Demographics

The workshop had a very high level of participation, with about 130 registered participants coming from all parts of the world and approximately two dozen unregistered participants from ESO and neighbouring institutes, including several software engineers, highlighting the great interest generated by the topic.

The Scientific Organising Committee worked hard to ensure fair representation from the community. Among the 10 invited speakers, five were female. Three of the five sessions were also chaired by women. Among the abstracts submitted, a quarter were by women, and this was also the female/male ratio among the contributed speakers. We had a very high level of participation from young researchers, most likely due to a combination of a highly discounted registration fee for students and the fact that this field is relatively young. Thus, among the registered participants, we had 41% students, 22% postdoctoral researchers, and 37% tenure-track or tenured faculty. The talk selection was made blindly (the chair of the SOC removed names and identifying information about the authors, including their seniority and their affiliation), and was based solely on the merits of the abstract and its relation to the themes of the workshop. This resulted in 62% of the talks and 50% of the posters being given by students.

Acknowledgements

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References

Adorf, H.-M. 1991, The Messenger, 63, 69
Baron, D. 2019, arXiv: 1904.07248
Griffin, R. F. 2014, The Observatory, 134, 109
Stoehr, F. 2019, ASPC, 387, 523

Notes

[a] Machine learning is one of the most commonly used subsets of AI.

Links

[1] Workshop website: https://www.eso.org/sci/meetings/2019/AIA2019.html
[2] The Kaggle platform website: kaggle.com
[3] Numerical Information Field Theory: http://ift.pages.mpcdf.de/nifty/
[4] 2019 AIA workshop programme: https://www.eso.org/sci/meetings/2019/AIA2019/Booklet_final.pdf

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Report on the IAU Conference

Astronomy Education — Bridging Research & Practice

held at the ESO Supernova Planetarium & Visitor Centre, Garching, Germany, 16–18 September 2019

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Astronomy education contributes to the spread of scientific literacy among successive generations, helping to attract students into science, technology, engineering and mathematics (STEM) subjects and potentially also into astronomy research. Although the field of research into astronomy education has grown significantly, the sustainable transfer from research institutes into the classroom is lacking. The goal of this conference was to bring together all stakeholders — teachers, educators and researchers — to communicate and discuss their various needs in order to effectively bridge the gap between astronomy education research and its practical application.

Astronomy is not only one of the oldest sciences, but also a perennially fascinating one to the broader public, who often ask educators questions such as, “where do we come from?”, or “are we alone?” For this reason, astronomy has always been a relatively easy area of science to convey to the public and it can serve as a gateway to other scientific concepts, especially in young people.

Astronomy therefore plays a special role within public science communication. The literature is full of suggestions and advice about how to best communicate astronomy to the public. Astronomy education or teaching astronomy is different from communication, however. Whereas communication and outreach are processes aimed at generating inspiration and awareness, education aims to develop knowledge, skills and competences, and core values and attitudes through a range of pedagogies and methodologies that account for the abilities and development level of the learner. Astronomy education is less prominent within the scientific community than

astronomy communication and outreach even though the International Astronomical Union (IAU) established Commission 46 on "The Teaching of Astronomy" in 1964. The Commission's designation changed from 46 to C1 in 2015 but its mandate has remained essentially the same: *to further the development and improvement of astronomical education at all levels throughout the world through various projects developed and maintained by the Commission and by disseminating information concerning astronomy education.*

To foster this mandate, the IAU will establish the Office of Astronomy for Education (OAE) this year; its objective will be to provide structured support to for astronomy education in all countries. This includes, but is not limited to, providing training and resources for encouraging the use of astronomy as a stimulus for teaching and learning from primary to secondary school levels. At a workshop between 17 and 19 December 2019 at the Institut Astrophysique de Paris, the IAU revealed that the location of the OAE would be at the Haus der Astronomie in Heidelberg, Germany. In addition, at that same workshop the remit of the new office was presented along with its plans regarding the goals set out in the IAU Strategic Plan for 2020–2030.

The field of astronomy education has grown significantly over the last few decades, with an increasing number of research articles having been published by a growing number of researchers. Despite this, there has been no regular international conference for astronomy education researchers and practitioners around the world to convene and discuss their work. This conference is intended to be the first of a regular, biennial, IAU-Commission C1 Astronomy Education Conference series. The aim is to increase the quality, quantity, community and impact of astronomy education research and practice by bringing together astronomers, astronomy education researchers and education practitioners to communicate, discuss and tackle common issues.

The three key themes of this conference — Astronomy Education Research; Astronomy Education Standards, Curriculum and Instruction; and Primary and Secondary Teacher Education — span traditional and practical research, exploring the purely theoretical issues encountered when attempting to embed research results into practical situations, usually mediated by standards, curriculum and instruction.

This conference was organised by IAU Commission C, together with ESO, the ESO Supernova, and Leiden University. It was hosted at the ESO Supernova using all its facilities, including the planetarium as the lecture theatre. The programme comprised three invited talks, 44 contributed talks, 10 hands-on workshops and 50 posters. As it is an educational facility, the ESO Supernova proved to be the perfect location for this conference and the participants were enthusiastic about this inspiring environment. Details of the programme can be found via the conference webpage[1]. Each talk was followed by a five-minute session dedicated to questions and discussion that continued during the breaks. Poster viewing took place during all coffee breaks and was particularly encouraged during 30-minute poster sessions every day.

The IAU President Ewine van Dishoeck, the IAU General Secretary Teresa Lago and ESO's Director General Xavier Barcons all acknowledged the necessity of such a conference in their welcome addresses. The IAU President also gave a summary of the activities and events commemorating 100 years of the IAU, including the travelling exhibition, and announced the inauguration of the OAE.

Astronomy education research

The invited talk by Janelle Bailey summarised the broad field of astronomy education research (AER), highlighting upcoming projects, for example a two-volume work about astronomy education, and introduced modern education concepts like active learning. Future directions of AER were also discussed, such as the use of qualitative and mixed methods, robust quantitative analyses and longitudinal studies.

Contributed talks covered more specialised topics such as students' (mis-)conceptions about astronomical topics and how these could be organised into coherent patterns of understanding. A new AER study now provides a wider and more coherent framework about the high conceptual understanding of astrophysics that is necessary to develop research-based teaching-learning sequences for high school students — something that will be developed in the near future. Other contributed talks focused on how multidimensionality in the field of astronomy or astronomical time- and length-scales can be made understandable for students. In both fields, models can help students learn about relevant aspects, but they need to be built by experienced teachers. Some contributed talks surveyed and analysed the production of AER studies in different countries like Brazil, France, Japan and Portugal, focusing not only on school grade levels or the type of academic research but also on gender balance.

Astronomy education standards, curriculum and instruction

In his invited talk Robert Hollow discussed opportunities and issues regarding curricula at the school level, particularly in the context of the recent IAU Framework for Astronomy Literacy. The science curriculum of Australia served as an example to illustrate the possibilities and the challenges of using astronomy in teaching science. A contributed talk by Saeed Salimpour gave a review of how often astronomy is encountered in the school curriculum of 37 countries (OECD, China and South Africa), highlighting that 77% of all curricula in Grade 1 include astronomy, 54% in Grades 2 & 7 and 27% in Grades 1 to 12. The highest percentage of astronomy (85%) can be found in Grade 6. The study also revealed that one curriculum explicitly mentioned only two women astronomers and only three of the 37 countries explicitly mentioned indigenous astronomy.

Several contributed talks highlighted the importance of research-based science education, in which real data are analysed with research-quality tools to investigate questions for which the answer is not known. One talk recounted how the practices employed to use archival image and spectral data have evolved over time

Figure 1. Conference participants gathered on balconies inside the ESO Supernova, overlooking the exhibition space called The Void.

and described some of the challenges of working with real data. The lack of user-friendly interfaces aimed at non-experts and documentation emerged as the main bottlenecks preventing the broader use of archive data.

Another talk described an activity in which potential targets for the James Webb Space Telescope are identified via spectroscopic observations of stars taken by the Spitzer Space Telescope. This activity turned out to be beneficial not only for students, who showed an increased inclination to pursue a career in science after this activity, but also for the teachers' levels of motivation. Another contributed talk addressed the diversity of curricula in a big country like Canada, which creates a challenge for pan-Canadian programmes. It was shown that this issue can be overcome by offering online astronomy workshops and webinars that focus on science topics that are common to all curricula.

Internet resources like videos were shown to be extremely helpful for hearing-impaired or deaf people in a contributed talk about astronomy education among deaf children and school-age youth in Brazil, through the Brazilian sign language project Libras (*Língua Brasileira de Sinais*). Another contributed talk by Marco Brusa described how video games for educational purposes that are free of violence and focused on STEM related science can result in a growing interest in STEM.

Other internet-based education resources were discussed like the IAU AstroEDU platform[2] for high-quality, peer-reviewed astronomy education activities, whose Italian version was launched in 2017. The Open University (UK) is also accessible online and its curriculum is open to all and delivered entirely by distance teaching. Its OpenSTEM Labs allow students to perform remote experiments, including the use of robotic observatories.

Primary and secondary teacher education

The invited talk by Agueda Gras-Velazquez focused on the struggles of teachers in their daily work; challenges include a lack of time, excessively large curricula, and often isolation within the faculty. A promising way to overcome these problems is via professional development and collaboration, taking advantage of the many European initiatives on offer. These collaborations in science, technology, engineering and mathematics in general, and astronomy education in particular, were intensively discussed.

A contributed talk by An Steegen focused on the level of the teacher's awareness of student ideas and on the possible strategies they use in class related to astronomical concepts. Studies found that this level of awareness varies considerably among teachers and attention should be paid to misconceptions, in both pre-service teacher programmes and professional development activities.

Another contributed talk described continuous professional development workshops for primary and secondary school

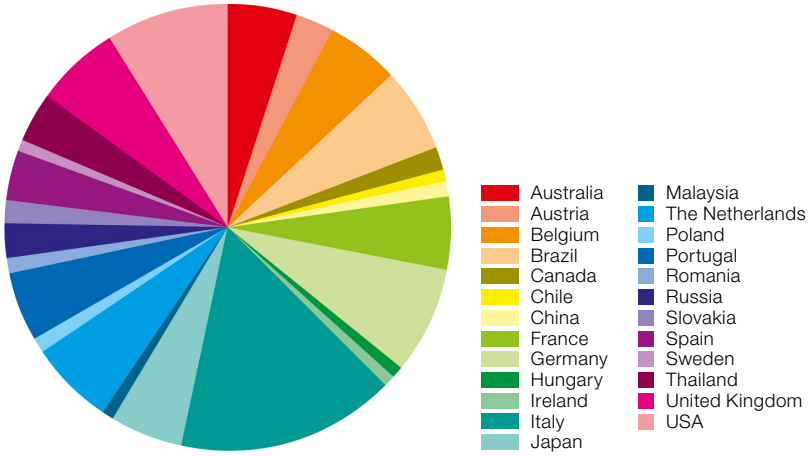

Figure 2. Pie chart showing the distribution of countries from which the 114 participants came.

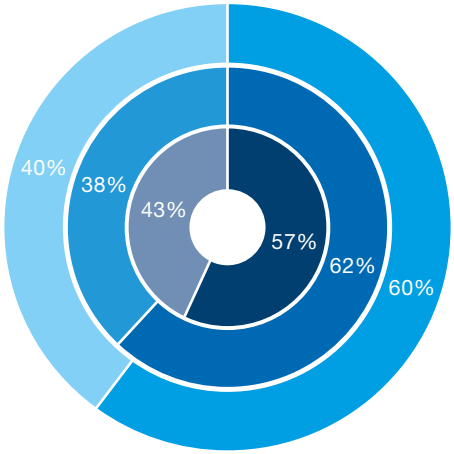

Figure 3. Multi-level pie chart showing the gender ratio amongst participants (outer ring), talks (middle ring), accepted posters (inner ring); in each of these the lighter and darker colours represent the female and male ratios, respectively.

teachers based around the Irish National Junior Certificate theme of Earth and Space. With these workshops, teachers are kept informed of current research and discoveries, and are provided with content and material to engage students using space research. A further contributed talk presented teacher trainings in the use of robotic telescopes. The focus was to bring astronomy closer to teachers in an enjoyable way, so that they lose the fear of working on these topics with their students, and to provide them with the tools and knowledge so that they can introduce them in a practical way and develop enquiry-based projects.

Workshops

The workshops covered a broad range of activities:
- the positive and negative effects of the use of technology in the classroom;
- the use of real astronomical data in the classroom;
- presentation of the recently published booklet *Big ideas in Astronomy: A proposed Definition of Astronomy Literacy;*
- two workshops combining STEM with the arts (STEAM), one dealing with programmable materials that are important for future space travel, the other with the creative use of satellite images;
- an art-based approach to teaching astronomy via Visual Thinking Strategies;
- limitations and opportunities of planetariums, often seen as natural places to run informal education activities;
- how to make astronomy projects more diverse and inclusive;
- developing and testing new interdisciplinary and inclusive educational and outreach activities;
- links between astronomy and environmental education;
- how to design inquiry-based workshops for secondary school students and teacher trainings that are relevant to curricula and cost effective.

The conference highlighted that astronomy education is a well-established field with a global community. Education — alongside research, outreach and development — is one of the main activities of the IAU. Some trends in astronomy education recurred throughout the conference, such as multidisciplinary approaches, the options for online collaboration, training, and distribution. Also, the societal relevance of education was addressed and discussed with topics like inclusion and diversity and climate change. Very fruitful discussions took place during the conference and the majority of participants felt that they are acting towards a common goal. However, there is still a need to improve knowledge transfer between researchers and practitioners, as the wheel tends to be reinvented too often, with efforts being duplicated. After this meeting, the baseline has now been set, and the community looks forward to marking its progress by the next conference in 2021.

Demographics

The demand for this conference was extremely high, but owing to the limited seating in the planetarium, the number of possible participants had to be capped at 114. The participants came from 25 countries, including 13 ESO member states, the Host Country Chile and Strategic Partner, Australia (see Figures 1 & 2). In total, 112 talk abstracts were submitted, 46% of which came from female colleagues (Figure 3). The gender balance among the speakers in the final programme reflected the 40:60 (female:male) distribution of the participants, similar to that of the Scientific Organising Committee (SOC), which had a corresponding ratio of 44:56 (female:male).

Links

[1] Conference webpage: https://iau-dc-c1.org/astroedu-conference/
[2] AstroEdu platform: https://astroedu.iau.org/en/