

IAU Working Group on Astronomy Education Research and Methods



IAU Commission C1

Annual report on the 2019 IAU WG for Astronomy Education Research and Methods (AERM)

Chair: Urban Eriksson

Co-chairs: Akihiko Tomita, and Robert Hollow

OC members: Urban Eriksson (Swe), Tomita Akihiko (Jp), Robert Hollow (Au)

Introduction

On 22nd August 2019, the IAU Commission C1 approved the WG for AERM based on the proposal submitted by the chair and co-chairs above. Building on the successful work of the previous WG for Theory and Methods in Astronomy Education, the WG for AERM will have three main foci, in accordance with the proposal and decision made by the IAU Commission C1:

- 1) Astronomy Education Research (AER, Urban Eriksson chair)
- 2) Teachers and Educators Training (TET, Akihiko Tomita chair) and,
- 3) Astronomy Literacy and Curriculum Development (ALCD, Robert Hollow chair).

This report is structured as such that it starts with the common activities done by the WG and then the three sub-groups report individually on their work.

Due to many factors, the WG has had a slow start, mainly because the delay of the formal decision and now the Corona pandemic preventing us from prioritizing the WG activities. However, from the below it is clear what the WG has done.

Common activities – the First Astronomy Education Conference: Bridging Research & Practice

After some years of preparation, we organized the first conference/meeting under IAU Commission C1 on Astronomy Education. It was held 16th-18th September 2019 at ESO/Supernova planetarium in Garching, Germany (<https://iau-dc-c1.org/astroedu-conference/>). Three invited keynote speakers, many oral presentations and poster presentations, covering all areas of astronomy education, made the conference a success! The visit and talk by the IAU President Ewine van Dishoeck was much appreciated!

There were 114 Participants from 25 Countries, with an almost perfect gender balance: 44 Talks, 10 Workshops and 50 Posters.

More information are available in:

Vieser W. et al. – Report on the IAU Conference “Astronomy Education — Bridging Research & Practice”, The Messenger, No. 178 – Quarter 4, 2019, p. 63-66, at:

<https://www.eso.org/sci/publications/messenger/archive/no.178-dec19/messenger-no178.pdf>

About the event (from the conference web page)

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 academic and practitioner groups. Despite this, there has been no regular international conference place for astronomy education researchers and practitioners around the world to

convene and discuss their work in the field. Hence this meeting was the first of a regular, biennial, IAU Commission C1 Astronomy Education Conference with an aim to increase the quality, quantity, community and impact of astronomy education research and practice. This conference aimed to bring together astronomers, astronomy education researchers and education practitioners to communicate, discuss and tackle common issues. The three key topics span traditional and practical research exploring the purely theoretical to issues encountered attempting to embed research results into practical situations, usually mediated by standards, curriculum and instruction. The conference also provided an opportunity for the community to discuss the results in astronomy education stemming from the IAU Strategic Plan 2010-2020 and discuss the requirements for meeting the next IAU Strategic Plan goals regarding astronomy education.

Scientific Organising Committee Co-Chairs

Paulo S. Bretones (Universidade Federal de São Carlos, Brazil)

Urban Eriksson (Lund University, Sweden)

Pedro Russo (Leiden University, Netherlands)

Scientific Organising Committee (SOC)

Janelle Bailey (Temple University, USA)

Ian Bearden (University of Copenhagen, Denmark)

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Akihiko Tomita (Wakayama University, Japan)

Local Organising Committee (LOC)

Wolfgang Vieser (ESO, Germany) – LOC Chair

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Tania Johnston (ESO, Germany)

Álvaro Caseiro de Almeida (ESO, Germany)

Lars Lindberg Christensen (ESO, Germany)

Saeed Salimpour (Deakin University, Australia)

We thank the Co-chairs, SOC and *in particular* the LOC for an excellent job in making the conference a big success! Thank you all!

Conference Proceedings

21 manuscripts were submitted to the conference proceedings and the work on reviewing these are underway (April-May 2020) and will lead to a published conference proceeding, planned for late autumn 2020.

The Astronomy Education Journal (AEJ)

As a consequence of the preparation of the conference, and discussions during the conference, Urban Eriksson and Paulo Bretones, at the conference, announced the inauguration of a new journal: *the Astronomy Education Journal* (AEJ). This journal is to publish both astronomy education research articles and astronomy education papers, to fill a whole in the international body of scholarly research and knowledge and practice in the field of astronomy education. Since the conference, preparations have been ongoing and during May 2020 the first call for papers will be announced. Unfortunately, we have had a delay in the process due to the corona virus outbreak.

Urban Eriksson and Paulo Bretones are co-editors of the AEJ.

Astronomy Education Research

Chair: Urban Eriksson

Members mainly in charge of the theme

(Additional members are in the table at the end):

Allie, Saalih (UCT, SA)

Bretones, Paulo (UFSCar, Br)

Lindstrøm, Christine (Univ. of South Wales, Au)

Objectives

The growing amount of emerging astronomy projects, stimulated by the existence of the e.g. IAUs OAD, and also the OAE, and its annual calls for projects, but also many new initiatives outside this channel, require adequate research into learning processes, educational tools, models, quality and impact evaluation.

As such the proposed the AER theme aims to fulfil the following needs.

- a) *Develop* a promotional strategy for enhancing AER by promoting summary reviews of scholarly production that already exists and report this to the iSTAR database.
- b) To *promote* discussions about a theoretical transdisciplinary approximation on how to effectively teach and learn contemporary astronomy at different levels.
- c) To actively encourage and nurture diversity in astronomy education research and researchers, to join the IAU through their national members or to join as Associate and Junior Members.

Goals

As first steps, the AER theme commits to three *goals*:

1. Promoting AER by adopting the international collaboration model used by astronomy researchers,
2. Fostering international astronomy education and AER capacity through the development of networks, training and shared resources, and
3. Improving astronomy education by describing research-based approaches to teaching and learning of astronomy.

In service of these goals, the AER theme commits to two immediate *tasks*:

1. Promote, in different regions and continents, *surveys, literature reviews and summary reviews* of scholarly production that already exists on PhD and MSc Thesis, published papers in journals and proceedings of meetings on Astronomy, Physics and Science Education, and

2. The organization of a series of symposia and conferences in AER, to include structured networking, collaborative research sessions, methodological and publishing workshops, and the presentation of works of interest.

Products from these beginning steps will be a result of collaborations in the diverse body of astronomy education researchers. In the near term these *products* will include:

1. The production of works that describe the nature of the existing literature in the field, and
2. The production of works describing the range of methods and findings found in international research databases, across a variety of constructs, including subject matter, instructional settings, audiences, cognitive processes, etc.

From these products the AER theme will be able to *create documents* that describe:

1. State-of-the-art research-based practices in astronomy education, addressing the diversity of educational needs internationally, and
2. A research agenda for the international astronomy education community.

Most importantly, since the ultimate implementation of the WG's efforts is to improve astronomy education internationally, the results of the WG's effort will continuously be communicated, and discussed, with professional astronomers and astronomy educators or else the work will have no use. This could best be done at meetings, conferences and via the new Astronomy Education Journal, similar to the successful CAP journal. Finally, the IAU offices (OAO, OAE, OAD and, OYA) may all benefit for the results of the AER theme. However, AER theme will exclusively focus on research aspects of astronomy education and as such no direct conflicting overlap with the offices can be foreseen; we rather see cross collaboration that will nurture our collective struggles to better educate people in astronomy.

Timescale

The planned work for the AER theme will take at least three years to accomplish, since the outcome—to create an international active and engaging AER community—is, to say the least, bold. A detailed time plan will be developed, taking as a starting point the following suggested plan:

Year 1: Establish the AER theme within the WG for AERM and have the surveys starting and preferably being reported on by the end of year 1. During this first year there will also be a first AER meeting, which will then continue as a biannual meeting or symposium. Here, discussion on theoretical transdisciplinary approximation on how to effectively teach and learn contemporary astronomy at different levels will take place.

Year 2. Building networks internationally through smaller meetings and start the production of work that describe the nature of the existing literature in the field, the range of methods, findings and, theoretical and practical suggestions.

Year 3: Organize a second conference on AER, where the previous work will be presented and discussed. As a result of the previous work and conferences, the theme for AER will create a suggested agenda for state-of-the-art research-based practices in astronomy education, and finally an agenda for future work.

Accomplishments during the last year:

In the light of the above the WG can report on the following activities during the year, aligning with the AER WGs objectives and goals:

- Organized the Astronomy Education Conference described above.
- Starting surveys to identify more international AER work. This is a work in progress, coordinated by Urban Eriksson. All newly found work is added to the *Istar database* (istardb.org) and will also be presented in a paper later this year. Moreover, other researchers performed surveys on astronomy education and research different countries, here updated:

Name	Country	Results
Frederic Pitout	France	13 PhD theses; 9 MSc thesis; 59 papers; 32 works
Paulo Mauricio	Portugal	114 MSc theses; 2 PhD theses
Néstor Camino	Colombia	54 MSc theses

- Paulo Bretones and Michael Fitzgerald had done a successful regional astronomy education meeting, the Workshop **Space Sciences Education Research in the Middle East (2019)**. It was held at the Sharjah Academy for Astronomy, Space Sciences and Technology, United Arab Emirates on October the 28th and 29th, 2019. There were 35 participants from UAE, Turkey, Jordan, Brazil and Australia. More information are available in the website at: <http://saasst.myscass.com/AstroEduWorkshop> and at: <https://scass.sharjah.ac.ae/en/news/Pages/scassnd.aspx?mcid=289>
- The **IAU100 Global Project, Astronomy Day in the Schools** initiative was an IAU100 Global Project as a part of the agenda and activities of the IAU 100 years (<https://www.iau-100.org/>), with the vision of mobilising the astronomical community to organize activities in schools. This was a special opportunity for students to directly interact and engage with astronomers in their communities, and to learn about the important role of astronomy in our lives.
Any amateur or professional astronomer, scientist or teacher was invited to participate. IAU100 encouraged school visits taking place during or around the week of 10-17 NOVEMBER 2019. During this week, the 10th of November marked the World Science Day for Peace and Development and a Mercury transit also took place on the 11th of November, which offered an exciting outreach opportunity for the visiting astronomers.
There were over 500 events and activities in 70 countries worldwide. This was the inaugural event in 2019. In future years, the date is still to be decided, but it may be the date of the equinox in March (e.g. March 20 in 2020). It is an important date, even historically as many cultures use this date to begin the year and the equinox makes catering to both hemispheres easier to synchronize activities.
More information can be seen at: www.iau-100.org/astro-day-schools
- Plans for a second **Astronomy Education Conference** in 2021, to be held in Toronto, Canada. The preparation is ongoing, co-chaired by Urban Eriksson, Tanja Johnston and Paulo Bretones, with a LOC lead by Michael Reed. A venue is being negotiated and grants have been applied for. Things are progressing according to plan and we can soon announce the conference and call for abstracts.

- Finally, Paulo Bretones did a much appreciated interview on astronomy education:
<https://www.youtube.com/watch?v=ENFCODed0eA&feature=youtu.be>

The Teachers and Educators Training (TET) theme

Chair: Akihiko Tomita

Members mainly in charge of the theme:

(Additional members are in the table at the end):

Rosa Doran (NUCLIO)

Paulo Sergio Bretones (UFSCar)

Michael T. Fitzgerald (Edith Cowan Institute for Educational Research)

Rosa Ros (NASE)

Edward Gomez (Las Cumbres Observatory)

Lars Lindberg Christensen (ESO)

Boonrucksar Soonthornthum (NARIT)

Wichan Insiri (NARIT)

Tessa Vossen (Leiden/UNAWE)

Background of the TET Theme:

There are various teacher training programs including NASE, GTTP, GHOU, UNAWE/Space Awareness, many organized by space agencies such as NASA, ESA, JAXA, and many organized by observatories and societies such as ESO, Las Cumbres, PASP. There are not only the programs above which are publicized worldwide but also various programs in each country and community. Many teachers and educators have been developing their own skills through the training programs, and many children all around the world are enjoying learning astronomy by trained teachers and educators. Each of them has great importance and value and has a particular way of approach and material. The IAU will establish Office of Astronomy Education (OAE) in near future. It is time to survey and review as many as possible of the astronomy teacher and educator training programs in the world.

Objectives and goals:

The focus of this section is to provide the groundwork (see expected products below)

- 1) for the mandated Office of Astronomy Education "National Astronomy Education Coordinators" (NAECs), and
- 2) to encourage teacher training activities in all communities.

Expected products:

The survey and review (see description of the work below) will be summarized as a document which contributes to

- 1) framework and standards for teacher and educator training in astronomy education in all communities, and
- 2) the future OAE's "International School for Astronomy Education" in collaboration with the ALCD section.

Description of the work - Tasks:

- 1) Report the achievements of projects, such as NASE, GTTP, GHOU and all the projects which are publicized worldwide.
- 2) Survey various projects in each country and community which are not so publicized worldwide but show good practice.

- 3) Review all the programs the theme for TET group can reach and summarize best practices, best approaches, and scientifically and educationally innovative things.

In any stage of the work, we will respect all the projects and communicate with persons related to the projects, making a good network of the teacher and educator training.

A timescale for the work:

All the tasks #1 to #3 described above will be made simultaneously in each year, but we will focus on #1 in 2019, #2 in 2020, and #3 in 2021.

Ways of involving a good mix of people as appropriate:

For work#2, we need people with various geographical distribution who are familiar with local activities, and for work#1 and work#3, we need experienced people with various career stage, gender, and cultural background. We will continue to call as various people as possible considering gender balance as member of this theme.

Report in 2019

1. Network of TET work: discussion at astroEDUconf 2019 and new member:
Julie Bolduc-Duval, Discover the Universe, Canada
Hasan Baghbani, President of Iranian Teachers Astronomy Union, Iran
2. NASE practice:
NASE course in Japan for the first time, in November 2019
Japanese is the 12th language of NASE materials after Spanish, English, Romanian, Chinese, Indonesian, French, Portuguese, Persian, Catalan, Mongolian, Russian.

The Astronomy Literacy and Curriculum Development (ALCD) theme

Chair:

Robert Hollow (CSIRO, Australia)

Members mainly in charge of the theme

(Additional members are in the table at the end):

Hidehiko Agata (NAOJ, Japan)

Saeed Salimpour (Deakin University, Australia)

Pedro Russo (Leiden University, the Netherlands)

Lina Canas (IAU OAO/ NAOJ, Japan)

Tim Spuck (AUI, USA)

Introduction and background

This proposed theme for Astronomy Literacy and Curriculum Development addresses the need for a group to collect and analyse astronomy curricula from formal education systems around the world, both F-12 and at the Tertiary (college and university) level. The “Big Ideas in Astronomy, A Roadmap to Astronomy Literacy Goals” project, due for release by the IAU provides a current framework with which to measure and map how these formal curricula match the identified key concepts that comprise astronomy literacy. Data and trends identified will help inform the priorities for ongoing and future AER and provide tools and guidelines for IAU members seeking to contribute to or review relevant future STEM curricula in their countries or education systems.

The establishment of an IAU Office of Astronomy Education (OAE) is a timely and welcome initiative. One focus of the OAE will be in training teachers to effectively teach astronomical concepts and deliver authentic, engaging astronomy activities and programs. To maximise the effectiveness of teacher workshops and professional learning it should be matched to the needs of teachers in their specific systems whilst also informed by global trends. As such, this ALCD theme seeks to enhance professional training by developing focussed training programs and resources, with the intention that this work will result in a modern conception of the ways in which teaching, and learning can effectively happen in the context of astronomy.

Alignment with mandates of OAE:

The proposed IAU Office of Astronomy for Education (OAE) focuses on providing the training and resources necessary to use astronomy to stimulate teaching and education from elementary to high school level (astronomy and science education), with a network of National Astronomy Education Coordinators and a database of IAU volunteers.

The proposed ALCD theme provides a platform for the OAE to draw on focused research in order to enhance and fulfil its goals. Given that, the theme will be comprised of individuals from a range of backgrounds and experiences in AER.

Aims:

As such the proposed ALCD theme aims to fulfil the following needs:

1. Develop and maintain records of astronomy curriculum in F-12 and Tertiary education from around the world.
2. Develop, promote and regularly review the roadmap to Astronomy Literacy Goals, through discussion with astronomy and STEM education groups.
3. Through analysis of curricula and mapping to literacy goals provide advice to the IAU via the theme for AER and educators involved in Astronomy Education Research, professional learning for educators and curriculum developers, suggesting changes where appropriate,
4. To actively encourage astronomy educators to join the IAU through their national members or to join as Associate and Junior Members.

Goals:

As first steps, the ALCD theme commits to the following goals:

1. Expand the review of astronomy curricula in F-12 formal education beyond OECD curricula and further develop tools for analysing them.
2. Extend the review of astronomy curricula to tertiary level degree courses globally and identify the key elements of astronomy degrees and astronomy with in other degree paths.
3. Promote the Roadmap to Astronomy Literacy Goals within the professional astronomy community and more broadly to STEM educators globally.
4. Improving astronomy education, teacher professional learning and curriculum development by providing data and advice to relevant groups.
5. Establish mechanisms facilitating discussion and sharing of best practices and ideas in the astronomy and education communities.

Within the first three years, the ALCD theme initially commits to:

1. Solicit contributions to a broader range of astronomy curricula at both F-12 and tertiary levels to expand the data sets available for analysis.
2. Establish a database of curriculum contacts for each country and or system globally.
3. Provide input to planned and future symposia and conferences in AER, where the Roadmap to Astronomy Literacy Goals can be promoted and discussed.
4. Liaise with the other themes in AERM and the OAE to map out a plan for ongoing collaboration and identify the priorities for each group.

Through these initial activities and collaborations, the ALCD theme will:

1. Report and analyse astronomy curricula globally
2. Commence mapping these to the Roadmap of Astronomy Literacy Goals (ALGs), identifying areas of omission and error.
3. Provide advice on priorities for future astronomy curriculum development and priorities for AER and teacher professional development.

From these products the ALCD theme will produce within the triennium reports and databases that describe:

1. Astronomy curriculum with mapping to ALGs
2. A research agenda for the international astronomy education community
3. Review of Astronomy Literacy Goals.

Activities during the year:

Key points in the area have been:

- Saeed Salimpour's paper on OECD curricula has now been published (Salimpour, S., Bartlett, S., Fitzgerald, M.T. *et al.* The Gateway Science: a Review of Astronomy in the OECD School Curricula, Including China and South Africa. *Res Sci Educ* (2020). <https://doi.org/10.1007/s11165-020-09922-0>)
- the IAU "**Big Ideas in Astronomy**" booklet.
What does it mean for a citizen to be "literate" in astronomy? Those members of the International Astronomical Union (IAU) who are active in public outreach have practical experience of the kinds of astronomical knowledge commonly held by the general public. Until recently, however, there had not been a systematic evaluation and a clear definition of what astronomical literacy means. In May 2019, a "Big Ideas in Astronomy: A Proposed Definition of Astronomy Literacy" booklet has been released with the aim of clarifying these ideas. It is intended for use by the astronomy education and outreach community, and within a process of community consultation. The booklet is the culmination of years of debate and discussion over the essential things that an astronomically literate person should know.
For more detailed information, please go to the official IAU announcement page here: <https://iau.org/news/announcements/detail/ann19029/>

These will inform ongoing expansion of curricula coverage and help us map out work for rest of the year.

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