

DRIVEN TO DISCOVER: ENABLING AUTHENTIC INQUIRY THROUGH CITIZEN SCIENCE

Grounding a Program Theory to Enable Authentic Inquiry through Citizen Science

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INTRODUCTION

Extension programs are well-suited to provide youth & adults with exposure to science. However, designing programming to fully engage participants in deeper experience with science practice is a complicated challenge. Grounded theory is one research approach that Extension staff can use to explicate these program models. The Driven to Discover: Enabling Authentic Inquiry through Citizen Science project (D2D), funded by the National Science Foundation, demonstrates potential for using grounded theory to identify factors that provoke authentic inquiry by youth/adult research teams using citizen science experiences.

STUDY METHOD

The Grounded theory approach (Glaser and Strauss, 1967) systematically generates theory from data about participant experiences. D2D staff are utilizing a theory grounding approach to identify key factors that provoke authentic inquiry by youth/adult research teams using citizen science experiences. During the first three years of the five-year project, Extension staff trained & supported a purposefully varied mix of research teams, which used a flexible



Citizen science is a rich environment for science inquiry. After observing Monarch larvae in a field of milkweed, young research team members become curious and ask questions about what they see.

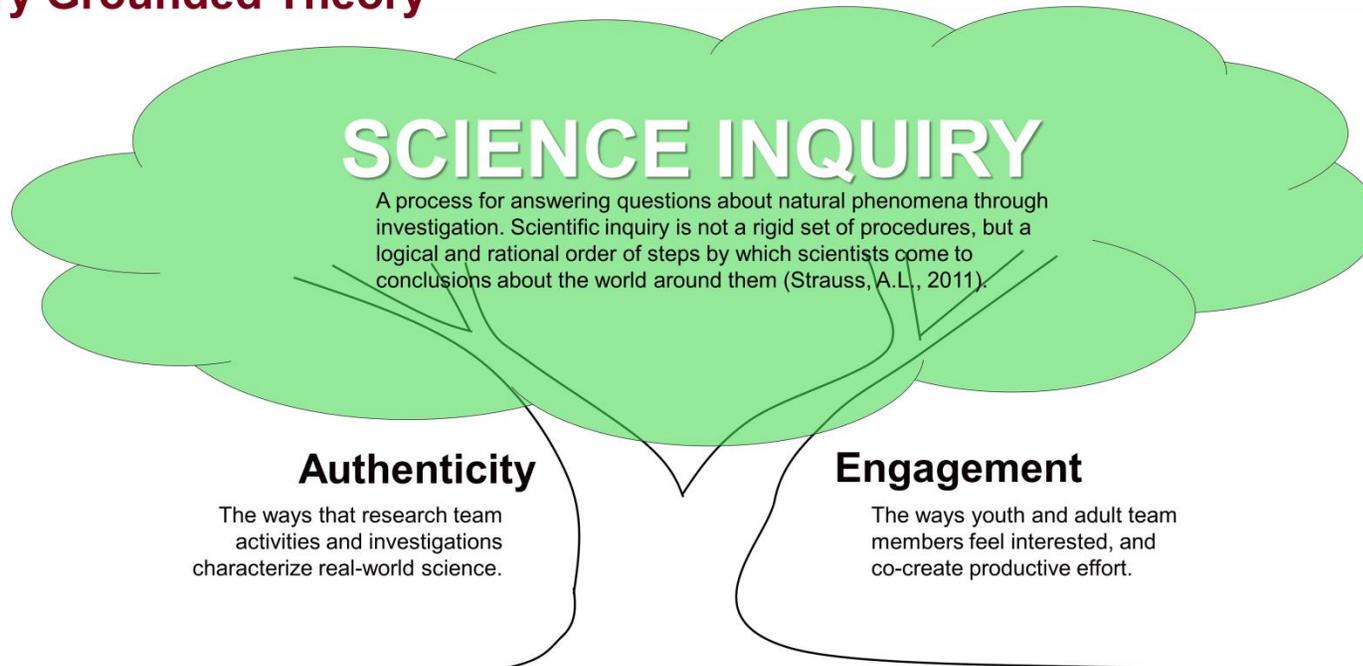
curriculum to help youth conduct their own ecological investigations. Through a deductive coding approach, data from observations & interviews with team members are being analyzed for elements of a pilot program model that both supported and challenge the study teams.

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Preliminary Grounded Theory



Program Setting/Situation

Learning Suitability. Youth and adult team member's reactions to physical and psychological demands of the setting influence engagement in citizen science and other learning activities.

Group Context. Youth and adult team member's pre-existing group identity and make-up influence engagement in citizen science and other learning activities. Pre-existing group identity and make-up, due to factors like group history and goals, familiarity with each other, and recruitment into the group, influences outcomes of data collection, discovery, active skill building, and engagement of youth team members.

Novelty Space. New cognitive, geographical and psychological elements of the experience can positively and negatively influence engagement of youth and adult team members.

Ecological Suitability. The observable variety of species over time due to factors like population changes or site management, influences outcomes of CS data collection, discovery, active skill building, and engagement of youth team members.

Team Characteristics

Science Identity. Adult and youth team members tend to demonstrate competence, affinity, and recognize themselves and/or others recognize them as "doing science."

Facilitation Practice. Adult leaders practice "social, interactive, and holistic" methods that promote youth observation, questioning and authentic scientific investigation within contexts of citizen science data collection.

Scientific Practice. Research teams capitalize on the skills and also knowledge of individual members specific to the citizen science project in which they are involved.

Self-directed Learning. Youth and adult team members tend to take the initiative, with or without the assistance of others, in diagnosing their needs, formulating goals, and learning improved practice.

Program Design/Structure

Value of Contribution to Citizen Science. Strategies promote the worth, importance, and accuracy assigned to data collected by citizen scientists.

Activation of Knowledge. Field experiences create practical applications for previously inert knowledge, and knowledge that can activate in other settings.

Welcoming Atmosphere. Learning environments in which youth and adult team members feel a sense of belonging support engagement.

Active Skill-building. Activity approaches that provide opportunities for youth and adult team members to engage in a hands-on, minds-on manner with materials and ideas supports engagement and authenticity.

Discovery. The systematic act of observing/recording phenomena sparks youth and adult team members to notice and become curious about new things.

Team Member-involvement in Planning, Making Choices about, and Reflecting on Activities. Approaches that involve youth with adult team members in decision-making and reflection about goals, activities and outcomes support engagement and authenticity.

PRELIMINARY RESULTS

Preliminary analysis has identified 14 themes that describe important design elements across categories of the setting/situation for the program, program design/structure, and team characteristics. Relationships among these themes also highlight interconnections between setting, program, and participants.



We currently conceive citizen science as a rich environment for sparking science inquiry. The program setting/situation, design/structure, and team characteristics are the roots from which authenticity and engagement grow into inquiry.

Research teams can pull from their programmatic roots on 14 key elements, which serve as nutrients to fuel the growth. Some of these elements interact to strengthen or weaken engagement and authenticity. Teams balance focus on both engagement and authenticity. Too much focus on either can hinder growth in inquiry.

Definitions for Core Program Goal and Processes

Science Inquiry. A process for answering questions about natural phenomena through investigation. Scientific inquiry is not a rigid set of procedures, but a logical and rational order of steps by which scientists come to conclusions about the world around them (Strauss, A.L., 2011).

Authenticity. The ways that research team activities and investigations characterize real-world science.

Engagement. The ways that youth and adult team members feel interested, and co-create productive effort.

Definitions for 14 Key Elements

NOTE Statements in italics represent quotes from program participants that exemplify each element.

TEAM CHARACTERISTICS

The aptitudes, attitudes, skills of team members that facilitate and influence how the program operates.

Science Identity. Adult and youth team members tend to demonstrate competence, affinity, and recognize themselves and/or others recognize them as “doing science.”

“I’m here cause I thought it would be fun and I like butterflies.” Youth Focus Group Participant

Facilitation practice. Adult leaders practice “social, interactive, and holistic” methods that promote youth observation, questioning and authentic scientific investigation within contexts of citizen science data collection.

“She split the younger kids up with the older students as mentors, and took one student herself. I was very impressed with that way of doing it. It really engaged the older students in teaching, and instantly elevated the younger students by lowering the age gap between mentor and mentee.” Scientist Meeting Report

Scientific Practice. Research teams capitalize on the skills and also knowledge of

individual members specific to the citizen science project in which they are involved.

"I was really excited to hear the youth identifying a diversity of birds, something I had not heard them doing in previous meetings.... One of the things that impressed me most was evidence that they are starting to develop bird ID 'reasoning skills:' they saw a raptor they could not identify and started building a short-list of possible species based on characteristics they had noted, something experienced birders do all the time with ambiguous sightings." Scientist Meeting Report

Self-directed learning. Youth and adult team members tend to take the initiative, with or without the assistance of others, in diagnosing their needs, formulating goals, and learning improved practice.

"For a lot of our observations and experiments that we had we didn't have (leader) or (second leader) there. It was just the two of us totally on our own like we'd call each other like hey do you wanna go do this at Hawk's Ridge on Sunday and we're like sure let's do it." Youth Focus Group Participant

PROGRAM DESIGN/STRUCTURE

The series of experiences, activities, and resources in which the research team participates.

Value of Contribution to Citizen Science. Strategies promote the worth, importance, and accuracy assigned to data collected by citizen scientists.

"As an added incentive, I really like the idea that we can offer them um the web to see how their questions, their questioning is literally going to affect the outcome of the project and

that they are an integral part of the program. They can see it, they can show their friends, they can take ownership of the positive things they are doing." Adult Leader Pre-Program Focus Group Participant

Activation of knowledge. Field experiences create practical applications for previously inert knowledge, and knowledge that can activate in other settings.

"Yeah like when we were out there we'd see like the Monarchs and some would be dead and we'd go ask (leader) and she would be like well that's from a tachinid fly. And then in class you're learning about relationships between different animals, and talk about the tachinid fly. And I would be like, 'Oh I already knew that but I didn't realize I knew that until we actually started learning about that in class.'" Youth Focus Group Participant

"And you really can learn a lot ... I was doing an experiment that showed which part of or which milkweed plant part was ... the most nutritious and ... I raised so many Monarchs that I will feed them that food now cause I know that they will grow and have a high survival rate. So it's just really helpful too to know and you can teach so many other people. And there's so much stuff that like that you get from this experience that you don't even realize that you have learned until later when ... you'll be in class and we'll be learning about something else and the whole class will be... confused and I'll be like oh I know this cause it's like, even when you weren't studying it that specifically, you remember it cause it's something you just happened to learn while you were outside." Youth Focus Group Participant

Welcoming Atmosphere. Learning environments in which youth and adult team members feel a sense of belonging support engagement.

“And I think it made us feel that we weren’t any different than you guys were, we all fit right in together. Everybody was equal. We were accepted as citizen scientists from the get go.” Adult Leader Focus Group Participant

Active Skill-building. Activity approaches that provide opportunities for youth and adult team members to engage in a hands-on, minds-on manner with materials and ideas supports engagement and authenticity.

“...When (scientist) was out there with us we saw a bunch of birds the first week we went out and (scientist) was there our second week and with him there the second week we saw more birds, we heard more birds just the how in tuned he was to the sounds and the actual site of different birds that you know we didn’t, we weren’t cued in on so I think it’s that, I think that helped the girls learn how to be a scientist a little better because then they learned, they became more patient.” Adult Leader Post-Program Focus Group Participant

Discovery. The systematic act of observing/recording phenomena sparks youth and adult team members to notice and become curious about new things.

“I would have to agree that with both of the groups if there was anything in common they really got excited when they saw something unusual with the organisms. So for example the bird group we would walk for maybe five minutes and there seeing house sparrow, house sparrow, house sparrow all of a sudden there’s a red tail hawk sitting on a line and it’s being mobbed by crows and suddenly you

could just see that spark of excitement go through them....” Scientist Post-Program Focus Participant

Team Member involvement in planning, making choices about, and reflecting on activities. Approaches that involve youth with adult team members in decision-making and reflection about goals, activities and outcomes support engagement and authenticity.

“LEADER decided to have them select a single focal species upon which to base their investigation, and they voted overwhelmingly for Barn Swallows (there are a couple of nests at the entrance to the building).” Scientist Meeting Report

PROGRAM SETTING/SITUATION

The characteristics of the site and group that influence how the program operates, and research team members participate. These are largely uncontrollable but sometimes predictable factors.

Learning Suitability. Youth and adult team member’s reactions to physical and psychological demands of the setting influence engagement in citizen science and other learning activities.

“The really hot days were just hard, everyone’s energy was just low and it seemed more like a job to be out there doing things on the days when it was just physically unpleasant and (leader)’s site got a lot of thistles in it so it was itchy to walk through it so just the physical discomfort was hard for them.” Scientist Focus Group Participant

Group Context. Youth and adult team member’s pre-existing group identity and make-up influence engagement in citizen

science and other learning activities. pre-existing group identity and make-up, due to factors like group history and goals, familiarity with each other, and recruitment into the group, influences outcomes of data collection, discovery, active skill building, and engagement of youth team members.

"I'm doing this because I like butterflies and all my friends are doing it." Youth Focus Group Participant

Novelty Space. New cognitive, geographical and psychological elements of the experience can positively and negatively influence engagement of youth and adult team members.

"And also I think just being out there and doing it in the field not in the classroom, I think having the experience of being in the natural environment also just helps you learn more about whatever topic you're learning about." Youth Focus Group Participant

Ecological Suitability. The observable variety of species over time, due to factors like population changes or site management, influences outcomes of Citizen Science data collection, discovery, active skill building, and engagement of youth team members.

"Well the field we worked in it was really nice like there was plenty of milkweed and one part that was fun to chase dragon flies and water flies. The only thing there was a little poison ivy on one section but it never really affected anyone." Youth Focus Group Participant

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