IUPAP International Conference on Physics Education 2022

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The IUPAP has Commissions which focus on different aspects of physics. Commission C14 focuses on Physics Education. The flagship conference of C14 is the International Conference on Physics Education, ICPE. It was hosted by Australia for the first time in December 2022. This was a unique opportunity to showcase physics education in Australia to the world. Here we will describe the conference, discuss the benefits and disadvantages of online conferences over face-to-face conferences and discuss trends in physics education as observed from themes arising from the conference.

The International Conference on Physics Education (ICPE) 2022 was hosted by Australia with co-hosts in Thailand and Indonesia from 5th-9th December 2022. The conference was held online with 268 registrants from 43 different countries. 106 of these registrations were from Australia. The theme of the conference was "Physics Education: Preparing for the Future". Participants included academics teaching undergraduate physics, academics teaching future high school teachers as well as high school teachers. Our aim was to make the conference accessible to all. We achieved this through offering many fee-waiver scholarships, minimising costs and accounting for different time zones and busy schedules.

Figure 1: Countries represented by participants at the conference.

History of ICPE

The International Commission on Physics Education was conceptualised by a group of physicists in the late 1950s. A request submitted to IUPAP for an education related commission was granted before the end of the year. The Commission on Physics Education is officially Commission C14: Physics Education, established in 1960 under the umbrella of IUPAP. It promotes the exchange of information and views among the members of the international scientific community in Physics Education, for example by organizing and endorsing conferences, publishing a Newsletter and producing Handbooks. C14 also awards the ICPE Medal to those who have made significant enduring contributions and whose influence is international. The aim is to improve the teaching of physics worldwide, mainly in the 60 countries associated to IUPAP. Manjula Sharma is currently the Vice Chair of Commission C14 and is also Editor of the ICPE Newsletter.

The International Conference on Physics Education, ICPE is the flagship conference of Commission C14 of IUPAP. The first ICPE occurred in 1960 in Paris, followed by Rio de Janeiro in 1963 and London in 1965. The aim is to run ICPE every year, and it mostly does. Often times it partners with other conferences such as GIREP or the World Conference on Physics Education (WCPE). This is the first time it has run

from Australia. ICPE 2023 will be run from Punjab, India.

Online, face-to-face or hybrid?

Since the COVID-19 pandemic we have all had many experiences with online conferences. When we were considering whether to host our conference online, face-to-face or hybrid our main considerations were:

- We wanted the conference to be affordable to everyone, we were very aware of the travel and accommodation costs to Australia for people in other countries and were keen to avoid these. Expensive conferences mean that people from many countries in the world, and most school teachers, cannot participate.

- We were worried about the uncertainty around travel with borders opening and closing. Making the decision to make the conference online from the start gave us certainty and allowed us to plan for the best possible online experience for everyone.

There are advantages and disadvantages to both online and face-to-face conferences. The big advantages of face-to-face over online conferences are:

- Easier to network and meet new people. Conversations happen more naturally.

- Most people in attendance have taken time off work and are away from personal and family demands and so are able to engage in social activities at the conference.

The big advantages of online conferences are:

- They are cheaper to run so no need to book venues, as well as cheaper for participants as no accommodation or transport.

- If talks are recorded, people can watch multiple talks that are on at the same time.

- They are better for the environment; you do not have the greenhouse gas emission associated with all the flights that a face-to-face conference entails.

Another disadvantage of online conferences is that people are in different time zones. While this means that people do not need to deal with jet lag it does mean people are either attending events in the middle of the night or talks need to be recorded and made accessible which decreases the level of interaction.

Hybrid conferences can have some of the advantages and many of the disadvantages of both online and face-to-face but it can be challenging getting online participants to interact with those face-to-face. It can be similar to running two separate conferences and so twice as much work for the organisers.

Ultimately, it depends on the aim of your conference which format will be most suitable.

Running online conferences

Our top tips for running an online conference are:

- Communicate clearly and regularly with participants. We sent out daily emails with a timetable and zoom links so that participants did not have any trouble knowing what was on each day or how to access it. These emails were mail-merged, so we assigned each participant a unique "zoom name", a number followed by their name, in order to keep track of attendance.

- We used the "Virtual Poster Platform" for posters as well as to provide links to the recordings of each of the sessions. People had access to the talks at the end of each day. This worked exceptionally well. The link was only provided to people who had registered.

- We used discord to communicate among the technical committee in the lead up to the conference and with the casuals assisting with the conference. This was incredibly useful, we

felt very connected and were able to quickly fix problems despite working in different locations.

- Train technical staff well, we had a practice dry run for the different session types, and have run sheets for them to refer to. We have placed our run sheets (created by Tom Dixon) on the conference website in case they are useful for other people planning a conference.
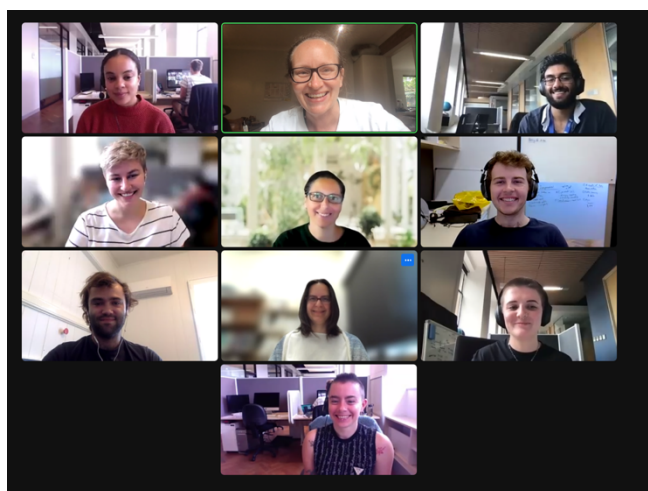

Figure 2: Technical team training session in week prior to conference.

One thing we found surprising was the number of participants who needed a "participation certificate". As everyone was assigned a unique zoom name we were able to send participation emails to everyone who attended at least three zoom sessions during the conference and send .pdfs to those who needed them.

Interactivity can be harder in an online conference so we aimed to make our workshops as interactive as possible. We bookended the days with the workshops, scheduling them at times that were suitable for different participants (due to time-zones) and kept the numbers suitable for meaningful interaction, around 20 participants. We provided instructions to workshop facilitators encouraging them to include a number of interactive elements. These instructions are included on our website. This structure worked well, though did lead to long days for technical staff with workshops starting at 9 AM and ending at 9 PM.

Figure 3: Program for first three days of conference, workshops were in the morning and evenings.

Emerging trends in physics education

Much of the conversation at the conference centred on a few key themes that are discussed below.

Student well-being

There are an increasing number of researchers looking into student well-being and how they feel in the classroom. From psychology literature, self-determination theory, it is well established that people (and students are people) have three psychological needs [1]:

1. Autonomy – some control over their situation, can be addressed by giving students choice.

2. Competence – opportunity to become very good at something and master the material.

3. Relatedness – need to feel like they belong to the community.

Many of the talks and workshops looked at how these needs could be addressed in different contexts.

The proliferation of online resources during COVID-19 lockdowns means that it is now much easier to give students choice about how they learn, increasing their autonomy. A number of talks looked at giving students more control over how they were assessed.

Many talks considered how to make students more effective and competent problem solvers. Again, online resources offer many opportunities in this realm. Students can use online question banks to

practice answering questions numerous times, receiving constructive feedback as they go. Many talks focussed on how to achieve this in different areas of physics.

The importance of building students' sense of belonging was addressed in many talks, including the plenary talk by Prof. Chandralekha Singh. This is especially important for minority students, which in physics includes female students. In order to improve the gender balance and the learning experience of all students it is important to speak to them in a way that builds rather than destroys their sense of belonging to the physics community. Ways that this can be achieved were addressed in workshops and talks. A. Prof. Kate Wilson presented an interesting talk outlining some of the things we should keep in mind when setting assessments to ensure we are not inadvertently disadvantaging female students in our classes.

Online Resources

Online tools can offer effective ways to address student's needs for competence and autonomy. There were many talks and workshops demonstrating the use of different online tools. With the recent emergence of ChatGPT (which was too recent for discussion at this conference) online tools are and continue to be a game-changer in education. A number of different technologies were discussed.

Dr Derek Muller (Veritasium) discussed the use of videos for online learning. How to create and effectively use videos in teaching was a common theme among other talks in the conference as well. Using videos to present some concepts to students can be an effective way to free up class time for more active learning activities such as discussions and problem solving.

Laboratory learning was also a theme of numerous talks and workshops at the conference. Dr Sebastian Staaks, the creator of Phyphox gave an invited talk on how smartphone apps can be used to take readings of many phenomena, such as the angular velocity and acceleration of a bicycle wheel. The increasing availability of apps such as this to students opens up possibilities for students to be able to collect data outside of physics labs, possibly giving them more autonomy over what lab exercises they perform.

Other useful online tools and resources that were discussed at the conference included: the PhET and CoSci simulations and how they can be effectively embedded into courses; PhysPort, an incredibly useful resource for finding out about evidence-based best practice in physics; and virtual reality. Online tools also have their place in higher year physics courses, one of the workshops – held as a memorial to Ian Johnston - looked at how this could be achieved in Computational Physics. The emphasis of the workshop was on the tricky balance between physics, modelling and coding. Students need to know sufficient coding, or be taught within the course to be able to analyse and model specially selected problems which maybe broader than physics; real life problems. The coding language needs to fit within institutional structures. The benefit is developing 21st Century skills as well as computational thinking.

Teacher training

Many of the pressures felt by higher education are first felt in high schools. In her plenary talk Prof. Nam Hwa Kang talked about the expectations of Generation Z (zoomers) around education and how we can meet these expectations by using online tools and ensuring we are making use of active learning pedagogies. One of the themes that emerged in the high school space was how to ensure there is a balanced and interesting high school curriculum that has the right amount of content to give students a little autonomy over how the run their classes and allow space for active learning.

There were also many interesting uses of technology in the outreach domain, the ubiquity of online platforms now makes it much easier to reach students in remote schools.

Conclusion

We hope that many of you are able to make it to an education conference this year or the education stream at the AIP meeting. With technology advancing so quickly it is important that we all think carefully about how and what we are teaching our students and learn

from each other about what works, what does not work and what possibilities new technologies make available to us.

About the author

Elizabeth Angstmann is a professor, education focussed academic and first year director in the school of Physics at UNSW. Liz won the AIP Education medal in 2020. Liz was the conference chair of ICPE 2022.

Jacinta den Besten is a Senior Lecturer in the School of Physics at the University of Melbourne. She is the Director of First Year Physics and was on the organising and program committee and chaired the Technical committee for the conference.

Thomas Dixon is an Associate Lecturer (Education Focused) in the School of Physics at UNSW. He is the first year lab director in the School. Thomas managed

the technical staff and co-ordinated much of the technical aspects of the conference.

Manjula Sharma is a Professor of Science Education and Director of the STEM Teacher Enrichment Academy. She has co-founded the Australian Conference on Science and Mathematics Education and International Journal of Innovation in Science and Mathematics Education and has been awarded the 2012 AIP Education Medal, 2013 Australian Learning and Teaching Fellowship, 2019 STANSW Dedicated Service Award and is a Principal Fellow of the UK HEA, Fellow of AIP and Honorary Fellow of Teacher's Guild of NSW.

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