Mentoring Philosophy and practices: Chandralekha Singh, Department of Physics and Astronomy

I believe in mentoring each Ph.D. student in a highly individualized manner and I try to adapt my mentoring approach to suit each student's prior preparation, background and goals. For me, mentoring involves a very intense and personal relationship with each mentee. I develop a mentoring relation with each Ph.D. student recognizing their strengths and weakness. I always praise and recognize students on their strengths and keep their morale up while also trying to work on the areas that may need improvement. Although it is very time-consuming, it is personally very satisfying endeavor for me. I derive immense joy from seeing that my personalized mentoring approach helps each of my Ph.D. students grow and develop as individuals and get closer to reaching their goals. I am extremely proud of the fact that my Ph.D. students have accomplished a lot and all of my Ph.D. students are in academia (many are faculty members). They are all pursuing academic careers that are consistent with their Ph.D. work and are contributing to the scientific enterprise.

I want to ensure that all my graduate students succeed in their professional pursuits and they grow into what they want to be consistent with their goals. Out of the 19 Ph.D. students I have mentored at Pitt, some have shown interest in a particular area of research I pursue, e.g., using research for improving student learning of quantum mechanics, improving students' problem solving skills in physics, or investigating the role that intuition and expertise play in learning physics. On the other hand, other graduate students initially do not have a clear idea of the direction they want to pursue for their Ph.D. thesis. Regardless of the initial certainty or uncertainty that the students who approach me to supervise their Ph.D. have about their specific research interests within the area of Physics Education Research (PER), I embrace the task of mentoring all of them to suit their goals and interests with enthusiasm. At the same time, it is very important to me to hold each student accountable to high standards while guiding them through.

My mentoring approach is inspired by the cognitive apprenticeship framework which is the field-tested cognitive model. This mentoring approach has three major components: "modeling", "coaching" and "scaffolding and weaning". Modeling refers to me demonstrating the criteria of good research for Ph.D. students so that they learn to pursue research in an effective manner. Coaching means providing my Ph.D. students opportunity to carry out different components of research, e.g., planning a research study and thinking about its big picture implications to the discipline, considering different aspects of research methodology, implementation of the plan, contemplation of the timeline and possible outcomes while providing immediate guidance, feedback and support to students at different stages of their research as needed. Scaffolding and weaning refer to gradually reducing the feedback and support to help students develop self-reliance in their research so that they are able to carry out different aspects of the research on their own. According to the American Institute of Physics (AIP) data, in physics Ph.D. programs across the US, only 55% of the graduate students who begin their pursuit of a Ph.D. in physics complete it. The percentage of students who are admitted to my department of Physics and Astronomy also approximately hovers around 55% for those who complete their Ph.D. Among those who drop out, some drop out due to various reasons even after they have successfully finished their mandatory course work that we require in physics and are pursuing research with individual faculty members. However, I am very proud of the fact that due to my personalized adaptive mentoring none of the Ph.D. students who have begun their Ph.D. research with me have dropped out and the 14 who have completed their Ph.D. under my supervision have all found academic positions (these positions in physics and related areas are coveted

and very difficult to secure so the number of my mentees who have succeeded in getting such positions is most likely the largest number in my department of physics and astronomy in the last two decades).

One thing I emphasize in my mentoring of Ph.D. student is that research is never a linear path and setbacks are common. Therefore, students should not take their setbacks personally and use it as a stepping stone to getting ahead. I discuss with them that realizing that a research study did not work out the way intended is itself a useful learning experience. Different students who have obtained their Ph.D. with me have had different levels of initial self-confidence in pursuing research. I actively work with each Ph.D. student to ensure that they develop higher level of self-efficacy, persist despite the setbacks and keep their morale up. I also discuss with students the importance of presenting their research at conferences and also of networking with researchers in our discipline as much as possible. I also encourage them to develop leadership skills and get involved in various executive committees that has graduate student involvement in professional organizations such as AAPT and APS. I also encourage them to organize sessions and not only give contributed talks but also give them opportunities to give invited talks at conferences, colloquia and seminars. I discuss with each Ph.D. student who is my mentee, their career goals after they finish their Ph.D. and together we evaluate periodically how they are getting closer to achieving those goals. All of my Ph.D. students go to at least one national conference in our discipline each year and present their findings. This is a great way for them to showcase their work and get inspired by all the interactions with other researchers in the discipline. I also work with honing the scientific writing skills of each of my Ph.D. students and while they are all at very different points initially, by the time they graduate, they are all very good at writing about their research for scientific journals.

I am also passionate about mentoring women in physics who are severely underrepresented in Ph.D. physics programs (according to the AIP data, women currently represent 18% of physics Ph.Ds. in the US). Roughly 42% of my Ph.D. students have been women. Equally importantly, I make time to mentor female Ph.D. students in my department one-on-one even if they are not pursuing research with me. I still remember the uneasy feeling and loneliness I experienced 30 years ago in 1988 when I met my cohort of 36 Ph.D. students in physics at the University of California Santa Barbara and realized that I was the only female Ph.D. student in my class! Making sure that the female students at Pitt in my department are supported and thrive in our department despite the fact that they are underrepresented is extremely important to me. I want them to feel that they belong in the physics department despite the fact that there are only three tenure-track female faculty in my department (including me) out of about 40 faculty members and few women in their cohort of Ph.D. students. Moreover, since my discipline, physics, has often been associated with brilliant men, women in physics often lack a sense of belonging in the physics department and experience stereotype threats. I want them to know that they always have a mentor whom they can go to when they want someone to talk to or have a concern about something. Furthermore, similar to discussions with my own Ph.D. students, I discuss with the female Ph.D. students in my department views about whether intelligence is “fixed” or “malleable” and how by working hard and smart in their research, they can excel. This type of informal mentoring of female Ph.D. students (even if they are not doing research with me) gives me great satisfaction similar to the satisfaction I get from mentoring my own Ph.D. students.

I won the Pitt STRIVE Outstanding Graduate Mentor Award in 2017 from Swanson School of Engineering (Pitt STRIVE focuses on providing excellent mentoring to graduate students from the underrepresented groups in the STEM disciplines). Since mentoring plays a critical role in student success, I have conducted several workshops on inclusive mentoring at Pitt in different forums and also at National Conferences.