



ILETES: Informal Learning Environments and Teacher Education for STEM

Early Career Research Award AISL#1254075

Jennifer D. Adams, Brooklyn College and The Graduate Center, CUNY



OVERVIEW

This Early CAREER project is an integrated research and education project that focuses on formal/informal collaborations and activities for STEM teacher education. This poster presents a) quantitative survey findings based on initial theoretical framework and b) emerging qualitative findings of 1.5 years of an ongoing dialogue between a group of new teachers who engaged in dialogues and shared teaching artifacts in relation to classroom science teaching and learning and informal science learning and expanded framework on teacher learning and identity. The central questions that guide the latter are 1) how do teachers define informal science education and 2) how do they enact their definitions in their teaching practice? First the definitions of formal, informal, nonformal learning are revisited, then using a framework of identity, agency, and learning to teach teachers' experiences were restored into narratives that describe how teachers defined and adapted informal science learning in their classrooms and used their notions of ISE to create equitable learning experiences for their students.

PHASE 1 QUANTITATIVE DATA

69 K-12 teachers who currently teach in a large urban and are alumni from two university-based formal/informal programs for teacher education. Forty-three (62%) female and 26 (38%) male; ages span 6 decades with 60% 21 and 35 y.o.; 83% (n=57) have post graduate degrees varied content areas. Instruments The self-administered questionnaire used for the analyses was the Informal Learning Environment Survey, v.1 (Adams, O'Connor-Petruso & Miele, 2015). This survey instrument was pilot tested and has a strong Cronbach's alpha reliability coefficient of .955. The survey consists of 60 questions and is divided into five parts: Part I) Demographics, Part II) Programs, Part III) Frequencies (which measure the teacher's "behaviors and practices"), Part IV) Attitude (which measure the "teacher's perceptions of courses that were beneficial and motivating"), Part V) Teacher Identity (which again measures the teacher's "beliefs"), Part V) Motivation, and Part VI) Open-Ended Question. Procedure: All participants were asked to take the online survey located at <http://globalskillstudies.org>. Data were collected over a five-week period. Analysis The research data were analyzed using IBM's PASW (Predictive Analytics Software), v. 22. Descriptive statistics and correlations were run to ascertain frequencies and linkages. Results are reported as well as patterns among teacher identity variables.

Quantitative Results: Patterns in the survey responses indicate that ILE educated teachers a) have positive perceptions of students as learners, b) are oriented towards "constructivist" teaching and experiences that afford equitable science-learning, c) seek out-of-classroom learning experiences for students and, d) have hands-on oriented classrooms.

Significant linkages (ranging from small to large) adhering to Cohen's Coefficient of Determination Guidelines (1988) were found between the teacher's ILE experiences and their instructional practices as measured by. Alumni from both programs have implemented the resources they gained from their ILE experiences into current curricula, including lesson planning and replication of ILE field trips for their students as well turn-keyed their expertise of ILE project-based assessments to their students who now produce their own ILE project-based assessments.

Significant linkages were found between the teacher's attitude towards their ILE experiences and their philosophical and instructional behavior as measured by a Likert Scale: Agree/Disagree. Alumni from both programs strongly advocate ILE experiences for their students for several reasons: both their content knowledge and the content knowledge of their students increased as a direct result of these experiences and implementation of ILE resources into curriculum; teachers believe that ESL/ELL's (including special needs) will greatly benefit academically from these experiences.

Similarly as a direct result of their ILE experiences, alumni from both programs have changed their instructional methodology and now advocate the constructivist approach in addition to the inquiry approach for leaning science. Both groups also advocate the need for additional funding for ILE experiences.

Formal, Informal and Nonformal learning definitions: There are elements of F, IF, and NF (Mocker & Spear, 1982) in all learning contexts and when attempting to make the distinction important to understand aspects and interrelationships of the learning approaches as situated in the contexts in which they occur (Colley, Hodkinson & Malcolm, 2002)

F	The learner decides neither the learning objectives nor approach. This largely defines K-12 learning and university degree programs and certification.
IF	The objectives are predetermined, however the learner's approach is self-directed, this would probably describe most visitor's experiences in informal science institutions.
NF	The learner determines the learning objectives and approach. This describes the learning that happens through everyday conversations and activities and is often closely related to learners' cultures and communities.



Figure 1: "Archetypes" of ISL Teacher Identities. Not meant to essentialize but to describe the different ways teachers present themselves in relation to ISL in the classroom.

Phase 2: ILETES Teacher meeting: Collaborative Teacher Inquiry around Informal Science Learning and Science Teaching in Urban Classrooms

A group of 10 new teachers were recruited to meet bi-for about 1.5 hours each over the course of 1.5 academic years. They shared artifacts of their teaching (student work, lesson plans, ideas, pictures and digital video recordings of their teaching enactments) for group analysis and discussion. Meetings were also digitally recorded for later analysis. Two methodologies were used to inform the data analysis: narrative analysis and grounded theory (Charmaz, 2005; Strauss & Corbin, 1998). The analysis of narratives (Polkinghorne, 1995) informed the trajectories of teacher identity-development including how they negotiate the different contexts and institutions in which they learn to teach and ultimately do teach. The process of restoring, i.e. "reorganizing the narratives into some general type of framework" (Creswell 2007, p. 56) was used to determine how teacher identity develops across learning-to-teach contexts with a particular attention to the role of the informal science learning experiences in their teaching practice.

THEORETICAL FRAMEWORK

Teacher agency and identity in relation to self, place, practice.

A framework that describes identity, agency, and learning to teach is salient for understanding the relationship between informal science learning and classroom teacher identity. Through the process of learning to teach, a teacher develops identity in relation to both the learning contexts and interactions with others in these contexts. Teachers enter professional learning with notions of what it means to teach and be a teacher and shape these notions based on the contexts in which they learn to teach and enact teaching and in relation to others (students, colleagues, administrators, etc.) throughout a career. Through this process they develop agency in teaching; that is learning and knowing which resources to use, when, and why to teach these students. Defining teacher identity as "the ways in which a teacher represents herself through her views, orientations, attitudes, emotions, understandings, and knowledge and beliefs about science teaching and learning" (Avraamidou 2014, p. 826) allows us to move beyond what is learned to focus more on the contexts in which the learner engages and allows us to ask questions about who a teacher is and what does this mean in terms of how she teaches (Beauchamp & Thomas, 2011). In this sense, teacher identity is not an end product, but rather an ongoing process teaching and learning about self, others, resources, places, and practices in different contexts, and who were are in relation to others, "identities are the part of self that are defined by the different positions we hold in society" (Varelas 2012, p. 3).

Identity and Agency

Agency is belief that the self is capable of effective science teaching. This means making the right pedagogical decisions, adapting and using different resources to meet those pedagogical decisions, and having confidence in science content knowledge and engaging students in science learning. Through the process of learning, one gains capacity in these skills and begins to develop an identity associated with competence in those skills. Depending on the learning contexts and one's self-perception in relation to others, one starts to define themselves as "kind" of teacher, whether it is inquiry-based, hands-on, fun, hard, strict, etc. Important to developing agency and a corresponding identity is being able to access and appropriate affordances available to be an effective teacher (Adams & Gupta, 2015). Affordances include physical and intellectual resources, practices, social and professional networks and other resources that shape and enable teaching and learning. Through agency, teachers appropriate and adapt affordances available or, in a polyphonic bricolage (Schmidt, 2008), create new resources from existing ones in order to create or maintain a particular teaching identity. Agency allows one to transform how one uses affordances within and across settings to expand and transform science teaching and learning opportunities available.

OVERARCHING THEMES

- Teachers appropriated different aspects of informal science learning and enacted them in their teaching in ways that they saw best met their students' needs as learners and resonated with their identities as educators.
- The definitions of F, IF, and NF, as they play out in the lives of teachers do not fall neatly into matrix of learner objective and approach, but rather converge and overlap in salient ways.
- Teachers developed identities and corresponding agencies that related to how they defined, adapted, and used ISE resources in their classrooms.
- Common themes across teachers were:
 - Hands-on activities
 - Self-directed learning
 - Field trips
 - Problem-based learning
 - Advocacy for meaningful science
 - ISE as a way of expanding students' experiences with science
 - Novelty and creativity in teaching enactments
- However, the degree to which teachers enacted these aspects and the learning experiences created based on these notions presented very differently depending on the "kind" of teacher—the role that the teachers viewed themselves in relation to their students.

SUMMARY

- In order to help all learners achieve science literacy, it is important to teach teachers how to create equitable learning environments in their classroom and how to appropriate resources beyond the classroom for science learning.
- Teachers will adapt ISE resources according to the choices they make as teachers, their own experiences with teaching and the role in which they find themselves vis-à-vis their students.
- Teachers "voiced" their pedagogy in different, yet meaningful ways that were different from established descriptions of informal science learning.

IMPLICATIONS

- It is necessary to begin to think differently about the relationship between informal science learning and teacher identity; moving from teaching teachers to use resources towards thinking about how the help teachers appropriate and adapt resources to meet students' needs thus creating more opportunities for equitable science learning and
- Thinking more about the meanings that teachers make of particular resources in relation to their identities and their self-perceived roles vis-à-vis their students.

Selected References: Adams, J. D. & Gupta, P. (2015). Informal Science Institutions And Learning To Teach: An Examination Of Identity, Agency And Affordances. *Journal of Research in Science Teaching*, DOI: 10.1002/tea.21270 Avraamidou, L. (2014). Developing a reform-minded science teaching identity: The role of informal science environments. *Journal of Science Teacher Education*, 25, 823-843. Charmaz, K. (2005). Grounded theory in the 21st Century: Applications for advancing social justice studies. In N. Denzin & Y. Lincoln (Eds.) *The Sage handbook of qualitative research 3rd edition*. Thousand Oaks, CA: Sage Publications. Colley, H., Hodkinson, P., & Malcolm, J., (2002). Non-formal learning: Mapping the conceptual terrain. Consultation Report, Leeds: University of Leeds Lifelong Learning Institute. Also available in the Informal Education Archives: http://www.infed.org/archives/etexts/colley_informal_learning.htm Creswell, J. W. (2007). *Qualitative inquiry and research design: Choosing among five approaches*. Thousand Oaks, CA: Sage Publishers. Hofstein, A. & Rosenfeld, S. (1997). Bridging the gap between formal and informal science learning. *Studies in Science Education*, 28, 87-112. Mocker, D. W., & Spear, G. E. (1982) "Lifelong Learning: Formal, Nonformal, Informal, and Self-Directed." Information Series No. 241. Columbus: ERIC Clearinghouse on Adult, Career, and Vocational Education, The National Center for Research in Vocational Education, The Ohio State University(ERIC Document Reproduction Service No. ED 220 723).

Contact: jadams@brooklyn.cuny.edu