ETOP 2019 Conference Report

University of South Florida

I participated the 2019 SPIE Education and Training in Optics and Photonics (ETOP) conference in Quebec City, Quebec, Canada from May 21 – May 24, 2019. I learned a lot of things from the conference, and below are some of the highlights that I feel would impact my teaching the most in the future.

1. Enhancing students' engagement and learning outcomes through peer instruction

In the session of "Online classroom and remote learning", I have learned new approaches to enhance students' engagement and learning outcome. In particular, Prof. Phys Adams from Vanier College has shown their approach of using a new online student engagement tool "myDALITE" in general physics. The key difference between myDALITE and other common online homework systems is that the students are not only required to do the homework, but they need to offer their "rationale" as text input to each problem. All the rationale inputs from all the students will be archived, and some will be provided to students who have made mistakes. By reading the rationales for both correct and wrong choices, the students can learn better about how to correctly approach problems and reach the correct answer with correct strategies. The information can also be shared between the same course among different classes and different years.

I feel like forcing students to provide rationales and allow them the study the rationales from peers are excellent choices for STEM classes. Due to the limited teaching resources, most of lower-level STEM classes, including General Physics, uses mostly multiple choices as in-class and out-of-class exercises. This has serious limitations to students as they cannot guarantee the students to use the correct problem-solving procedures to each problem. Thus, collecting information of how each students analyze and solve the problems as "rationales" would allow students to review the "methodologies" from the peers and learn from peers, which is more useful than memorizing the answers of the problems. I plan to enhance peer discussion and exchange rationales for the in-class exercises in my Calculus-based General Physics I (PHY 2048) and Problem Solving for Calculus-based General Physics I (PHZ 2102) in Fall 2019. I plan to experiment the use of myDALITE in in-class exercises or part of the homework problems for PHY 4424/5937 (Optics/Optics for Scientists) for Spring 2020.

In the workshop "Using digital technology into STEM", the host heighted ten techniques that can use digital technologies to engage students in domain-specific activities. For small class sizes, the use of "reflective writing" would encourage students to prepare better for class by reading section of text or video ahead of time. The students are then asked to write in free style anything that they struggle to understand by submitting a short paragraph via email. The instructor would then summarize the feedbacks from the students and use as the focus of the class to better tune the teaching towards the students' actual needs. The workshop also demonstrated in-live to use SMART board technologies to perform dynamic lecturing, which I feel like to be more powerful than regular PowerPoint slides that are commonly used in regular STEM courses. Moreover, it is shown that SMART board can be used for both a teaching tool and student's interaction tool if a modernized classroom can be designed with multiple SMART boards, each for one

group of students. The workshop also highlighted the use of embodied and virtual simulation demos that can let the students to interact more with specific physical concepts or physical model and by playing with it to receive customized feedback. I plan to look into how to use the available technologies in classrooms to incorporate these ideas into my Calculus-based General Physics I (PHY 2048) and Problem Solving for Calculus-based General Physics I (PHZ 2102) in Fall 2019 and my PHY 4424/5937 (Optics/Optics for Scientists) for Spring 2020.

2. Curriculum development and improvement for "Optics"-related upper-level STEM courses.

In the session of "curriculum development and improvement", I learned a lot of new thoughts of experimental demonstrations from the talk "Undergraduate course on biomedical optics at a liberal arts college" given by Prof. Michael E. Durst from Middlebury College USA and from the talk "quantum harmonic oscillator fluorescence" given by Prof. Daniel Boye from Davidson College, USA. They provided a lot of hands-on demonstration ideas that can visualize the concepts of optical imaging, optical spectroscopy, which are extremely helpful to convey the knowledge to students who have limited exposures to Optics before taking the class. I plan to take some of the ideas into my PHY, such as the demonstration of structured illumination for super-resolution imaging, and the florescence of natural minerals, into my PHY 4424/5937 (Optics/Optics for Scientists) for Spring 2020.

In the same session, Prof. Bahaa Saleh (Director of CREOL, UCF) presented his new course in the talk "Teaching Optics from a linear Vector Space Perspective". This is a graduate level course for first-year graduates at CREOL before they take Quantum Mechanics. Prof. Saleh emphasized the mathematical commonality in polarization optics, matrix optics, Fourier Optics, and quantum mechanics in terms of linear algebra. By unifying the mathematical tool, he shows that students could feel much more comfortable to learn different physics without struggling the maths which is often formulated with different symbols and terminologies for different physics. I feel Dr. Saleh's approach to be extremely enlightening as it is common to see the students struggling in learning physical concepts due to the lack of adequate math skills. I have been teaching General Physics, Mechanics and Optics in the past, and I have observed such struggling a lot. Pointing out the similarity of math tools in different classes would reduce the stress of students, and would prepare them with a broader perspective in learning different classes. I plan to improve my lecture notes of PHY 4424/5937 (Optics/Optics for Scientists) for Spring 2020 in terms of pointing out the similarity between Optics and Classical Mechanics.

3. Undergraduate research in STEM education

From the session "Education through Publication and Research", I learned many new ideas of interacting and advising undergraduate students as well as supports from potential funding agencies and industrial partners. From the talk given by Mrs. Carmina Londono from National Science Foundation, I learned that NSF is supporting Optics and Photonics Education in a non-centralized fashion through multiple disciplines, divisions and aimed at different levels. In specific, NSF may show more support for education proposals that have emphasis on training veterans. As one of the major universities in the country that has a large number of veterans, I feel this is critical information for future proposal writing in USF.

In the workshop of “Problem-Based Learning: Engaging Students in STEM”, the host presented their efforts in promoting problem based learning to enhance students’ critical thinking & problem-solving , teamworking, written and oral communication and employability skills. The site “www.pblorojects.org” provides a lot of demonstrated ideas that closely connects STEM learning, everyday life and industrial needs. The workshop also shows how to perform assessment for such problem-solving-based learning, and how to create our own problem-solving learning challenges. Moreover, the workshop also showed us how to explore opportunities to interact with industrial partners in developing real-world challenges that are also suitable for undergraduate students. This idea connects with the philosophy of “Applied Physics” program of the Physics department as USF, and I plan to find more connections with local optics/photonics/laser companies in the metropolitan area of Tampa to develop more research experience for both undergraduate and graduate students. With all the information provided from the workshop, I plan to improve the designing and assessment of my existing course project in PHY 4424/5937 (Optics/Optics for Scientists) for Spring 2020.

4. Outreach activities for broader impact

I have learned numerous ideas for outreach activities that can be incorporated into various outreach programs, including the EngineeringExpo and various outreach programs with local schools through Physics.

For example, the three sponsoring professional society, IEEE, SPIE and OSA gives out holographic googles that can demonstrate diffraction and color separation from white light sources. The McMaster University also presented a paper-based microscopy that can be easily mass-produced and distributed to K-12 students as well as general public. I have also talked with students and teachers from various universities about the exciting outreach activities that are carried to promote STEM education to K-12 students. I plan to interact more with the student chapter of OSA at USF and the Society of Physics Students (SPS) at USF to implement these ideas and explore new demonstration ideas in the coming calendar year of 2019-2020.

In summary, I really appreciate the support from USF STEER grant and the department of Physics to support me to attend SPIE ETOP 2019 conference. I have truly enjoyed the conference, learned greatly from the well-designed workshops, presentation sessions and social events. The confenrece has provided me with exposures to a large amount of effective teaching pedagogies and curriculum development. It has fueled me with inspirations for improving my future teaching in both lower and upper level STEM courses. I wish to have opportunities to attend more such conferences or other activities to boost my STEM teaching and research in the near future.