Tapping Familiarity to Increase the Effectiveness of Clean Energy Workforce Training Efforts: Research Results and Recommended Strategies

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ABSTRACT

Despite considerable hype about the "new" clean energy economy, in reality such an economy will emerge incrementally out of the current system. Likewise, the clean energy workforce will not be trained, per se, but will, in large part, be "retrained;" adapting existing skills and knowledge to clean energy practices. While energy system innovation faces well-understood economic, political, and technological barriers, these infrastructural factors may be less critical to workforce development than individual responses. With workforce training, individuals' reactions and often resistance to unfamiliar practices may determine successes or failures, and by extension the adoption of innovative practices. Understanding and addressing the role of familiarity in individual response to change can increase workforce training effectiveness.

In this paper the authors will present 1) an overview of workforce development issues in the clean energy sector, 2) provide an outline of the role of familiarity as a relevant construct to workforce development, 3) describe a case study from a 2006 survey of 171 homebuilders that gauged knowledge, attitudes, and familiarity with respect to green building, 4) describe a case study of a solar sales workforce training program that applied familiarity-based principles, and 5) describe some elements of a framework based on this work for designing effective, clean energy workforce training programs.

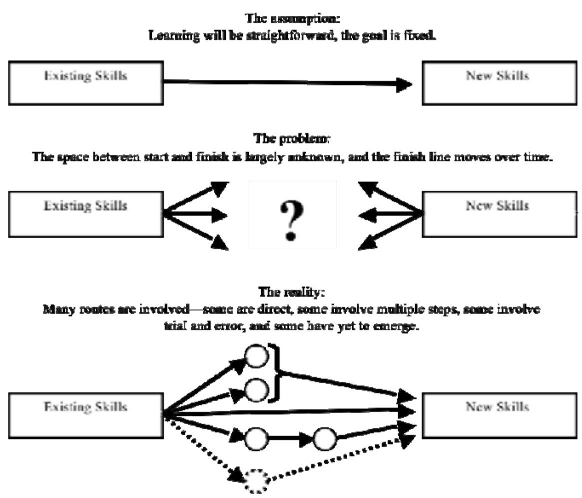
Introduction

There is much excitement about the potential for "green" jobs, especially in the energy sector. According to one study, every $1 million invested in efficiency retrofits generates 8 to 11 on-site jobs (Urban Agenda 2008). The $787 billion economic stimulus bill enacted in February includes $500 million for green jobs training out of $3.4 billion devoted to workforce development. Sen. Mike Enzi, R-Wyoming, the ranking Republican on the Senate labor Committee recently stated, "green jobs training should be integrated into a comprehensive approach to enhancing the skills of American workers" (Schoeff 2009). However, scaling up clean energy industries demands a well-trained and specialized workforce. As noted in a recent EPA workforce forum, "Clean energy workforce development programs are becoming more important at both state and local levels. Appropriately trained employees will be needed to transition to a cleaner economy that will help address climate change and energy challenges while creating new jobs. Many of these jobs will require little additional training beyond applying traditional skills to new fields. However, other jobs do require training or advanced degrees" (EPA 2009. p1). Unfortunately, the infrastructure and resources to deliver this workforce appear to be lacking. A recent survey showed that employers had the most difficulty with "Recruiting enough non entry-level employees with adequate skills and experience" (63% difficulty) and "Recruiting enough entry-level employees with appropriate training and education" (56% difficulty) (BW Research Partnership 2008). A 2006 study identified the shortage of skills and training as a leading non-technical barrier to clean energy market growth (Lindstrom 2007). The study identified a number of critical unmet training needs, including; lack of reliable installation, maintenance, and inspection services; the shortage of key technical and manufacturing skills; and failure of the educational system to provide adequate training in new technologies.

The Learning Challenge for Clean Energy Jobs Workforce Development

Many of the practices associated with clean energy jobs, such as, lighting and equipment retrofits, are the same or similar to existing jobs. As such, existing industry structures may be sufficient to manage labor force changes. Other practices, however, such as extensive energy retrofits, new wind and solar technologies and advanced green building construction are of a different scale and scope than their contemporary counterpart. As one author notes, "it's hard to describe the future "typical" job in the home energy efficiency industry, because that industry encompasses so many skills and trades…. A different kind of expert will be needed" (Meier 2009). This variation poses a challenge to those who want to train or retrain workers for these industries. Retraining existing workers to function well in these new jobs involves a process of transforming knowledge from existing practices into those required for the new field. In many cases, this learning process can be thought of as a search for appropriate solutions. In such a search, the commonly assumed process can turn out to be quite different from reality (Figure 1).

Figure 1: Learning About Clean Energy Jobs Is Neither Straightforward Nor Terminal



Traditional leaning approaches assume that learning is straightforward and terminal. With such a perspective, once a person knows the requirement for a particular job in a particular field, they are assumed to be able to adapt their knowledge to their new job demands, and once they know that new job, they have completed the task. However, with many clean energy jobs, the starting place and the finish line are as yet largely unknown. As the various fields that fall under the clean energy banner are still very much developing, the endpoint for learning becomes a constantly emerging target. Exactly what and how one needs to learn about a new job can be difficult to determine. In this sector, practices and technologies are not well established. What one knows today may be relevant to particular tasks, but to keep current practitioners will need to regularly update their knowledge and skills. Development of new skills will thus involve experimentation and trial and error. This complicated, layered, and shifting learning process poses a challenge to those seeking to help people enter these industries.

The Importance of Psychology in Workforce Development

Prevalent models of human behavior, assume that people are rational actors conducting cost/benefit analyses prior to making their decisions (for a critique of rationality, see Shafir & LeBouf 2002). If people were rational decision makers, the learning that accompanies implementation of new practices and technologies would in fact hinge on information delivery, because people would fully utilize all available information to make decisions and the most "rational" knowledge would quickly rise to the top. Common sense and abundant research, however, refute this position (Gilovich et al. 2002; Kahneman 2003; McElroy & Seta 2003; Simon et al. 2004; Sloman 2002). There is ample empirical evidence that various psychological processes influence what people perceive, how they make decisions, and ultimately how they change their behavior (Evans 2003; Gigarenzer 1997; Kahneman 2003; Kaplan 1991, Myers, 2002). In sum, rational decision-making may be more the exception than the rule. This appears to hold true in industries related to clean energy development. Authors have long studied the so-called "efficiency-gap" in the energy sector (Sanstad and Koomey 2007) and a number of researchers have identified social / psychological factors that play important roles (Costanzo et al. 1986; Lutzenhiser 1994), Kaplan (1999) highlighted the role of utility manager perceptions on adoption of new technologies. In the construction sector, Martin and Bernstein (2006) note, "In order to knock down barriers to innovation it becomes essential to understand the different learning processes of consumers, builders, manufacturers and others" (p18). Hoffman and Henn (2008), recently cataloged social / psychological barriers to the development of green building practices and identify specific strategies including, issue framing and education. For many people looking to shift into a clean energy job, or retrain from a related career, these psychological influences on decision-making may have a large impact on their engagement with and/or development of new skills, which can be central to their successful transition into this new field.

Familiarity as a Critical to Change

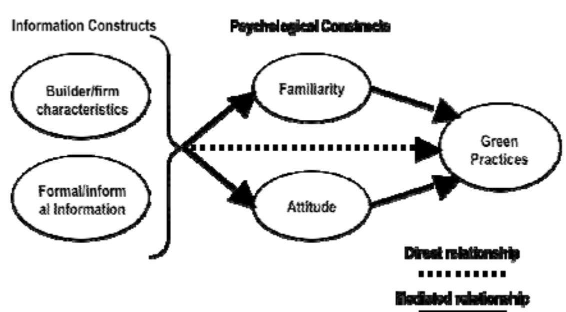
This paper examines one such psychological construct – familiarity - that is proposed to play a significant role in adoption of new practices, and as such may prove to be a useful construct in looking at workforce development needs for the clean energy sector. Familiarity refers to a facility with knowledge applied to the current situation. Being familiar suggests confidence in one's grasp of a topic or in one's ability to apply current knowledge to new problems. How much familiarity affects decision making is dependent on the presence (and strength) of relevant knowledge and the degree to which environments support decision making (Atran et al. 1999; De Young & Kaplan 1988; Kaplan & Kaplan 1983; Kaplan & Peterson 1992). Research suggests that the match between what people are familiar with and what they are confronted with plays a critical role in their problem solving (A.W. Kaplan, 1999; Myers 2002; Rogers 2003; Sloman 2002; Todd & Gigarenzer 2000). There is a common tendency for people to overestimate the value of familiar information and underestimate or disregard unfamiliar information (Kaplan 2000). An example illustrates the special place of familiarity in development and application of skills. In the construction industry, familiarity distinguishes the well-schooled but inept novice from the wizened journeyman. Being effective with materials and tools requires more than mere possession of information, it requires familiarity. However, familiarity also biases people especially when it comes to new practices. Those with extensive experience in a field such as roofing, have a wide array of skills they know well. In comparison, new practices such as those related to installation of solar panels, may appear to require giving up hard-earned skills to take on something with vaguely defined benefits and many risks. For these reasons, familiarity is a critical factor at the intersection of the known and the unknown. Therefore, identifying general characteristics of familiarity among groups of people can provide insight on how they will respond to change and thus has the potential to be useful in generating strategies to facilitate change in a learning context.

Green Building as Case Study of the Role of Familiarity

In the United States, adoption of green homebuilding presents a valuable case study for looking at the role of familiarity in clean energy workforce development. Ideally, green buildings utilize an integrated, whole-building approach as opposed to the modular and highly subcontracted approach common in conventional construction (Mead 2001). For homebuilders, implementation of any particular innovation requires development of new skills, however implementation of multiple innovations increases the number of variables that must be understood at once (Mead 2001; Riley et al. 2003; Vanegas & Pearce 2000). Such an environment provides a ready setting to examine the role of familiarity.

In 2006, research was conducted that explored the role of familiarity as a potential link—or mediating variable—in explaining the likelihood of adopting green practices. This paper presents an abbreviated selection of outcomes for the purposes of this case study, complete details of the research can be found in Scheuer (2007). The approach taken in this study was to assess how direct information (in terms of formal or informal information sources, as well as builder/firm characteristics) about building practices might be mediated by psychological constructs (familiarity as well as attitudes). The theoretical model for the study, with specific survey constructs is provided in Figure 2 below.

Figure 2: Construct Diagram with Lines Showing Theoretical Relationships



Methods

In the spring of 2006, a five-page survey was sent to 1672 builders. The survey consisted of banks of questions relevant to each theoretical construct and a number of builder / firm demographic questions. Three weeks after the original survey, a reminder card was sent out with a link to an online version of the survey. In order to sample builders with a wide range of green building experience, participants were recruited from directories of green building organizations and local homebuilder organizations. Where possible, participants were recruited from regions with both an active residential green building program and a local homebuilder association. Of the 1672 surveys that were distributed, 171 were returned. The response rate, approximately 14 percent, is close to what Bueche (2005) considers typical. However, according to Ed Hudson, NAHB's Manager of Builder and Consumer Practices (Hudson 2006) this figure is at the high end of industry response rates.

Results

Analysis consisted of three iterative stages; identification of construct measures, prediction of use of green practices, and modeling of relationships. This paper briefly summarizes the first two stages, and presents more full results for the third stage.

Identification of constructs. To identify salient constructs for builder/firm characteristics relevant variables were taken directly from the demographic portion of the survey. For the other survey constructs, exploratory factor analyses were conducted to identify latent constructs on banks of related questions[1]. Stem questions for each bank of questions reflected the construct of interest (e.g. "how important are…", "how confident do you feel with your current knowledge of…"). Relevant construct variables and component items are provided below (Table 1).

Results of the factor analysis generated 1 independent variable measure – Green Information Sources, 3 mediating variable measures – familiarity with green techniques, familiarity with green systems, and environmental performance attitude, and 2 dependent variable measures – Use of More common green practices, and use of less common green practices. Looking at the stem question, the resulting component items and making an analytic judgment regarding construct definition provided the conceptual definition for these measures.

Predicting use of green practices. To test the individual measure relationships described in the theoretical model (Figure 1), separate linear regressions were performed on both dependent variables using the measures from each of the other domains (i.e., builder/firm characteristics, formal/informal information, psychological constructs). Results eliminated some variables and measures and identified which set to use in the final modeling step described below. Significant constructs and variables with Beta weights and significance are provided below (Table 2)

[1] Factor structure = eigenvalues greater than 1.0, factor loadings greater than 0.5, exclusion of items that loaded on multiple factors above 0.4, no less than 3 items per factor, absolute skew or kurtosis < 2.0, and alpha reliability greater than 0.7. Scale scores are the mean of items comprising the factor

Table 1: Construct Measures

Factor name and included items	Mean	SD	alpha	Factor name and included items	Mean	SD	alpha
Independent Variable Construct Measure				***Mediating Variable Construct Measures***			
Green Information Sources	**2.8**	**1.12**	**0.85**	**Familiarity with green techniques**	**3.5**	**0.91**	**0.82**
Green local seminars and workshops				Ventilations systems for improving IAQ			
Green Conferences				Health effects from mold and moisture			
Green Building Organizations				Equipment and appliance efficiency			
Green Trade magazines				Climate change from energy consumption			
Dependent Variable Construct Measures							
More common green practices	**4.3**	**0.75**	**0.73**	**Familiarity with green systems**	**3.0**	**0.99**	**0.9**
High performance envelopes				Suppliers of green building products and equipment			
High-efficiency energy systems				Costs for green building features			
Protection of trees and natural features				Reliability of green products			
				Availability of trades / subcontractors w/green exp.			
				Customer demand for green features			
Less common green practices	**3.1**	**1.00**	**0.83**	**Environmental performance attitude**	**4.3**	**0.68**	**0.81**
Natural or renewable materials				Water resource use			
Construction waste minimization				Material resource use			
Passive solar designs				Plant and animal habitat impacts			
Green building certification programs				Energy consumption			
Low-toxicity materials				Indoor air quality			
Low-consumption water systems							

Table 2: Significant Predictors

	More common green practices		Less common green practices	
Variable	***B***	**sig.**	***B***	**sig.**
Gross Sales			-0.40	***
Price range of houses built	0.19	*		
Green information sources	0.24	**	0.43	***
Familiarity with green techniques	0.33	***		
Familiarity with green systems			0.65	***
Environmental performance attitude	0.22	**	0.3	***

**p<0.05, **p<0.01, ***p<0.001*

Modeled relationships. In order to test the proposition that familiarity (and/or attitude) has a mediating relationship between information sources and use of green practices, the authors' utilized structural equation modeling (SEM) using AMOS 4.0 (Arbuckle 2005). Model estimation occurred in two stages. First, a saturated, or over identified, model including all paths from the theoretical model was created. Next, a parsimonious model was identified by iteratively deleting nonsignificant paths with the highest p-values until the change in chi-square became nonsignificant (Kline 2005; Wells 2006)[2]. Table 4 illustrates the fit statistics for the saturated and parsimonious models. With both the *more common green practices* and the *less common green practices*, the parsimonious models show good fit to the data, are significantly improved over the saturated models, and explain the data as well as the fully developed models (Table 3)[3].

[2] Model fit was assessed using standard measures of model fit: a nonsignificant chi-square statistic ($p>0.05$), a comparative fit index and a non-normed fit index close to one (CFI and NNFI >0.90), a significant root-mean-squared error of approximation (RMSEA $p<0.05$) and a nonsignificant close fit statistic (PCLOSE >0.05).

[3] In all instances, the chi-square p-value is not significant and NNFI and CFI values are above .90 and .95 respectively. The RMSEA statistic is significant for *more common green practices* but just misses being significant for *less common green practices.* The latter was nevertheless considered a close fit based on the other fit indices

Table 3: SEM Fit Statistics

		df	N	χ^2	p	NNFI	CFI	RMSEA	PCLOSE
More Common Green Practices	Saturated	2	171	0.74	0.69	1.00	1.00	0.00	0.78
	Parsimonious	5	171	5.25	0.39	0.99	1.00	0.02	0.61
	Change in χ^2			4.51	0.21				
Less Common Green Practices	Saturated	2	171	5.18	0.08	0.86	0.98	0.10	0.16
	Parsimonious	4	171	7.41	0.12	0.93	0.98	0.07	0.27
	Change in χ^2			2.23	0.33				

More common green practices. Figure 3 illustrates the structural model for *more common green practices.* In this model, *price range* was the only significant builder/firm characteristics variable in the regression analysis, and *familiarity with techniques* was the only significant familiarity factor. In identifying a parsimonious model, the paths from *price range* both to *environmental performance attitude* and to *more common green practices,* as well as the path from *green information sources* to *more common green practices* were deleted. As a whole, this model explains 35 percent of the variance in *more common green practices*. *Price range* and *green information sources* explain 21 percent of the variance in *familiarity with techniques*. *Green information sources* explain 18 percent of the variance in *building performance attitude*. *Price range* has a positive relationship with *familiarity with techniques,* suggesting that working on more expensive homes may provide builders with more experience of these techniques. The lack of significant path coefficients between information sources and green practices, in conjunction with the significant path coefficients between information sources and information processing and between information processing and green practices, support a mediating relationship for this model. The effects of both *price range* and *green information sources* on *more common green practices* are fully mediated by the information-processing factors, as calculated using the Sobel tests (Sobel 1982) for the significance of mediators. The indirect effect of *green information sources* on *more common green practices* is mediated by both *environmental performance attitude* and *familiarity with techniques* and is divided approximately 40 percent through attitude and 60 percent through familiarity, with familiarity being a more significant mediator than attitude ($p<0.001$ versus $p<0.05$). The indirect effect of *price range* is mediated by *familiarity with techniques* alone. These results indicate that neither *price range* nor *green information sources* have any direct effect on *more common green practices* after controlling for psychological measures.

Less common green practices. Figure 4 illustrates the structural model for *less common green practices*. With this model, *gross sales* is the only significant builder/firm characteristics variable, and *familiarity with green systems* is the only significant familiarity factor. In identifying a parsimonious model, the paths from *gross sales* to *familiarity with green systems* and *less common green practices* were deleted. In this model, *green information sources* is partially mediated by the information-processing factors. Although controlling for information processing does reduce the effect of *green information sources* on *less common green practices*, the effect is still greater than zero. As a whole, this model explains 62 percent of the variance in *less common green practices*. *Green information sources* explain 21 percent of the variance in *familiarity with green systems*. *Gross sales* and *green information sources* explain 28 percent of the variance in *environmental performance attitude*. The relationship of *gross sales* to *environmental performance attitude* is negative, suggesting that larger building companies are more likely to have negative attitudes towards green building. The effect of *green information sources* on *less common green practices* is partially mediated (30 percent direct effect and 70 percent indirect effect) by both *familiarity with green systems* and *environmental performance attitude*. Of the indirect effect, 30 percent is through attitude and 70 percent is through familiarity. As with the model for *less common green practices*, familiarity is a more significant mediator than attitude ($p<0.0005$ versus $p<0.005$)

Figure 3: Parsimonious Model for More Common Green Practices

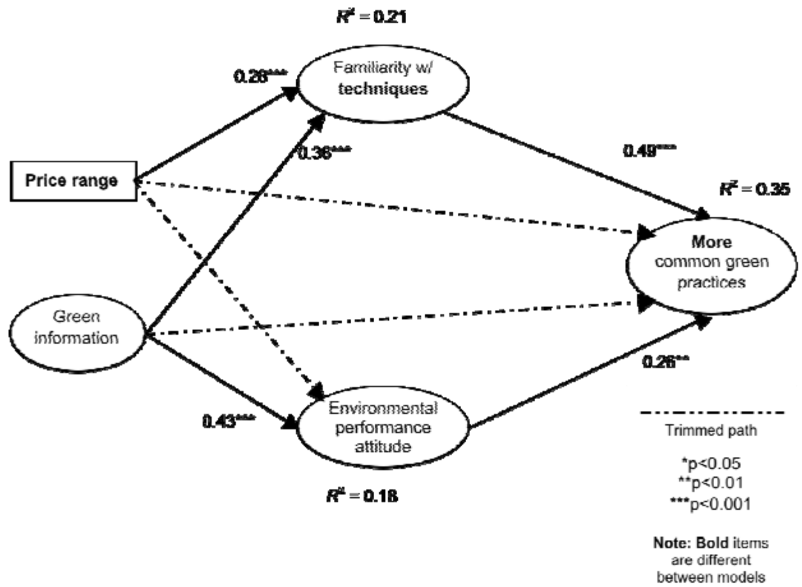
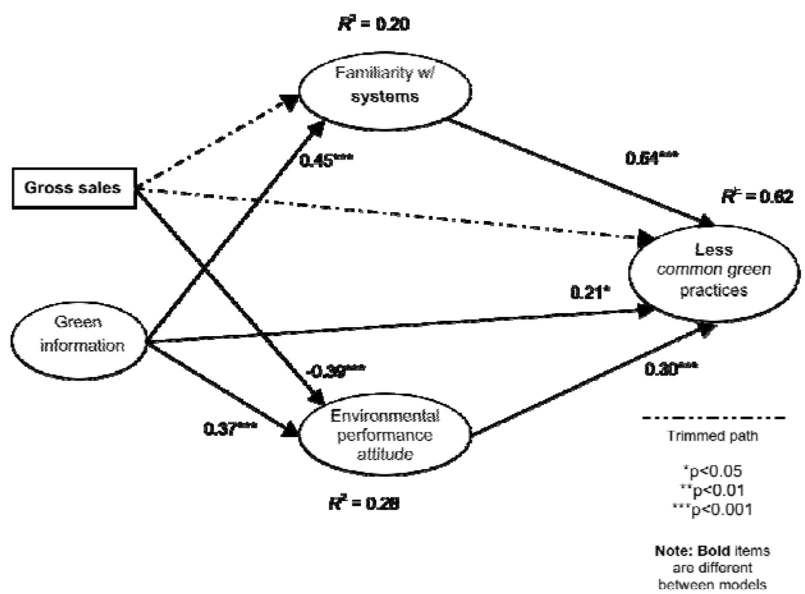


Figure 4: Parsimonious Model for *Less Common Green Practices*



Survey Conclusions

In both cases, inclusion of psychological constructs provides a richer account of home builders' use of green practices than is provided through the use of information sources alone.

The first structural model accounts for a modest amount of the variance in *more common green practices* (R^2 = 0.35), and the psychological measures fully mediate information sources. The second model accounts for a much greater amount of the variance in *less common green practices* (R^2 = 0.62), but the psychological measures have a more mixed relationship with information sources. This case study illustrates the potential role of familiarity as a mediator of information in situations where a group of practitioners (homebuilders), are moving from a place where they have well-developed knowledge and skills into a place where they need to 1) adapt existing skills to new circumstances, 2) learn entirely new skills, and 3) perhaps discard some now outdated skills to accommodate the new practices. If we consider that information is the original source for change (i.e. without some new information about products and practices, a builder is not going to change), then this study points towards the importance of systemic familiarity (more so than technique familiarity) as a potentially important mediator of this transition. In this capacity, this study provides considerations that could be applicable to training and re-training programs for the clean energy sector workforce. The application of a familiarity-based approach is developed further in the following case study training programs.

Clean Energy Training Case Study

Starting in 2009, the authors worked to develop a solar sales, estimation and design program. This program is a collaboration of industry representatives, community partners and Skyline College. The goal was to create a replicable certification program for unemployed professionals to transition into the solar sales field. The program was funded through a grant from the Department of Labor. To date, two cohorts of students (a total of 40) have participated in Skyline's Solar Design, Estimation and Sales class.

The class was designed from the ground up to address familiarity issues among the students. The class is structured in two parts. The first week of the class, "introduction to clean energy concepts" provides overview of sustainability issues broadly, energy systems both current and future. The remaining 4 weeks of the course are devoted to building understanding and comfort with a range of solar sales topics.

The first week of the course provides the systemic context necessary for students to understand how the solar industry fits into the overall energy field. Students start with an exploration of sustainability and climate change, which provide the background necessary to understand the movement towards "clean energy", and the motivations many of their future customers may be driven by. Following this overview, students study the history, current status and issues related to specific energy systems from coal and nuclear to wind, solar and biofuels. This exposure provides students with the opportunity to both understand where solar fits within the energy industry, but also to examine the many layered issues that surround discrete energy technologies. This portion of the class finishes with a group project to develop a "climate stabilization strategy" that incorporates all of their preceding information into a presentation before a panel of industry professionals. By exposing students to both broader issues of sustainability and climate change, and giving them a foundation of knowledge about all energy systems, students can begin to develop a vocabulary and comfort with the range of issues that are involved in working in the energy field. The use of debates, discussions and presentation techniques throughout this section of the class provide students with an opportunity to articulate their knowledge, a practice that cultivates their familiarity with the information and provides an opportunity for them to develop the confidence and comfort with their knowledge that is so essential to familiarity.

The bulk of the course is intended to provide a platform for students to adapt existing skills to the ‘new’ field of solar technology. Valuable transferrable skills such as knowledge of sales process, relationship building, understanding needs of the customer, articulation of value, and knowing how to close a deal serve as a foundation for success in a solar technology sales position. The Skyline class builds on this existing skill set and provides specific information around the technology, product and marketplace. By leveraging their existing skill set, students are able to make the transition into a new field. In addition to a lesson structure that focuses on adaptation of existing skill, the class also focuses on hands-on activities. Though the Design, Estimation and Sales students will not be pursuing installation-related careers, the authors felt it was important that students gain real-world familiarity with solar technologies. The more students have personal experiences with the technology, the more they are able to clearly articulate the inner workings and benefits of the technology. During the 5-week session, students assemble a small-scale electrical circuit, and then apply that basic knowledge to a large-scale solar array. They participate in many field trips and industry events, do roof measurements, and have discussions with industry experts. They do a mock trade show to practice using their sales skills towards solar technology. They use a variety of tools such as Google Earth to measure roofs, Solar Pathfinder to evaluate shading, string sizing tools to design the size and configuration of panels, PVWatts Solar Calculator to model array performance, and the OnGrid Solar Financial Analysis Tool to model different financing scenarios. These efforts culminate with a final project where they design, estimate and sell a residential solar array.

By applying principles of familiarity to this class design, the authors feel they have provided an effective platform for students to adapt existing skill sets of students to a new technology. Initial results from the course evaluations suggest the familiarity-based structure of this course has been successful. Students have expressed strong comfort and confidence with their new skills and are enthusiastic about a career path in this field. To date, only a few students have obtained jobs in the field, but this low placement is principally due to the current economic situation, rather than a limitation of the training program.

Towards a Framework

The case studies provided in this paper provide an argument that integration of familiarity into training programs could enhance the effectiveness of clean energy workforce development efforts. The reported survey, provided evidence from existing practitioners of the role of familiarity in their adoption of new practices, and the reported training program illustrates the potential for using familiarity as a guiding design concept for specific clean energy training programs. Based on these outcomes we propose three elements for consideration that could help define a starting place for creating a familiarity-based training framework.

1. Address Changes in Roles

By many accounts, clean energy jobs, whether as a laborer, manager or business owner involve significant changes for current practices. Such changes require new approaches to understanding and promoting these new practices. This paper suggests that working on clean energy projects not only involves a change in practices but also involves changes for the practitioners themselves. The green builder survey results identified two types of familiarity with green building—*familiarity with techniques* and *familiarity with green systems*—that were differentially related to use of *more common green practices* and *less common green practices*. The Solar Training program focused on setting the context for solar sales professionals and exposing them to a rich set of experiences that articulated their potential future role. Our survey results and experience working with students lead us to conclude that workforce training programs need to be sensitive to changes in roles and may need to foster systemic industry understanding along with individual job skills. If training programs introduce such a systemic perspective from the beginning, then needed skills and perspectives will not be something practitioners have to adapt to but will be something they are always aware of and thus more comfortable with.

2. Shift the Focus from Innovations to Adopters

There are many important barriers to innovation and change, including regulations, technical diffusion, and costs. These barriers offer important insights into the conditions that are favorable to innovation. Focusing on innovation leads us into the "post-hoc paradox" (Shields, 2005)—wherein we have a great ability to identify the particular circumstances of a specific past innovation, but less capacity to develop strategies for stimulating innovation, and it is the stimulation of innovation through training and workforce development that we are concerned with here. This paper provides an alternative lens by which to examine innovation, and the cultivation of new practices. As a psychological process, familiarity is relevant, regardless of context. Clearly familiarity is not going to be wholly determinative industry change, however addressing familiarity may prove to support individual change in ways that can be proactively planned for. For example, if we can cultivate an early familiarity with solar sales among professionals seeking to enter the field they may find themselves more adaptable to specific job requirements. By creating familiarity-based training programs we may be able to substantially reduce the burdens associated with learning new practices. Such an approach has the potential to increase practitioners' engagement with new skills and industries, while not being tied to any particular field, allowing this approach to be adapted to many settings and populations.

3. Recognize that Familiarity Can Be Both Friend and Foe

At the same time, as increasing familiarity may be marshaled to support change, familiarity is a potential barrier to change. To capitalize on familiarity, training programs can build on what is already familiar to participants, while simultaneously providing additional attention to unfamiliar territory. Participants who know that some of what they are doing is relevant and applicable are more likely to be engaged in the learning process. This engagement is crucial to training on more advanced and unfamiliar material. Programs might focus on cultivating a foundation of knowledge (e.g. of systemic issues and concerns) before moving into specific technical applications. Based on our experience with the solar sales course, experiential activities, such as simulations, case studies, and narratives, can be well suited to developing familiarity. Although experiential activities may not seem an effective way to share technical information, they provide the opportunity to explore material that is essential to the development of familiarity. By taking the opportunity and challenges of familiarity into account, a training program may more effectively facilitate development of new skills among participants.

Conclusions

Given the arguments and evidence for the role of familiarity, developing a labor force that is more familiar with clean energy industry and with innovation in their sector will contribute to greater adoption of innovative practices. Increasing the quality and availability of educational programs, is going to help prepare practitioners for the new roles that are coming out of these sectors.

At its broadest level, this paper is about understanding how to develop training programs that help a new workforce engage in an experimental learning process to uncover what the clean energy workforce of the future will be. As mentioned at the outset, learning about new jobs is neither straightforward nor terminal. Focusing on the outcome (i.e., specific skills development), rather than the process (i.e., being more comfortable with the sector as a whole), may limit change over the long term. Developing familiarity with a new area of knowledge, a new skill set, requires a commitment to both understanding (e.g. development of knowledge) and exploration (development of familiarity). We have illustrated how a system perspective is useful for adoption of green building practices, and how holistic training engages participants' more than technical training. If the training pathways for clean energy careers are narrowly considered in terms of understanding (i.e., through mastery of particular topics), we will squander an opportunity to engage participants in exploration (i.e., through familiarity building). By focusing on individuals' familiarity and describing how familiarity plays a role in adoption of innovative practices, and learning processes, this paper illustrates a conceptual argument for the relevance of familiarity to workforce development in the clean energy sector. As a whole, this is not about finding solutions to particular training needs. It is about identifying ways to support development of a workforce who can engage effectively in the larger task of creating a more sustainable world.

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