- Accessible learning for all students
- Authentic scientific argumentation tasks
- Deep understanding of science concepts



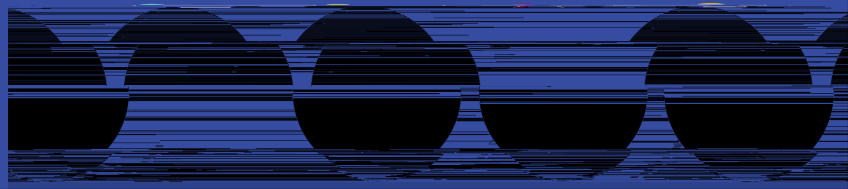






Literature ReviewArgumentation

- Scientific argumentation (McNeill et al., 2006)
  - Claim: addresses a question of interest
  - Evidence: scientific data
  - Reasoning: justification for using the data in relation to the claim
- Learning progression (Berland & McNeill, 2010; Osborne et al., 2016)
- Shortcomings in student argumentation common (Lemke, 1990; Krajcik et al., 1998; McNeill & Knight, 2013; Sadler, 2004)
- Challenges addressing argumentation in the classroom (Driver et al., 2000; McNeill & Berland, 2017; McNeill et al., 2016; Osborne et al., 2003)



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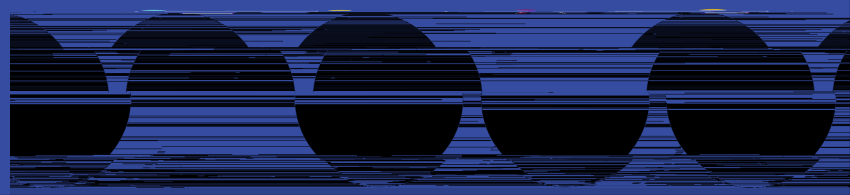


Theoretical Framework-Translanguaging

Historical deficit perspectives of multilingual students (e.g., Cummins, 2000; Probyn, 2019)

Translanguaging: students use full range of linguistic resources (García & Sylvan, 2011; Li, 2018; Otheguy et al., 2015)

Translanguaging can make learning more equitable (García & Wei, 2014)

understanding of science concepts (Karlsson et al., 2019; Poza, 2018) and argumentation (Licona & Kelly, 2020)

Research Methods

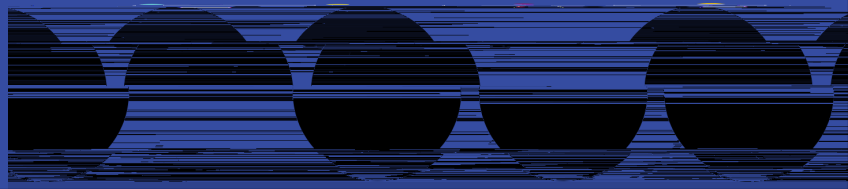
- Design-based implementation research (DBIR)
  - Collaborative design, testing, and improvement of classroom interventions (Penuel et al., 2011)
  - Responsive to classroom context (Cobb et al., 2003)
- Mixed-methods analysis
  - Quantitative: rubric-based scores of argument quality
  - Qualitative: use of English and Spanish resources

Context and Participants

- 77 students in grade 7
- Single middle school
  - 96% of students identify as Hispanic
  - Approximately 68% considered emergent bilingual
- Three subpopulations
  - On-level scientists (= 35)
  - On-

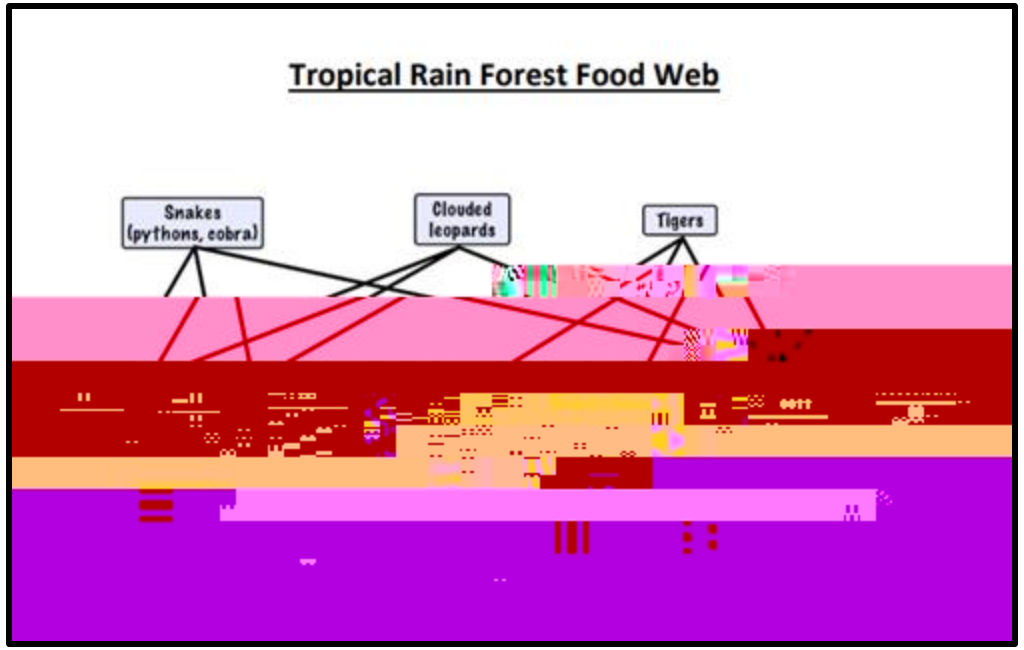
Data Collection

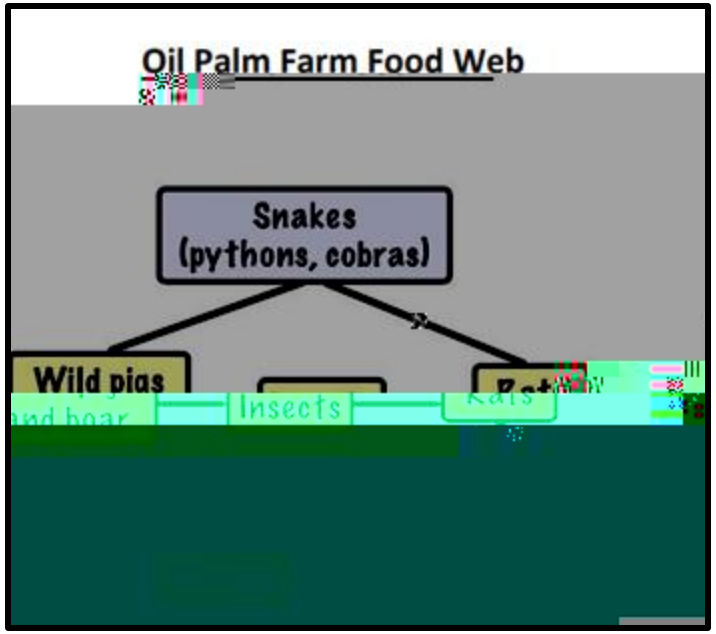
- Students completed 5-6 written arguments on science topics
- Explicit instruction and varying amounts of scaffolding over time and based upon student needs
  - Graphic organizers
  - Sentence frames
  - Materials in English and Spanish
  - Translation services
  - Audio-recording prior to writing



Example Scientific Argument

Does the biodiversity of an ecosystem affect its ability to handle a disruption?





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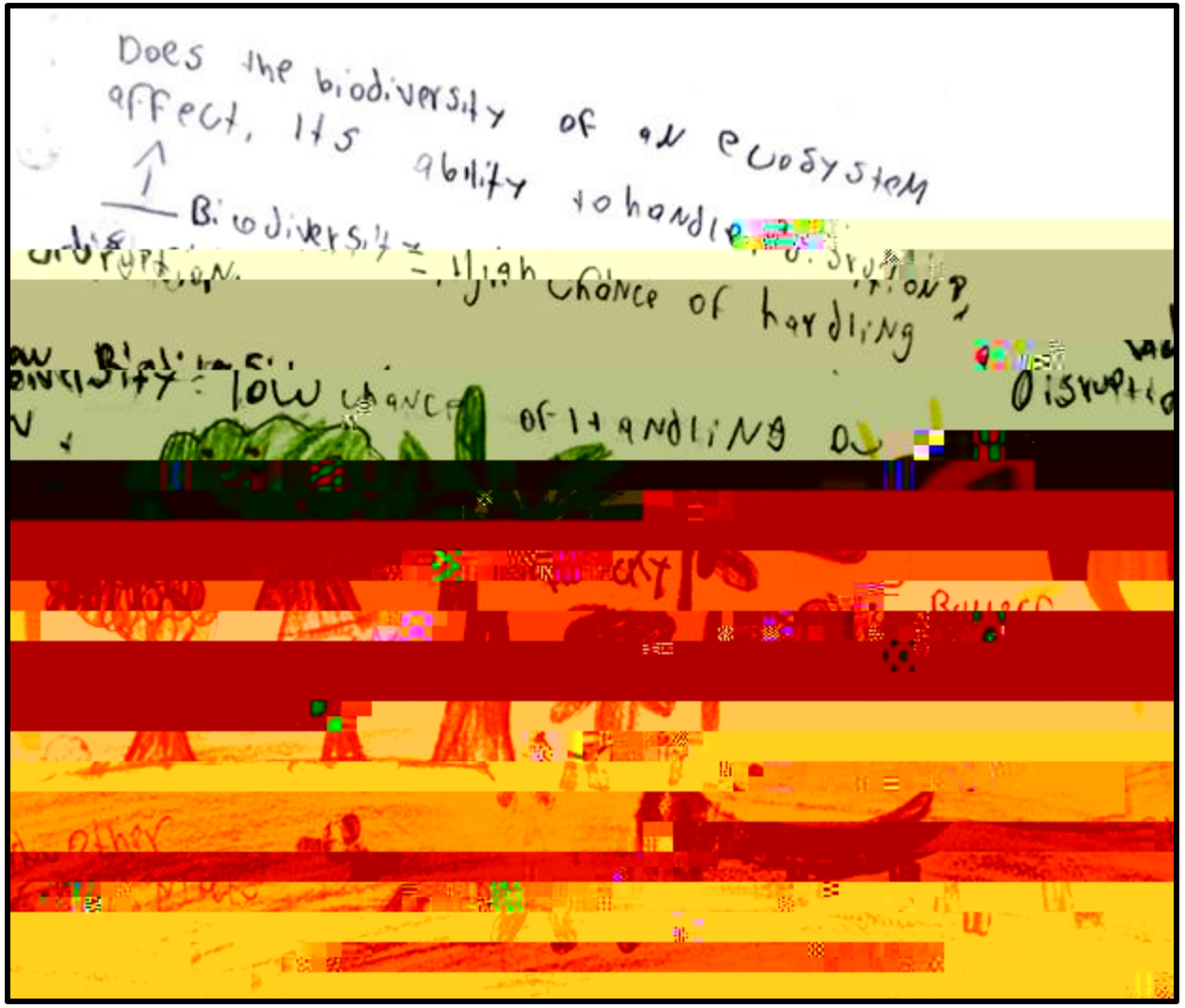


Findings- Quantitative

Across individuals, increase in total argumentation score (out of

Findings: Quantitative: Emergent Bilingual

Greatest growth of all class periods: average increase of 1.18 points in each progressive argumentation occasion

Final argumentation occasion:

- Claim: all 16 students received score of 3
- Evidence: all 16 students received score of
- Reasoning: 13 of 16 received score of 2 or

Findings: Qualitative: Emergent Bilingual

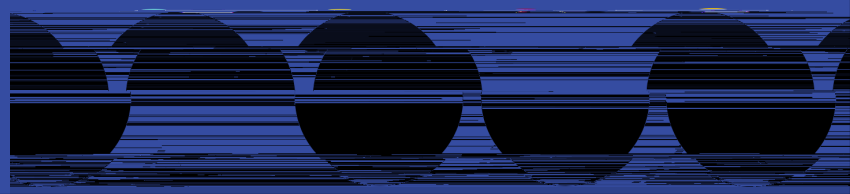
- Changes in relative use of Spanish and English
- Two cases (all names pseudonyms)
  - Highlight different use of language and instructional resources

Qualitative Findings: Case 1: Felipe

- Change in argumentation scores
  - Initial argument: 5 out of 9 possible points
  - Following three arguments: scores of 8 - 9
- Patterns in language use
  - Initial argument:
    - One sentence in English, remainder in Spanish
    - Total length: 104 words
  - Final argument:
    - All in English
    - Total length: 208 words
    - Review and revision evident
    - Did not use provided graphic organizer to structure argument

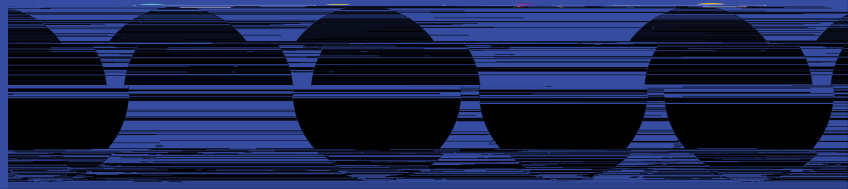
Qualitative Findings: Case 2: Alejandra

- Change in argumentation scores
  - Initial argument: 3 out of 9 possible points
  - Final argument: 8 out of 9 possible points
- Patterns in language use
  - More English over school year
  - Consistent use of drawings and visual representations
  - Fluid use of languages, without clear separation
  - Initial argument: 116 words
  - Final argument: 225 words



Discussion

- Unique mixed-level written argumentation skills
- Reasoning is most challenging for students (e.g., Berland & McNeill, 2010; Osborne et al., 2016)
- Different approaches to leveraging language resources in creating written arguments
- At time of final argument, emergent bilingual class period met or exceeded the average performance of other-level students on all argumentation elements, and met or exceeded the performance of honors students on all argumentation elements except reasoning

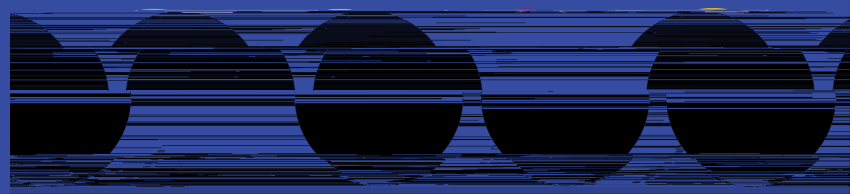


Implications and Next Steps for Teaching

- Overcoming challenges of argumentation instruction
- Importance of instructional supports
  - Translation services and language support tools
  - Collaborative student small groups
  - Teacher and peer feedback on writing samples
  - Developing culture of writing in science
- Instruction now
  - Prioritized scientific argumentation tasks based on key science concepts

Implications and Next Steps for Teaching

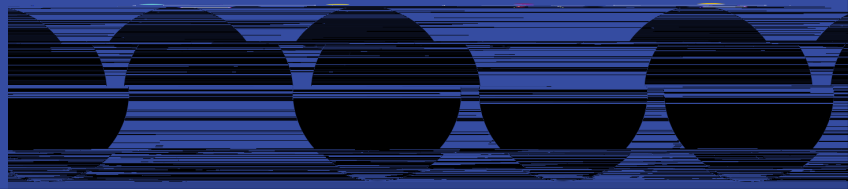
Personal Reflections on the Collaboration



Next Steps in Research

Conference proposal under review

Developing full research manuscript for publication



Personal Reflections on the Collaboration

- Bridging gap between research and practice
- Importance of invested partners
- Organizational structures to support research-practitioner collaborations

Questions?

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Thank you!

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