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"I WISH THAT I BELONGED MORE IN THIS WHOLE ENGINEERING GROUP:" ACHIEVING INDIVIDUAL DIVERSITY - WALDEN - HOW TO FUNCTION IN AND WITH A COLLABORATIVE, MULTI-DISCIPLINARY, CROSS-EPISTEMOLOGY RESEARCH TEAM!

 How to function in and with a collaborative, multi-disciplinary, cross-epistemology research team!

One of the most challenging aspects of the conceptualization and creation of the paper "'I Wish that I Belonged More in this Whole Engineering Group:' Achieving Individual Diversity," for all the authors, was negotiating common space and language in which to discuss, debate, and ultimately describe this student and her experiences. This experience has been, without a doubt, the most authentically collaborative undertaking that I have ever been associated with.

Some background of the three authors of this paper: One author (DAT) is an associate professor in computer science. She has an undergraduate degree in mathematics and physics, master's degrees in applied mathematics and computer science, and a Ph.D. in computer science. She had been pursuing scholarship of computer science (CS) and engineering education for approximately ten years, yet still approached this research from a positivist (engineer) perspective – it may be multi-faceted, but there is **an** answer to improving female participation in CS and engineering. She brings a task-orientation, focused, "let's get this job done" attitude to the group, as well as lived understanding of the male hegemony in engineering. One author (CEF), who came of age in the early 70's, has a bachelor's degree in anthropology, but worked in business for 14 years before pursuing a master's degree in cultural anthropology. She has held positions as lecturer for women's studies and anthropology at a comprehensive university. Besides her breadth of knowledge of the conceptual approaches for studying human behavior and cultures, she brings a deeply entrenched belief system based on a naturalist paradigm – there is not now, nor will there ever be, **one** answer to any question – everything is situational, dynamic, relative to the forces, constraints, history and future that surrounds it. And me – I'm somewhere in the middle – well, to be more accurate, I go back and forth. I have earned bachelor, master, and doctoral degrees in chemistry; the graduate degrees are in one of the most technically-oriented chemistry fields – computational chemistry. Yet, my deepest beliefs are closer to the anthropologist. In my memory, I have always recognized and relished the dynamic, situational, relativistic nature of life. I'm the person that thrives on duplicity – seeing both sides of the coin at the same time, enjoying the vastness of the forest while studying the detailed characteristics of the trees, simultaneously thinking about the big picture while burrowing into the intricacy of the details. On every personality, learning styles, work habit, career interest, etc. test that I've ever taken, I came out in the middle. I'm the liaison, the translator, the facilitator. Two practical abilities that I contributed to the strength of this team are a knack for the quirks of Microsoft Word and Endnote reference manager formatting and a tenacity for finding tedious pieces of information such as the median income for a county.

Thus, we embarked on the journey of interpreting Inez's story, wrapping her words in the anthropologist's language of critical cultural theory, and translating the meaning so that other engineering educators could understand.

As we individually intersected with Inez's story, each of us was so moved by the story that she wanted to get it out to the engineering education community. The chemist and computer scientist doubted the acceptability to the community of a paper with one research participant and based on a story that was different from 99% of the other interviews. We wanted to pull her story out of the larger projects so that we didn't lose the impact of her experiences. However, Inez's story was that of an outlier, data generally dismissed by engineers. The social scientist pointed out that in her discipline outliers are actually considered the unheard, the ones whose voices are lost in generalizing quantitative studies, the ones for whom qualitative methods are most useful. She suggested that we write Inez's story as a case study.

The diverse backgrounds and perspectives of the authors provided the challenges for and the strengths of our team and this paper. Over the course of about six months, we met for four to six hours each week to develop our common language, understanding, and the written paper.

(1) Different Language – though we are all native English speakers, the education and professional experiences we brought to the project and this paper were based on very different professional languages. The chemist and computer scientist understood the concepts of social and cultural capital, but had never heard of Bourdieu and did not have the language to describe and define the theory or Inez's experiences. During the early meetings, the anthropologist explained the theories in her professional language and the other authors worked to translate the concepts into language, definitions, and metaphors that they and other engineers could understand. These conversations had aspects of cultural anthropology tutoring sessions and of personal therapy as we (DAT and SEW) explored our own experiences in the early days of women's entry into our fields in a series of examples, what-ifs, and evolving analogies and metaphors to build our understanding of the cultural theories. Through this process, the authors trained in the positivist paradigm gained deeper understanding and appreciation of the naturalist perspective. While this presented as a challenge in writing the paper, it also resulted in strength for the paper. The anthropologist alone would have written a paper that would have been incomprehensible for most engineers, but the computer scientist and chemist working alone or together would not have had the language to describe the impact of accrued disadvantages.

(2) Writing styles – One thing we discovered early in the process was that it was extremely difficult to write as a committee from a blank word document with such varied viewpoints. To get around this, the anthropologist pulled salient quotations from the interview transcript, began collecting theoretical literature, and constructed a document somewhere between a bulleted list and

publishable prose for the group to review and discuss. The computer scientist wrote the first draft of the methodology section and the chemist wrote the introduction, searched the internet for supporting factual data, and listened to the original interview recording to interpret the audible nuances of meaning and emotion. We used our weekly meetings to dissect, debate, and reconstruct the relevant prose, frameworks, interpretations, to build an accurate and compelling story. We found in this process that not only were the professional paradigms and languages different but the disparate disciplines also promoted opposite writing styles. The anthropologist's training and writing style included a complex and nuanced elaboration of the entire context of the environment, the agent, and the findings. The chemist and computer scientist, in attempting to write in a style more congruent with an engineering journal, had to make the statements more concise while not going as far as stating the findings in positivist language. The process of continually deconstructing and reconstructing the prose resulted in a much more readable and complete paper than could have been written by any one of us alone.

Unlike the challenge of negotiated language that added to the strength of the team and the paper, academic bureaucracy did not. These challenges are not specific to this paper, yet are important for engineering educators seeking to work in interdisciplinary teams to consider. One issue in this category is the pressure related to publishing in the accepted journals and paradigms of one's own discipline. The take-home messages from Inez needed to be delivered to engineering educators and administrators in a widely-read engineering education journal; yet the theoretical frameworks and the case study approach we used to get those messages across are more common in the anthropological literature and largely absent from engineering journals. We were concerned that the case study approach would not be acceptable to the reviewers and editors of the *Journal of Engineering Education*. Corollary questions surround publishing findings from such interdisciplinary work:

· the number of authors of a paper (Are solo publications valued more or exclusively in a discipline?);

· the order of author names (Is the first or last author listed the "primary" author? Does a publication count for an author if they aren't in the most prestigious position?);

· the type of publication (What is countable – a book, an article (how long is too short or too long), a conference paper?).

All of these issues of the academic bureaucracy have to be negotiated in interdisciplinary research groups.

Finally, the social scientist wanted me to add that as she developed the other authors' understanding of cultural theories we were helping her move from being a luddite who rejected technology to a competent user of Excel, NVivo, and even, real-time document and calendar sharing. Thus, in the true spirit of a team, we each contributed and received greater knowledge and understanding from our participation in the group.

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