Supporting Identification with Science Through Student Directed Research Projects

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"I did experiments that I thought I never could do…and they say we're the scientists right now so I start acting like a scientist."

Research Questions

1) In what ways do students express identification with science? How does participation in a marine science research camp affect students' identification with science?

2) How do specific components of the research camp (e.g. designing experiments, working with scientists) influence students' identification with science?

Program Description

Participants:
- East Oakland Middle School
- School demographics: 80% Latino, 20% African American

Program Context:
- 7-day residential experience
- Based at a marine lab in N. California

Program Feature:
Students design and conduct investigations based on their own questions about marine organisms and make presentations of their findings.

Program Elements:
- ***Group Investigations*** (groups of 2-3 students design/conduct research projects)
- ***Observations Skills*** (collect organisms, focus on behaviors)
- ***Field Sampling/Data Collection*** (learn marine ecology field sampling techniques)
- ***Research Questions*** (ask/write investigable questions; refine questions)
- ***Experimental Design*** (lessons on testing variables; collect data)
- ***Data Analysis*** (learn to represent data)
- ***Presentation*** (present project and findings to peers and scientific community)

Examples of Student Generated Research Questions:
1) Do shore crabs and hairy hermit crabs prefer light or dark environments?
2) Is the predator-prey relationship between the Aeolid nudibranch and Sunburst anemone dependent on anemone size?

Methods

Method/ Data Sources	Description
Case Selection	• 9th grade (school year 2010-11) camp participants • 3 students who participated in the camp three times (3x):1 African American boy, 1 African American girl, 1 Latino boy, • 3 students who participated in the camp once (1x): 1 Latino girl, 2 Latino boys
Interviews	• Semi-structured interviews during camp (Spring 2009, 2010) or at school (Fall 2010) • 3x students (Spring 2009, 2010, Fall 2010) • 1x students (Spring 2009 or 2010, Fall 2010)
Analysis	• Coding: Ways students described science in relation to themselves - Categories constructed from iterative process • Relationships between: 1. Identity categories vs. camp participation (1x vs. 3x) } RQ #1 2. Identity categories vs. factors leading to identification (e.g. school, camp) 3. Camp components vs. statements of Agency and Identification } RQ#2

Emergent Science Identity Categories

Science Identity Categories	Definition	Examples
1. Identification with science/ scientists	Identifying (or not identifying) as being a scientist, using skills like a scientist	a) I want to be a scientist b) I question things like a scientist c) I am not a scientist
2. Agency in relation to science	Expressing power or influence (or lack of power/influence) on some aspect of science	a) I can ask my own research question. b) We designed our own experiment d) I must follow steps to do science correctly (lack of agency)
3. Interest in science	Expressing interest (or lack of interest) in some aspect of science; likes and dislikes about science	a) I like science more now b) Science is interesting c) Science is boring
4. Role of science in life	Uses for science thinking/science knowledge in life/role science plays in one's life	a) I use science thinking in my everyday life. b) I make up experiments at home

Greatest differences between groups (3x vs. 1x students) = Identification and Agency categories

Findings: Comparing Levels of Participation

Research Question #1: Identification & Agency Categories

Identification with Science

Greater participation in camp leads to stronger identification with science.

	1X Group (# students)	3X Group (# students)
Identify as scientist	1	3
Identify as NOT scientist	1	0
Science career	3	3
Non-science career	3	3
Use scientist skills	3	3
Science part of me	1	1

3x: Identify as Scientist

R: I learned a lot from science so **I think if I didn't have science then I wouldn't be like me**, I guess. Because science is, you don't know everything in science, so that's how I explore and like if I see an animal, I'll be like it moves differently, like question.

1x: Identify as Not a Scientist

R: Scientists, they do like experiments try to figure out how the elements react to each other. It depends what type of scientist it is, like all those people trying to find a chemical reaction there are just like right there on the table with all of the tools, like microscopes and stuff.

Me: **Do you do any of these things you just described?**

R: Nope, cause **I don't have the tools, like the things you need**.

Agency in Relation to Science

	1X Group (# students)	3X Group (# students)
I can do science	1	3
Science process - create own	2	2
Science process – prescribed steps	2	0
Cannot do science wrong	0	1
Can do science wrong	2	0
Distinguish creative science	0	2

Greater participation in camp leads to greater agency to "do" science:

- **1x students describe following prescribed steps and doing science "wrong"**
- **3x students distinguished creative science from school science**

"I did experiments that I thought I never could do..and they say we're the scientists right now so I start acting like a scientist." (3x student)

Findings: Camp vs. Other Factors

Factors Impacting Identification & Agency

Camp vs. School Science:
- **Greater identification and agency at camp**
- **Agency to create own science process at camp**

Identity Category	Identification		Agency		
FACTOR	ID as scientist	ID not as scientist	I can do science	Science Process: create own	Science Process: pre-scribed
1x Participants					
Camp	1		1		
School					2
Home				2	
TV/Media		1			
3x Participants					
Camp	2		3	1	
School					
Home				1	
TV/Media					

1x: Science Process: Prescribed Steps (Factor = School)

R: They give us steps on what to do.
Me: So how do you know what question you are answering?
R: Well as you do the experiment, you start getting the answers to the questions
Me: Where do the questions come from though?
R: The teacher **gives us a handout**
Me: Where are the steps written down?
R: On the handout
Me: And **what if you don't follow the steps?**
R: They say **something bad is going to happen,** but I don't know I never tried it.

3x: Science Process: Create Own (Factor = Camp)

Me: Do you think there are different ways to do science?
R: I think there are a lot of ways - like I was taught one way but..at (Camp) **they taught us the steps ,but they didn't tell you, you have to do the steps this way**. Like everyone has a different way of doing things.

Findings: Camp Specific Experiences

Research Question #2: Camp Components & Identification/ Agency

Participants expressed authenticity of camp experience due to:

1. Mentorship from scientists

Learning leads to agency

"I learn a lot of things from them, from like the scientists and from the people that work with us, and I think that it's going to lead up to me knowing more and being able to do. **I learn things and I think, I could do something like that**."

2. Revising Research Designs

Learning from "messing up"

Me: What was the **favorite part** of designing the project?
R: I think **it was messing up**.
Me: Messing up was your favorite part?
R: Well, not, just fixing, like coming up with an actual experiment that could actually be accurate.
Me: Why was that your favorite part?
R: I don't know, I enjoyed it. Because **that made me feel like I was actually learning**. The first day, I was confused and stuff, and then, the second day, **they taught us some strategies** and then I got better and it made me good …**I was understanding a lot of things better.**

3. Room for Creativity in the Science Process

You can't be wrong at camp

R: Science...I like the fact that you can just combine things and be creative with it.
Me: What do you like about science at camp?
R: I like that you can't really mess up because it is your experiment . Like you research the animal and you figure out how you want things to be run and **you can't be wrong, you can mess up but you can't be wrong.**
R: **Can you be wrong in school?**
Me: Yeah, if you're being graded, but **if you're doing creative science, then no.**

Implications & Future Research

Implications
- Greater participation in camp led to stronger identification with science, greater agency to "do" science, and feelings that you can't do science "wrong".
- Students expressed agency to create their own rigorous scientific process at camp and that they learned through "messing up".

Future Work
- Further explore camp components in relation to students' identification with science.
- Address issues of race in relation to science for underrepresented students.

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