“The Trajectory of Physics Curriculum and Its Impact on Society” - Physics Education Panel

July 13, 2022- IUPAP Centenary Symposium, July 11-13, 2022

Panelists:

Dr. Jenaro Guisasola, Associate Professor, University of the Basque Country (C14 Member, second term)

Dr. Nam-Hwa Kang, Professor, National University of Education (C14 Member, first term)

Dr. Chandralekha Singh, Professor, University of Pittsburgh (Former AAPT President).

Convenor:

Dr. Tetyana Antimirova, Professor, Toronto Metropolitan University (formerly Ryerson University) (present C14 Chair)

IUPAP Centenary Symposium took place in Trieste, July 11-13, 2022. The Physics Education panel titled: “The Trajectory of Physics Curriculum and Its Impact on Society” took place on July 13, 2022, the last day of the Symposium. The three panelists are accomplished educators at different stages of their careers and from different parts of the world. They reflected on, shared and discussed the questions the C14 (Physics Education) Commission prepared for them.

The Questions offered during the panel session included:

- What are the features of a purposeful and meaningful "physics curriculum for 21st century and its delivery”? How to optimize Physics programs delivery ranging from face-to-face to remote approaches prompted by the pandemic which is still ongoing in many parts of the world?
- How do we engage today’s students? How to make physics more attractive to the modern students? Would teaching modern physics early on instead of introducing it later in the curriculum help better to engage students?
- What is the place of the experimentation and ‘generic skills’? What other skills are important for work in the industry and for society (especially keeping in mind that many of our current and future students will have

careers outside of an academia including ones that are multi-disciplined, and non-traditional areas of employment).

The panelists were also invited to share their insights on how teaching and learning of physics has changed since they started their careers and how they envision the future of physics education.

Each panelist was introduced by the Panel convenor and gave their opening statements addressing one of the questions above. Their opening statement was followed by the open discussion (with the questions taken from the in-person and online audiences).

Dr. Jenaro Guisasola focused on Physics degree curriculum for 21st century. He discussed the employment paths for today's physics students, noting that physics courses and programs have traditionally focused on the potential for intellectual development offered by the discipline growth. He outlined a number of challenges experienced by today's recent graduates. In particular, he pointed out that generic competencies like project management and teamwork are only seldom acquired by the graduates of the traditional physics programs.

While the graduates appreciated the foundations that they obtained in problem-solving, experience in research, and teaching as well as programming competencies, many recent graduates find it challenging to transfer from the context of their studies into the cultural context of the workplace, as well as applying physics to solve interdisciplinary problems, designing and developing products. Since many current students will work in non-academic careers, therefore better preparing students for non-academic careers becomes more important than ever.

Dr. Nam-Hwa Kang focused on what research says about student engagement while learning physics: How do we engage today's students and make physics more attractive to today's students? Would teaching modern physics early on instead of introducing it later in the curriculum help better to engage students? Dr. Kang focused on student motivation and agency, students' self-determination, self-regulation and a sense of belonging. She stressed the importance of enabling students to work autonomously, enjoy relationships with others and feel they are competent to achieve their own objectives, creating a learning environment that is active and collaborative and, most importantly, ensuring that institutional cultures are welcoming to students from diverse backgrounds. It was pointed out that the content of physics is important to student engagement. She touched upon the question whether introducing modern physics early on would make physics more attractive. Other panelists mentioned also relevance to student lives as well and as the need for a proper level of challenge for successful learning to take place.

Dr. Chandralekha Singh provided some thoughts on both the challenges and opportunities in physics education for the 21st century. Her opening statement focused on providing access to quality physics education and mentoring to those who have been traditionally left out from higher education process. Dr. Singh focused on creating equitable and inclusive learning environments. She noted that basic physics education is foundational to careers in most science disciplines. Even though a lot is known about how to improve student learning of physics, at all levels, evidence-based learning approaches and tools are frequently underused. Dr. Singh discussed the need for professional development of physics educators in order to improve teaching and inclusive mentoring and talked about a cognitive apprenticeship model. She stressed the need to articulate purpose of evidence-based teaching and learning in order to get buy-in from the students. She advocated including more contemporary topics in the physics curriculum for physics majors while still teaching them the fundamentals and taking advantage of many exciting interdisciplinary areas, including computational tools throughout the curriculum. Focus on developing professional skills including developing oral and written communications skills, the ability to work in teams, leadership skills, the ability to see big picture, the ability to ask questions, the ability to take measured risks, and ability to learn from mistakes. A big challenge is how to make students learn to think like a scientist. The need to address rising anti-intellectualism and ignoring scientific evidence was also discussed.

An open discussion followed that built upon the above-mentioned themes. Student representatives raised issues of accommodations. It was noted that humanizing physics learning, cultivating compassion and creating empathetic community are needed to draw more potential students to study physics. The lively discussion could continue well beyond the time allocated.

Panelists BIOs

- Dr. Jenaro Guisasola is (C14 Member) is an associate professor of physics, at the Applied Physics Department of the University of Basque Country (UPV/EHU) and the leader of the Donostia Physics Education Research Group (DoPER). He received his BS. in Physics and a MS. in Theoretical Physics, both from the University of Barcelona, as well as a PhD in Applied Physics (line Physics Education), from the University of the Basque Country. Since 2008 he has been participating in the MA for Initial Training of Secondary Science Teachers. His teaching career started in 1978 when he was appointed to teach Science in Secondary Education at a private School. Since 1990 he has been teaching at the University of the Basque Country (UPV/EHU) and investigating cognitive and epistemological aspects of learning and teaching physics and designing and evaluating teaching/learning sequences. His research work has more than 6000 citations from Google scholar. As a leader of DoPER Jenaro played a leadership role in the regional and state-wide teacher education efforts. He is instrumental in building one of the most prolific groups of science education researchers in Spain. At University of the Basque Country (UPV/EHU) from 2002 until 2012, he has designed and coordinated the program called “ERAGIN” for university teacher training in active teaching methodologies. Has served on multiple committees of Royal Spanish Society of Physics, GIREP and IUPAP C-14 (2018-2021). I serve as chair of the GIREP Thematic Group of Physics Education Research at University.

- Dr. Nam-Hwa Kang is a professor of physics education at Korea National University of Education (KNUE) in South Korea. Before she joined KNUE in 2012, she was an associate professor at Oregon State University and an assistant professor at University of Nevada, Las Vegas in the USA over 10 years. She received her BS and MS degrees from Seoul National University, South Korea in physics education and her Ph.D. degree in science education from University of Georgia in the USA. She studied condensed matter physics for her master’s degree and science teacher education for her Ph.D. Her research centres on bringing science/physics inquiry practices to school classrooms through science/physics teacher education. She was the chair of the 2015 revision of the physics national curriculum in South Korea. She is affiliated with the Korean Physical Society (KPS), the Korean Association for Science Education (KASE), and NARST-A Global Organization for Improving Science Education through Research (NARST). She was an executive chair of the physics education committee of the KPS and a board member of NARST. Her recent publications include, “Emerging online science teaching practices: Insights from high school physics teaching cases in South Korea during COVID-19 pandemic.”

- Dr. Chandralekha Singh is a Distinguished Professor in the Department of Physics and Astronomy and the Founding Director of the Discipline-based Science Education Research Center (dB-SERC) at the University of Pittsburgh. She is a Past President of the American Association of Physics Teachers. She obtained her bachelors and master’s degrees from the Indian Institute of Technology Kharagpur and her Ph.D. in theoretical condensed matter physics from the University of California Santa Barbara. She was a postdoctoral fellow at the University of Illinois Urbana Champaign, before joining the University of Pittsburgh. She has been conducting research in physics education for more than two decades. She co-led the US team to the International

Conference on Women in Physics in Birmingham UK in 2017. She is a Fellow of the American Physical Society, American Association for the Advancement of Science and American Association of Physics Teachers. More information about her can be found here.