

# **The Impacts of Extraordinary Experiences on Teacher Science Identity**

Michael P. Marlow

Bradley McLain

**School of Education and Human Development  
University of Colorado Denver  
Campus Box 106 • P.O. Box 173364  
Denver, Colorado 80217**

**mike.marlow@ucdenver.edu  
BRADLEY.MCLAIN@ucdenver.edu**

## **Abstract**

This paper focuses on science identity construction through the professional development of formal science educators engaged in extraordinary experiences that occur within the realm of informal science learning. In these experiences educators gain direct, first person experiences involving multidisciplinary science. These experiences are made more powerful and memorable because they are set within unique and often challenging environments. With this paper, we describe the components necessary for the experience to be an extraordinary professional development experiences (in the view of the participant) and how we measure the impacts of these experiences on the participant's science identity. This approach utilizes several data sources, including teacher-created video documentaries as personal narratives of their extraordinary experiences; narrative journals completed throughout the experiences, educator and student interviews, and participant observations. Specifically, the research examines the *interpretation* of these experiences through the teacher narratives in terms of science identity construction.

## **Introduction**

This type of professional development is about inspiring teachers. It focuses on the development of science educators through extraordinary learning experiences. Such experiences are potentially life changing, involve opportunities to take risks, and purposively integrate wonder, curiosity, and passion within science learning. For many years the University of Colorado Denver (UCD) has offered programs that take teachers on "science learning journeys" to Africa, South America, through the Pacific, and many U.S. destinations through its Experiential Science Education Research Collaborative - XSci. On these adventures, teachers gain direct, first person experiences of unique and often challenging environments and multidisciplinary science within those settings.

Similar professional development opportunities for teachers are widespread as summer programs through organizations nationwide. Examples include the nonprofit foundation Fund for Teachers, the Earthwatch Institute, the Fulbright-Hays Seminars Abroad Program, the U.S. Department of Education's International Education Programs Service, the Toyota International Teacher Program, the American Councils for International

Education Seminars in Greece, India, and Italy, the Transatlantic Outreach Program through the Goethe-Institut, the Teaching Excellence and Achievement Program (TEA) of the Bureau of Educational and Cultural Affairs of the U.S. Department of State, and many others. Typically these programs are funded through government-sponsored programs, museums/science centers, foundations, corporations, or through universities, both in the United States and internationally.

Although many organizations offer such experiential learning opportunities, there is little in the literature about the value of science learning professional development approaches as lived experiences, how they are interpreted by educators, how meaning is made and communicated, how such experiences are integrated into the identities and practice of those who choose to participate in them, and the impact on student perceptions and outcomes. If a teacher goes to Africa and climbs Mount Kilimanjaro with a volcanologist, how does it matter to them as professional educators? Does it impact their personal and/or professional identity and practice in ways that are meaningful to their students? If so, how is that meaning made? What is the role of a cohort in making such experiences valuable? What is the essence of these experiences that makes them extraordinary for the participants? And ultimately, if the meaning of such experiences is created through personal reflection and interpretation, what is the process of constructing an extraordinary learning experience for oneself and others?

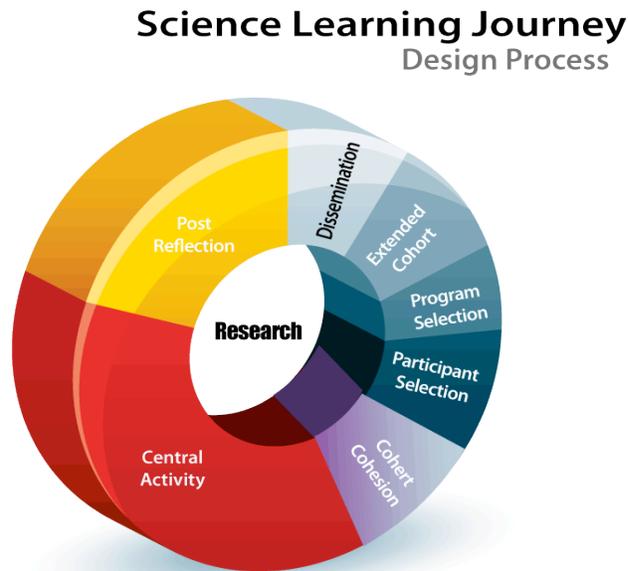
The research agenda for XSci examines educators engaged in extraordinary professional development experiences in order to understand the personal processes that make them extraordinary and valuable as well as how they contribute to improved classroom practice and student outcomes.

The central focus of XSci's work with these experiences is science identity construction – or the psychological processes by which people become inspired by science. It takes the point of personal relevance, ownership, and integration into the sense of self and also the position that the learning of new things can go beyond their incorporation into internal frameworks (or schema) for understanding (as traditional theories suggest), to actually inform, modify, and become integrated into a person's identity or identities. Simply put... learning changes us, sometimes deeply. Science identity incorporates the *self* into the learning equation and considers the relationship of the “knower” to the “known” as an essential element to learning, meaning making, agency, inspiration, and ultimately action. (Beler & Rittmayer, 2008). Therefore science identity construction is the forging of a personally relevant relationship to science in the form of an identity out of which meaning is made and modified over time (Falk & Dierking, 2000; Roth & Li, 2005; Hull & Greeno, 2006). The results can enhance science literacy, promote STEM career choice, and for our science teachers... enrich their self-concepts and capacities as passionate professionals able to ignite lifelong curiosity and inspiration within their students. This is the goal of XSci's extraordinary experiences.

Importantly, this approach considers the larger picture surrounding such extraordinary experiences, including: the complete design process; pre-journey, journey, and post-journey components; and the formation of durable educator cohorts that extend into the

future.

## The XSci Design Process



1. Program selection - identify the central activity/theme based on need and opportunity
  - a. What are the activities around that experience?
  - b. Map the potential activities for what they bring to the experience in terms of the 3 science identity construction zones: intellectual, emotional, and physical.

2. Participant Selection - Recruitment/ Self-selection/Application process.

3. Cohort Cohesion includes activities that support Initial

Cohort formation as a "Community of Practice" (kick-off meeting, video workshops, skill activities, training, online interactions)

4. Central Activity Engagement - the actual journey and associated activities with embedded reflections and assessments
5. Post-Journey Reflections include video editing, journal completion, group sharing, film festival, course product delivery, curricular development)
6. Dissemination
  - a. Classroom implementation - resource sharing, classroom collaborations, networking with partners, sharing videos of discussing the experience with their class, etc.
  - b. Professional / Collegial Outreach - Conference presentations, research papers and articles, collaborative curricula creation, website distribution of resources, short films, documentaries, etc.
7. Extended Cohort Involvement includes alumni activities, involvement in other projects, further curricula development, involvement with other alums -- a continuing menu of opportunities to interact

Our research approach synthesizes previous research and evaluations efforts that have examined various components of the process in addition to a fresh examination of the design process and participant experiences as a whole. Specifically, this includes an analysis of the sequence, timing, frequency, and nature of cohort interactions through the various activities (pre-journey, journey, and post-journey) and cohort collaborations

towards guided (semi-structured) classroom implementation strategies. This research necessarily examines the *interpretation* of these experiences as teacher narratives in terms of science identity construction and the resulting *changes* in classroom practice and associated student outcomes due to that interpretation. We've selected a mixed methods research approach that includes case study analysis and quantitative measures to conduct this research. The research generally focuses on the following research questions.

- (1) What is the content and nature of the individual meanings constructed by participants about their experiences?
- (2) What is the type and nature of the influence of the “cohort effect” on these constructions and resulting teacher collaborations?
- (3) What are the consequences of these constructions and collaborations for teacher practice?
- (4) What are the impacts of these experiences, constructions, and resulting practice changes on their students' science identities and performance?

This mixed methods research approach allows for comparison and triangulation across the different experiences and to examine congruency among the different forms of data for validation. Data sources may include: (1) Iterative and recorded participant and student interviews and observations (pre-journey, journey, post-journey, and several months up to 2 years post-journey); (2) participant travel journals as written narrative forms; (3) Teacher-created personal video documentaries as multi-dimensional narrative forms; (4) Survey instruments towards development of a science identity scale. All procedures will follow appropriate protocols and ensure the confidentiality of participants.

The interviews are both grouped and individual, semi-structured, guided interviews focused on open-ended questions to allow for the emergence of themes and identification of themes. Each is video recorded for later transcription and open-coding analysis, and we take observational notes during the interview process.

The review of the participant travel journals involve treatment of them as narratives using narrative analysis and an open-coding approach to identify emergent themes and categories, and to include significant quotations and comments that represent them. Our journal protocol imposes a narrative structure *a priori* for teachers to use when writing in order to facilitate narrative form. During this process it relies heavily on the researchers' reflexive journals to compose reactions to and interpretations of the narratives, make metaphors, and attempt to relate emerging themes to the theoretical base of constructivism, and the theoretical framework of science identity construction. This notion stems from the ideas of Jerome Bruner (1991), who asserted that narrative is a form of reality construction, “we organize our experience and our memory of human happenings mainly in the form of narrative – stories, excuses, myths, reasons for doing and not doing, and so on,” (p. 4). He goes on to say that knowledge is never without a point of view and that while the science of the natural world is concerned with empirically verifiable or falsifiable constructs, the “rich and messy” human and symbolic social world (where we construct reality and its meaning to us) is accessible only through

interpretation.

Regarding the analysis of the video documentaries as data sources, we use a narrative analysis approach that considers each film as a holistic story, as well as a deconstruction of its elements in order to better elucidate the multi-dimensional meaning of the films. Under this framework, we will apply a visual coding strategy to examine the imagery chosen by the teachers to identify visual themes and categories, a verbal-linguistic coding of dialogue and/or narration based on a textual transcription of each film to identify text-based themes and categories, a scene-by-scene plot mapping approach to create a conceptual map of each film to examine the sequential order of “scenes” chosen or developed by the video creators, and finally a running narrative commentary in which video creators comment in real-time about their choices and what they were “going for” in their documentaries. This is modeled on the “director’s commentary” option common on DVD movies as part of the special features menu and is recorded for video playback with commentary.

Finally, the survey instruments build upon prior work in identity theory to characterize and describe individually held perceptions of self and role taking in professional and personal contexts. Our goal is to ultimately develop and implement a science identity scale that helps describe growth and change resulting from extraordinary science learning experiences.

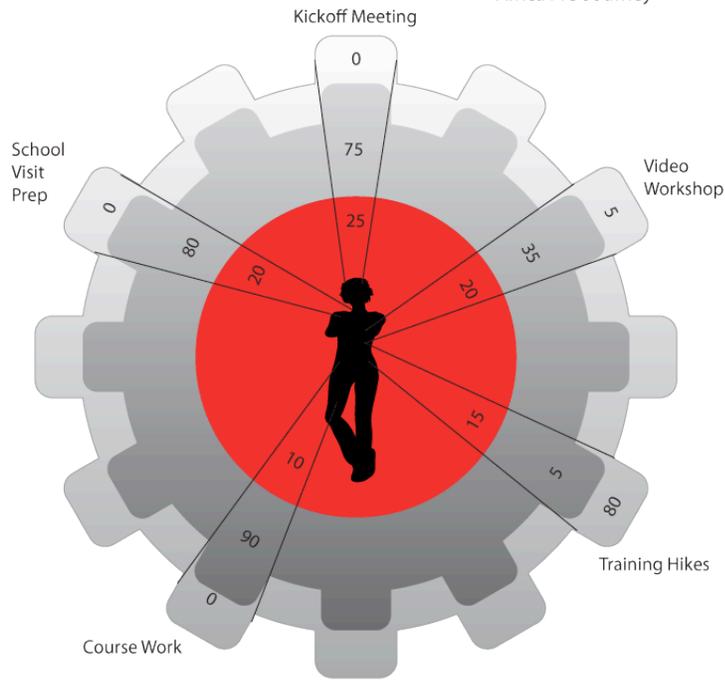
Additionally, we create a customized online community for cohort interaction, content and curricular materials sharing, and other collaborations for each of the experiences. This web presence uses off-the-shelf tools (such as Facebook and Basecamp), but include elements for engaging alumni from prior XSci experiences to interact with the new cohorts.

### **The XSci Experience Map model**

The XSci Experience Map model includes physical, intellectual, and emotional aspects. Following is an example of an XSci Experience Map for an Africa Science Learning Journey, presented for pre-journey, journey, and post-journey activities. Note that the outermost ring depicts physical elements, the middle ring is for intellectual elements, and the center ring is for emotional elements. Note also that the different activities listed are broken down for each category by percentage. These kinds of maps serve to guide the design process for an overall experience. The intent is to impact all three elements through a number of activities in order to assure positive science identity construction. It is not necessary that all activities within the experience include all three aspects, nor that there is an equal percentages total for the entire experience. It is just a guide to help us recognize that all three are being addressed to some degree. We recognize that a single experience does not in fact create major change in an individual’s science identity but that in fact ongoing experiences are required.

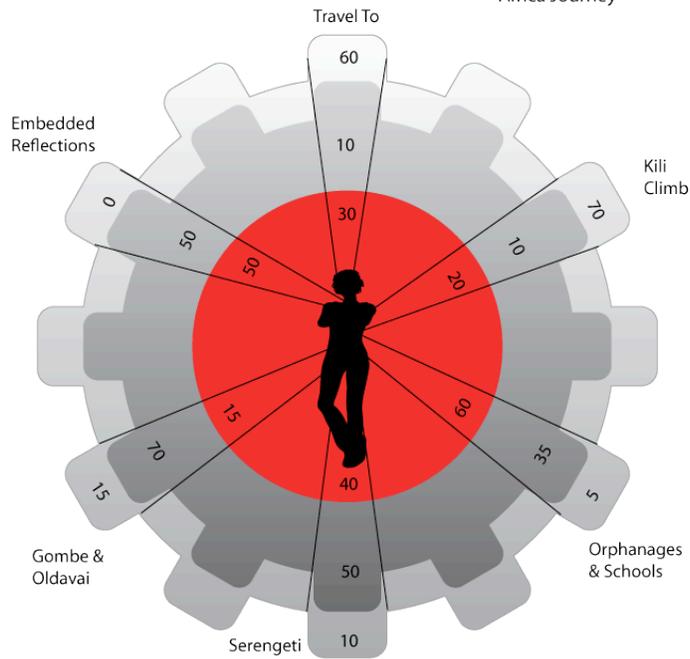
# Experience Map

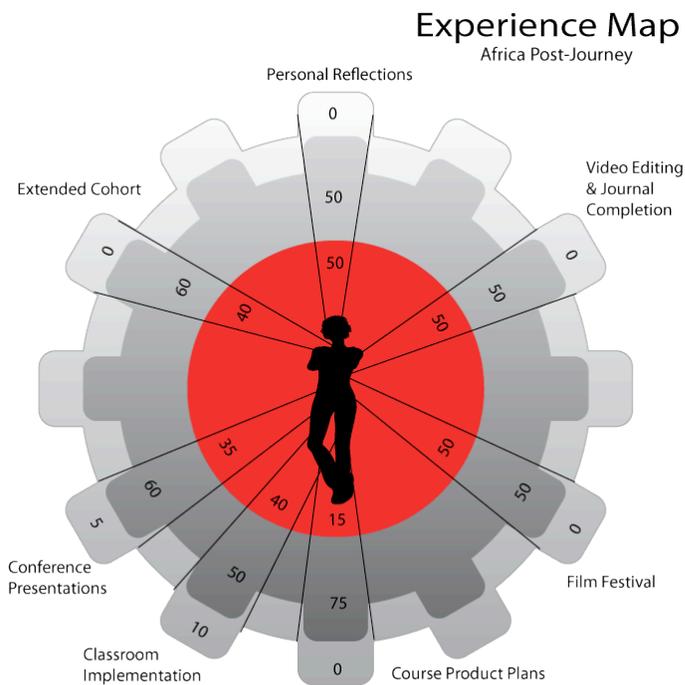
Africa Pre-Journey



# Experience Map

Africa Journey





A critical aspect of any Xsci Science Learning Journey is reunion opportunities for the cohort. Built into the model is a post-journey gathering of the cohort that includes sharing of their videos in an educator’s film festival format. Also, the cohort is included in the online community for both regional and national interactions with other cohorts.

Research involving the participants continues after the experience both in their classrooms and in professional settings. For example the educators from an Africa journey may prepare and present in teams at a future NSTA Conference. This is an important aspect of the experience post-journey -- the opportunity to lead, communicate and disseminate science content to peers. It also continues and strengthens the collaboration of the cohort.

### Summary

The approach we’ve described in this paper supports the following overall outcomes:

- (1) Promote construction of more effective experientially based teacher professional development programs through connecting theory with practice and informing designers of the psychological processes involved and how to connect them to student outcomes;
- (2) Contribute to the growing research into science identity through the formulation of a new model for experiential design processes based on identity theory and innovative research methods (such as teacher-created videos);
- (3) Empower educators themselves to become wiser consumers of experiential professional development opportunities, given their limited PD resources, and provide meaningful forums for collaboration on experiential methods (in-person regionally, online, and via a national conference).

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