Challenges of Changing Faculty Attitudes about the Underlying Nature of Gender Inequities

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Abstract

Increasing diversity of the engineering student body requires at least one of two parties, either the incoming student population or the institution offering engineering programs, to change. Efforts to increase diversity in engineering have historically focused on changing the incoming student population. At Texas A&M University, the second alternative, changing the institution (by changing faculty) is being explored in an NSF-supported project "Changing Faculty through Learning Communities." The project employs four mechanisms to promote change in faculty members: speakers, workshops, faculty learning communities (FLC), and matching grants to support women students. Specifically, the project aims to catalyze changes in the way faculty think about four concepts that are tightly linked to the concept of gender diversity: 1) mental models, 2) development and invitation, 3) personal vision and commitment, and 4) the culture of engineering and science. The following paper describes change mechanisms, highlighting FLC, and four changes that learning community participants report. Participants a) shifted from searching for external solutions to changing internally, b) recognized that faculty members help create a welcoming environment, c) realized that accumulation of subtle inequities create large disparities for women, and d) reported heightened awareness of mental models, gender schemas, and differences in ways men and women develop and communicate.

Introduction

The majority of engineering schools throughout the country lack diversity among both their student populations and faculty ranks [1], [2, chapter 2]. Almost all of the programs to date that have been implemented to rectify this situation have focused on changing the student population to cope with an environment that the data suggests is not sufficiently conducive to supporting a diverse student population. Creating pervasive, transformational change within engineering programs in higher education requires institutional change as well as change among the faculty, the principal population that develops and maintains the institutional culture.

In their book "Taking the Reins," Peter Eckel and Adrianna Kezar note that helping people think differently is an essential element of transformation.

> *Transformation is as much about getting people to think differently as it is about anything else. Forging new collective understandings and creating new beliefs about institutional activities and people's roles are essential to transformation and, we found, more important than changing structures, creating reward incentives, aligning budgets, or making and implementing difficult decisions. A key part of transformation is*

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> *changing mind-sets, which, in turn, alters behaviors, appreciations, commitments, and priorities …people develop new beliefs and interpretations and adopt new ways of thinking and perceiving that help create the foundation of significant change. Transformation is about making new sense. Without exploring what the changes mean for the institution and capturing the minds and hearts of faculty, staff, students and trustees, institutional change will be limited to new organizational structures and policies that may not add up to transformation [3, chapter 3].*

One element of getting people to think differently about gender inequities and about institutional and learning environments that would promote greater equity is stimulating greater understanding of the nature of gender inequities, gender differences, and actions that might be taken to promote greater equity. Although it is not the only step toward promoting greater understanding, surely one step in this direction would be greater awareness, knowledge, comprehension, and application of the research to date. The primary challenge in taking this step is to find ways of providing faculty members with a means of learning about current research on these issues without each faculty member starting from ground zero on her or his own. A starting point in contemplating matters about thinking differently is the book Why So Slow? The Advancement of Women by Virginia Valian [4].

In the book, Valian presents a model in which gender inequity arises through accumulation of small disadvantages, most of which are created by gender schemas held by males and females alike. She posits that a set of implicit hypotheses about sex differences, which she refers to as gender schemas, plays a crucial role in shaping the professional lives of men and women. She explains that gender schemas affect our expectations of men and women, our evaluations of their work, and their performance as professionals. As a result, men in professional life are consistently overrated, while women are consistently underrated. Valian suggests that whatever accentuates a man's gender repeatedly places him at an advantage by giving him an implicit "plus" mark while the perceivable feminine traits of a woman result in small losses for her, "minus" marks [4, pp.2].

Over time significant advantages accumulate as the summation of the numerous plus marks received by men increases. Similarly, significant disadvantages are created as small minus marks received by women add up. Although most individual differences in treatment are typically quite subtle and seemingly small, accumulation of small advantages and disadvantages over time results in significant discrepancies in salary, promotion and prestige. Valian illustrates this point by citing a study that describes a computer simulation of promotion practices at a hypothetical corporation which had eight levels staffed at the bottom level by equal numbers of men and women [5]. A model-specified percentage of the staff would be promoted from one level to the next over a given period of time. The model imposed a small (1%) bias in favor of promoting men. After running the model through numerous iterations, the highest level in the company was 65% male [4, pp.3]. Based on these results, even small disadvantages can create huge disparities over time.

If this model of gender inequity is accepted, then initiatives to enhance equity must be similarly pervasive and systemic. Efforts are required to help faculty members uncover their gender schemas, see how their schemas affect decisions they make about women students and faculty, and decide how they might alter their gender schemas to arrive at different decisions. Data on

imbalances between numbers of males and females at the undergraduate, graduate, and faculty ranks, as well as studies that help characterize the environments for women at these three levels are helpful. However, none of these studies will help faculty members clearly understand how subtle, but collectively massive, discrepancies construct environments that lead to imbalances.

What is required is a culture change where culture is not a static entity, but a continuously evolving phenomenon based upon emerging consensus, derived both explicitly and tacitly from the people in the culture as they interact with the environment as described by Seel:

> *Organizational culture is an emergent result of continuing negotiations about values, meanings and properties between the members of that organization and with its environment. In other words, culture is the result of all the daily conversations and negotiations between the members of an organization. ...If you want to change a culture you have to change all these conversations—or at least the majority of them [6].*

Core Strategies of Change

Getting people to think differently or changing the majority of conversations that take place within a given environment requires a comprehensive approach. A single strategy will not work. From their analysis of twenty-six institutions that attempted transformational change, Eckel and Kezar recommended five core strategies of transformation [3, chapter 4].

- Senior administrative support
- Collaborative leadership
- Flexible vision
- Staff development
- Visible action

These core strategies will be used to analyze the project strategies in an effort to gauge effectiveness and thus the potential for change.

Senior Administrative Support

One way that people draw clues about thinking differently or changing their conversations is to look at what the leadership says and does. There seems to be reluctance among the components of any organization to believe that change might occur unless there is obvious commitment from senior administration to promote a change. At the time the proposal for the Gender Diversity Project (GDP) was submitted, the principal investigator, Karan Watson, was Associate Dean of Graduate and Undergraduate Studies in the Dwight Look College of Engineering and a co-PI, H. Joseph Newton, was the Interim Dean of the College of Science. The project team had a nucleus for building senior administrative support.

Once the project got underway, senior administrators played an active role in planning activities associated with the project and participating in a number of events. For instance, Dr. Watson (now the Associate Provost and Dean of Faculties) along with Dr. Newton (now the Dean of Science) and John Niedzwecki (the Executive Associate Dean of Engineering) attended project team meetings, suggested potential candidates to invite to the TAMU campus as guest speakers and organized and participated in meetings with guest speakers. Their valuable participation sent a strong message to faculty and students that the goals of this project were a high priority.

Collaborative Leadership

The GDP project team continually strives to collaborate with other entities on the TAMU campus in an effort to maximize effectiveness. The GDP actively cooperates with the Center for Teaching Excellence (CTE) in publicizing events and in developing resource materials. The GDP project manager actively works with the CTE Director for Sustained Programs in learning to facilitate faculty learning communities and in constructing the syllabi for the learning communities. The GDP joined with the WISE (Women in Science and Engineering) chapter on the TAMU campus to bring Dr. Debra Rolison, a renowned female chemist and outspoken advocate for increasing diversity of chemistry faculty, to visit with faculty, staff and students during the annual WISE conference. The project team has also enlisted the support of several people in key positions within the colleges of science and engineering to assist in planning and promoting various events.

Although a number of efforts have been made to collaborate with leaders throughout the colleges of science and engineering, there remains a void in the collaboration among at least two groups of key personnel. Department heads and distinguished professors both play a major role in creating and sustaining the cultures in their respective environments. Continued efforts are necessary to build bridges and initiate collaboration among these groups so that their leadership might bolster the effectiveness of project-related activities.

Flexible Vision

Eckel and Kezar describe flexible vision as:

> *a vision that is consistent and has a targeted direction, and yet is opportunistic and does not foreclose important opportunities – can seem counterintuitive to the belief that good leadership sets a vision and charts a decisive course. Yet creating a flexible vision that allows details and variations to emerge is the essential pattern, not a detailed vision of the future [3, chapter 4].*

If the aim is to create learning and institutional environments that are both more inviting and more welcoming, it is not sufficient to bombard faculty with messages such as "Be inviting!" or "Be welcoming!" Further, it is impossible to prescribe to faculty members how they should structure their learning and work environments to promote greater equity and provide the necessary intellectual challenges and support. Instead, the project has focused on getting faculty members to think differently by providing access to the research and practice that is occurring around the country on issues related to gender diversity. The project has identified four disciplines, branches of knowledge and practice that are related to gender equity and require sustained reflection and conversation in order to bring about change. Working with each of the disciplines does not prescribe thought or action; instead, it provokes reflection that will lead to constructive and informed change. Descriptions of the specific project strategies that are provided below will illustrate how flexible vision has been incorporated into the project.

Staff Development

Three of the four action-oriented strategies: speakers, workshops and learning communities, have focused on faculty and staff development. Although invited speakers are most visible in their public talks, the most effective change activities in which invited speakers have been involved are conversations with smaller groups of faculty members, particularly department heads or their representatives. The Colleges of Engineering and Science hosted luncheons for the majority of the invited speakers so that department heads (or their representatives) would have an opportunity to visit with each guest. In these more informal settings, invited speakers engaged these influential persons and invited them to examine research and experiences to stimulate different ways of thinking. In each meeting, the audience's questions both during and after the formal discussion, showed they were thinking about data presented and its implications for enrollment, retention rates, and faculty searches in their respective departments. Large step changes are not likely, but cumulative change over time is anticipated.

Visible Action

Can the faculty see project events happening and see progress as a result of the project? Eckel and Kezar describe visible action as

> *progress in the change process that marks continual advancement toward the articulated goals of the transformation agenda [3, chapter 4].*

Visible action is the core strategy in which the project has made the least progress. Faculty members that have participated in one or more project events, particularly faculty learning communities (FLC), are aware of the GDP and its activities. These faculty members have also talked about their FLC experiences with other colleagues who have yet to participate. News blurbs are sent every other month to the deans and associate deans within each college. Brochures and flyers advertising the project are distributed widely and the GDP partners with other groups on campus. Still, awareness of the GDP is lower than the project team desires and additional efforts to raise awareness will be taken in the remainder of the project.

Mechanisms of Change

So how does an institution, namely faculty members – the primary component of an institution – create and sustain the type of transformation that the core strategies listed above should promote? The National Science Foundation demonstration project "Gender Diversity Project: Changing Faculty through Learning Communities" at Texas A&M University has implemented four mechanisms of change: 1) speakers, 2) workshops, 3) matching grants to support women students, and 4) faculty learning communities, that are intended to help faculty members think differently regarding gender diversity within their respective environments.

Speakers

To prompt discussions on issues related to gender equity in science and engineering, six prominent speakers visited the TAMU campus from November 2002-November 2003. Each of these guests met with numerous groups of faculty and administrators in the Colleges of Science and Engineering. They also conducted open lectures during their respective visits and many of them visited with various other administrative and faculty groups.

In the fall of 2002, the project hosted Dr. Virginia Valian, who is a professor of psychology and linguistics at Hunter College and the City University of New York Graduate Center. Her influential 1998 book [4] has placed her in the forefront of those studying the progress of women in academia, medicine, law, and business. During her visit, Dr. Valian interacted with approximately seventy administrators and faculty members via small group discussions, including a meeting with deans from across the university as well as a meeting in the College of Engineering that included the executive associate dean, department heads and graduate advisors. She also conducted two open lectures, which were attended by faculty, staff and students from across the campus.

Dr. Valian's visit prompted her audiences to reflect on a several issues in their individual environments. Some of the questions raised during her visit were:

- There are very few women in our discipline. How can we form a diverse candidate pool if they will not apply for the advertised positions?
- How would this institution go about implementing total turnabout in policy to ensure an equitable environment for all members of our community?
- The diversity argument has not found a receptive audience in my case. How can I convince my colleagues that diversity does not lead to a decrease in quality?

In response to these and similar questions, Dr. Valian repeatedly referred to gender schemas as the root problem in most cases. She also encouraged her audiences to recognize the benefits of insuring gender equity [7]. Her data-based discussions seemed to bolster her credibility among her audiences, which have been historically skeptical of colleagues from outside of the disciplines of science and engineering. A common question that emerged after her visit was, "Knowing all of this, what do we do now?" As a follow up to Dr. Valian's visit, a Faculty Learning Community on Mental Models was initiated and is described below.

The second speaker was Dr. Debra Rolison, head of Advanced Electrochemical Materials, Surface Chemistry Branch at the Naval Research Laboratory in Washington D.C. Since she is an outstanding chemist and a knowledgeable promoter for gender equity the project team thought she would be an effective advocate for change in the Colleges of Science and Engineering. Dr. Rolison visited the TAMU campus in February 2003 as a prelude to the WISE Conference. She interacted with approximately fifty members of the A&M faculty and staff during an open lecture and several small group sessions. Dr. Rolison delivered a powerful message, "Time to Thrive, Not Just Survive: Accumulating Advantage for Women in Science and Engineering." During her various talks, she stated:

> *"Science and engineering (S&E) departments need more women as faculty-and not only to show their undergraduate students (the majority of whom in some disciplines are now women) that a career in academia is a viable path. Yet applications from women for advertised faculty positions in S&E departments rarely match the numbers of women granted Ph.D.s. The disproportionate absence of women who have chosen not to enter the applicant pool for faculty openings gives notice that an unhealthy environment exists in S&E departments and institutions. The women aren't broken: the system is."*

Dr. Rolison's message, although bleak in terms of what is currently being done to attract women and minorities to the sciences, seemed to go over quite well with her audiences. It appeared that her message was received with less resistance than what might be expected, perhaps due to her status as a well-known chemist.

In March of 2003 Dr. Bernice Sandler, Senior Scholar at the Women's Research and Education Institute in Washington, DC visited members of the TAMU community. Dr. Sandler, who played a major role in the development and passage of Title IX and other legislation prohibiting discrimination against women and girls in education, delivered the lecture "Warming Up the Chilly Climate for Women: Strategies for Individuals and Faculty." During this presentation as well as in the various meetings she conducted with faculty members in science and engineering, Dr. Sandler offered advice on ways to improve the climate for both women faculty and women students at TAMU. Although Dr. Sandler's message provided a great deal of historical data and valuable insight, it appeared that her visit was less effective than those of other speakers. This observation is based on the number of comments and questions received both during and after her visit as well as the small number of participants in each of her meetings. Two of the factors that might have contributed to this decline in interest was that 1) she was on the TAMU campus for a single day while other speakers had two days to visit with various groups and 2) she was invited to campus the week following spring break; therefore, publicity for her public talks and small group meetings was more difficult to disseminate.

Dr. Judy (JJ) Jackson visited the TAMU campus in September, 2003. Dr. Jackson, then the Associate Provost for Institutional Engagement at New York University and now the Vice President for Student Affairs at NYU, focused on her research regarding ethnic and gender diversity in higher education with an emphasis on faculty and leadership. In her open lecture, she described much of the data found in her dissertation, "Race and Gender in Engineering Faculty Productivity: What Difference Do They Make?", which is a landmark empirical study. The study covers the research, teaching, and service activities of 665 tenured engineering faculty members in 19 research-1 institutions. Dr. Jackson concluded that productivity of tenured engineering faculty differs little by gender and race/ethnicity. She noted that faculty assessment processes do not take full account of some of the most significant, non-quantitative factors determining performance. She suggested that there is a need for institutions to conduct regular and systematic reviews that take socialization factors into account.

Dr. Jackson's discussions, both small group and public talks, were well attended. Her audiences seemed genuinely interested in her research and indicated as much by asking questions and initiating conversations about her research even after her departure. Her pervasive study of engineering faculty throughout the country seemed to offer her a certain amount of credibility among the faculty members that visited with her at TAMU.

Dr. Allan Fisher was the fifth guest speaker to be hosted by the project. Dr. Fisher visited the TAMU campus in October of 2003. Dr. Fisher is the President and CEO of iCarnegie, Inc. and former Associate Dean of Undergraduate Education in the School of Computer Science at Carnegie Mellon University. While at CMU, Dr. Fisher and Dr. Jane Margolis carried out a program of research and intervention that increased the proportion of women entering the computer science program from 7% in 1995 to 42% in 2000. Their work is described in their book, "*Unlocking the Clubhouse: Women in Computing*" [8], which was the topic of his open lecture. The information presented by Dr. Fisher was used as a springboard for discussions in the FLC on Development and Invitation, which is described in more detail later in this paper. Although Dr. Fisher's work is well-known among computer scientists, his audiences consisted of

few people outside of this arena. There was little interest from other groups across the campus, including women's studies and other women's organizations, to meet with Dr. Fisher. However, the groups that did visit with him (especially the administration and faculty from the computer science department) seemed to leave their conversations with valuable information regarding ways to attract and retain women in their programs.

The last speaker hosted was Dr. Karen Tonso. Dr. Tonso, an assistant professor in the College of Education at Wayne State University, spoke to members of the TAMU community in November, 2003. During her visit, Dr. Tonso described her experiences as she studied the culture of an engineering campus from 1993-1996 by participating in three design courses as an engineering colleague on seven student teams who were completing real-world projects for industry and government clients. Her research grew from her experiences during 15 years as an engineer in the petroleum industry. Dr. Tonso's lectures focused on the cultures of engineering and science, especially the social organization of practitioners (men and women). She suggested that cultural change is a prerequisite to creating gender equity and that change requires critical reflection among engineering and science practitioners as they unpack taken-for-granted assumptions about the way their world is supposed to be. Dr. Tonso's article "Designing Gender Equity into Engineering and Science Cultures: Have We Met the Enemy and Is He Us?" [9] is scheduled to be discussed in the upcoming FLC on the Culture of Science and Engineering.

Dr. Tonso's visit prompted several discussions about the current culture of engineering. For example, 49 participants (14 faculty and 35 graduate students) have signed up for learning communities on the culture of science and engineering to be held in April 2004. Her experience as an "actual" engineer combined with her thorough investigation of the culture of a renowned engineering campus afforded her the luxury of talking with faculty members, especially in engineering, with a degree of candidness that had not been experienced with previous speakers.

Outside speakers have been an effective strategy for promoting change. Their knowledge of current research and their own life experiences, when shared, have provoked reflection and consideration of issues. However, their greatest contributions to change have occurred in small-group meetings with key administrators and faculty members and not in the public presentations. First, intimacy in the small-group meetings has allowed participants to interact with speakers, through both verbal and non-verbal communication, in a more open and free flowing manner than that observed during the public presentations. Second, since the small-group meetings have been sponsored by one or more of the deans and/or associate deans of the Colleges of Engineering and Science, participants have included department heads or their representatives who did not attend the public presentations. Third, participation in the small-group meetings has encouraged some people to attend the public presentations who otherwise might not have come. So the greatest value of the speakers has been their willingness to engage small groups of faculty members and administrators in sessions that have opened avenues for change.

Workshops

The first phase of a workshop "Designing More Effective Conversations" was held in January 2003 and was attended by graduate advisors from a majority of the departments in the College of Engineering. The second phase of the workshop was held on March 11, 2003. Facilitated by

consultants from the Action Design group [10], the workshop was intended to help faculty members make explicit, subtle, but influential interpersonal hypotheses and test them rigorously using observable data. Workshop topics included:

- Understanding dilemmas that block learning and change that might lead to improved research or better teaching;
- Understanding how assumptions, especially unexamined assumptions, hinder conversations and productivity;
- Monitoring and adjusting assumptions and reactions, even in the heat of the moment;
- Asking questions that shift people's perspectives and move understanding forward;
- Creating a customized action plan for continuing personal and professional development.

In the workshops, these topics were explored in plenary forums and in facilitated case discussion groups. Participants were also given the opportunity to further investigate these topics in coaching sessions with Action Design consultants between the two meeting dates. In preparation for the case discussion groups, participants were asked to develop a case study of an important unproductive conversation they would like to learn to handle more effectively. Once in the case discussion groups, the facilitator and other group members reviewed the cases and discussed what each person might have done differently using productive conversation tools presented in the plenary forum. Then, they reenacted the case in a productive manner. In the second workshop phase, participants further developed their skills by exploring a second case study and reviewing video recordings of each case as it was played out.

At the conclusion of the first two-day session of the workshop, feedback from the group participants was very positive. The participants agreed that the content of the session along with constructive coaching by the consultants helped them to understand why certain conversations do not go well. Moreover, the participants agreed that they now saw ways in which each of the conversations might have been more productive. Many expressed interest in furthering their knowledge of the topics covered in the workshop, specifically the use of the ladder of inference [11, pp. 242-246] and the balancing of advocacy and inquiry [11, pp. 253-259] in their conversations with colleagues and students.

Matching Grants to Support Women Students

In an effort to encourage faculty members to invite women students in their discipline to enter the academic pipeline, matching funds were made available. The funds can be used either for undergraduate student research or for travel stipends for women students to attend and participate in technical conferences. To date, 12 women students have received travel support and 23 women have received matching support for summer undergraduate research projects. No request for matching support has been denied for lack of funds.

In the summer of 2003, the GDP provided matching support for 16 female engineering students who were participating in undergraduate student research. Ten of the participants were students at Texas A&M University while the other six students were from Purdue, Xavier, University of Maryland, Smith College and TAMU-Kingsville. All of the participants were U.S. citizens and came from a variety of ethnic backgrounds. Their areas of interest included aerospace, biomedical, chemical, computer, electrical, industrial, civil, and nuclear engineering.

Faculty Learning Communities

The final mechanism of change utilized in the GDP is the faculty learning community (FLC). A FLC is a group of faculty members who agree to meet regularly to probe selected articles from the literature about a strategic initiative and collaboratively build meaning from the readings and conversation. While the preceding three mechanisms of change are largely one-time or short term events, learning communities are a sustained initiative intended to engage participants over a longer period of time, and thus increase the likelihood of change. The four areas that have been identified by the GDP as key components to creating equitable environments are the topics of the learning communities.

1) ***Mental Models*** – Faculty members understand and make explicit how they build chains of reasoning from observable data through assumptions to action.
2) ***Development and Invitation*** – Faculty members examine mechanisms through which women and men develop intellectually and motivationally in order to increase understanding of the role of invitation in the development process.
3) ***Culture of Science and Engineering*** – Faculty members investigate the culture of science and engineering, how it might need to change to attract equal numbers of women and men, and what role they might play in catalyzing change.
4) ***Personal Vision and Commitment*** – Faculty members improve their capacity to imagine and act in ways that maximize their individual self-fulfillment and improve their capacity to move from creating a personal vision to recognizing that they have the power and responsibility to realize it.

Because of the sustained nature of these groups, certain energy forms while the group progresses through the given material from week to week. As a result of this energy, a momentum is created among the participants. This momentum creates the necessary force that eventually produces change in each of the participants, not just temporary change but change that seemingly restructures even the most deeply held beliefs in many of the community members. Because the learning communities have been the most effective tool thus far in the GDP in getting people to think differently, a more in-depth look at FLC follows.

An In-depth Look at Faculty Learning Communities

In FLC, small groups of faculty members (5-12 participants) meet weekly for ninety minutes for four weeks to discuss one of the four above-mentioned strategic disciplines. FLC participants explore the issue at hand using selected resources, facilitated dialogue and interactive activities. Group members prepare for and attend all team meetings, focus on ways to create a more inclusive environment for their colleagues as well as their students, share personal experiences, interact collaboratively with colleagues, consider new ideas and perspectives, and serve as a resource for other faculty members.

Mental Models

To date, two FLCs on Mental Models have been conducted. Faculty from across the TAMU campus were invited to participate in each of the communities. Communities for graduate students in science and engineering were hosted simultaneously as well. Mental models are deeply ingrained assumptions, generalizations, or even pictures or images that influence how we understand the world and how we take action [12]. There are two types of skills that are central to practicing the discipline of mental models: reflection (slowing down our thinking processes to become more aware of how we form our mental models) and inquiry (holding conversations where we openly share views and develop knowledge about each other's assumptions) [11].

An example of a commonly held mental model that continues to plague organizations striving for equity and diversity is that most people tend to invite and encourage people like themselves. Presentations of research results along this line are typically ineffective unless faculty members develop the discipline to perceive their mental models and realize their importance. Once faculty members surface their own mental models of whom they encourage and invite and why, they can examine their mental models and decide whether and how changes could be made.

Throughout the four-week FLC, faculty members (and graduate students) read articles related to mental models and discuss such topics as what mental models are, the effects of gender schemas (a subset of mental models), the power of subtle discrimination, and how to move from defensive reasoning to productive reasoning via critical reflection [13, 14]. It has been evident at the end of each of the four week sessions that many of the participants experienced a certain level of change in the way that they thought about and acted upon their own mental models.

One faculty member commented on her experience in the Mental Models FLC. "My own learning was primarily awareness of differences in mental models of others, and that these models are carried within even those of an elite group of intelligent persons. I learned that mental models are good when they are dynamic and help one to adjust to change and learn, but bad if they are rigid or imposed on others, thus limiting learning and progress." Another female faculty member stated, "For many years, I considered myself a victim. But now I see that I am also a part of the problem. I also carry around inaccurate mental models that result in biased behavior." A male faculty member noted that "… women are just as biased against women as men are and… it is a cultural rather than a man vs. woman issue. This is liberating because otherwise I would be very defensive (or more defensive) about discussing gender equity issues." These and similar comments show participants experienced a certain level of change in the way that they think about their own mental models and the models held by others around them.

On occasion, several participants expressed frustration at the authors' reluctance (in the readings assigned for each week's discussion) to offer clear-cut remedies for correcting inaccurate mental models. However, as the discussions progressed, the complexity of the problem became more evident and the quest for solutions moved from an external to internal search. One participant concluded, "A person has to be willing to accept that they need to change. The only way to truly change is through critical self reflection." Another participant noted, "What we are dealing with is indeed very complex and very abstract, and at the end of the day the easiest thing to change is yourself - not the world."

In each Mental Models FLC, participants exhibited a heightened awareness of how mental models shape their daily conversations and actions. An increased understanding of gender schemas and the various ways that these schemas might influence daily activities of the participants was also observed. This was true for both the men and the women in each of the groups, which were approximately 50-50 in their gender composition. The majority of the participants concurred that subtle, sometimes inadvertent, inequities accumulate over time to eventually create such a large disparity for women. For one participant, this recognition brought new revelations. "I feel empowered as a result of today's discussion. Now that I can identify some of the subtle inequities that women and minorities face, I can work to change them both personally and professionally."

Although the articles assigned to the groups typically introduced material and research previously unseen or unnoticed by most of the group members, the most influential component of the FLC seems to be dialogue between peers. As the groups progressed through the four-week sessions and became more comfortable with one another, they began to share personal stories that often illustrated consequences of incorrect mental models on their own careers. These stories seemed to have a profound effect on other members of the group, and often acted as a springboard for a more enriched and meaningful discussion. It is doubtful that the participants would have entered into this level of conversation based on the readings alone.

Development and Invitation

Learning Communities on Development and Invitation (both for faculty and graduate students) have been hosted twice during 2003. In this FLC, faculty members examine mechanisms through which women and men develop intellectually and motivationally in order to increase understanding of the role of invitation in the development process. Faculty members were assigned articles related to several topics. These included 1) Why are women and men so different: nature vs. nurture? 2) School experiences and psychological perspectives of women vs. men 3) Differences in the communicative patterns of women vs. men and 4) Creating a more inviting learning environment [15, 16].

Each participant finished with greater appreciation and understanding of differences in development between men and women. They seemed to understand that because of these differences, there is likely just cause for men and women to be treated differently in certain situations based on the typical historical components of a female's socialization vs. a male's socialization experiences. One male faculty member from the College of Science submitted the following comments: "The community helped me focus on the little things that make the difference in the long run. Even the most well educated and well intentioned people would have learned a lot and would have realized that the problem is much more subtle than just the simple question of being fair. I would recommend the [event] to everybody, especially to the people in decision making positions." A male faculty member from the College of Engineering stated, "I am certainly more conscious of the issues. I realize that the engineering community needs to do more to invite women into this profession. I also realized that we need to create and maintain a healthier environment for the women after they choose to be engineers." Group members (both men and women) also appeared to have a heightened sense of the vital role that they play in

creating a welcoming climate for both their students (both one-on-one and in large group interactions) and colleagues, specifically in recruiting and retaining fellow faculty members.

Similar to the discussions in Mental Models FLCs, group members shared numerous personal stories in the FLC on Development and Invitation. Many of these stories described group members' experiences with their own children's development, or the development of a close family member. They discussed how their children have been socialized differently (or in some cases the same), depending on their gender. Again, the willingness of the group members to be so candid with their peers provided a platform for conversations that likely would not have been present if dialogue had centered on assigned material alone.

Participants in each of these communities seemed to scrutinize the assigned material, often noting a lack of data presented by the authors or focusing on details of a given situation and not on the implications in a broader sense. Because of this, the dialogue often relied heavily on the personal experiences of some of the group members. For instance, when it was ascertained that meetings (in this case a search committee meeting) were conducted in a much different manner when women were present vs. when they were not, some participants found this hard to believe. A story was then told by a male faculty member about his experience in a search committee meeting when the one female committee member was absent. The resulting comments and actions of the committee were far different, in a negative way in this case, than when the female member was present. This sort of dialogue seemed to force the group to progress through their doubts about the assigned material, and move to the next level of conversation.

Culture of Science and Engineering

The FLC on the Culture of Science and Engineering will occur in Spring 2004. In this community, participants will investigate the culture of science and engineering, how it might need to change to attract equal numbers of women and men, and what role they might play in catalyzing change. Participants will explore a number of questions including 1) What is culture? 2) How does classroom culture in science and engineering affect men and women differently? 3) Is there room for difference in the culture of science and engineering? and 4) How might a culture be transformed? To investigate these questions, group members will explore a variety of materials including work from Edgar Schein [17] who has studied organizational culture as well as the research of William Tierney [18] whose research focuses specifically on organizational culture in higher education. Participants will also draw from two authors' expertise on women's experiences in engineering: Elaine Seymour [19], and Karen Tonso [9]. In an attempt to better understand the implications of a given culture, community members will view the documentary video "A Class Divided" [20] and will also read a segment from Virginia Valian's book "Why So Slow?" [4] as well as two chapters from "Athena Unbound: The Advancement of Women in Science and Technology" [21]. Finally, the participants will explore Kezar and Eckel's [22] work on interactions between institutional culture and change and conclude with a look at how a specific culture was able to change by reviewing the work of Blum and Frieze [23, 24].

The primary challenge encountered in organizing this community has been the lack of literature available on cultural change. Although there are numerous articles that define culture and offer descriptions of cultures in many different environments, there are few resources that investigate

the impact of culture on a specific population. Since the focus of this community is to explore the meaning of culture, the implications of culture, and ultimately how a culture might be altered to promote change, resources describing cultural change are essential, but currently elusive, components of the assigned reading material.

Personal Vision and Commitment

In the final learning community, the FLC on Personal Vision and Commitment, faculty members will improve their capacity to imagine and act in ways that maximize their individual self-fulfillment and improve their ability to move from creating a personal vision to recognizing that they have the power and responsibility to realize it. In higher education there appears to be a tendency for faculty, as is true for most employees of large organizations, to assume that change should start at the top. While top-down change is likely the most effective and efficient manner of changing an organization, it is certainly unlikely that pervasive and transformational change will occur without the buy-in and active participation of constituents at all levels of the institution. This learning community will be of great importance to faculty that seek changes in their respective environments, but feel that they are powerless as individuals to promote significant change.

Participants will investigate how to create a personal vision by exploring the work of Robert Fritz [25], Stephen Covey [26] and Peter Senge [11]. Once they have refined the process of creating a vision, participants will investigate how they can commit to their vision in a way that will bring their vision into being. This will be accomplished by exploring a number of works, including Peter Block's book "The Answer to How is Yes" [27].

Conclusions

Based on the experience of the project to date, cultural change with respect to equity can be catalyzed and accelerated, if it is recognized that cultural change is about thinking, talking, and acting differently in subtle, but pervasive, scales. Change initiatives that are willing to engage faculty can demonstrate subtle, but significant, changes in patterns of thinking. Comments from participants in each event that the project has sponsored indicate degrees of change in understanding and attitudes about gender inequities, especially the complexity and subtlety associated with constructive changes. It is likely that pervasive cultural changes will not occur within the time span of the current project. However, it is posited that continued investment in efforts to change faculty through constructive conversations will lead to desired cultural change.

Challenges still remain. How we frame our challenges relates directly to continued improvement and success of the GDP. If we frame challenges so that responsibility for future action lies outside our locus of control, then we provide ourselves no alternatives for action. If we frame challenges so that we can take action, then we provide opportunities for improvement. The learning activities and environments that we have created are successful at engaging, intriguing, and causing change among participants. However, the number of participants is lower than desired. The single most constructive improvement that the project can make is to increase the number of participants, both among faculty members and graduate students. One explanation for the current participation rate is that an insufficient number of faculty members place an

adequately high priority on the issue to justify participation. However, framing the challenge in this way places of the locus of control with the faculty members, out of our reach. Another way of framing the challenge is to identify alternatives that the project could explore. One alternative is to engage department heads and deans in recruiting faculty participants. Another alternative is to create a more compelling learning experience for those that participate in project-sponsored events. A third alternative is to raise the level of awareness among faculty members of the opportunities that are available to explore gender inequities and ways in which inequities might be addressed. These alternatives will be explored during the remainder of the project.

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