

# The Allochthon of Misfit Toys

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## ABSTRACT

This study provides a narrative analysis of the challenges and opportunities faced by scholars in the field of geoscience education (GED). A set of interviews was conducted with five GED professionals in 2010. Participants discussed challenges and opportunities in GED both for individual practitioners and as a discipline. Select participants were interviewed again 2 years later to reflect on their earlier statements and describe subsequent developments in their thoughts, perceptions, and lived experiences. Participants also discussed, and revisited 2 years later, the GED research topics they considered to be of widespread interest and those they did not. Their notable results were unsurprising: Practitioners in 2010 battled for acceptance and legitimacy and continue to do so. Professional isolation remains a major perceived issue, as do career prospects and accessibility of GED publications. Practitioners face an ongoing struggle with a lack of formalized training in educational research methods. However, GED is perceived as a young, vibrant field in which practitioners enjoy healthy intraprofessional relationships and opportunities for collaboration. Participants agreed that abundant space exists in which to generate ideas and to collect and generate data. They also suggested that acceptance, perceived legitimacy, and professional respect are all increasing, albeit slowly. Challenges and opportunities were assembled into metaphorical models to illustrate the experiences and ontologies reported by the participants. Three recommendations are made for institutions and for aspiring and practicing GED workers: (1) repurposing of GED literature types, (2) addressing the disconnect between teaching reform and the tenure process through targeted marketing, and (3) formalizing and codifying training processes for GED professionals. © 2013 National Association of Geoscience Teachers. [DOI: 10.5408/13-004.1]

**Key words:** higher education, practitioner, qualitative, geoscience education, challenges, opportunities

## INTRODUCTION

The geoscience education (GED) subdiscipline is experiencing growth and increasing recognition among the greater geoscientific community. However, negative or misinformed preconceptions and perceptions of the value of GED research also exist within the greater community. In higher education settings, it is all too easy to converse with a group of GED workers and get a strong sense of the frustrations, challenges, and opportunities that are part of their lived experiences. This “strong sense,” however frequent and forceful, is also anecdotal. We have all heard stories about that rude audience member at a GED presentation, the department that retains but never tenures GED workers, and our GED peers being labeled as “failed scientists.” Anecdotes like these seem to form a collective wisdom among us, even an ethos. Why is this?

Collective identity theory (Polletta and Jasper, 2001) provides some insight. By collecting and retelling these stories of strife, we identify as members of an “oppressed” group, however spuriously. As a result, we as GED workers forge a collective identity and a solidarity that is both personal and interpersonal (e.g., Shelby, 2002). Alternatively, our common wisdom of professional difficulties as GED practitioners may simply be the result of congeniality bias (Hart et al., 2009), because it supports the preexisting notions we hold about how we are perceived. The title of

this article is a deliberate expression of congeniality bias on my part, labeling GED workers (including myself) as “misfit toys.” This label refers to the 1964 Rankin and Bass Productions animated television feature, *Rudolph, the Red-Nosed Reindeer* (Internet Movie Database, 2013). During the story, viewers encounter characters that are unwanted toys, which have been discarded because they are unconventional in ways that ostensibly preclude their enjoyment by children in modernist consumer cultures. In the story, these toys have taken up residence on an isolated and unpopulated landmass proximal to Earth’s northern geographic pole, referred to as the Island of Misfit Toys. The misfit toys eventually experience redemption through repurposing via interactions with Santa Claus (Father Christmas) and a nihilistic adventurer named Yukon Cornelius. In American popular culture, the “misfit toy” is a pervasive iconography, typically invoked to denote the status of a person or object as a de facto outsider. The misfit toy reference occurs regularly in scholarly literature (e.g., Haldeman, 2007; Lalvani, 2012).

Apart from collective identity and congeniality bias, the GED outsider or misfit toy ethos may represent a real, predictable, and widespread phenomenon. If our subdiscipline presents systemic challenges—and opportunities—to us as practitioners, how do we cope with them? What can we learn from them? The problem of understanding the pervasiveness of our vocational difficulties, and extracting meaning from them, is best approached through qualitative study. This allows the presentation of individual lived experiences and constructed realities as ontological objects of study—transforming anecdotes into data. These data then allow the documentation of common experience, illustrating a phenomenon and the people it affects.

Received 25 January 2013; revised 5 April 2013; accepted 8 May 2013; published online 27 August 2013.

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## Purpose of This Study

The primary purpose of this study is to address the following questions:

- How pervasive are challenges to GED workers?
- What are those challenges?
- What are the opportunities for GED workers and the subdiscipline?
- Do patterns and commonalities exist among the lived experiences of GED workers?
- What is the current state of the subdiscipline?
- What are some lessons to be learned from all this?

The secondary purpose of this study is to serve as a jumping-off point for future work, particularly that of a more empirical and quantitative nature. Qualitative studies often form the impetus for quantitative studies (Feig, 2010, p. 215), giving rise to empirically testable hypotheses as a result of illustrating a phenomenon. The data and themes I present here are available to shape other routes of inquiry, such as a focused survey instrument with quantifiable responses or a policy analysis of the deployment of science educators in university settings.

Because this is a qualitative study, it has a different appearance from the more familiar geoscientific or GED paper. The results (themes and interpretations) of this study are laid out in a manner consistent with the ethnographic tradition, as described and demonstrated, respectively, in Wolcott (1994) and Feig (2010). The data I present are primarily in the form of participant quotes, from which I build interpretations and identify emergent themes, in keeping with the ethnographic tradition.

## THEORETICAL FRAMEWORKS AND LOCATIONS

### Theoretical Frameworks

This study is a qualitative inquiry into the perceptions and variable lived experiences of GED practitioners. The data generated are the thoughts, perceptions, attitudes, and experiences of individual people. The theoretical framework chosen is a blend of logical empiricism and critical theory. Empiricism is an appropriate framework, because I hypothesized that other GED practitioners might share my lived experiences and ontologies. It is also the standard mode of inquiry in geoscientific investigations. I further hypothesized that the common experiences in our subdiscipline include a lack of acceptance, a struggle for validation, and a low place in the geoscientific hierarchy. I expected to document commonalities of experience and illustrate the process of “being” a GED practitioner among a group of participants.

But it is not enough for me to simply document experiences. Therefore, I turned to critical theory. My intention was to interpret and ultimately act on these data in a way that is deconstructive, liberationist, and transformational. I wanted to deconstruct the power relationships that build barrier, sought to promote freedom from figurative oppression, and ultimately wanted to affect change for my subdiscipline and its practitioners. These praxes are consistent with a critical theory framework. An example of critical theory in science education research is work that focuses on making a discipline more inclusive of women (e.g., Barton, 1998). The impact of Barton’s work was to

illustrate how traditional lecture-based pedagogies have their roots in a “weeding-out” approach to chemistry education, which presented barriers to many learners (frequently women) who were otherwise quite capable of success. For an in-depth treatment of critical theory and other theoretical frameworks in qualitative GED research, see Atchison and Feig (2011) and Feig (2011).

### Locating This Study in Time, Space, and Culture

This study does not have a spatial location other than where I conducted interviews. Its temporal location is longitudinal, consisting of multiple snapshots 2 years apart. The cultural space of this study is that of being a teacher, researcher, or both in the discipline of GED. The participants both wholly form and reside within a space generated by their shared experiences and patterns of behavior. This common set of experiences and behavior patterns defines a culture-sharing group (Wolcott, 1990).

In qualitative research, the question “Who is the researcher?” must be answered, because the researcher is not an objective, detached observer looking down upon a universal reality. Furthermore, the declaration of the researcher’s location in the study provides the opportunity to explore the purpose of the study, frame the problem being addressed, and examine potential bias (Feig, 2011). As the researcher, I am a part of this study because I am also a participant. My experiences and ontologies are part of the dataset, along with those of people I interviewed. My “data” seeded this study. In the past, finding acceptance and validation as a GED worker was tremendously challenging for me. I observed power disparities and other problematic systemic issues. In reaching out informally to other GED workers, I learned that they were encountering similar problems.

I sought to understand and take control of this situation in the way we naturally want to do as scientists: through research and study. My attempts to systematically document the experiences of GED workers, and then use those results to affect change, define me as a participatory action-researcher (Whyte, 1991; Feig, 2011). Such researchers approach educational questions (e.g., what happens to GED practitioners) as social problems solvable by research. Table I provides another example of the application of action-research to GED.

### Bias

Because participant action-research involves the researcher (in this case, me) as a participant, it is common for the audience to raise the question of bias. Am I just repackaging my anecdotes? This issue has its roots in the comparison of qualitative inquiry to more traditional scientific and geoscientific investigations. In the study of paleomagnetism, for example, a single physical reality exists. The rocks were imparted with a primary remanent magnetism upon formation and possibly a secondary magnetism afterward. Through laboratory analysis, the movement of the rocks over Earth’s surface through time, driven by tectonics, can be understood. The paleomagnetist is separate from the phenomena being studied and is a detached observer investigating a physical process.

In contrast, a description of human experience contains multiple parallel realities, because social actors, i.e., people, construct those realities. My experiences seeded this study.

TABLE I: Matrix of qualitative methodologies, as well as action-research, and their applications in GED research. Action-research is not a methodology per se, but its inclusion is meant to clarify its utility in GED research.

Methodology	Utility	Example Results	Reference
Phenomenography	Empirical understanding of different ways students approach and conceptualize a geological problem or issue	Students tend to have simplistic conceptualizations of the discipline of geology; faculty members tend to hold more process-oriented conceptions. Convergence between these conceptualizations enhances curricular design in the discipline.	Stokes, 2011
Ethnography	Understanding common lived experiences of geology students, how students construct reality, and how students conceptualize a geological problem	Field camp students apply inappropriate levels of technology, assuming more is better. Students do not differentiate between accuracy and precision.	Feig, 2010
Participatory action-research	Increasing participation of underrepresented groups in geology programs and classes	Incorporating multiple ways of knowing, and acknowledging indigenous wisdom, increases the relevance of the geosciences among Native American learners.	Riggs et al., 2007

They are one reality. Through ethnography, I collected the experiences and ideas of others, which represent other realities. The transformation from anecdote to data takes place by weaving these experiences into a common thread and then extracting meaning from them. This meaning is supported by data in the form of participant quotes. The result is not the documentation of a single reality common among all GED practitioners. Rather, the result illustrates lived experience among a group of individuals and common themes that may exist among GED practitioners. Bias is avoided by supporting interpretations and extracted meanings with data—in this case, participant quotes.

## METHODOLOGY, METHODS, AND MEASURES

### Methodology

My methodological approach in this study is that of phenomenographic auto-ethnography. I examined datasets (transcripts) for variance in experience and ontology, as a phenomenographer would (Stokes, 2011). However, my approach to this was not rigorously empirical, because phenomenography is typically conceptualized (Cousin, 2009). Rather, my results are shaped by the process of categorizing the discrete ways in which a phenomenon is conceived and experienced by a group. My methodology is also informed by ethnography, because my goal is to understand the cultural group, of which I am a part, through documentation and description (Wolcott, 1999; Feig, 2001). This includes sharing my experiences, as well as those of my participants. My strategy is best described by Schwandt (2001):

*The aim in composing an autoethnographic account is to keep both the subject (knower) and object (that which is being examined) in simultaneous view.... The stories that frequently comprise autoethnography are intended to illustrate and evoke rather than to state or make a claim, and...the author of such a text aims to invite readers into the text to relive the experience rather than to interpret or analyze what the author is saying. (p. 13)*

In this study, my purpose is to narrate and illuminate the lived experiences of GED practitioners. I am a GED practitioner, and my experiences form part of the narrative. Table I displays examples of how the methodologies of phenomenography and ethnography, along with participant action-research, have been used in GED research.

### Methods

I conducted semistructured interviews with five active GED practitioners. I recruited participants through the Geoscience Education Listserv (Geocognition Research Laboratory, 2012) and arranged to secure consent and conduct in-person interviews at the 2010 Annual Meeting of the Geological Society of America (GSA). I asked the following questions in these interviews:

1. What do you consider to be the current “hot” research topics in GED?
2. What topics do you consider to be not “hot” or of interest?
3. What are the challenges faced by individual GED workers?
4. What are the challenges faced by the discipline as a whole?
5. What are the opportunities for individual GED workers and for the discipline as a whole?

The purpose of asking about hot topics is twofold. First, these questions focused the conversation and provided thoughtful icebreakers. Second, scholars typically identify with (and against) specific topics. Topical analysis provided a lens through which to view challenges and, in particular, opportunities.

I coded transcripts of the audio-recorded interviews using simple serial indexing (Lincoln and Guba, 1985). Simple serial indexing is the process of grouping interview responses into categories to produce packages of data across multiple transcripts that converge into emergent themes. Two participants agreed to conduct follow-up interviews via web conference in 2012. Follow-up interviews were unstructured. I asked participants to discuss whether and how their thoughts and attitudes had changed once they read the

transcripts of their first interviews. They also read and discussed the emergent themes I flagged in their transcripts, as well as my interpretations of those themes.

The participants included one tenure-track professor, one tenured professor, and three nonfaculty education professionals. This latter category may seem opaque, but it is my intention to maintain the confidentiality of the participants. Four participants were male, and one was female. All participants work in higher education settings. The pseudonyms I assigned them have no relation to their ethnicity or national origin. What follows is a “quick reference” to the participants, their assigned pseudonyms, and the subjective key words that describe them while maintaining their confidentiality.

- Keeshawn: Tenure-track professor; known and well established within the GED community
- Konstantin: Tenured professor; widely recognized as a leader or elder statesman in GED
- Korina: Nonfaculty education professional; job duties focused on research, employed in a permanent position, not seeking a tenure-track position
- Kaiwen: Nonfaculty educational professional; job duties focused on teaching, employed on a contractual basis, passively seeking a tenure-track position
- Koa: Nonfaculty educational professional; job duties focused on teaching, employed on a contractual basis, actively seeking a tenure-track position

### Reliability, Trustworthiness, and Saturation

Qualitative data and analyses are subject to measures of reliability and trustworthiness, just as quantitative data are subject to measures of validity. Comprehensive literature now exists on the treatment of qualitative data in GED research. Rather than summarize this literature base here, I refer the reader to Feig (2010, 2011), Feig and Stokes (2011), Libarkin and Anderson (2005), and Lincoln and Guba (1985).

In this study, I established reliability and trustworthiness through the processes of excerpting data and member checking. Excerpted data ensure that the construction of my arguments is fully transparent and based on the raw data of expressed ontologies. In this way, it is possible to gauge whether my interpretations of the data are valid. Excerpted data are in the form of block quotes, and text inserted by me for clarification is placed within square brackets.

Member checking is considered the most crucial dynamic process for establishing trustworthiness in qualitative research (Lincoln and Guba, 1985; Creswell, 2007). Participants of this study reviewed my field notes as I wrote them, as well as my subsequent transcripts of our interviews. I then discussed with them my interpretations, analysis, and conclusions, which gave them opportunities to reflect, correct, or expand as they saw fit. By doing this, I made my participants stakeholders in the research process, allowing them to be not only the focus of the study but also its codirectors (Stake, 1995).

The data I generated do not statistically represent the entire population of GED workers the way a representative sample does. My goal is to illustrate, document, and “understand specific ontological realities” (Feig, 2011, p. 3). This requires not a large sample size but rather a purposive one, guided by my stated research purpose. The emergent

themes I identify and the meaning I extract result, in part, from data saturation. For example, each participant in this study reported that a primary challenge to them as GED workers is that of educational research being perceived as a legitimate by their peers. This is true for me as well. Given this frequency, I have a reasonable picture that “legitimacy” affects the professional lives of GED workers. If I were to interview 10 more workers, or five, or 100, I would expect this issue to be expressed that many times. Those less familiar with qualitative inquiry will note the small sample size and the corresponding amount of data (quotes). Again, the purpose of this study is not to represent a population but to illustrate shared experience.

In conducting this study, I made hypotheses about what I would document. I also described my analysis of data as allowing themes to emerge. Although qualitative inquiries are not hypothesis driven per se, they often are seeded by informal or formal expectations. The coding of themes is “emergent” because I did not guide the participants to a particular conclusion. Rather, I placed their data alongside my own and contextualized both datasets as a summative illustration of lived experience among GED practitioners. As I describe in the next section, some themes emerged independent of my expectations—or my hypotheses, to use an empirical language consistent with my blended theoretical frameworks. A traditional geoscientific study might be hypothesis driven, and it is incumbent upon the researcher to present supporting data if the study supports the hypotheses. The same is true for a qualitative study. As the researcher, I must ensure that emergent themes exist in parallel with my expectations, rather than having been colored by them. A properly rigorous description containing excerpted data is requisite to this task.

## DESCRIPTIONS AND EMERGENT THEMES

In this section, I describe the data I generated and my analysis and interpretation of emergent themes. It may be helpful to consider this section analogous to results. The implications of these themes, and their relation to the stated purposes of this study, are discussed in the implications section.

### Hot Topics and Not Topics

Table II presents a matrix summarizing what the five participants identified in 2010 as the most interesting or relevant research topics. The table also shows what topics they considered to be of little or no interest. Cognitive psychology, together with cognition in fieldwork and mapping, were frequently identified as hot. Spatial reasoning was also frequently identified as hot, along with studies of the affective domain of learning. In our first interview, Koa identified access for disabled students as not hot. He was quick to point out, however, that this was because he felt that more work needed to be done on this topic. He questioned rhetorically whether “not hot” meant “not valuable” or “not hot but should be.” In our follow-up interview, Koa noted the growth of interest in this topic during the intervening 2 years (e.g., Geological Society of America, 2012).<sup>1</sup>

<sup>1</sup> Koa is not an active worker in the fields of accessibility, disabilities, or diverse abilities in the geosciences.

TABLE II: Topics identified as interesting or relevant and not of interest by the five participants.

Participant	Hot Topics	Not Hot Topics
Keeshawn	Fieldwork or mapping	Projects without data
	Cognition or cognitive psychology	
	Affective domain or attitudes	
	Teaching or teacher training	
	Eye tracking	
Konstantin	Cognition or cognitive psychology	Projects without data
	Spatial reasoning or skill	Student perceptions
	Role of culture in learning	
Korina	Spatial reasoning or skill	None reported
	Affective domain or attitudes	
	Assessment	
Kaiwen	Fieldwork or mapping	Projects without data
	Spatial reasoning or skill	Learning styles
	Affective domain or attitudes	
	GPS tracking studies <sup>1</sup>	
Koa	Fieldwork or mapping	Curriculum reform
	Cognition or cognitive psychology	Curricular workshops
	Assessment	Accessibility for disabled students <sup>2</sup>
	Teaching or teacher training	
	Novice versus expert thinking	
	Learning, course, and program outcomes	
	Virtual field trips	

<sup>1</sup>GPS = global positioning system.

<sup>2</sup>This statement was unpacked and modified by Koa in subsequent interviews (see text).

The most frequent citation of not-hot topics was that of studies unsupported by data, or as Konstantin stated, “Data-free talks [and] programs...you know, ‘this is what the students thought’...are not hot.” The participants and I both attribute this frequent sentiment to the growth that has taken place in our discipline in terms of the increase in publications that are empirical, data driven, or both. This growth is notably expressed through the evolution, over the last 5 years, of the periodical *Journal of Geoscience Education* and the production of its sibling news magazine *In the Trenches* (Libarkin and St. John, 2011). The journal’s current niche as an academic forum is perceived to lend legitimacy to our educational research by aligning its content more with the hypothesis-based, empirical praxis of traditional geoscientific inquiry. Kaiwen, however, stated, “What we did [in the classroom] and how they liked it [is] the entry point or gateway research into GED.”

Keeshawn had this to say:

*If you go back and look at the Journal of Geological Education in the ‘70s, it’s almost all papers on, “I built this flume model and here’s how I used it in my sedimentology class,” and it might have a few statistics in it and maybe you’ll see a t-test; that’s about it. And so I guess what I was saying about the old guard [geoscientists skeptical of GED] there, the people who to them, that’s GED. Or GED is helping teachers.... Whereas...I consider myself to have been a part of this community [for a few years], and one of the*

*first things that I noticed, and I continue to see it, is how there seems to be sort of a new generation that’s coming along, people that are willing to go out and learn new techniques, like qualitative techniques, or go to other areas like cognitive psychology and whatever, and pull the findings from those fields and do more rigorous kinds of studies. You see those kinds of studies becoming more, more common every year here at GSA [meetings].*

Keeshawn added that “Most people enter GED through a backdoor, through a desire to improve [their] teaching.”

#### ***Emergent Theme: How GED Research Is Perceived and Consumed***

The statements made by the participants suggest that access to our body of work for the “uninitiated” might look something like the workflow shown in Fig. 1. As depicted in this idealized workflow, the geoscientist with casual interest learns about or accesses descriptive, data-free items such as those described by Konstantin and Kaiwen; this is the “backdoor” referenced by Keeshawn. Without further exposure, this geoscientist might conclude that these products are the standard of GED research. As Kaiwen phrased it in our follow-up interview, “Scientists think that educational literature is full of crap.”

Alternatively, by accessing an academic forum for GED research, our hypothetical geoscientist would most frequently encounter statistical or otherwise quantitative studies of

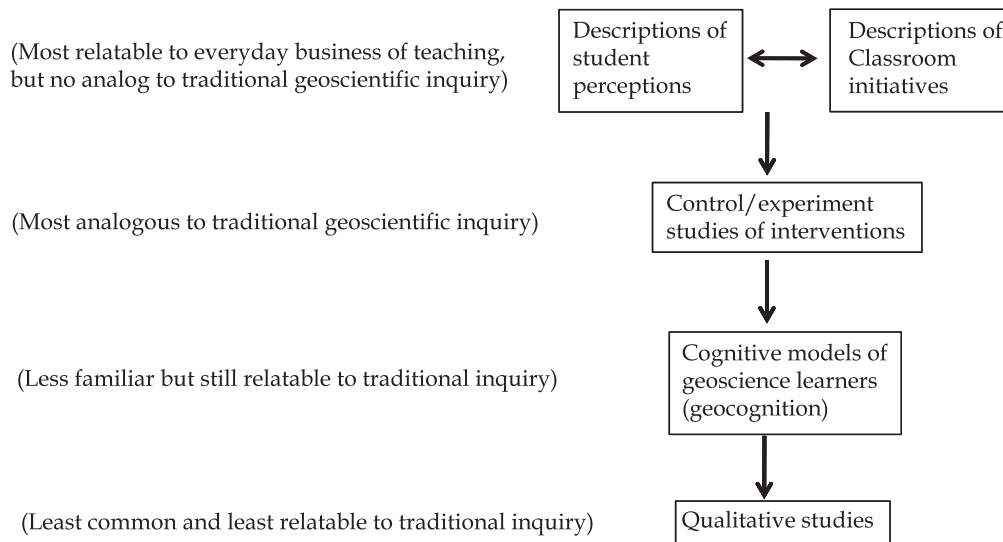


FIGURE 1: Idealized workflow of access to GED research for traditional geoscientists.

classroom or programmatic interventions. This gives the geoscientist something to chew on that is immediately familiar and has the look and feel of traditional geoscientific inquiry. Less familiar, but still readily understandable to geoscientists, are model-driven studies of student cognition. I placed qualitative studies deepest in the model not to falsely portray them as some kind of apotheosis but rather to portray them as a function of their paucity. They also have no analog to traditional geoscientific inquiry.

In reality, this tidy, idealized model of access to GED research is likely to be scrambled. The traditional geoscientist whose first taste of GED research is a qualitative study is likely to be bewildered and/or angered by it. On the other hand, given exposure to rigorous, data- or model-driven studies, our geoscientist would recognize that a “data-free” product is not standard currency in GED, and is therefore likely to perceive the discipline as more legitimate/valuable than she or he would otherwise.

### Challenges

Table III displays a matrix of the challenges and opportunities perceived by the participants. Given the breadth of diversity among the participants in terms of career type and attainment, it can be argued that frequently reported challenges are more than illustrative—they are pervasive. The most frequently cited challenges overlap: the lack of respect or prestige for practitioners and a perception that GED research is not legitimate or valuable. While the participants universally expressed the challenges of the lack of legitimacy and respect, each saw them through a different lens. For Keeshawn, it had to do with the status quo at the department level:

*I'm picturing a colleague of mine, who is an excellent teacher and really fosters a lot of critical thinking and math skills, has very rigorous classes...so in that case...a very good teacher, but when it comes to talking about education research, he almost borders on being disparaging...doesn't necessarily believe in inquiry learning.... It appears to me [he] doesn't seem to really value the contributions that*

*[GED] research can bring.... People [like him], they're used to not having [GED] in the field, and so they don't understand the contributions of it. And you know, it's my understanding that our discipline's gone through that many times before, starting with hydrogeology; hydrologists were not part of geology departments, and now they're considered in many cases an integral if not critical component of geology departments.*

Kaiwen invoked cultural change in addressing this topic:

*[Cultural change is going] very slowly, and I think it does it the way science advances, people get old and die, and new people come out with new ideas. I think a lot of the new—newer ideas, it's often a lot easier to get those [newer, younger] people to change...[but] not always.*

Koa's expression of respect and prestige challenges was complex. In 2010, he tied them to professional isolation:

*I think we're kind of scattered around, even though there's plenty of geoscience education practitioners...nine times out of ten [departments] would much rather have a geologist doing geology work, as opposed to geoscience education work and that oftentimes our folks have joint appointments in the department of ed and geoscience, and it's kind of a bridge, which I don't know that's appropriate.... I like to think that here at GSA, there's a lot of respect—I think we have a lot of sessions here, and that shows that at a national level it's something of value. I guess my question is how trickle down is—I mean, how isolated are we?*

He underscored this notion in our follow-up interview in 2012, saying “Isolation problems bleed into legitimacy issues.” In that same 2012 interview, he turned the tables on me:

*Koa: Do you still lecture?*

*Feig: Yeah, sure.*

TABLE III: Challenges and opportunities reported by participants in the 2010 interviews.

Participant	Challenges	Opportunities
Keeshawn	Lack of respect or prestige for practitioners	Substantial research opportunities
	Research not seen as legitimate or valuable	Science departments housing teacher training programs, possibly leading to more GED jobs
	Professional isolation	Technology use in geological sciences
	Perception that GED is only about helping teachers	
	GED at meetings: big groups or projects peppered by “lone rangers”	
Konstantin	Lack of respect or prestige for practitioners	Collaborations with cognitive psychologists
	Professional isolation	Little or no infighting among GED practitioners
	Career path for GED PhDs unclear	Publishers interested in introductory classes
	Low citation frequency	High retention of GED workers in discipline
	Complacency among practitioners	GED inroads at NSF <sup>1</sup>
	Danger of overspecialization for practitioners	
Korina	Lack of respect or prestige for practitioners	Substantial research opportunities
	Lack of training in educational research methods	Collaborations with cognitive psychologists
	GED behind other sciences in affective domain study	
Kaiwen	Research not seen as legitimate or valuable	Substantial research opportunities
	Career path for GED PhDs unclear	Site-specific GED research, which lends ease to reproducibility
	GED very young	GED of universal importance
	GED workers with chips on shoulders	
	GED research inaccessible to geoscience community	
	Slow cultural change	
Koa	Lack of respect or prestige for practitioners	Substantial research opportunities
	Research not seen as legitimate or valuable	Little or no infighting among GED practitioners
	Professional isolation	Potential to broaden GED market appeal
	Career path for GED PhDs unclear	Potential to grow GED faculty cadre
	Lack of training in educational research methods	Communication among GED practitioners
	Shallow literature base in GED	Good collaboration among GED practitioners
	Lack of standardized PhD training in GED	Active, dynamic GED practitioners

<sup>1</sup>NSF = National Science Foundation.

*Koa: Why? Why do you still do that?*

*Feig: Because...It's safe?*

*Koa: Exactly. Lecturing [as opposed to reforming teaching] is a safe way to progress through to tenure, so there's no need for our work focused on teaching improvement, in many institutions.*

*Feig: Should we move into more theoretical realms in our research?*

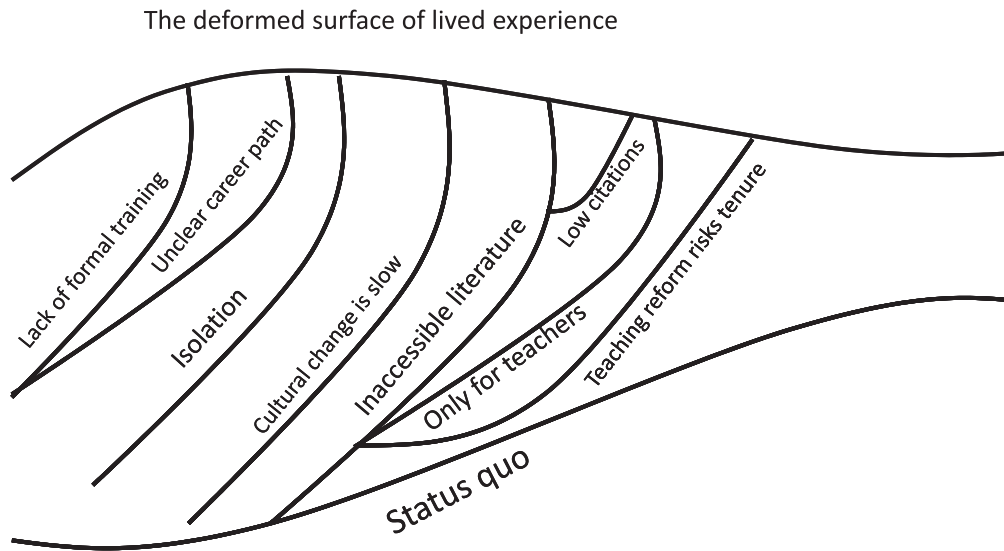
*Koa: [I'm] not ready for this.... [I want] to focus on interventions, transformations, best practices. Theoretical [work gets] low citations.*

My experiences add to Koa's data. As one example, in the past I found it difficult to convince some colleagues to accept evidence that an active learning approach typically results in higher-than-average grade distributions, coupled

with positive student evaluations of teaching (e.g., Gray et al., 2008). Instead, these kinds of results are often viewed as teaching deficiencies. I was counseled to only employ lecture and high-stakes testing as pedagogical tools. By doing so, I would demonstrate that my teaching was appropriately rigorous. A Gaussian grade distribution, I was warned, was far stronger evidence of classroom rigor than the pre- and posttest Geoscience Concept Inventory (Libarkin and Anderson, 2005) that I had administered. The statistically significant learning gains I measured did not mitigate the negative feedback that resulted from my reform efforts. As Koa described, I had strayed off the safe path.

#### ***Emergent Theme: Legitimacy and the Self-Defeating Job Description***

Koa's job is to promote teaching reform in the sciences; he also sees this task as a fundamental part of his identity. However, in both his experience and mine, this fundamental part of ourselves, this job and drive to improve the business of teaching science, interferes with the business of tenure,



**FIGURE 2:** Metaphorical representation of challenges to GED workers as an orogenic, crustal-shortening belt, producing a tectonic *mélange* of lived experience. The entirety of these challenges forms a metaphorical allochthon, which represents our struggle for legitimacy as a group. The view is cross-sectional and not planimetric. The faults depicted are reverse faults, because the overall stress regime is compressional. The magnitude of displacement along each fault, and thus the deformation of the land surface, can be conceptualized as directly proportional to the severity of the challenge as experienced by the individual. Therefore, each landscape of lived experience is unique, with its own challenges to navigation. Displacement also moves the landscape away from the status quo detachment fault, which translates into increased alienation of the GED worker from workplace culture.

either our own or those whose teaching we are working to enhance.

Koa also discussed what he perceived as a shallow literature base in GED. “What is our literature canon? You’re asking the right question here,” he said. Both Koa and Keeshawn noted that there exists no formal PhD-level training for GED workers or a suitably indexed literature base for that training. Korina, Konstantin, and Kaiwen described the lack of training in educational research methods and an unclear career path for workers with PhDs in GED. As Koa put it:

*What could we do to be better prepared? Better prepared as in how to set up a study, or.... I want my grad students to become geoscience education folks, okay? They got a master’s degree in geology, and they want to do their PhD in geoscience education, okay? What’s the curriculum for them or for anyone else?*

#### **Emergent Theme: The Relationship Between Training and Career**

Without a formal, known training process, it follows that institutions would be hesitant to take risks on hiring GED faculty, leading to murky career prospects for GED workers. These challenges seem to converge as a common theme.

#### **Overarching Emergent Theme: Challenges as Tectonic Elements**

Taken as a whole, the challenges that each participant outlined form a complex *mélange* of juxtaposed phenomena, forming a rugged landscape of personal and professional experience for GED workers. The challenges appear to exist

in parallel, or en echelon, occasionally splaying off each other. A logical extension of parallel and splaying disruptions, forming a *mélange*, is to represent them metaphorically as an orogenic, crustal-shortening belt, where each challenge is a fault plane that forms—and deforms—our collective experience and where related challenges meet as fault splays (Fig. 2). In this representation, the challenge of (overcoming) the status quo in departments is given the position of the listric detachment fault because of my interpretation of its nature as being at the base of other problems. This challenge and its metaphorical expression lie both near the surface and at depth in real and metaphorical terrains. Because of the perception that GED is only for teachers, the literature we produce is not seen as relevant or accessible, thus relating to the challenge of low citation rates. These three challenges are therefore represented as a fault splay. The tenure risks associated with GED-driven teaching reform are also part of this splay. Training and career challenges are also represented as a splay, but slow cultural change (leading to greater acceptance of GED) and professional isolation are drawn separately, deforming the landscape of lived experience independently. Taken as a whole, these challenges are part of the greater phenomenon of the lack of respect and prestige for GED workers and our research. The faults are the challenges; the allochthon they form is the lack of respect and prestige that we experience. The rugged, deformed landscape at the surface represents our daily lives; the greater the number of tectonic elements, the more rugged our lived experience. The overall stress regime is compressional, and deformation occurs via displacement along reverse faults.

Alternative fault labels would be just as valid; e.g., we could logically assign isolation or cultural change to the



position of detachment fault. I have not represented every reported challenge, such as Kaiwen’s “chip on the shoulder,” in the crustal-shortening orogenic belt metaphor. (In our 2012 follow-up interview, Kaiwen suggested the possibility that he was projecting his “chip” onto others.) Konstantin discussed complacency but contextualized it in the ebb and flow of GED abstracts submitted to GSA from year to year. These are isolated data points, and I did not weave them into the crustal shortening orogenic belt metaphor.

The allochthon metaphor is rather opaque to the nongeologist. A reasonable biological metaphor may be a deoxyribonucleic acid molecule experiencing damage by cosmic rays. The rays represent challenges, and the damaged molecule is individual lived experience. A physical chemist might identify with challenges represented by catalysts that disrupt expected chemical reactions or with challenges represented as crystal lattice defects.

### Opportunities

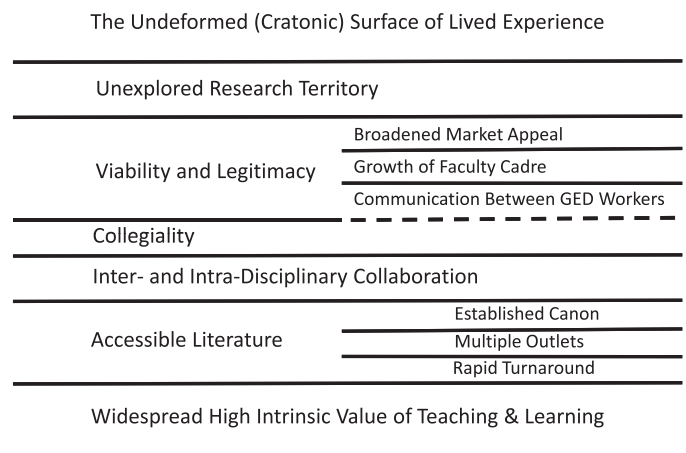
Reported opportunities are displayed in Table III. The most commonly reported item is that of extensive research opportunities, meaning that substantial unexplored territory exists in the field of GED. In their own words from their separate interviews:

*Koa: There’s a growing field of field research right now, there’s plenty of room for us to collect a lot of data; we have almost no data, we don’t understand the data that we do have, okay?*

*Kaiwen: There’s a lot of space we can cover; [there are lots] of places we can go. And right now I think people are going to places that are interesting to the discipline of geology as a whole, like researching fieldwork stuff.*

*Korina: I would say that in many ways geoscience education is unexplored territory, right, [and] that it [has] only recently begun to have a sizable presence, for example, at GSA; it’s got an even smaller presence at AGU [American Geophysical Union]. So just looking at the number of researchers in the area [and] what they’re doing, I think [there are] still lots of different aspects of learning to be studied.*

*Keeshawn: You know, as, as our subdiscipline matures, and develops more of an identity, and starts developing techniques on its own, I mean, for instance, like several studies that look at field mapping using GPS [global positioning system] technology, that’s sort of a novel approach—I mean physics education, chemistry education, because they’re so experiment based, they’re looking more at what goes on in the laboratory and in the classroom.... As we sort of develop that unique identity, I can see eventually there will be opportunities for more cross-disciplinary research, taking what we understand about how people learn about the Earth and, say, working with geographers, or climatologists, or biologists, or possibly even sociologists [or] anthropologists. I think it’s a matter of having that expertise base develop first and then, secondly, getting the word out so that people in other fields know how to do that kind of stuff. Oh, and I could use their help.*



**FIGURE 3: Metaphorical palinspastic reconstruction of the mélange of challenges to geoscience workers and the discipline. Opportunities and goals are represented as strata. Some strata are groups that contain members. The surface (lived experience) is undeformed and thus straightforwardly navigable. The view is cross-sectional and not planimetric.**

Keeshawn discussed the opportunity for collaboration in the preceding excerpt. Other participants noted collaboration as an opportunity, although in the context of collaborating specifically with cognitive psychologists. Another opportunity yielded more than once from the interviews is collegiality among GED practitioners. As Konstantin said, “We play together very well.” And as Kaiwen said, “It’s us against the [research] problem, not us against ourselves.”

My experiences converge with these data. I was a coeditor on a volume of GED-specific articles. The response to our request for proposals, the quality and rigor of the reviews, and the general discourse among the authors—even in matters of professional disagreement—left me in a state of gratified astonishment.

### Emergent Theme: Opportunities in GED as Potentialities

The opportunities discussed here and listed in Table III are potentialities, leading to restoration of a more cratonic lived experience for practitioners. They are mostly objects that exist conditionally: we could research this or that, we could collaborate with these other workers, we could house teacher training programs in science departments, we could broaden our market appeal, etc. They move in and out of concrete existence, because they are generated by humans. Some items are as more concrete, e.g., our collegiality.

Structural geologists attempt to reverse observed deformations to visualize a terrain before it was tectonically deformed. This process is called palinspastic reconstruction, and its end product is a laterally continuous set of strata that lay more or less conformably on one another. I invoked a metaphorical allochthon to package the challenges to GED practitioners. It is possible to extend this metaphor to the process of palinspastic reconstruction. If challenges deform the landscape of our lived experiences, then opportunities reside in an undeformed state, providing a smooth landscape.

TABLE IV: Matrix of emergent themes with notes on analysis and implications. The overarching themes of challenges as tectonic elements and opportunities as potentialities are not included in this table because they illustrate the lived experiences of GED practitioners, and they do not themselves form the basis of subsequent recommendations made in this paper.

Emergent Theme	Analysis	What Is To Be Done? (Implications)
How GED research is perceived and consumed	Workflow of access to GED research (Fig. 1)	Make data-free products more directly analogous to field guides
Legitimacy and the self-defeating job description	Multiple challenges assemble a metaphorical allochthonous terrain (Fig. 2)	Make targeted marketing of teaching reform a research area and an expected outcome for GED faculty
The relationship between training and career	Multiple challenges assemble a metaphorical allochthonous terrain (Fig. 2)	Recommend and endorse a training process for GED workers

Figure 3 shows a metaphorical restoration of the GED terrain. GED opportunities are arranged as stratigraphic layers with formation names. Some formations are stratigraphic groups that contain supporting members. For example, accessible literature is an achieved by having multiple publication outlets, rapid turnaround times for publication, and an established canon. Viability and legitimacy are achieved, in part, through a broadened market appeal, increase in the number of faculty practitioners (cadre), and continued good communication among GED workers. This last group member has a gradational relationship with the formation below it, collegiality, as denoted by the dashed line in Fig. 3.

My ordering of strata has been arbitrary with two exceptions. First, the landscape of our Lived experience rests on the stratum of unexplored research territory. I made this placement because I interpret this GED opportunity as being key to our daily professional lives and therefore closest to our landscape in the metaphor. Second, I placed the widespread high intrinsic value of teaching and learning in the position of basement rock. This stratum is not a GED opportunity specifically reported by the participants. Rather, I inserted it as a goal—not an overarching one, but an underlying one. In my thematic interpretation, the existence of a widely held value for teaching, for learning, and for the scholarship thereof is the foundation upon which everything else rests.

I have not included every reported GED opportunity in the metaphorical palimpsestic reconstruction. Table III lists all reported opportunities. I blended some of my analysis in the restoration metaphor. Multiple publication outlets were not specifically discussed by the participants. Inclusion of this opportunity reflects my position that a discipline’s literature more readily flourishes when it is not limited to a few periodicals. As with the allochthon metaphor, multiple legitimate interpretations and constructions are possible. For the nongeologist, a reasonable analog to palimpsestic reconstruction might be found in forensics, where opportunities are portrayed as the evidence that unscrambles a crime scene. For the chemist, disciplinary opportunities might be reasonably portrayed as filled electron shells.

**IMPLICATIONS**

The question “What is to be done with us?” is the requisite one in ethnographic research (Wolcott, 1994). Given the data, the emergent themes, and my interpretations of them, now what? This question is addressed in part by returning to the stated primary purposes of this study, as

described earlier. I reported the perceived challenges and opportunities of the GED subdiscipline. I demonstrated the pervasiveness of challenges among the participants and a commonality of experience among them (including myself). Our thoughts, feelings, and experiences can be patterned into meaningful metaphorical models. That leaves two issues: assessing the current state of the subdiscipline and deciding what lessons can be learned. For reference, Table IV lists the emergent themes I discussed, a note about the analysis of each, and a summary of what is to be done with them. This last point takes the form of recommendations, discussed in detail later.

**GED: A Continuously Nascent Discipline**

Keeshawn, Korina, Konstantin, and Koa all noted that GED lags behind its peer disciplines in chemistry and physics. Kaiwen said in our 2012 interview that GED is “still adolescent.” All participants noted that GED is full of unexplored research territory. Koa discussed how its literature canon—and thus its identity—is still being formed. GED and its practitioners are often dismissed by an “older” generation, as narrated by Keeshawn. GED practitioners get along with their peers yet feel isolated, as Konstantin expressed. GED is growing in size and stature. Identity development, isolation, dismissal, and physical growth are the hallmarks of adolescence, as any parent will confirm. To view ourselves wryly, we are collectively a teenager.

Yet GED has existed since at least 1979, which is the oldest volume referenced on the *Journal of Geoscience Education’s* website (National Association of Geoscience Teachers, 2012). This, then, appears to be the state of our discipline: we have a history, but a short one; we strive for acceptance from our peers and are beginning to see it; and there are still many questions and problems to investigate. We are old and new, established, and nascent—continuously nascent thus far.

In light of this nascence, I make three practical recommendations for GED as a discipline. These recommendations are based on the emergent themes I identified, which themselves arose because of data saturation, an identified ontological significance, or both. Because the data scaffold the themes, I do not reproduce them in the form of block quotes in my recommendations that follow. The first recommendation is based on the emergent theme of how GED research is perceived and consumed (Kaiwen). The second recommendation is based on the theme of legitimacy and the self-defeating job description (Koa). The third recommendation is based on the theme of how training intersects with career for GED workers (all participants).

Table IV summarizes these themes, their analysis, and my recommendations.

### **Practical Recommendation 1: A Utilitarian Application for Data-Free Products**

All participants identified data-free investigations as not-hot topics. Interview data on this issue led to my identification of the emergent theme of how our research is perceived and consumed. If descriptive papers, e.g., “What we did in a classroom and how the students liked it,” represent a common gateway into GED for the traditional geoscientist, then we must, as gatekeepers, learn to cope with their existence, because we cannot undo them. What if they were like road logs? A road log in a field guide is not a scientific document—that is not its purpose. Its purpose is to describe how to get to a feature so that it can be studied, or at least appreciated. If descriptive papers are how geoscientists “get” to us, then we can purposefully adapt them to serve this function and embrace them—not by framing them as our research but by presenting them as the road logs to GED field sites, where the real research takes place. Adopting this ideal and communicating it to the geoscientific community would support our legitimacy as researchers and contextualize these products appropriately.

### **Practical Recommendation 2: Deliberate Marketing Efforts to Contextualize Our Research and Build Community**

Why do departments hire GED workers, or science educators in general? Is it about teaching improvement? Is it about establishing competitive, externally funded research centers? Is it about both, or something else? As GED workers, our research area is, broadly, the scholarship of teaching and learning in the geosciences. What we produce, then, is a greater understanding of this teaching and learning. What does this lead to—that is, what is the deliverable? Certainly one deliverable is, or should be, reform—that is, improvement of our teaching or, more ominously, change.

Yet change is risky business. Koa described an ontology in which teaching reform is downright unsafe for pretenure (and by extension, for non-tenure-track) faculty members. He went so far as to say that his efforts might not be needed because of this. This left him—and me—in a state of profound dissonance. Improving our craft of teaching is a major portion of our research output, but it threatens the status quo in many settings; therefore, it threatens us. This formed the emergent theme of legitimacy and the self-defeating job description.

Arguably, we have not mitigated this for ourselves. If we are simply “those ‘ed’ people over there doing that ‘ed’ stuff,” then our research output of teaching reform will likely come as an unpleasant surprise for those who adjudicate our careers shortly before it surprises us by ending our careers. However, if we approach this problem with a mindset of targeted marketing strategy, we might accomplish two goals. First, we could make our research output understood through analogy. For example, a groundwater hydrologist tracks contaminant plumes, and a neotectonicist identifies active faults. They produce new knowledge with concrete deliverables: a rate of movement and a fault map, respectively. GED workers identify or discover ways of knowing, teaching, and learning. But “increased under-

standing” is not a concrete deliverable. It is intangible. We must more carefully articulate, i.e., market, our deliverables, whether they are cognitive models, ontological narratives, or specific teaching techniques. Reform is an expression of new knowledge, like a palimpsestic reconstruction or a stratigraphic column. Framed in this manner, our activities become more readily grasped by our geoscientist peers. If we actively market this form of cultural wisdom about what we produce, our teaching reforms are more properly contextualized. We then accomplish a second critical goal: assuring our peers that teaching reform does not mean they are bad teachers. That is a community-building process, eliminating perceived threats to others. The first step is an inclusive conversation about what our unified marketing strategy might look like.

### **Practical Recommendation 3: Endorse a Recommended Training Process for Aspiring GED Professionals**

All participants identified the lack of formalized GED training as a challenge, leading to my identification of the emergent theme of how training affects careers. If a student wants to be a hydrologist, a curriculum exists; a list of required courses can be located, an expectation of prerequisites can be identified, and a short list of potential institutions to attend can be drafted. Hydrologists have a common set of skills, training, and experiences known among nonhydrologists. The same cannot be said for GED workers. What do we know, what have we learned, and what can we do for a department? No codified answers to these questions exist at present. Many of us have ideas, but no formal consensus has emerged. No formal conversation has taken place.

We will not experience reasonable growth as a discipline if we continually reinvent the wheel in our work, if we struggle in isolation to learn unfamiliar but well-established methodologies, and if we are then hard put to prove the validity of those methodologies to our geoscientist peers. We will instead be running in place. Those of us who are established in GED—whatever that means, and whoever we are—would serve ourselves and our discipline well by making and enacting proposals about the baseline training a practitioner of our discipline should have. This might simply be a suggested number of graduate-level courses in educational research design, parametric and nonparametric statistics, and qualitative inquiry. Proposed training might include a form of apprenticeship or internship. In an extreme case, we might develop some form of cooperative doctoral-level curriculum to be distributed among multiple institutions. Perhaps a national certification exam, registry, or both could be explored. In any case, the question of our training can no longer be ignored. Entities such as the GSA and the National Association of Geoscience Teachers are positioned to host such discussions, pending a call for action and leadership on the issue: So moved. Second? Discussion?

### **Recommendations for Further Study and a Note on International GED**

Formalized, unified movement on the issue of training would be served by a policy-analysis approach (Feig, 2011). Through such study, a dataset of what is being done throughout the nation in terms of training would emerge and present itself for subsequent modification and codifica-

tion. Another area now ripe for study is to quantitatively measure the challenges and stressors experienced by GED workers at various levels, because they have now been qualitatively explored. An inventory or survey of instrument could be developed to measure and quantify practitioner experience.

Despite its challenges, GED in the U.S. is generally more established here than in other countries. Institutions outside the U.S. without GED in place are positioned to design their programs and build their faculty cadres utilizing teachable moments from the American GED experience. Specifically, this would include codified training, consensus on research deliverables, and defining and growing their national literature bases. International efforts would strengthen our programs here in the U.S., as well as our resolve to shape them.

## CONCLUSION

The landscape of our lived experience is complex and occasionally hazardous. Realizing the potentials of our opportunities reduces its deformation. These potentials include the space for novel research, continuation of our practice of collegiality, and ongoing effort to make our literature base more accessible. In parallel, we must collectively conceptualize our scholarly output, codify our professional training, and repurpose our existing literature of descriptive papers. These efforts will lead us down the path of legitimacy and exhume the basement rock that is the deeply held value of teaching and learning and its scholarship.

## Acknowledgments

Financial support for travel associated with this project was provided by the Central Michigan University College of Science and Technology. I am indebted to the five participants of this study and to the anonymous reviewers of this manuscript.

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