Building a Conceptual Model of Science Ownership in Design Activities

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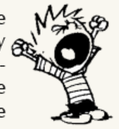
Introduction & Potential Significance



What is the problem?: Students often find science learning to be disconnected from their everyday lives (e.g.. Atwater, 1996). One reason for this disengagement is that learners are often not given the chance to develop **ownership** of their science learning.

Ownership can mean the different ways that learners are able to develop control over their learning environment, to create opportunities for more personalized learning, to make investments into their learning, and to express a sense of territoriality.

Why study ownership?: While researchers cite the importance of ownership for learners to engage in science learning, few studies have explored a deeper understanding of how student ownership evolves. For example, science inquiry frameworks, such as *Learning by Design* (Kolodner et al., 2003) and *Problem-Based Learning* (Savery & Duffy, 1996), only briefly discuss the need for ownership among learners, but do not document the evolution of ownership.

Assumptions about ownership: Within the literature there is an overly positive assumption that that if science connected to learners' lives or encouraged active participation in a culture of science, this would help develop ownership of the knowledge and process of science. In turn, ownership would help motivate learners to engage in science learning.

Despite these assumptions, researchers have only started to document the evolution of ownership in learners in science (e.g., O'Neill & Barton, 2005). Cornelius and Herrenkohl's (2004) work on power relations call for more studies that account for how different types of learners come to accept and develop ownership when affordances of power are made to them. Specifically, the research community does not yet understand how changes in participation structures in classrooms may support or hinder learners' development of ownership.

Research question: *How does ownership evolve as learners engage in a guided inquiry-based science learning environment focused on design?*

Theoretical Framework

The perception of ownership as a singular outcome ***(noun)*** is limiting to our understanding of learners. Instead, ownership can be treated a set of actions ***(verb)*** that reflect a **learner's identity.**

Pierce et al., 2003: A person's target (or targets) of ownership is a reflection of a person's self-identity.

O'Neill and Barton (2005) argue that actions that indicate ownership of science learning are 1) learners indicating positive perceptions of self in relation to science and school; 2) learners making investments into science; 3) learners expressing of pride in science; 4) learners displaying agency; and 5) learners viewing positive community changes through science.

Wenger, 1998: Actions such as ownership indicate a learners' self identity within a community of practice.

Nasir (2002): The personal goals of a learner and what learning has occurred also contributes to personal self-identity.

Methods & Analysis

Case selection: The study is a selection of *four focal learners* from an after-school program called *Kitchen Chemistry* (KC). KC is a life-relevant learning (LRL) environment that explore the science of foods.

KC was implemented once a week for 12 sessions from February to May 2012 at a Montessori school. Five aspects of KC may help to promote ownership: facilitation, semi-structured activities, Choice Day, whole group discussions, and technology use. Six learners from ages 9 - 12 participated in KC.

Case studies approach: This study uses Yin's (2003) approach to case studies. KC represents an ideal case, that is, few institutional barriers exist to observe the evolution of ownership. I acted as a participant observer. I was both a facilitator and researcher in this study.

Data collection: February to May 2012


Video recordings of 12 sessions of KC


Field notes of KC and the focal learners' classrooms


Interviews of the focal learners (2) and their parents (2), facilitators (3), and teachers (1)

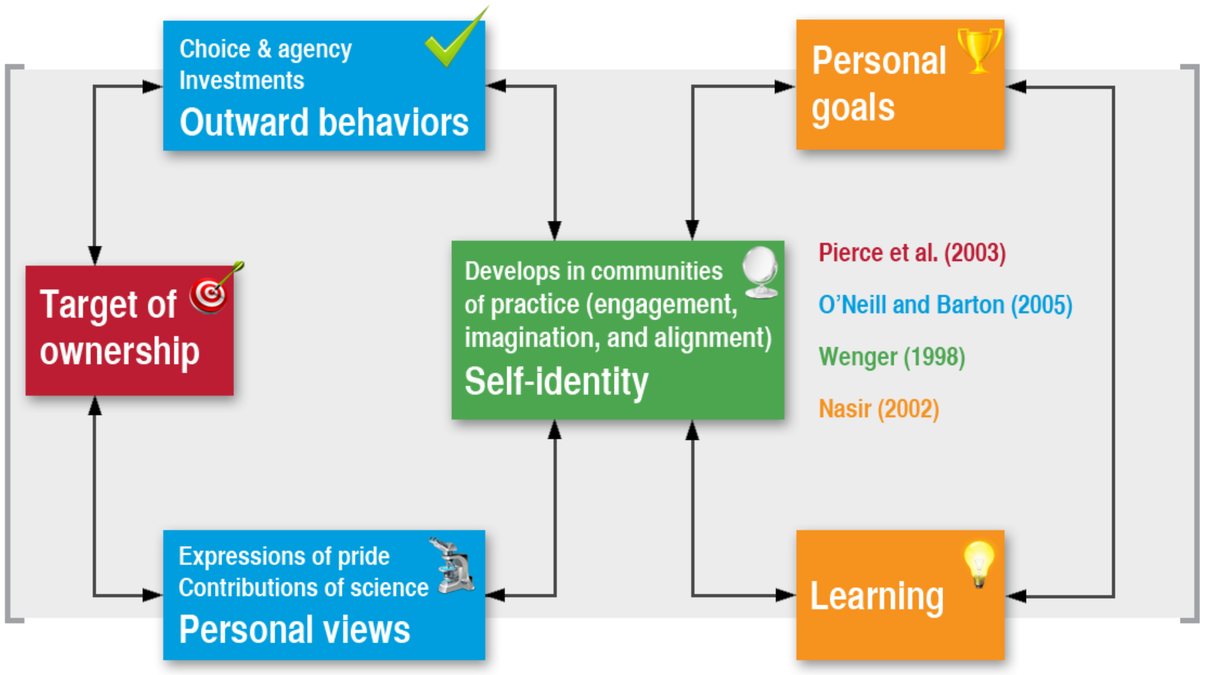

Software artifacts such as lab investigations, question writing, and tagging.

Data Analysis:

Phase 1: Single case study analysis using a developed case studies protocol

Phase 2: Comparative case study analysis

Proposed Conceptual Model



Preliminary Findings

Arman - male, age 10
Arman has a lot of expectations for product outcome. In his interviews, he talks about not being a "real" scientist or designer. If he is unable to make a product or attain a certain amount of knowledge, he tends not to express himself. For him, ownership might be an expression of control, but because he does not feel comfortable enough to take on these roles and identities, he may not choose to assert his ideas.

Benjamin - male, age 10
Ben expresses that the most important aspect of science is learning from mistakes and developing new ideas from them. For him, science is boring when he already knows the ideas. Ben's hardest taskes in KC were developing ideas for investigations. Although Ben likes coming up with his own ideas, he can develop a sense of ownership in other's work if the ideas are also intriguing for him.

Charlie - male, age 10
For Charlie, there may be a balance between the ownership of his ideas and the limitations of scaffolds. At home, there are no limitations (except when mom says no). You can choose whatever you want to do and how you want to do them. In KC, there are limits. He likes doing his own thing in KC, but had a hard time wanting to do his own thing versus what the adults were trying to get him to think.

Donna - female, age 11
Donna calls herself a "dreamer" and prides herself on designing toys and foods. However, she is very mindful of her intellecutal property. In several episodes, Donna gets very upset when her friend, Karl, "stole" her idea on making candy. Her ownership and pursuit of an ideas is constantly mediated by the social interactions and contexts. Donna is not as interested in the science ideas behind the cooking, but more focused on developing a good product.

Expected Contributions

Intellectual merit:
While ownership is an innate characteristic in people, how it manifests in science learning may be *more delicate and fragile* than first considered.

The use of a finer-grained analysis of focal learners can help us understand why ownership takes place in learners and how it might be sustained.

This examination provides us of good snapshots of learners' evolution of ownership and a rich and detailed portrayal of the how and why ownership takes place.

The results of this study can help to build a **conceptual model of ownership** that supports the understanding of human behavior in complex social settings.

Broader merit:
The broader impact of this work is the understanding of how to build and cultivate ownership in learners.

In particular, the responsibility of ownership may not just lie in the individual learner, but by all aspects of a classroom system.

Using this knowledge, I can suggest **design implications** for science curriculum development, teacher professional development, and technology development that promote ownership in learners.

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