Classroom Research by Teachers



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USING STORYLINES TO INCREASE STUDENT PERFORMANCE IN THE CHEMISTRY CLASSROOM

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Outline

- Background
- The What and Why of Storylines
- My Classroom Intervention \rightarrow Maria Storyline
- Results
- Major Takeaways and Future Considerations



Background

- 8th Year Teaching
- 9th and 10th Biology and Chemistry
- Middleton, Wisconsin
- ~2100 students Percentage
 15.3% tee and reduced
 ^{9%} ^{9%} ^{9%} ^{78%} ^{78%}
 White/Cauasian (1580)
 Latin@ (178)
 Black (106)

Two or more (68)

(WISEDash, 2018)

American Indian (10)

Apostle Islands Nat, Lakeshore (13) Bayfield Duluth Madeline Marquette /531 MICHIGAN 63 MINNESOTA urtle Flambeau Flowar 45 Hayward 63 Chippew 51 NORTH WOODS St. Croix Nat, Scenic Riverway Escanaba, Flambeau R 45 Rhinelander Chippewa R 53 St. Croix R. Rice Lake Washington 51 (141) 27 WISCONSIN /53 164) New Richmond Marinet Antigo 51 45 Wausau 141 41 Chippewa Falls DOOL lenomonie (29) Weston (29) 13 River Falls Eau Claire Sturge Mosinee Marshfield (57 10 10 Howar Stevens Point Green Bay 12 Ashwaubenoi 94 Wisconsin Rapids lew London • 45 Black River Falls 10 Appleton Mississippi R. 53 Neenah Two Rivers Rochester Manitowoc 90 Sparta Tomah Oshkosh Onalaska 41 Elkhart Lake La Crosse Sheboygan Plymouth Wisconsin Dells 14 Reedsburg • over Dam/41 West Bend P Port Washington 26 Germantown Cedarburg 61 Spring Green Prairie du Chien Middleton 📍 MILWAUKEE Horeb 18 Waukesha Fitchburg Atkinson toughto Whitewater State Caledonia New Glarus Mississippi **IOWA** Platteville Monroe Racine (69) Janesville 43 141 32) Genera Kenosha Waterloo Dubuque Waukegan ILLINOIS 90 380 Rockford

(Fotolip, 2016)

Background cont.

- Inclusive classrooms with Special Education Co-Teacher in some sections
 - 10.7% SWD
 - 3% EL
- PLC Teams of 10-12
- 18 total science teachers and three special education staff



What is a storyline?

• "a coherent sequence of lessons, in which each step is driven by students' questions that arise from their interactions with phenomena"

-Next Generation Science Storylines



(Next Generation Science Storylines, 2018)

Why Storylines cont.Provides context/relevance

- Promotes engagement
- Easily allows for differentiation



Research Questions

- Focus Question: Does the use of storylines in the science classroom increase the *level of content understanding* among students?
 - Sub Question #1: Do students perceive themselves as more prepared for the unit assessment if provided the opportunity to connect unit content to real life scenarios using storylines?
 - Sub Question #2: Do students who are exposed to the storyline approach report more positive attitudes towards chemistry than students who are not taught with the storyline approach?

Treatment Group

N=38

- Pre-Assessment
- Bonding Unit Content w/ Storyline Component
- Post-Assessment
- Student Self Assessment Survey
- End of Unit Feedback Form
- Student Interviews Bonding Unit Content: Warm-Ups, Takeaways, Bonding Lab, Lewis Dot Activity, Jigsaw Reading, Review Stations

Comparison Group

N=22

- Pre-Assessment
- Bonding Unit Content w/o Storyline Component
- Post-Assessment
- Student Self Assessment Survey
- End of Unit Feedback Form
- Student Interviews

Maria Storyline





Focus Question: Does the use of storylines in the science classroom increase the <u>level of content understanding</u> among students?



Average percent gain for treatment and comparison group

- Treatment Group Percent Gain=26%
- Comparison Group Percent Gain=20%

Focus Question: Does the use of storylines in the science classroom increase the <u>level of content understanding</u> among students?



- Treatment Group
 - Pre-Assessment Avg.= 39%
 - Post-Assessment Avg.= 64%
- Comparison Group
 - Pre-Assessment Avg.= 44%
 - Post-Assessment Avg.=65%

Sub Question #1: Do students <u>perceive themselves as more</u> <u>prepared</u> for the unit assessment if provided the opportunity to connect unit content to real life scenarios using storylines?

Perceived Level of Preparedness for Post Assessment Among Students in Both the Treatment and Comparison Groups

Statement: I felt prepared for this unit assessment.					
Perceived Preparedness (Linkert Score)	4	3	2	1	
Block 1 Treatment Group	5	13	2	1	N=21
Block 7 Treatment Group	2	10	4	1	N=17
Block 2 Comparison Group	4	12	4	2	N=22

Note. 4-Strongly Agree, 3-Agree, 2-Disagree, 1-Strongly Disagree.

Percentage of students who strongly agree or agreed:

- Treatment Group=79%
- Comparison Group=74%

Sub Question #2: Do students who are exposed to the storyline approach report <u>positive attitudes</u> towards chemistry more often than students who are not taught with the storyline approach?

Self-Reported Enjoyment for Chemistry Class Among Students in Both the Treatment and Comparison Groups

Statement: I enjoy coming to chemistry class.					
Perceived Preparedness (Linkert Score)	4	3	2	1	
Block 1 Treatment Group	2	14	4	1	N=21
Block 7 Treatment Group	3	11	3	0	N=17
Block 2 Comparison Group	5	10	6	2	N=22

Note. 4-Strongly Agree, 3-Agree, 2-Disagree, 1-Strongly Disagree.

- Treatment Group=79%
- Comparison Group= 65%

Student Quotes from Feedback Forms and Student Interviews

- Praise for Maria Storyline:
 - "It was fun to talk about chem with other kids."
 - "Working with others helped me to see different thoughts."
 - "I liked doing the Maria poster and drawing. Drawing the amino acid change was fun. I liked doing the model because it belood me



- Polish for Maria *Storyline*:
 - "Kind of stressful to keep changing and switching what we are doing."
 - "We already know about Maria and it was boring."
 - "A lot of things were simple and repetitive and just involved going back to notes"
 - "The posters and activities. I don't really understand the point of them all. They don't seem to connect to anything."
 - " "Make it have more movement."

Student Quotes from Feedback Forms and Student Interviews

- Praise for Unit Challenges:
 - "I think challenges between groups feed my understanding."
 - "[I enjoyed]...the can crushing lab. It was interactive and you got to see what happened."
 - "[I enjoyed]..getting to work with teammates. Testing out things that we learned hands-on."
 - "I enjoyed getting to explore chemistry."
 - "I enjoyed imploding the soda can. I enjoyed that we got to do these projects any way that we wanted."

- Polish for Unit Challenges:
 - "[I do not]...enjoy labs. Everyone has a different method of learning and I feel that all aspects are covered..."
 - "Maybe provide more specific info about how the tanker implodes or how to filter water."

Tanker Implosion



(Sound Effects, 2017)

Resources

- Nextgenstorylines.org
- North Country 3DScience Cafe

Why do some things get colder (or hotter) when they react? [HS: HS-PS1-4, HS-PS3-5. DCIs: PS1, PS3]



(Next Generation Science Storylines, 2018)

Why I choose MSSE?

- Balance of education/science courses
 - Education classes regarding best practices ideas as they relate to science
 - High quality science courses (Lab Safety Class)





Why I choose MSSE?

- Flexibility of online/campus courses
 - Allowed work throughout the school year to be at my own pace
 - Allowed me to form in person relationships on campus





Why I choose MSSE?



References

"3D Lesson Design." North Country 3D Science Café, northcountrynyssls.blogspot.com/p/3d.html.

Can Crush Noise Sound Effect. (2015, January 17). Retrieved from https://www.youtube.com/watch?v=4KZw6694iO0

Next Generation Science Standards. (2017, July 18). Retrieved from <u>https://www.mbari.org/next-generation-science-standards/</u>

What Are Storylines? (n.d.). Retrieved from http://www.nextgenstorylines.org/what-are-storylines/

Wisconsin Department. (n.d.). WISEdash Public Portal. Retrieved from http://wisedash.dpi.wi.gov/Dashboard/portalHome.jsp

Wisconsin Map. (2016, May 17). Retrieved from http://www.fotolip.com/wisconsin-map-3045.html

Tracing matter and energy in the high school chemistry classroom





Background—About Me

- University of Wisconsin—Oshkosh, Graduated 2010
 Major: Bachelor's of Science in Broadfield Natural Science
 Minor: Biology
- 9 Years of Teaching Experience: Physical Science, Biology, Chemistry, Honors Chemistry, Physics
- Montana State University: Masters of Science in Science Education, Started 2015, Graduated in 2018

Background—About my School

- DeForest Area High School, in DeForest, WI
- 1,033 students containing the following ethnicities: White (83.5%), Hispanic (5.3%), Black or African American (4.3%), two or more Races (3.1%), and American Indian or Alaskan Native (.3%); in terms of student groups, 7.4% are students with disabilities, 16.7% are economically disadvantaged, and 1.1% have limited English proficiency (2017).
- My class schedule for 2017-2018 included 3 classes of Honors Chemistry and two classes of Physics.
- I used my Honors Chemistry classes for my action research; this consisted of 74 students total.

Think for a moment:

- Where does the matter come from as a tree grows from seed to adult?
- If someone goes on a diet and they lose weight—where did that matter go?
- Where does the matter go as gasoline burns in your car engine? Where does the energy come from to power your car?

Tracing Matter and Energy

- Use systems-based approach
- Following pathway of matter (atoms) and energy separately through a chemical change
- Ensuring Conservation Laws are followed
- Correctly identifying chemical equations—reactants and products
- Correctly identify forms of energy (energy storage accounts)

Matter and Energy Content Standards

- NGSS Cross-cutting concept:
- **Energy and Matter**
 - The total amount of matter and energy in closed systems is conserved.
 - Tracking energy and matter flows, into, out of, and within systems helps one understand their system's behavior.
- NGSS Disciplinary Core Idea (DCI)

Matter

Energy

Matter and Energy Instructional Research

- Research calls for:
 - scaffolding of explicit matter and energy fundamentals
 - modeling matter and energy using a systems-based view on both microscopic and macroscopic scales
 - revisions to teaching chemical bond energetics
 - integrated and interdisciplinary approaches
 - technology!
 - Multimedia example

Data Collection

Data Triangulation Matrix

Focus Questions	Data Source		
Primary Question:	Pre and Postunit	Pre and Postunit	Pre and Postunit
What are the effects of tracing matter	Student	Student	Student Surveys
and energy on student understanding	Assessments	Interviews	
of chemistry?			
Subquestion 1:	Pre and Postunit	Pre and Postunit	Instructor Field
How does incorporating energy into a	Student	Student	Observations
chemical bonding unit affect student	Assessments	Interviews	
understanding of energy in chemical			
reactions?			
Subquestion 2:	Pre and Postunit	Pre and Postunit	Instructor Field
How does the use of tools that allow	Student	Student	Observations
students to trace matter and energy	Assessments	Interviews	
changes affect their understanding of			
the laws of conservation of matter			
and energy?			

Intervention

- Semester 2 Bonding Unit
- Learning Target on Bond Energy:

I am able to determine whether a reaction is endothermic or exothermic based on the bond energies of reactants and products.

- Instruction on tracing matter and energy
 - Energy diagrams
 - POGIL Bond Energy
 - Reaction Types Lab
 - Enthalpy of Photosynthesis and Cellular Respiration



Average scores of comparison group (N=47), pre-Assessment (N=73) and post-assessment (N=74) groups on 4 categories of the tracing matter and energy assessment

Assessment Results

- Mean score for the non-intervention group=16.33
- Mean score for the intervention group=18.02
- 24 points possible
- T-test p-score was .067643
- The null hypothesis is accepted, so the resulting gains for the interventional group are not statistically significant.

Survey Results Chemistry Bonding Unit Survey

Domains	Description of Domain
Atoms and Bonding	Student understanding of atoms bonding to build
	molecules
Chemical Reaction Basics	Types of chemical reactions; understanding
	reactants and products in a chemical reaction
Energy of Chemical Reactions	Endothermic vs. exothermic reactions and bond
	energy
Real Life Relevance of Chemistry	Student perception on the importance of chemistry
	to everyday life
Personal Interest in Chemistry	Student affinity for learning chemistry
Problem Solving Abilities and Sense-	Self-perceptions on the ability to problem solve and
Making	correctly complete mathematical and chemistry
	based skills
Biology Connections	Student understanding of the chemical reactions
	for photosynthesis and cellular respiration



Chemical Bonding Pre-Survey and Post-Survey (n=73), Student Attitudes on Seven Domains

Survey Results



Chemical bonding pre-survey and post-survey (N=73), percentage of student responses to the question: "In chemistry lab, I can easily identify an endothermic and exothermic reaction based on how it feels."

Journal Responses during Bonding Unit

- Generally positive
- Using magnetic water molecule kits to show intramolecular vs. intermolecular bonds: "this is what makes chemistry fun"
- "I thought that you overplayed how difficult this unit would be."
- Predicting the products of a chemical reaction for the first time:"I liked this unit until now"
- One student thought that we should complete more labs
- "I hate POGILs"

Interview Responses

- "It was tricky, but with extra help I began to feel more comfortable"
- "very complicated but interesting to learn about"
- "fun, but a bit on the longer side"
- "super hard, confusing, and a lot to remember."
- A couple of the interviewed students had a hard time explaining what tracing matter and energy meant specifically in terms of a chemical reaction.
- All of the students interviewed correctly associated exothermic reactions as feeling hot to an observer in the surroundings and endothermic feeling cold

Interpretation and Conclusion

- Based on:
 - the results of the Tracing Matter and Energy Assessment
 - Student confidence on the Chemistry Bonding Unit Survey
 - Evidence gained through interviewing and journaling student interactions

Students have clearly advanced in their abilities to clearly explain and comprehend the difference between matter and energy.

Interpretation and Conclusion

- As shown from the data collected through assessments, surveys, interviews, and journaling, the interventions applied during the bonding unit had a positive impact on student outcomes.
- Effective tools and resources exist for tracing matter and energy through chemical change

Applying Tracing Matter and Energy

- Carbon Time Curriculum Resources
 <u>http://carbontime.bscs.org/</u>
- Great Lakes Bioenergy Research Center
 https://www.glbrc.org/outreach/classroom-materials
- Plant Inquiry Project—Energy Transformation in Plants
- Investigating Combustion

Learn More on Friday, Room J 3PM!

References

- American Chemical Society. (2018). Methane and Oxygen React. http://www.middleschoolchemistry.com/multimedia/chapter6/le sson1
- NGSS Lead States. 2013. Next Generation Science Standards: For States, By States. Washington, DC: The National Academies Press.

Why did I choose MSU MSSE?

- Online and On-Campus Courses
- Relevant to my Position—Select Courses
- Science!
- Adventure!



