Gender and STEM Research Symposium

Date: February 19, 2010 ◆ Time: 8:00 AM - 4:30 PM ◆ Location: Stewart 310

8:00 **Registration opens**

8:30 **Welcome, from Dr. Christine Taylor, VP for Diversity and Inclusion**

8:45 **Welcome and logistics from Alice Pawley, ADVANCE Research Director**

9:00 **Session 1: Theorizing about gender and STEM in social structures**

10:30 **Break**

10:45 **Session 2: Looking at the data**

12:15 **Networking Lunch– STEW 306** (Open to pre-registered symposium attendees only)

1:30 **Session 3: Talking solutions**

3:15 **Session 4: Returning to Theory (Person-Thing Orientation)**

4:15 **Wrap-up and Moving Forward; Alice Pawley, ADVANCE Research Director**

4:30 **Adjourn**

Acknowledgements

This event is presented in conjunction with *Intersections: A Student Conference on Diversity*. This year's Intersections theme is "Many Voices, One Campus: Living the Questions"; more information is at http://www.purdue.edu/diversikey.

We are very grateful for the financial support of the these organizations.
Susan Bulkeley Butler Center for Leadership Excellence, the College of Consumer and Family Sciences, the Diversity Resource Office and DiversiKey, the ADVANCE Research team, and the College of Science Women in Academia group.

Thank you to the abstract reviewers! (listed alphabetically)
Omolola Adedokun, Colleen Arendt, Dina Banerjee, Megan Grunert, Mindy Hart, Jordana Hoegh, Beth Holloway, Julia Kalish, Rene Ketterer, Daphene Koch, Alice Pawley, Wendy Peer, Johannes Strobel, Michele Tomarelli, Ralph Webb, Anna Woodcock.

Thanks also to the symposium planning committee.
Dina Banerjee, Lana Rice, Alice Pawley, Saranya Srinivasan, and Suzanne Zurn- Birkhimer.

9:00-10:30 Theorizing about gender and STEM in social structures

1. Graduate Students' Perceptions of Work and Family: Gender and Program Comparisons. (Research-to-Practice).
   Colleen Pagnan and Shelley MacDermid Wadsworth.

   Recent political debates have suggested that the United States is on the verge of a crisis and their position as a leader in producing talented and ambitious individuals in technical professions, such as engineering, is in jeopardy. A National Academy of Sciences 2006 report stated, "the United States can no longer afford the underperformance of our academic institutions in attracting the best and brightest minds to the science and engineering enterprise. Nor can it afford to devalue the contributions of some members of that workforce through gender inequities and discrimination" (2006).

   Recent years have seen the movement of women into male-predominated programs and the movement of some programs toward gender-neutral compositions. However, a study of undergraduate college women revealed that women in male-predominated programs were more likely than those in female-predominated programs to report thinking about changing their major (Steele, James, & Bartnett, 2002) indicating that there is a problem in retaining these women recruited into male-predominated programs.

   This study assessed perceptions of family supportiveness in academic program and anticipated career, anticipated career barriers, gender ideology and strategies for combining career and family among 181 graduate students from male-predominated, female-predominated, and gender-neutral programs at 11 research-extensive universities in the United States. Gender and program comparisons in perceptions of family supportiveness and anticipated career barriers were examined. Unexpectedly, students in female-predominated programs perceived their programs and future careers to be less supportive of families than students in other programs. Women also anticipated more barriers to their chosen careers than men, with a significant gender by program interaction with women in male-predominated programs anticipating the most severe career barriers. While an egalitarian gender ideology was found to be a significant predictor of career scaling back for women it was not associated with career scaling back for men.

   Keywords: Gender; Work-Family; Retention; Scaling Back; Gender Ideology.
   Topics: engineering, graduate students participants, work-life balance.

2. Gender and Race: Workplace Benefits and Job Satisfaction of the American Workers. (Research)
   Dina Banerjee.

   The purpose of my paper is to examine the impacts of workplace-related benefits on the job satisfaction of salaried workers in the U.S. labor market. In so doing, I also compare and contrast job satisfaction of the female and male workers as well as that of the white and non-white workers. Literature on gender, work and occupation underpins the impact of workplace benefits and policies on the well-being of the workers. The literature also suggests that this well-being varies across gender and race. Using this theoretical background, I ask: (1) Is there any difference in job satisfaction between female and male workers? (2) Is there any difference in job-satisfaction between white and non-white workers? and (3) What are the impacts of workplace benefits on the job satisfaction of the workers? Using the data from the National Study of Changing Workforce (2002), I define workplace benefits as the workers' 'workplace autonomy,' 'personal benefits' and, 'child care benefits.' I conduct quantitative methods of analyses and the findings show that job satisfaction significantly varies across gender and race. And workplace autonomy and personal benefits have considerable impacts on the job satisfaction of the workers. I interpret the results in terms of the

gendered and racial perspectives on job satisfaction.

Keywords: gender, race, job satisfaction, benefit.
Topics: intersectionality, quantitative methods, survey-based methods, theory testing.

3. Three theoretical approaches to gender: Implications for creating effective programs to increase the participation of women in STEM discipline. (Best Practices)
Omolola Adedokun and Wilella Burgess.

In recent decades, there have been increasing national, state, local and institutional efforts to increase the representation of women in Science, Technology, Engineering and Mathematics (STEM) disciplines and careers. For example, many Colleges and Universities have established programs to recruit female students, and increase female students' persistence in STEM majors. While some of these programs have been successful in their efforts, a major limitation is that most of the programs do not address the underlying socio-psychological factors that may inhibit the representation of women in STEM disciplines. This presentation provides a discussion of three socio-psychological theoretical perspectives of gender and how these theories highlight some misleading societal explanations for the gender disparity in STEM majors and careers. Specifically, this presentation will discuss the essentialist approach, socialization approach and social constructionist approach, and their implications for creating effective programs to increase the participation of women in the STEM pipeline.

Essentialist perspective holds that behavioral differences between men and women result from innate biological differences that are culturally stable, and not susceptible to the influences of socio-cultural factors. Sex and gender are thought to be "isomorphic" and "conceptualized as stable, innate, bipolar property of individuals" (Howard and Hollander, p. 27). Although the essentialist perspective is no longer considered valid in recent social psychological research, this presentation will highlight some of its underlying assumptions that still prevail in the explanation of gender disparities in STEM. For example, the gender gap in STEM is often explained as a result of the biological and psychological differences between men and women. Men are thought of as "wired" for STEM disciplines while women are viewed as lacking the "intelligent capacity" needed to be successful scientists and engineers.

Socialization perspective holds that gendered behaviors are not biologically determined, but, are learned through a myriad of social learning processes. That is, children learn to be 'male' or 'female' by observing and imitating their parents and other members of the society, and by internalizing the gender norms of the society. This approach argues that children, through the process of socialization, learn and fulfill the gender stereotypes and role expectations (e.g., career choices) embedded in the norms of their societies. For example, parents are likely to encourage and stir their sons to engineering careers and girls to education and liberal arts. Similarly, boys are viewed as capable of succeeding in STEM careers because the requirements and qualities associated with these professions (e.g., strength and confidence) are consistent with societal views of male roles. This presentation will discuss how gender focused STEM programs can effectively address the effects of the socialization process on the participation of women in STEM careers.

Social constructionist perspective views gendered behaviors as the result of complex and dynamic processes, external to the individual. The basic argument of the social constructionist approach is that gendered behaviors are created by the daily lived experiences of people, the complex interactions between people and by the discourse of a culture. Social constructionists opine that men

and women often act in gender-defined ways because they face different societal constraints and expectations. For example, women may not choose full time research careers in STEM disciplines because of other time demanding roles (e.g., parenting and other family responsibilities.) This presentation will provide some insights to how effective programs can address the societal constraints that hinder women's participation in STEM careers.

In summary, this presentation will examine the impact of each of these perspectives on the development of programs that can successfully recruit and retain women in STEM disciplines.

Keywords: Gender theories; Effective programs; Women participation in STEM.
Topics: educational contexts, engineering, mathematics, other contexts, science, technology, theory testing.

4. What science and engineering means: Discourses of young children across the world. (Research)
Lorraine Kisselburgh, Patrice Buzzanell and Brenda Berkelaar.

In this presentation, we review the findings of a 2-year cross-cultural research program in which we interviewed over 800 young children (K-4) in four countries—the United States, China, Belgium, and Lebanon—about the meanings of science and engineering work and careers. Our project focused on how meanings of work in STEM are discursively created, and examined cross-cultural, gender, and class differences in career and work socialization. This research offers communicative perspectives about the challenges of gender representation and the gendered organizing and career processes in science, technology, engineering, and math (STEM) areas.

Some themes we will review regarding the discourses of these children include:
1. The discursive intersections of imagination and material realities;
2. The contradictory discourses regarding occupational status and stigma; and
3. The cultural influences of honor and duty to one's family or country

We discuss these findings in terms of the theoretical contributions they make to career and occupational socialization theory. In examining the constructed nature of STEM work, and its meaningfulness to different developmental, gender and cultural groups, we highlight how meanings of work, context, and career socialization operate synergistically to shape children's understandings of work. We also invite discussion of how the research findings can be translated into practical changes to early messages about work and careers, in order to "change the conversation" and shape new futures for young women in STEM careers.

We believe these findings provide unique insights into early developments in children's anticipation of and socialization into STEM work and careers, and enable comparison of national, cultural, class, and developmental discourses. The findings have important implications for understanding the underrepresentation of women in STEM careers, and the class and cultural differences in young children's conceptualizations of such work.

Keywords: discourse; career socialization; culture development.
Topics: discourse analysis, educational contexts, engineering, graduate students participants, interview-based methods, P-12 participants or contexts, qualitative methods, technology, theory generating.

5. The Value in being The Flashlight Holder. (Other presentation)
Shirl Donaldson.

Marrying an entrepreneur is like marrying into the mob. Once you get in, you never get out and you do things that you never considered. In a family owned business you do your job and then anything else required to garner payment from the customer. Gender becomes almost irrelevant. Knowledge and experience are critical. Working in a family owned business brings a unique perspective.

It is often said that everyone wears several hats in a small business. Wearing the office hats is easy. Donning the steel toe shoes, tool kit or safety glasses changes the scope. Spending time in a small manufacturing firm gives individual opportunities to learn skills continuously. These skills include sales, marketing, quality functions, purchasing, machining, material handling, maintenance and repair, logistics and yes - holding the flashlight.

As an insider, the demand and compensation for technical talent versus clerical or administrative talent becomes obvious. Economic decisions often hinge on the skill level and availability of mechanical and industrial personnel.

Every task, whether significant or not, holds the potential to teach great lessons. If you hold the flashlight for two hours while someone disassembles a drive shaft inside the back panel of a CNC machine to replace a broken part, you learn about; schematics, team work, force and friction, lubricants, ergonomics and opportunity costs. Similarly, if you inspect and sort three crates of finished goods, individually, by hand, you start to question what went wrong. Was there an operator error, a machine failure or is the manufacturing process flawed? Opportunities for critical thinking emerge. Very few tasks are actually mindless. Flashlight holders develop a respect for logic, science, technology and excellence.

Keywords: Family owned business; industrial; Gender; Manufacturing process; CNC machine.
Topics: educational contexts, femininities, industry participants or contexts, masculinities, observation-based methods, other contexts, science, survey-based methods, technology.

10:30-10:45 Break

10:45-12:15 Looking at the data

1. Oral Histories as Building Blocks for New Theoretical Models: Individual Agency, Gendered Experiences, and Critical Junctures in Women's Pathways into STEM Faculty Careers. (Research)
Jordana Hoegh.

The number of women faculty members in science, technology, engineering, and mathematics (STEM) disciplines in the US remains disproportionately small compared to women's PhD graduation rates, despite the creation and implementation of numerous programs designed to promote women's academic success. Much of the existing research draws on "chilly climate" and "pipeline" theoretical models to explain this phenomenon. These models address gendered experiences to an extent, but they do not adequately consider the role of individual agency on the direction of women's career pathways. Examining the ways gendered experiences shape women's decision-making processes at critical junctures in their career pathways may lead to new theoretical models that reflect women's actual career paths to STEM faculty careers.

This research is part of a broader project that models women's career pathways into STEM faculty positions and examines the ways they are similar to and/or different from chilly climate and pipeline

models, and if they vary based on race and/or ethnicity. Modeling women's career pathways into STEM faculty positions will uncover critical junctures when women's choices may have led them to alternative careers or in the inverse, retained them in STEM faculty careers. Identifying these critical junctures has potential to inform hiring, recruitment, and retention policies aimed at increasing women's representation among STEM faculty.

In this paper, I demonstrate the potential of oral histories to illuminate the ways individual agency and gendered experiences shape women's pathways to STEM faculty careers. In particular, I discuss the use of oral histories to identify critical career pathway junctures and examine the relationship between gendered experiences and women's decision-making in their career pathways to and in STEM faculty positions. I describe the results from a set of oral histories of women faculty in STEM disciplines collected as part of a NSF-funded ADVANCE grant research project aimed at improving the career success of women STEM faculty. Oral histories give participants greater voice to discuss points along their career pathways they feel are important. For context, the oral history includes biographical information, family life information, educational history, and employment history. Career path modeling includes women's first interests in STEM disciplines, the ways those interests were fostered through education, and in-depth discussions about each job held after doctoral receipt with particular focus on current STEM faculty positions. The oral history concludes by discussing the ways participants feel gender, race and/or ethnicity affect feelings of fitting into their departments and perceptions of treatment by others because of their gender, race and/or ethnicity.

Because of the open-ended nature of oral histories, gendered experiences and emerge naturally through women's stories about their career pathways. Women's reflections on and perceptions of their career paths and the role of gender within it will produce rich, real-life data from which new theoretical models may be developed.

Keywords: gender; oral histories; career pathways.
Topics: identity, interview-based methods, qualitative methods, theory generating.

2. Technology Education and Educational Technology – Two Fields, Very Different Representation of Women. (Research-to-Practice)
Johannes Strobel, Heather Tillberg-Webb and Celia Pan.

Women have earned 40% of Ph.D.s in STEM disciplines in the U.S., yet their representation in academic STEM faculty and administrative positions has not wholly reflected this distribution (Hoffer, 2007; NSF, 2007): Women constitute on average only 20% of the faculty in fields related to science, technology, engineering and mathematics (NSF, 2000) a number which did not change proportionally to the degrees earned.

In education fields in which the representation of women is traditionally much higher, an interesting conundrum exists: (1) Whereas men typically dominate technology fields, educational technology/instructional technology appears to be a field that has incorporated women more successfully than other STEM domains. (2) Technology education on the other side serves as a stark contrast as a K-12 oriented field that is noted for being male-dominated (Liedtke, 1995; Zuga, 1998).

The fields of educational technology and technology education have arisen out of differing socio-historical and cultural contexts, which appear to have impacted the gender parity of each domain differently. This research study will explore the characteristics of graduate programs in Educational

Technology/Instructional Technology as compared to Technology Education and explore the relationship of these characteristics to gender parity. Results of this study provide insight into strategies other fields might employ to increase participation of women.

Through an evaluation of departmental characteristics such as highest degree offered and gender composition of faculty, we will present statistical data to demonstrate the gender parity/disparity in the academic domain in these two areas. Faculty gender composition can be a pivotal factor in a field's ability to attract and retain a diverse student body due to role-model effect (Rask & Bailey, 2002). A content analysis of program descriptions and the prerequisite academic preparation and work experience to enter instructional technology versus technology education programs will be explored, as prerequisites (Klein, 2007) are another noted academic barrier to gender equity.

This data will be contextualized in a historical analysis of the roots of these two similar, yet disparate, areas of study. While educational technology /instructional technology arose out of audio-visual education and school media, as well as programmed instruction, technology education arose out of the industrial arts tradition (Foster, 1994; O'Riley, 1996). Today, both fields are preoccupied with the concept of technological literacy and are dominated by the use of computer applications in a variety of contexts.

As highly skilled educators are needed to model high level problem-solving and critical thinking skills through their use of technology, whether the field is technology education or educational technology, this analysis will offer insight into the cultural-historical perspectives that resulted in different gender parity, and recommend strategies for attracting women across technology-oriented domains.

Keywords: gender parity; STEM diversity; curricular impact on diversity; role model impact on diversity.
Topics: discourse analysis, educational contexts, historical analysis, science, technology.

3. Chartering Factors that may contribute to Gender Differences in Spatial Ability: Consideration of the Effect of Performance Factors through a Meta-analysis. (Research)
So Yoon Yoon and Yukiko Maeda.

This study aimed to quantitatively synthesize the literature on gender differences in mental rotation ability in order to characterize the typical magnitude of the differences and their variations across studies. Since a series of studies led by Lubinski and Benbow has reported a critical role of spatial ability as a predictor of successful performance and developing expertise in science, technology, engineering, and mathematics (STEM) disciplines (e.g., Wai, Lubinski, Benbow, 2009), the value of spatial ability seems to be refreshed in STEM education more than ever. Since the early stages of research on spatial ability (Carroll, 1993; Eliot, 1987; Harris, 1978), studies on mental rotation ability, one sub-type of spatial ability, tend to provide consistent evidence for gender differences favoring males (Linn & Petersen, 1985; Voyer, Voyer, & Bryden, 1995). While the trend seems evident, the magnitude of the effect varies across studies with different populations and settings. In addition, the causes of the observed gender differences in mental rotation ability are not clarified yet (Masters, 1998; Moè, 2009).

However, the literature suggests that the observed gender differences in mental rotation ability can be explained by at least five distinguishable factors: biological, strategic, experiential, affective, and performance. Among those five factors, we focused on performance factors to understand whether

gender differences observed in scores are true or are due to the artifacts of the testing conditions. Specifically, we focused on the gender difference in three-dimensional mental rotation ability measured by The Purdue Spatial Visualization Tests: Visualization of Rotations (PSVT:R) (Guay, 1976), which has been prevalently used in STEM education for more than three decades.

Addressed research questions are as follows: (a) What is the typical effect size of gender differences in mental rotation ability measured by the PSVT:R?; (b) To what extent do effect sizes vary across studies?; and (c) How do effect sizes differ by the types of the test, length of the test, time limits, administration modes, education levels, and participants' majors?

Fifty-four effect sizes obtained from 35 out of 153 studies that utilized PSVT:R were included in the meta-analysis. This study revealed that the PSVT:R has a significant gender difference favoring males with the weighted average of Cohen's d=0.63, indicating a relatively large gender difference in spatial ability scores. The chi-square test of homogeneity (Q statistics) (Hedges, & Olkin, 1985) of effect sizes rejected the null hypothesis, implying that true effect sizes do vary across studies. Thus, additional analyses investigating moderating effects with random-effects models were warranted. Based on the descriptive results, testing conditions and sample and study characteristics were used as possible moderators in a multilevel model for a meta-analysis. Through this analysis, conclusions were made for each research question and followed by the discussion including implications in practice and suggestions for future research.

Keywords: spatial ability; gender; meta-analysis; mental rotation ability; STEM.
Topics: educational contexts, engineering, mathematics, quantitative methods, science, technology.

4. Understanding Women's Career Choices in Chemistry. (Research)
Megan Grunert and George Bodner.

The goals of this research study are to better understand the choices women in chemistry make with regards to career, to identify rewards and obstacles associated with available career choices in chemistry, and to compare graduate students' perceptions of careers with the descriptions of women in those careers. Ten women graduate students in chemistry from two different institutions participated in a series of three interviews with the researcher. These interviews examined their chosen career path, their perceptions of available career options, their values about work-personal life balance, and their experiences as women in a graduate chemistry program. Women faculty members were also interviewed and asked to reflect on their career choices and provide insight into their lifestyle as academic chemists. Ten faculty members were interviewed, six from three different research-intensive universities and four from three different primarily undergraduate teaching institutions. All interviews were transcribed verbatim and subsequently analyzed using the qualitative methods of thematic analysis and the constant comparative method (Miles & Huberman, 1994).

Preliminary analysis shows that women graduate students have negative perceptions of the research professor lifestyle at large universities. They feel there is little to no balance between work and personal life. Careers at primarily undergraduate teaching schools, at government labs, and in industry were viewed much more favorably. These findings add a depth of understanding to the numerous studies showing women's tendency to favor academic careers at teaching institutions over research institutions (see Bentley & Adamson, 2003; Kuck, Marzabadi, Nolan, & Buckner, 2004; Kulis, Sicotte, & Collins, 2002; Sears, 2003).

Women faculty members at large research institutions report deciding on their careers fairly early on

in their graduate studies. They pursued this path even though they recognized the challenges associated with this career. Their primary motivation for continuing in their career was the intellectual freedom they experienced, followed by being able to work with students and help them develop into independent researchers. In contrast, the faculty members from smaller teaching institutions felt rewarded and fulfilled by teaching and working with students, rather than through chemical research. They valued the flexibility of their schedules and the ownership they had over their teaching and the research they did with undergraduates.

The findings from this study offer suggestions for future interventions with graduate students, as well as faculty recruitment at research-intensive institutions. Women graduate students felt that women faculty in their department were not positive role models with respect to balancing a career with a family. They also did not see or value the intellectual freedom associated with this career or the rewards of working as an advisor to graduate students. Candid conversations or mentoring relationships outside of the advisor-advisee dynamic could shed insight into what life is really like as a faculty member at these institutions. Hiring and benefits packages at research institutions could also be modified with the addition of family-friendly benefits and policies, including maternity leave, on-site childcare, flexible tenure clocks, and clear departmental expectations for work schedules, to appeal to more women.

Keywords: Career decision-making; Graduate students; Faculty members; Chemistry/science; Work-life balance.
Topics: faculty participants, graduate students participants, interview-based methods, qualitative methods, science, teaching-research balance, work-life balance.

5. Race, Gender, and Institutional Differences in Engineering Persistence. (Research)
Matthew Ohland, Catherine Brawner, Michelle Camacho, Richard Layton, Russell Long, Susan Lord and Mara Wasburn.

Using whole-population student records data from multiple institutions for cohorts matriculating in engineering from 1988-1998 and graduating through 2005, the extent to which institutional variation exceeds variation by gender and race discovered in earlier work is explored graphically and using multiple measures of persistence. A powerful new graph design illustrates the intersectionality of race and gender, the importance of institutional variation, and the diversity of pathways that can lead to the same overall rate of persistence. The results make it clear that some underrepresented racial groups can succeed while others do not succeed at the same institution, emphasizing the importance not only of disaggregating race and gender, but of disaggregating various races rather than considering underrepresented minorities as if they were a homogeneous group.

This would drawn on published work, work that is under review, and details that compliment but were beyond the scope of those. I can give a great presentation if there is interest, but the work is substantially visual, so the poster session is a very reasonable option as well -- whichever best meets your needs.

Keywords: persistence; intersectionality; engineering.
Topics: engineering, intersectionality, quantitative methods.

12:15-1:30 Networking Lunch– STEW 306

Open to pre-registered symposium attendees only.

1:30-3:00 Talking solutions

1. Attracting Underrepresented Minorities through Contextualized Learning Experiences. (Best Practices)
   Levon Esters and Neil Knobloch.

   In order for the United States to maintain its preeminence in the world economy of this new millennium, in which science-based fields are playing an increasingly prominent role, educators need to expand and diversify the STEM talent pool (Tsui, 2007). Unfortunately, the workforce diversity needed within the science, technology, engineering, agriculture, and math (STEAM) disciplines are not being met especially in terms of the number of underrepresented minorities (URMs). One obstacle to increasing workforce diversity in STEAM majors and careers is the lack of contextualized learning experiences afforded to URMs. Contextual learning involves students connecting the content with the context in which that content could be used (Hull, 1993; Berns & Erickson, 2001). An important component of contextual learning is the use of authentic activities—activities similar to those that take place in the real- world outside of school (Borko & Putnam, 2000). Brown, Collins, and Duiguid (1989) argued that, "authentic activity…is important for learners; because it is the only way they can access the standpoint that enables practitioners to act meaningfully and purposefully" (p. 36). For urban youth, not only do authentic learning experiences help sustain their interest in sciences (Basu & Narton, 2007); engagement in context-based learning experiences at the K-12 level could significantly increase the diversity of students who participate in STEM classes and ultimately pursue careers in these areas (Custer & Daughtery, 2000).

   One useful strategy in addressing the lack of URMs pursuing STEAM education and careers has been the development of precollege summer programs. For examples, pre-college agricultural summer programs have been somewhat effective in addressing the lack of diversity in the agricultural sciences. However, despite the success of pre-college agricultural summer programs, these programs have not engaged URMs high school students in solving real-world problems using contextualized inquiry experiences. By and large, these programs focus primarily on the use of demonstrations, laboratory exercises, field trips/tours, group discussions, and participation in leadership activities. Although this represents a variety of instructional activities, these types of experiences are not ideal in terms of fostering high levels of critical thinking, problem-solving, knowledge synthesis, and skill application which are necessary to help promote and sustain interest in STEAM disciplines. As such, the purpose of this poster will be to share an innovative idea whereby providing underrepresented high school students with contextualized inquiry experiences can effectively serve as a method of increasing their interest in and pursuit of postsecondary education and careers in STEAM disciplines thus resulting in a more diverse workforce.

   Keywords: STEM career development; underrepresented minorities; pre-college programs; contextual learning; authentic learning
   Topics: agriculture, educational contexts, other contexts, P-12 participants or contexts, science

2. Life Science Education Signature Area (LSESA): An Interdisciplinary Approach to the Contextual Application of STEM Learning. (Other presentation)
   Neil Knobloch and Levon Esters.

   The purpose of this poster is to highlight an innovative effort which involves the formation of the Life Science Education Signature Area (LSESA) in the Department of Youth Development and Agricultural Education at Purdue University. LSESA is comprised of faculty with specializations in several different areas who study the impact experiential and outreach programs in the life sciences have on human capital. A driving force of the research interests of LSESA faculty involves taking

an interdisciplinary approach to the contextual application of STEM learning. Collectively, our goal is to increase science understanding and interest while motivating students to pursue careers in the life sciences through engaging educational contexts.

LSESA faculty have expertise on the: 1) pedagogy of Life Science Education which consists of the theories and concepts by which Life Science is taught, and 2) the academic content taught in Life Science classes. Through our collective efforts we bring together the theories, concepts, and content of Life Science Education and place it in context thus giving Life Science a place in careers and real-world applications in technology, engineering, and agriculture.

Our research efforts focus on three primary areas: 1) pedagogy of experiential learning, 2) content of life sciences, and 3) application of inquiry and career development. Currently, seven faculty comprise the LSESA team. Content-based LSESA faculty provides expertise in three specific areas including animals, plants, and natural resources. The social science LSESA faculty specialize in human, social and cognitive development. Their role is to provide expertise on the theories of learning and apply them to both formal and informal science learning experiences. One additional faculty members' role on the LSESA team is to implement LSESA projects through technology.

LSESA faculty, graduate, and undergraduate students are involved in a number of research, professional development, and curriculum development projects most of which focus on P-14 students and teachers in both formal and informal settings. Recent LSESA accomplishments include serving as the leader on several P-14 engagement activities in the College of Agriculture, leading statewide 4-H SET professional development activities; and providing evaluation expertise on a number of college- and campus-wide projects. Future goals of the LSESA team include continued expansion of our research capacity; grant proposal development, and recruiting graduate students who are interested in formal and informal life science education research.

Keywords: STEM learning; Contextual learning; Life science; Experiential learning; Informal learning.
Topics: agriculture, educational contexts, other contexts, P-12 participants or contexts, science.

3. Exploring Gender Differences in the Benefits of Undergraduate Research Experiences. (Research)
Omolola Adedokun, Loran Carleton Parker and Wilella Burgess.

This presentation examines the effect of gender on student benefits from Undergraduate Research Experiences (UREs) in STEM disciplines. Much research has documented the benefits of UREs to students. For example, UREs have been shown to enhance students' research skills, research self-self-efficacy, and understanding of scientific processes, aspirations for graduate education and interests in research oriented STEM careers. While the research is convincing that participation in UREs is related to positive educational outcomes for students in general, little is known about the effect of gender in relationship to URE benefits on students. The few studies that have examined the influence of gender on student benefits from UREs have generated conflicting results. Some studies (e.g., Lopatto, 2004) have reported no significant gender differences in the benefits of URE, while other studies (e.g., Kardash, 2000) documented that male students reported higher gains in their abilities to generate research hypotheses than their female counterparts. Although URE experiences have been shown as effective tools in enlarging the STEM pipeline, harnessing its efficacy to enhance the persistence of female students in STEM disciplines requires that more studies be conducted to clarify gender differences in accrued gains from UREs. This presentation addresses the identified gaps in the literature by investigating gender differences in students' self-reported pre and post participation levels of research skills, understanding of the scientific process,

research self-efficacy and aspirations for graduate education.

Data for the study come from 52 students (Female=32; Male=19) that participated in Purdue University's Discovery Park's Undergraduate Research Internship (DURI) program in the summer or fall semesters of 2009 academic session. Interns completed a multi-section pre-post survey instrument requesting them to indicate the extent to which they agreed/disagreed with four Likert-items regarding their research skills (e.g., "I have the ability to have a successful career as a researcher"); six items regarding their understanding of scientific processes (e.g., "understanding of how to formulate a research question") and eleven items regarding their research skills (e.g., "documenting a research procedure.") We employed independent sample t-tests to examine gender differences in students' pre- and post DURI aspirations for graduate schools, research self-efficacy, research skills and understanding of scientific processes. The results revealed no statistically significant differences in any of the variables considered. Further, we calculated accrued gains/benefits from URE by subtracting the pre-participation from the post-participation values of the variables of interest. We observed no statistically significant gender differences in the variables considered. The results suggest that male and female students received similar levels of benefits from the experience.

Our presentation will discuss the importance, implications and applications of the findings to the issues of gender disparity in STEM disciplines. For example, earlier studies have attributed the attrition of women in STEM disciplines to the "abstract" nature of scientific knowledge and concepts. Given that UREs provide students the opportunities to have "hands-on" learning experiences and to understand the societal relevance of their research; we submit that UREs may be effective tools for enhancing the persistence of female students in STEM disciplines.

Keywords: Undergraduate Research Experiences; Gender differences.
Topics: quantitative methods, undergraduate students participants.

4. Summer research programs and academic-year continuity of summer research programs as components of doctoral & post-doctoral mentoring. (Best Practices)
Wendy Peer and Angus Murphy.

Recruitment of under-represented students to a career in the life sciences requires that the students believe that such a career is within their reach. The best way to instill that this possibility could be a reality is to engage the students in research at early stages in their academic careers. Hands-on experiences with state of the art equipment (usually not present at their home institutions), such as confocal laser spectral scanning microscopes and gas chromatography/mass spectrometers, gives them the opportunity to actively conduct research and thus imagine themselves as life scientists. Engaging the students in all aspects of research, from developing hypotheses to planning and executing experiments to collecting and analyzing data and preparing data for presentations, allows the students to experience the day-to-day activities of a life scientist. All of this is done with the guidance of their mentors. Mentoring is a critical component of the undergraduate research experience. Each student has a faculty mentor as well as a post-doc or graduate student mentor, which gives the undergraduates multiple senior investigators with whom to interact. This program also provides graduate students and post-docs the opportunity to develop mentoring skills that will contribute to their success as teachers and major professors.

This program began as a collaborative NSF funded research grant between Purdue University (a Tier I institution) and University of Texas - Pan American (a minority serving institution, MSI). This

program included a summer internship program at the Tier I institution which integrated academic year research at the MSI to invigorate the research at the MSI and recruit students to graduate school in the life sciences. From this initial program, we have developed a relationship with California State University Monterey Bay, another MSI. Since 2002, of the 33 students participating in the program, 28 have applied to graduate or medical school (3 are still undergraduates and plan to apply during their senior year). There have been >20 poster presentations, 5 presentations at meetings and 2 papers have been published as a result of these collaborations.

Keywords: mentoring; recruitment; life sciences; summer internship; academic year internship
Topics: educational contexts, faculty participants, graduate students participants, undergraduate students participants

5. Gender and Leadership: Expanding the Course Offerings at Purdue University. (Research-to-Practice)
Beth Holloway, Teri Reed-Rhoads, Rebecca Dohrman and Nathalie Duval-Couetil.

A new undergraduate course initially offered in fall of 2008 through Purdue University's Entrepreneurship Program called Women and Leadership created the foundation to develop a graduate course in Gender and Leadership. The undergraduate course is now cross-listed with Communication and is co-sponsored by the Burton D. Morgan Center for Entrepreneurship, Susan Bulkeley Butler Center for Leadership Development, and the Department of Communication. By expanding on the undergraduate course, a much needed graduate course focused on expanding the conversation and understandings of the theoretical underpinnings of diversity was developed for the School of Engineering Education. The development began with benchmarking of Gender and Leadership courses from around the nation. These results were incorporated with a literature search related to gender, leadership, and the intersection of the two. Both of these areas are of high importance to the future of engineering education in that understanding gender issues is of national interest along with the understanding of how to develop or cultivate leadership skills in our engineering undergraduate and graduate populations (Engineer of 2020, NAE). The resulting course examines the intersection of gender and leadership and its relevance to the lives of engineers and engineering educators with a slight expansion to broader diversity discussions of race and ethnicity relative to leadership as well. The course explores the social constructions of gender, gendered organizations, gendered leadership, obstacles to women's full participation in leadership positions, the intersections of gender with race, ethnicity, class and those effects on leadership, and a framework for gender equity. This course provides students the opportunity to explore facets of diversity (gender, race, and ethnicity) and its affect on the majority and non-majority populations with respect to leadership positions, particularly within an engineering professional context. The resulting course objectives are the following;

1. Examine the contexts of gender in society and work.
2. Define leadership.
3. Examine the intersections of gender/race/class/etc and leadership.
4. Understand the barriers to women in leadership positions.

The course outcomes are the following: Students who fulfill the course requirements will have demonstrated:

1. An understanding of the role of gender in the workplace.
2. An understanding of our own subconscious beliefs about gender.
3. An ability to critically think about the role of gender in leadership styles.

This paper is a discussion of the construction of the course and its related assessments with a presentation of the benchmarking results, literature review, and course assessment tools. It outlines the weekly schedule that includes discussions on gender schemas, definitions of leadership,

ambition, communication styles, challenges, strategies for success, and gendered organizations.

Keywords: Diversity; Gender; Graduate Education; Leadership
Topics: educational contexts, engineering, faculty participants

3:15-4:15 Returning to Theory (Person-Thing Orientation)

1. Motivational Foundations Underlying Science, Technology, Engineering, and Math (STEM): Does Sex Affect Interests in People and Things? (Research)
   William Graziano, Sara Branch, Feyza Corapci, Demetra Evangelou, Meara Habashi, Mica Estrada-Hollenbeck, Ida Ngambeki, Despoina Sakka and Anna Woodcock.

   Females are underrepresented in all STEM disciplines, particularly engineering. Women earn less than 20% of the undergraduate degrees in engineering and represent approximately 9% of tenured engineering faculty. This lack can be traced to both declining enrollment and disproportionate attrition among female engineering students. There is a demonstrated relationship between abilities and interest and enrollment and persistence in a field. A number of studies have shown that there is no significant difference in abilities between the sexes in engineering making interest rather than aptitude the key factor. This symposium examines personal interests in Things and People as motivational factors in academic preferences and achievement. Interests also underlie sex differences in career plans. Person-Thing interests may index motivational processes steering children toward/away from STEM. For USA university students Person Thing Orientation (PTO) was linked to commitments to academic majors, and retention within engineering programs. Evidence did not support the hypothesis that PO and TO were inversely related, or that PO undermines interest in STEM. In USA, sex differences were greater for TO than PO, but not for engineering students. Outcomes for 3rd and 6th grade children were similar. Sex differences in interests for STEM may be underway early in USA. In Greece and Turkey, sex differences in TO were negligible, but PO differences were pronounced. Kelman's social influence model was used to explore interests and commitments to academic career plans and classify self-reported motives into a Kelman system.

   Keywords: Person-Thing Orientation; Motivation; Interest.
   Topics: engineering, P-12 participants or contexts, quantitative methods, science, survey-based methods, undergraduate students participants.

2. Person-Thing Orientation in USA University Students. (Research)
   Ida Ngambeki, Demetra Evangelou and William Graziano.

   A study conducted by the NSF in 2006 found that more than half the bachelor's degrees earned in the US were earned by women. While women are well represented in some STEM fields such as Psychology (78% of degrees went to women), other fields such as engineering (21% of degrees earned) are not. Ability has largely been discounted as a factor in the sex differences observed in engineering persistence, as studies have shown that the female students who leave are not significantly less able than those who remain. Therefore focus has shifted to motivation. This study examines personal interests, specifically interests in persons and things as a motivation to pursue STEM careers. Person-Thing Orientation data were collected from Purdue University students: First year Engineering majors (N=979) and Introductory Psychology undergraduates (N=716). The introductory psychology sample included engineering students along with majors from any college within the university, including undecided students. Men were found to be significantly higher in T orientation than women across both groups. STEM majors were higher in T orientation than non-STEM majors. Engineering students also rated the condition of their engineering major. Individuals choosing to remain in an engineering major, especially female students, were higher in T orientation

than individuals leaving engineering or those who were undecided. This evidence shows that differences in thing orientation, not person orientation, predict success in engineering and science-related careers, especially among female students. Results are consistent with vocational psychology that differential interests in persons and things are pervasive, related to STEM occupational goals, and also to the sex differences that probably underlie both of them.

Keywords: Person-Thing Orientation; Motivation; Interest.
Topics: engineering, quantitative methods, survey-based methods, undergraduate students participants.

3. Teacher Knows Best: Interest as a Predictor of Children's Career Plans. (Research)
Meara Habashi, Demetra Evangelou, William Graziano and Ida Ngambeki.

Extensive research has proven differences in the games and activities male and female children express an interest in. These differences are believed to originate in part from socialization and in part as a result of children's personal interests, and are believed to be linked to sex differences in adults. Research has identified differences in men's and women's level of interest in people and things (PTO), which are related to differences in interest in careers for men and women. Data were collected from 3rd and 6th graders and their teachers (N = 203). Participants completed measures of students' PTO, interest in careers and interest in classes. Teachers also completed measures assessing their own PTO. Analyses assessed how well teacher ratings of student PTO predicted the student's self rated interest in careers. Results revealed a main effect of sex on both thing and person orientation, with boys being higher in thing orientation and girls higher in person. Results also indicate that teacher ratings of 3rd graders PTO emerged as better predictors of students' self-rated interest in career than the students' own ratings of PTO. For 6th graders, however, students' self-ratings of PTO emerged as better predictors of self-rated interest in careers than teacher ratings. Results are discussed in terms of teachers' assessment of children's motives and interests as an influence on children's self-ratings, and point to childhood precursors and developmental factors affecting the development of interest in STEM, especially in females.

Keywords: Person-Thing Orientation; Motivation; Interest.
Topics: educational contexts, P-12 participants or contexts, survey-based methods.

4. Cultural Applicability of the Predictors of Person-Thing Orientation in Greece and Turkey. (Research)
Demetra Evangelou, Despoina Sakka, Feyza Corapci and Ida Ngambeki.

Person-Thing Orientation (PTO) is conceptualized as a motivational process underlying preference for interpersonal relations and mastery over objects (Little, 1974). In studies performed in the US, thing orientation was found to be a strong predictor of persistence in engineering and interest in engineering careers. This study investigated sex differences and predictors of PTO in Greek and Turkish cultural contexts. Among both Greek university students (N=120; 80 female) and Turkish university students (N = 195; 60 females), there was no evidence that Person Orientation (PO) and Thing Orientation (TO) were inversely related. Instead they were positively related, if weakly. Both Greek and Turkish female students differed from their male counterparts in TO. However, contrary to the US sample, Greek and Turkish students differed more in PO than TO with female students reported significantly higher PO than males. No significant effect of sex on PTO was found among STEM students in Greece, while a main effect of sex on PO, but not TO was found among STEM students in Turkey. As in the USA, male students were significantly more interested in TO occupations (e.g., electrical engineering, auto mechanic). Females were significantly more interested in PO jobs (e.g., nurse, teacher). Separate hierarchical regression analyses were conducted for each

set of predictors. After age and gender were partialled, femininity predicted PO. None of the other personality variables predicted TO in the Greek or Turkish cultural contexts. The instruments used were found to hold up cross-culturally.

Keywords: Person-Thing Orientation; Motivation; Interest.
Topics: educational contexts, engineering, survey-based methods, undergraduate students participants.

5. Promoting Diversity: People and Things, Social Influence, and the Motivation to Persist (Research)
Anna Woodcock, Mica Estrada-Hollenbeck and Ida Ngambeki.

Increasing diversity has become a high priority for many academic disciplines. Attracting and retaining talented individuals from traditionally underrepresented groups is one key to this endeavor. Little (1974) proposed that individuals vary in their levels of orientation to people (PO) and things (TO). Gender diversity is often low in disciplines that are perceived as either strongly "thing-oriented" (such the STEM disciplines) or "person-oriented" (such as the humanities and health sciences) – leading to potential gender/major incongruity. Drawing from a sample of 1,045 male and female undergraduates we explore the relations among PO, TO and socialization to academics using Kelman's concepts of compliance, identification and internalization (Kelman, 1958, 2006), in disciplines perceived as being person or thing oriented. Empirical findings are discussed in terms of sex differences in motivation to persist and to pursue careers in PO and TO disciplines for persons in traditionally underrepresented groups.

Keywords: Person-Thing Orientation; Motivation; Interest.
Topics: educational contexts, engineering, survey-based methods, undergraduate students participants.

6. In Their Own Words: Classifying Free Descriptions of Motivation. (Research)
Sara Branch and Ida Ngambeki.

National average retention rates for engineering majors range from 30-56% (Fortenberry, Sullivan, Jordan, & Knight, 2007). Various lenses have been applied to examine students' motivation to pursue different fields of engineering. The research reported here employs Kelman's (1958, 2006) model of social influence as a framework to examine the self-reported free-response motives underlying students' choices. This model delineates three modes of social influence: compliance, identification, and internalization. These modes correspond to motive bases (rule, role, and value) that individuals have towards the larger social system (Kelman, 2006). Using first year engineering students (N=907, nfemale =138) at a large Midwestern university we collected qualitative data regarding their self-reported motives for pursuing degrees in various fields of engineering. Each response was coded for rule, role, or value oriented motives. Classifications show self-descriptions of motives were systematically related to gender, discipline choice, and commitment to remaining in engineering.

Keywords: Person-Thing Orientation; Motivation; Interest.
Topics: educational contexts, engineering, qualitative methods, undergraduate students participants.

4:15 Wrap-up and Moving Forward; Alice Pawley, ADVANCE Research Director

4:30 Adjourn