

TRANSFORMING SCIENCE PEDAGOGY: USING CONCEPT MAPPING TO DESIGN AN INTERDISCIPLINARY APPROACH TO TEACHING MIDDLE SCHOOL SCIENCE

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Deconstructing Silos [in science instruction]

Present Reality of
Science Instruction



FOCUS QUESTION:

What would it mean to integrate science content across 6th-8th grade?



TAKE HOME

- Visualization of propositional knowledge is critical for pre-service teacher capacity to distinguish interdisciplinary relationship(s)
- BUILDING CAPACITY:
 - (i) Initial Ideas: Individual concept maps
 - (ii) Finding Consensus: Comparison of individual concept maps
 - (iii) Making Meaning: Create a group concept map.

Connecting Content



RATIONALE

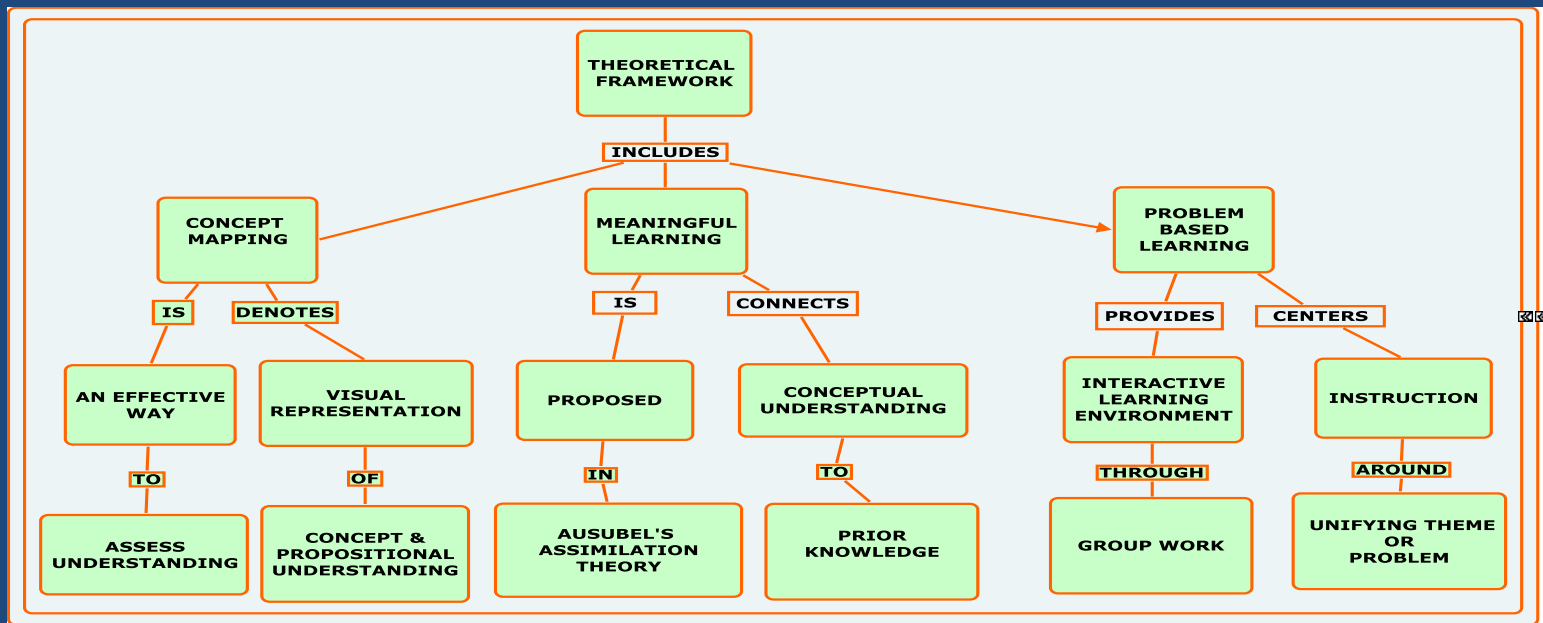
Moving Beyond Silos



- Build pre-service teacher capacity for integrating science, mathematics, and literacy across 6th-8th grades
- Support pre-service teacher induction

<http://www.nbcnews.com/storyline/flint-water-crisis>

THEORETICAL FRAMEWORK



THEORETICAL FRAMEWORK

- Making meaning requires a hands-on & minds-on approach

(Novak's theory of human constructivism)

- Co-construction of concept maps allows for negotiation of meaning

(influenced by prior understanding, Ausubel's Assimilation Theory)

- Use of sequential maps provides a framework for evaluating and guiding content understanding

(Trochim & Kane, 2005)





METHODOLOGY

- Design an interdisciplinary thematic unit based on real world case study
- 4 pre-service teachers enrolled in a Capstone Course Middle Grades Program Spring 2016
- Create rubric to evaluate sequential cmaps
- Sequential concept maps created at 4 different points during 8 week session:
 - Individual concept maps (n = 16)
 - Co-constructed Group concept maps (n = 4)



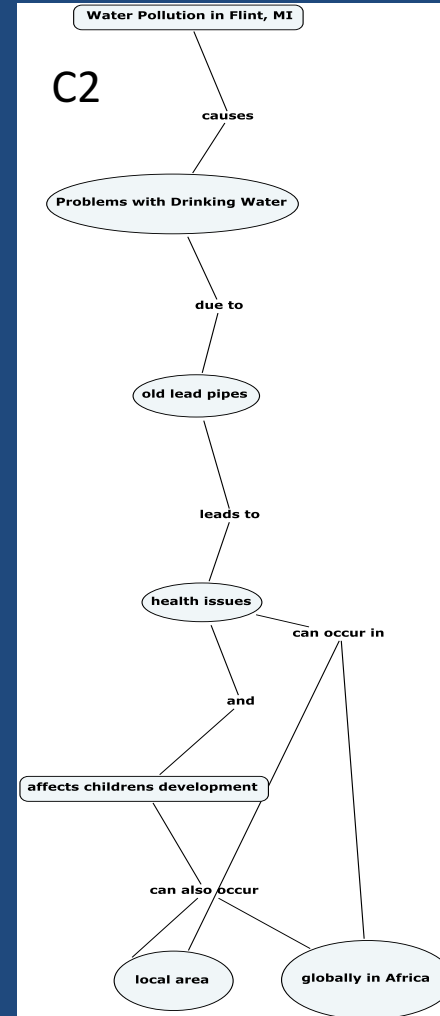
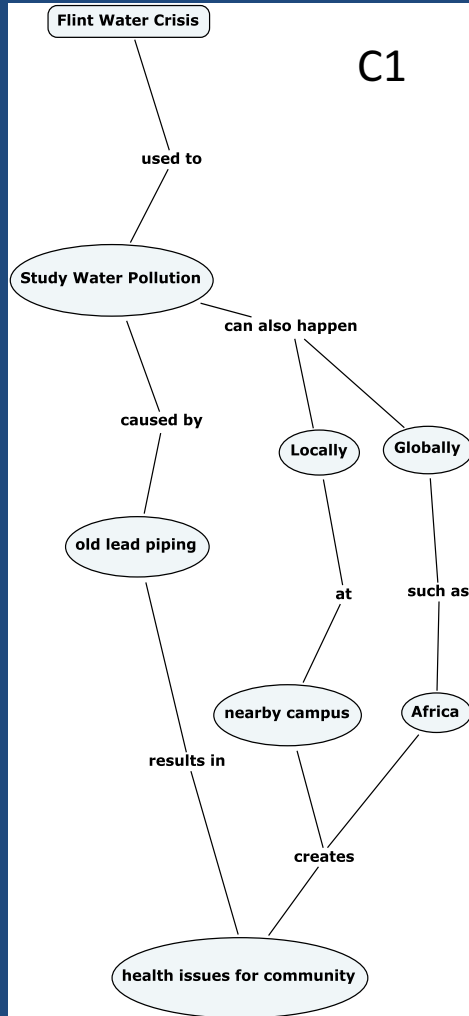


Initial Step

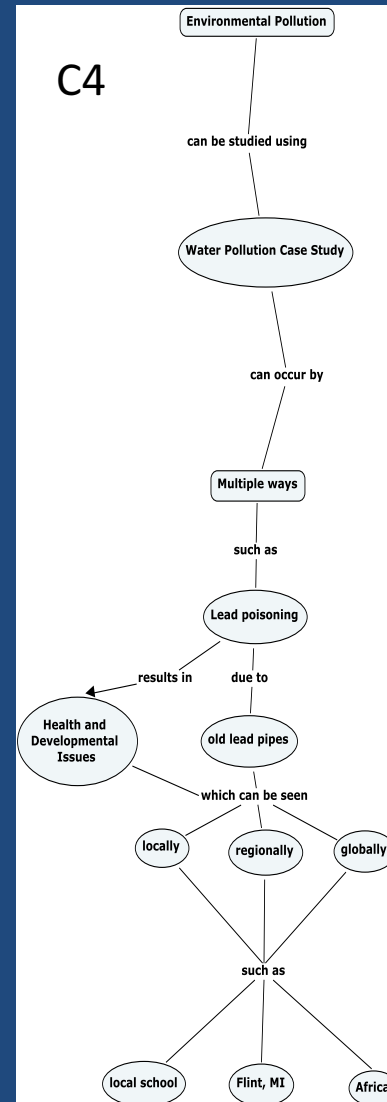
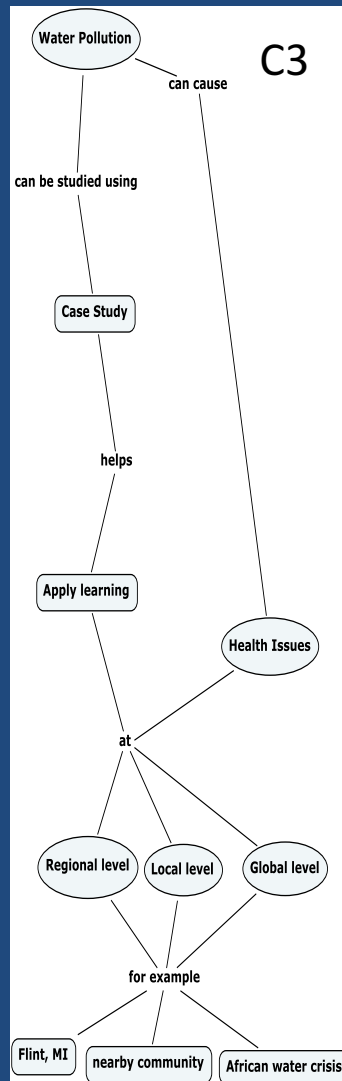
Pre-service teachers co-design rubric

Exemplary	Target	Developing	Superficial
Links are precisely labeled	Links are labeled	Links are not labeled	No Links
Simple & complex relationships between content standards are mapped effectively	Relationships are mapped and aligned to content standards	Some ideas, concepts are linked but not distinctive	Difficult to follow relationships
Includes cross-links between inter-disciplinary concepts that are extremely suitable for the topic and that show original or creative understanding	Most or all concepts are suitable for the topic – not all are interdisciplinary – few cross-links observed	Most concepts satisfy basic requirements but do not directly relate to interdisciplinary content – no cross-links observed	Many concepts are inappropriate for the topic

Finding Consensus



Finding Consensus





Making Meaning

Stage of Unit Design	Individual CMaps	Group CMap
Initial Draft	2 Developing/ 2 Superficial	Developing
Developing Draft	3 Developing/ 1 Superficial	Developing
Improved Draft	1 Exemplary/ 2 Target/ 1 Developing	Target - Exemplary
Final Draft	1 Exemplary/ 3 Target	Exemplary

CONCLUSION

- (i) The co-constructed group maps show that structural development of concepts is evidently triggered by the ability to visualize concept understanding
- (ii) Comparison between individual and co-constructed group maps showed accuracy of propositional knowledge
- (iii) Consolidation of pre-service teachers' understanding broadened real world application
- (iv) Identification of unique structure of knowledge – as connected to:



concepts within the larger domain of science
individual mis-conceptions
other academic domains
personal experience



Future Directions *for teacher induction*

- Build capacity for interdisciplinary science education curricula
- Discussion & co-construction of maps – visualize integration of topics
- Real world applications broadening individual understanding



Next Steps

Moving Beyond Silos

- Integrating STEM & literacy concepts through peer-induction by pairing recent graduates with current pre-service teachers
- Exploring dichotomy between knowledge acquisition and assessment

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Macon Cochran Dublin Eastman Warner Robins and online everywhere

