

MY MENTORING PHILOSOPHY IN STEM

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ABSTRACT

Over the past 25 years of my career, I have carried out extensive mentoring of early career scientists, students, and peers in STEM (Science, Technology, Engineering, and Mathematics) topics in general and cyber security and data analytics in particular. This article describes my philosophy in mentoring as well as a summary of my accomplishments.

1. INTRODUCTION

As stated in [1], “*Mentoring is a powerful personal development and empowerment tool. It is an effective way of helping people to progress in their careers and is becoming increasingly popular as its potential is realized. It is a partnership between two people (mentor and mentee) normally working in a similar field or sharing similar experiences. It is a helpful relationship based upon mutual trust and respect.*” Over my 34+ year career in computer science and information technology in general and cyber security and data analytics in particular, I have come to realize the critical role that mentoring has played in the advancement of my career. As a result of having an outstanding set of mentors over the past 20+ years not only have I had an extremely successful and varied career, it has also enabled me to receive some of the most prestigious awards in computer science and information technology. Through my mentors, I have learnt very good mentoring skills and have used them in my efforts to mentor early career scientists, students and peers many of whom are women and some of them from minority communities.

While there are excellent articles on mentoring that I have read and benefitted from, I believe that on the job training in mentoring has been most valuable to me. Over my 34 year career in the commercial industry, federally funded research and development center, government program management, and academia, I have had the opportunity to mentor numerous early career scientists, students and peers. I decided to write this motivational article to share my mentoring philosophy with others.

The organization of this article is as follows. My brief biography is provided in Section 2 so that the reader can understand where I am coming from. The reason as to why I got into mentoring is discussed in Section 3. My mentoring philosophy for early career scientists, students and peers is discussed in Sections 4, 5, and 6 respectively. My related mentoring efforts are discussed in Section 7. Demographics of my mentees are given in Section 8. Methods I have used for mentoring are given in Section 9. Finally the article is summarized with a discussion of future directions in Section 10.

2. MY BACKGROUND

First I would like to introduce myself so that one can have a better understanding of my mentoring philosophy. I am Dr. Bhavani Thuraisingham, the Louis A. Beecherl, Jr. Distinguished Professor of Computer Science and the Executive Director of the Cyber Security Research and Education Institute (CSI) at The University of Texas at Dallas (UTD). I am an elected Fellow of several organizations including the IEEE (Institute of Electronics and Electrical Engineers) and the AAAS (American Association for the Advancement of Science) and have received prestigious technical awards in cyber security and data analytics including the IEEE Computer Society’s 1997 Technical Achievement Award. The leadership awards I have received (partly for mentoring) include the Career Communications Group Inc.’s 2001 Woman of Color Research Leadership Award. I have unique experience working in the commercial industry, federal research lab, US government and academia and my 34 year career includes research and development, technology transfer, product development, program management, and mentoring at Honeywell, MITRE, NSF (the National Science Foundation) and UTD.

After my undergraduate degree in Mathematics and Physics from the University of Ceylon (now Sri-Lanka), I received my graduate education in the United Kingdom before moving to the United States in 1980 and worked first as visiting faculty and then in industry prior to joining academia. I have a strong

track record of mentoring numerous junior faculty, students and colleagues in STEM (Science, Technology, Engineering and Mathematics) topics in general and cyber security and data analytics in particular, several of whom are women and some of them minorities, during my 25+ years as project leader and department head at MITRE between 1989 and 2001, program director at the NSF between 2001 and 2004, and as professor at UTD since October 2004.

3. HOW DID I GET INTO MENTORING?

While I was introduced to mentoring when serving on our division diversity board at Honeywell, it was not until I joined MITRE that I realized how critical mentoring was. For 14 years into my career, I did not have a mentor and progressed through motivation, determination and sheer hard work, qualities taught to me by my mother. When I joined MITRE in January 1989, I had established technical teams for my projects and started informally mentoring my junior colleagues. We obtained patents and published high quality papers and we were successful in getting recognition for the work. However, when it came to a leadership position in 1994 for which I felt I had all the skills for, I realized that there was some reluctance in giving me the opportunity because I believe I had no one speaking up for me in the management circles due to a major reorganization in our division and changes in management. At that time I was fortunate to have had the opportunity to work with Dr. Maria Zemankova (now at NSF) who was in a senior position at MITRE. Maria pointed out my accomplishments to the senior management. In addition, I also had the privilege of working with Mr. Al Grasso who was my project leader at that time (now the CEO of MITRE). Al also wrote a strong support letter for me and I got the position. Before Maria left MITRE in the summer of 1994, she requested my manager, Mr. Henry Bayard, to promise her that he will mentor me. I had the privilege of being mentored by Henry for many years. Around 1995, following Maria's advice, I reached out to Prof. CV Ramamoorthy from UC Berkeley for mentoring and I benefitted a great deal from his guidance and received several prestigious awards in subsequent years. The ultimate recognition was when the MITRE president Mr. Marty Faga (back in 2003) requested an article to be written about me [2] so that I could be a role model.

It was in the mid 1990s that I seriously started mentoring individuals mainly in cyber security and data analytics. These individuals included: early career scientists, students and peers. I read some books on leadership and mentoring including the famous *seven habits* book by Steven Covey [3] and more recently *Mentoring 101* by John Maxwell [4] as well as articles from the *Harvard Business Review*. I also took a management leadership course at MITRE. While one can get a lot of great tips on mentoring from such excellent books and courses, I believe that first and foremost the passion for mentoring has to come from within, just like one's passion to study mathematics, computer science, history or geography. Second, one has to learn on-the-job and persevere. Third, a mentor needs to be patient and work with the mentees. Therefore the 3 Ps for a successful mentor are **Passion, Perseverance and Patience**.

4. MENTORING PHILOSOPHY FOR EARLY CAREER SCIENTISTS

Although I mentored early career scientists while at MITRE and NSF, it is at UTD that I gained recognition from the senior administration for being an outstanding mentor. I have had the honor and privilege of mentoring several early career scientists. As a result of my mentoring, these scientists have had exceptional success in their careers. I ask myself what mentoring model did I use? I believe I bring out the best in the junior faculty and motivate, inspire as well as encourage them to excel but at the same time work independently. I also help them to see the big picture and long-term rewards. I am effective in managing change and ensure that my mentees are recognized if there is a new administrator (e.g., department head, dean). Furthermore, a mentor/mentee relationship is two-way. While I help my mentee to excel in his/her work, he/she also helps me to enhance the CSI and as well as improve my knowledge in the field. We essentially build a partnership and find a win-win situation that is mutually beneficial. I study each mentee and arrive at a flexible plan tailored for each individual. I believe that there is no one-size-fits-all. Each individual is unique in terms of capability, talent, expertise and emotions. My goal is to provide an environment so that he/she can realize his/her full potential. As a result, my mentees have

received highly prestigious awards (e.g., NSF CAREER, AFOSR YIP (Young Investigator Program) and are becoming leaders themselves.

5. MENTORING PHILOSOPHY FOR STUDENTS

I started advising students in the mid-to-late 1980s while serving as an adjunct professor and member of the graduate faculty at the University of Minnesota, and I continued this activity throughout my career. However, it was not until I joined UTD when mentoring students became part and parcel of my work. I have mentored numerous BS, MS and PhD students at UTD and they have had numerous career accomplishments. The question I am asked is what is my mentoring philosophy with students? I motivate and encourage my students a great deal to work in teams. Therefore, we have a collegial atmosphere in our Institute. I give them challenging problems and expect them to work hard. However, I also encourage them to achieve a work-life balance. For those students whose first language is not English, I make sure they take lessons (e.g., speak at rotary clubs or take speech lessons on the web) so that by the time they graduate, they can speak effectively. My goal is to bring out the best in students. I want them to treasure the experience they have as a student. It is very important for me that they are not narrowly focused on their research problem. They have to read widely on topics related to their research and participate in team meetings. I keep in close contact with my students after graduation and continue to discuss their career options with them and advice them on challenging work situations.

During my ten years at UTD, I have graduated 12 PhD students, 4 of them women and one African American. I have three students in the pipeline, one woman and one African American. I am working hard on recruiting more students from the female and minority communities.

6. MENTORING PHILOSOPHY FOR COLLEAGUES AND PEERS

I have mentored numerous colleagues and peers, several of them female, throughout my career. As a result, my mentees have received NSF CAREER awards as well as awards from professional organizations (e.g., IEEE Fellowships). Several of them hold senior positions in academia, government and industry. Some of my mentees are also mothers with young children. Having had to cope with the challenges of balancing motherhood and career myself in the early 1980s, I advise these mentees on how to achieve a work-life balance. The question I am asked is whether my mentoring philosophy is different for those outside my organization? While my goal is again to bring out the best in my mentees, with outside colleagues, I try to learn about them and their organizations as well as talk to them to make sure that my mentoring will be valued and my advice will be followed. Only after that do I take on a mentoring role.

7. RELATED EFFORTS

I have mentored several other colleagues and written letters for their green cards, U.S. citizenships, tenure, promotion and awards. My efforts also include (i) organizing panels at the Secure Knowledge Management workshop on Women in Cyber Security, (ii) discussing cyber security challenges with high school and undergraduate students, (iii) speaking at events such as the Dallas chapter of SWE, UTD student chapter of SWE, DFW-ATW (Alliance of Technology and Women) meetings, and the Berkeley/Cornell TRUSTWISE (Women Institute for Summer Enrichment under the NSF TRUST program) conference and (iv) maintaining collaborations with professors at minority and women institutions to recruit students. I have also utilized the mentoring experience I have gained and have put together what I call an **8E Framework** for Advancing Women in STEM which I developed in 2011 and I utilize this framework for mentoring [5]. The 8E's are Empower, Entrepreneurialize, Educate, Establish, Employ, Energize, Encourage and Engage. Since then I am considering four more E's and they are Enrich, Enable, Excite, and Endear (women to STEM). I have given interviews on cyber security for women's magazines (e.g., womansday.com [6]). I also wrote an influential motivational article about my career [7] that has received several comments from female colleagues and students such as "it was riveting". I have been involved in events to promote cyber security to underdeveloped countries and was part of an NSF-funded U.S. delegation to India for the Indo-U.S. Cyber Security workshop in 2010. I am

discussing with NSF about organizing a similar workshop in Sri-Lanka in 2015. I have participated in panels on protecting children from inappropriate content on the Internet chaired by Hon. Richard Thornburgh ('00) and the East West Institute ('10). More recent outreach efforts include giving talks at public libraries as well as participating in events like the Grace Murray Hopper conference. I will also be participating in the Women in Cyber Security Conference Series.

8. DEMOGRAPHICS

Computer Science is a field dominated by Caucasian and Asian (both east and south) men. Women and minorities are a rarity in the field. I usually find about 10% of the undergraduate students in my classes to be female. The numbers are around the same at the PhD level. However, at the Master's level, the majority of our students are from South Asia and one can expect to find about 30% female students. At the faculty level in many CS departments, women are often fewer than 20%. Departments are trying their best to change this, but it's difficult to attract female and minority students into computer science at 18. One has to work with them in their formative years and even start at elementary school. Therefore CSI is part of a campaign (together with UTD's Center for Education and Outreach) to mentor and recruit more female and minority students by working at the elementary school level. Furthermore, in a field that is dominated by men, it is remarkable that I have mentored so many women (around 66%). I believe this is also partly due to the fact that I am a woman and therefore women researchers look up to me as a role model. I am also determined to add women faculty to CSI and am now searching for highly qualified female candidates. I have also begun discussions with a major social media company to sponsor lab projects so that we can attract more female students in areas like social media.

The percentage of minority students (e.g., African, Hispanic, and Native American) is even smaller than the percentage for women. This is also due to the fact that very few of them get into STEM. While I have tried my best to mentor and recruit minority students and faculty and have succeeded, significant improvement is needed. This is one of the main reasons I am collaborating with minority institutions. I am also planning to attend the National Society of Black Engineers (NSBE) and Society for Hispanic Professional Engineer (SHPE) meetings and give motivational talks starting in 2015. Career Communication Group Inc.'s Women of Color meetings also give me an opportunity to recruit minority women.

9. INNOVATIVE METHODS

I am often asked what innovative methods do I use? My answer to this question is to think of the person first and then the work. That is, the person has to be happy. Only then will he/she excel in their work. I believe this is something I learned from my mother who never pushed me into anything I did not want to do. If there was something important I had to do, she had a way of making it interesting so that in the end I absolutely wanted to do it. My motto is to "try and try until you succeed" and "never be afraid of failure". It is OK to get a proposal rejected. It is OK to be criticized. We have to be comfortable in our own skin. I learned mentoring mainly on-the-job. The more I did it, the better I got at it. I believe that mentoring is not a one-way street. The mentor also needs to see some benefit. I have benefitted by getting enormous satisfaction and also by being given a distinguished professorship.

10. SUMMARY AND DIRECTIONS

Successful mentoring is a careful balance between working closely with the mentee to help him/her excel but at the same time give him/her independence to pursue his/her dreams. Mentoring includes not only giving career advice but also motivating and inspiring the mentee as well as enabling him/her to handle change and develop a vision for the future.

I have mentored numerous early career scientists, students and colleagues, many of whom are women and some of them minorities. My mentoring philosophy is to understand the mentees and bring out the best in them by motivating, inspiring, encouraging and advising them. Essentially I encourage my mentees to exploit their strengths and work with them to address and improve their limitations. Each individual has a unique set of talents and my challenge is to make my mentee realize his/her full potential. I also ensure that my mentees are equipped with the skills to handle changes in the organization. I believe that my

success in mentoring also includes my mentees becoming good mentors and leaders themselves and I am encouraged with the initial results. I am following my 8E framework for mentoring as well as the 3Ps (Passion, Perseverance and Patience).

Future directions will include continued assessment of the progress, addressing the limitations, enhancing alumni relations at CSI, carrying out recruitment from organizations such as SWE, NSBE and SHPE, and making CSI a role model for mentoring in STEM. We will work more closely with the university-wide initiatives in STEM to learn from these initiatives as well as to share our success at CSI. We will develop a plan to use social media (e.g., @CyberUTD) as a constructive tool for mentoring. I will also work with the administration for succession planning (for my executive director position) and I am hoping that one of my mentees will be ready to compete for this position when advertised.

As my eighth grade teacher, who I now believe was my first mentor, used to tell us “the children of today are the citizens of tomorrow”. I am passionate about developing an outstanding next generation of educators and researchers in STEM. I believe I have gone beyond mentoring and have become what Ms. Sylvia Hewlett calls a “*sponsor*” [8].

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