



# ASERA

AUSTRALASIAN SCIENCE EDUCATION RESEARCH ASSOCIATION LTD

**ANNUAL  
CONFERENCE**

Deakin University  
Melbourne, Australia  
1 – 4 July 2025



**PROGRAM**  
**2025 Conference (ASERA56)**  
Deakin Downtown, Docklands (Melbourne, Australia)  
Tuesday 1<sup>st</sup> July to Friday 4<sup>th</sup> July 2025

## Table of Contents

<b>ACKNOWLEDGEMENT OF COUNTRY</b> .....	<b>3</b>
WELCOME EVENT .....	3
ACKNOWLEDGEMENT OF ANTHROPOCENE CHALLENGES.....	3
<b>THE ASERA COMMUNITY</b> .....	<b>3</b>
<b>WELCOME FROM THE CONFERENCE ORGANISERS</b> .....	<b>4</b>
<b>THANK YOU TO OUR CONFERENCE SPONSORS</b> .....	<b>5</b>
<b>CONFERENCE PROGRAM OVERVIEW</b> .....	<b>6</b>
<b>IMPORTANT INFORMATION FOR DELEGATES</b> .....	<b>9</b>
COMPLIMENTARY WI-FI .....	9
WELCOME RECEPTION .....	9
REFRESHMENTS .....	9
NAME BADGES.....	9
ONLINE CONFERENCE DELEGATES.....	9
PRESENTERS – PLEASE NOTE.....	9
SESSION CHAIRS – PLEASE NOTE.....	9
SYMPOSIUM PRESENTATIONS .....	10
POSTER PRESENTERS – PLEASE NOTE.....	10
UPDATES TO THE PROGRAM .....	10
DEDICATED PRAYER SPACE .....	10
SAFE PEOPLE AT ASERA56 .....	10
NEED HELP? .....	10
<b>SPECIAL ANNOUNCEMENTS</b> .....	<b>12</b>
PUBLISHING AND REVIEWING FOR RESEARCH IN SCIENCE EDUCATION (RISE) .....	12
ASERA56 TRAVEL AWARDS FUNDED BY THE NATIONAL ASSOCIATION FOR RESEARCH IN SCIENCE TEACHING (NARST).....	12
ACER SPONSORED SESSION – SYMPOSIUM.....	12
GRAPHIC ILLUSTRATION BY RAY ECKERMANN.....	12
<b>FIRESIDE CHAT</b> .....	<b>13</b>
<b>CONFERENCE DINNER</b> .....	<b>14</b>
<b>A BRIEF GUIDE TO MELBOURNE</b> .....	<b>15</b>
MELBOURNE AIRPORT TO CBD.....	15
<b>THINGS TO DO IN MELBOURNE</b> .....	<b>16</b>
<b>ASERA56 PLATINUM SPONSOR</b> .....	<b>17</b>
<b>PRESENTATIONS - WEDNESDAY (2<sup>ND</sup> JULY 2025)</b> .....	<b>18</b>
<b>PRESENTATIONS - THURSDAY (3<sup>RD</sup> JULY 2025)</b> .....	<b>21</b>
<b>PRESENTATIONS - FRIDAY (4<sup>TH</sup> JULY 2025)</b> .....	<b>24</b>
<b>ASERA56 GRAPHIC ILLUSTRATION (AND CONFERENCE SPONSOR)</b> .....	<b>26</b>
<b>PRESENTATION - ABSTRACTS</b> .....	<b>27</b>
<b>ASERA56 WELCOME EVENT SPONSOR</b> .....	<b>54</b>
<b>ASERA56 WELCOME EVENT SPONSOR</b> .....	<b>55</b>
<b>SYMPOSIA PRESENTATIONS AND ABSTRACTS</b> .....	<b>56</b>
ASERA56 SESSION SPONSOR.....	64
<b>POSTER PRESENTATIONS AND ABSTRACTS</b> .....	<b>69</b>
POSTERS - WADAWURRUNG 1.....	69
POSTERS - WADAWURRUNG 2.....	73
POSTERS - UPSTAIRS CREATIVE.....	77



**PROGRAM**  
**2025 Conference (ASERA56)**  
Deakin Downtown, Docklands (Melbourne, Australia)  
Tuesday 1<sup>st</sup> July to Friday 4<sup>th</sup> July 2025

## **Acknowledgement of Country**

We would like to acknowledge the Traditional Custodians of the unceded lands on which we gather - the Wurundjeri people of the Kulin Nation. We pay our respects to all Aboriginal, Torres Strait Islander, and First Nations Traditional Custodians, Elders and Ancestors of all the lands from which you may be joining. We express our gratitude for their care of Country which continues to sustain us as it has done for millennia.

### **Welcome Event**

At the ASERA56 Welcome Event on Tuesday 1<sup>st</sup> July from 5 to 7pm please join us for a traditional Welcome to Country from a Wurundjeri Elder. The Welcome to Country ceremony is a significant Indigenous Australian tradition that formally acknowledges and pays respect to the Traditional Custodians of the land, affirming their enduring connection to Country and inviting safe passage for visitors. We are pleased to connect with the Wurundjeri Woi-Wurrung Cultural Heritage Aboriginal Corporation.

Find out more from this site <https://www.wurundjeri.com.au/>.

### **Acknowledgement of Anthropocene Challenges**

ASERA56 comes at a time of considerable pressure for Science Education to adapt to the challenges of the Anthropocene, including responding to Anthropogenic Climate Change, the rise of mis/disinformation in media, fallout from the global pandemic, the 4<sup>th</sup> Industrial revolution and changes to industry demands, and the challenges and opportunities of Gen-AI. The implications of these for rethinking the nature and purposes of science education comes with system pressures in Australia and New Zealand to narrow the pedagogies in disciplinary subjects and impose restrictions on teacher educators to conform to these. Our conversations at ASERA and the influence of our organisation play an important part in maintaining an informed, evidence-based climate in which science education is framed.

## **The ASERA Community**

Join the ASERA community by becoming a member. See <https://www.asera.org.au/>. Follow us on [Twitter/X](#) (@ASERAeducation) and [LinkedIn](#) for updates on the conference and for information on other Science Education research events. When posting about the conference on social media, please use the official conference hashtag (#ASERA56). Please share others' posts and please tag us in your posts.





**PROGRAM**  
**2025 Conference (ASERA56)**  
Deakin Downtown, Docklands (Melbourne, Australia)  
Tuesday 1<sup>st</sup> July to Friday 4<sup>th</sup> July 2025

## Welcome from the Conference Organisers

Welcome to the Deakin Downtown Corporate Centre, Melbourne, Australia, for the 56th conference of the Australasian Science Education Research Association (ASERA). We are delighted that you have chosen to join with us, bringing researchers, educators, and practitioners together to discuss and progress science education. We look forward to the thinking, learning, and discussions that will take place over the next few days.

ASERA56 is the largest ASERA conference to date. We have over 160 delegates from 14 countries attending, presenting six symposia, 62 posters, and 90 paper presentations. This conference will offer a wonderful opportunity to encourage collaboration and the exchange of ideas to shape the future of science education in Australasia and beyond.

Leading science education researchers will share their research and insights, and as you can see in the program, there is much diversity in the presentations. We encourage you to engage in considered discussion, ask thoughtful questions, offer supportive feedback, and make connections.

ASERA has a rich history of supporting early career researchers (ECRs) and higher degree by research students (HDRs). This year, **Associate Professor Helen Georgiou** and **Dr Joseph Ferguson** will be hosting our annual ECR/HDR Fireside Chat. Thanks also to **Associate Professor Reece Mills** and **Professor Jan van Driel** for their ongoing support for our ECR/HDR ASERA community.

We offer a sincere thank you to our six **ASERA56 Conference Volunteers** for ASERA56: **Shefali Sharma-Wallis, Sarah Oliveira, Kyla Adams, Carol Martinez Camacho, Prina Bhugwan, and Nur Fitriyana.**

We also thank the **ASERA56 Reviewers** who volunteered to review over 205 abstracts (see acknowledgment page later in the program).

Thank you to **Tabetha Spiteri** -ASERA Executive Officer, **Dr. Jared Cependale** – ASERA Treasurer, and the ASERA Board for support in hosting this conference.

We are pleased to be making the most of our Melbourne location with our Conference Dinner located at the iconic Melbourne Cricket Ground (MCG). We hope that while visiting you will enjoy all that this city has to offer.

We extend our warmest welcome to you all, hoping that you enjoy being at Deakin Downtown – with our celebrated colleagues supporting us at this conference venue – and that you find the conference inspiring and return home feeling engaged, informed, and energised.

Best wishes

Peta, Russell, Joe, Amrita





**PROGRAM**  
**2025 Conference (ASERA56)**  
Deakin Downtown, Docklands (Melbourne, Australia)  
Tuesday 1<sup>st</sup> July to Friday 4<sup>th</sup> July 2025

**Thank You to Our Conference Sponsors**

ASERA56 enjoys significant sponsorship from the following organisations. See sponsor showcases throughout our program.

**Platinum Sponsors**



**Sponsors for the Welcome Event**



**Graphic Illustration with Ray Eckermann – a special treat at ASERA56**



Check out Ray at work in each session in the **Gunditjmara 1** room. Presenters nominated themselves to participate and have committed to collaborate with Ray in the process. See the description of how Ray works later in the program – you may like to contract him to communicate your research.

**Session Sponsors**



ACER selected to sponsor the Symposium in Session 8/9 - *Embedding Indigenous and First Nations Sciences in Science Education: From theory to practice.*

**Exhibitors** - The Springer Exhibition booth will be located near the registration table from Wednesday to Friday. *Thank you Springer!*



**Supporters** – ASERA enjoy a strong relationship with the Australian Science Teachers Association (ASTA).





**PROGRAM**  
**2025 Conference (ASERA56)**  
Deakin Downtown, Docklands (Melbourne, Australia)  
Tuesday 1<sup>st</sup> July to Friday 4<sup>th</sup> July 2025

**Conference Program Overview**

<b>Tuesday 1<sup>st</sup> July</b>	ASERA Board Meeting 2.30-4.30pm Conference Registration opens from 2pm <b>Conference Welcome Reception and Welcome to Country 5:00 – 7:00pm</b>
<b>Wednesday 2<sup>nd</sup> July</b>	Registration Desk opens at 8.00am Dedicated Poster Session 8:30 - 9:00am Parallel Sessions begin at 9:00am Morning Tea 10:30 – 11:00am Lunch 12:30 - 1:30pm RISE session 1:00 - 1:30pm Dedicated Poster Session 1:30 -2:00pm Afternoon Tea 3.30 – 4:00pm <b>HDR/ECR Fireside Chat 5:00 – 7:00pm (those who registered only)</b>
<b>Thursday 3<sup>rd</sup> July</b>	Registration Desk opens at 8.00am Dedicated Poster Session 8:30 - 9:00am Parallel Sessions begin at 9:00am Morning Tea 10:30 - 11:00am Lunch 12.30 - 1:30pm Afternoon Tea 3.00 – 3:30pm ASERA Annual General Meeting 3:30 - 5:30pm <b>Conference Dinner (MCG) 6:30 – 11pm (full registrants only)</b>
<b>Friday 4<sup>th</sup> July</b>	Registration Desk opens at 8.00am Dedicated Poster Session 8:30 - 9:00am Parallel Sessions begin at 9:00am Morning Tea 10:30 - 11:00am Lunch 12.30 - 1:30pm Conference concludes 1:30pm



## PROGRAM

**2025 Conference (ASERA56)**  
Deakin Downtown, Docklands (Melbourne, Australia)  
Tuesday 1<sup>st</sup> July to Friday 4<sup>th</sup> July 2025



# Deakin Downtown

Level 12 | Tower 2 | Collins Square

Offering the next level of sophisticated, technology-rich, flexible space for external engagement, meetings, conferences, functions and professional immersion.

### GETTING TO COLLINS SQUARE

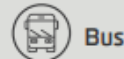
Deakin Downtown is located on Level 12 in Tower 2 of Collins Square. Here you will find out how to get there, your own way!



**Train**  
Southern Cross Station is just 350 metres from Collins Square providing access to over 15 different train lines and all Vline services. Southern Cross Station also has coach services to Melbourne Airport and Avalon Airport.



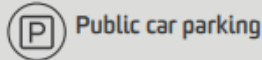
**Tram**  
Collins Square is directly opposite tram stop D15-Batmans Hill Drive / Collins Street offering tram accessibility for 10 different routes.



**Bus**  
**Bus stop locations**  
Cnr Collins & Spencer Street and Outside The Age building.  
Bus 237 & 235 – Queen Victoria Market/ Fisherman's Bend.  
Bus route information is available from Public Transport Victoria – [ptv.vic.gov.au](http://ptv.vic.gov.au)



**Bike**  
There are many bicycle paths which link Collins Square to various routes in and out of the city.



**Public car parking**  
**Secure Parking**  
664 Collins Street, Melbourne  
Mon-Fri: 6am-8pm  
700 Collins Street, Docklands  
Mon-Sun: 24/7  
**Wilson Parking**  
750 Collins Street, Docklands  
Mon- Fri: 6am-7pm



**Taxi**  
Collins Square hosts a dedicated taxi rank on Collins Street, located just outside the Commonwealth Bank, towards the corner of Collins Street and Batmans Hill Drive. Additional taxi ranks are located across the road outside 750 Collins Street and 700 Collins Street.

Check online for early bird times for the best rates.



Deakin Downtown

### COLLINS SQUARE RETAIL AND HOSPITALITY

Over 45 different retailers and services located within Collins Square ensures your visit to Deakin Downtown is enjoyable and convenient.

On the ground floor of Collins Square you'll find an array of food options, with both dine-in and grab and go varieties on offer to suit every situation.

You will also find useful services such as Australia Post, Commonwealth Bank, and dry cleaners.

**Contact us**  
+61 3 9918 9120  
[downtown@deakin.edu.au](mailto:downtown@deakin.edu.au)

**Visit us**  
Level 12, Tower 2  
727 Collins Street  
Melbourne VIC 3005

**Hours**  
Monday to Friday  
7.30am- 6.30pm

[deakin.edu.au](http://deakin.edu.au)  
Deakin University CRICOS Provider Code: 00211B



**PROGRAM**  
**2025 Conference (ASERA56)**  
Deakin Downtown, Docklands (Melbourne, Australia)  
Tuesday 1<sup>st</sup> July to Friday 4<sup>th</sup> July 2025



## Accessing Deakin Downtown

Level 12 | Tower 2 | Collins Square

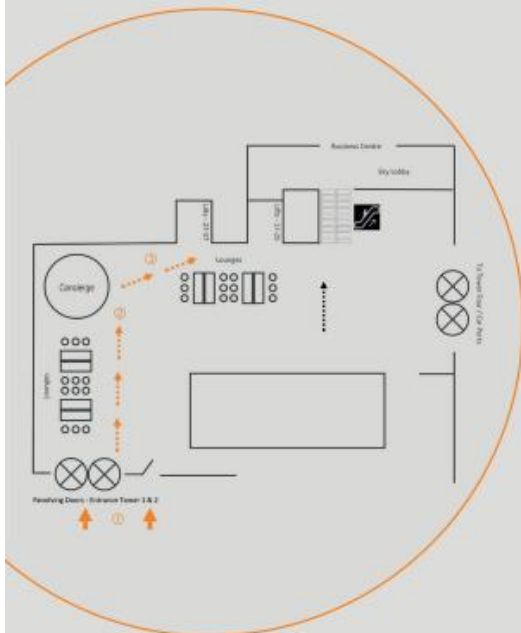
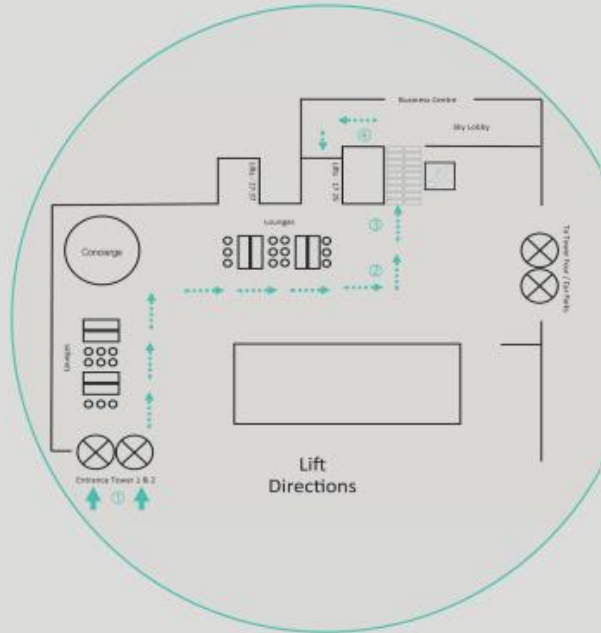
Offering the next level of sophisticated, technology-rich, flexible space for external engagement, meetings, conferences, functions and professional immersion.

### ONCE YOU ARRIVE AT COLLINS SQUARE

To make your way to Deakin Downtown, located in Tower 2:

1. Enter Collins Square via the Collins Street entrance underneath the yellow geometric sculpture
2. Make your way across the lobby floor towards the escalators on the right-hand side
3. Ascend the escalators and turn left, following signage to the elevators
4. Select Level 12 on the touch screen and wait to be allocated an elevator letter and then make your way to the corresponding elevator door
5. Upon arrival to level 12, turn right and proceed through the glass sliding doors where you will find our reception desk.

Welcome to Deakin Downtown.



### MOBILITY ACCESS

1. Enter Collins Square via the Collins Street entrance underneath the yellow geometric sculpture through the revolving doors or the mobility access door to the right
2. Make your way across the lobby floor towards the concierge desk
3. Concierge will escort you directly to the elevators with access to Level 12

Welcome to Deakin Downtown.

**Contact us**  
+61 3 9918 9120  
downtown@deakin.edu.au

**Visit us**  
Level 12, Tower 2  
727 Collins Street  
Melbourne VIC 3005

**Hours**  
Monday to Friday  
7.30am - 6.30pm

**deakin.edu.au**  
Deakin University (DUC) Provider Code: 502138



**PROGRAM**  
**2025 Conference (ASERA56)**  
Deakin Downtown, Docklands (Melbourne, Australia)  
Tuesday 1<sup>st</sup> July to Friday 4<sup>th</sup> July 2025

## Important Information for Delegates

### Complimentary Wi-Fi

**Network:** Guest\_Wifi\_Deakin, Username: 75kt3r, Password: 4830. Eduroam will work.

### Welcome Reception

Please join us on Tuesday evening for the **ASERA56 Welcome Reception**. This event will be hosted in the main area of Deakin Downtown from 5 to 7pm, and **you will be able to register at the conference from 2.30pm**. You can also put up your poster for the **dedicated poster sessions** throughout the conference.

### Refreshments

Breakfast canapes on arrival, morning tea, lunch, and afternoon tea is included for all delegates, including lunch on Friday (with take away boxes). Coffee and tea will be available for the duration of the conference. We invited all delegates to offer their dietary requirements prior to the conference via survey.

### Name Badges

You will be issued a name badge when you first check in at the registration desk. Your name badge serves as your conference pass, so please always wear it at all conference events. It's a great tool for meeting new colleagues. Blue dots = the ASERA Board members and Red Dots = Conference Chairs and Volunteers.

### Online Conference Delegates

We are pleased to have several online ASERA56 Conference delegates tuning into each room throughout the conference. Our **Conference Volunteers** will watch the chat and **Session Chairs** will include questions during discussion.

### Presenters – Please note...

Please visit the room you are presenting in during a break prior to your session. If you are using a presentation, please work with the **Conference Volunteer** assigned to that room to upload it to the laptop in the room. The easiest way to upload is via USB, and there will be USBs available in each room. You can use your own laptop (use an HDMI connection) – we recommend practicing. The Conference Volunteers will bring the presentation up or support you to plug in as you are introduced by the **Session Chair** at the start of your presentation. Each presentation is strictly 40 minutes where it is expected that the presentation is no longer than 20 minutes, followed by discussion.

### Session Chairs – Please note...

To ensure the program runs to schedule, please adhere strictly to the program. Please be at the session early to meet your presenter/s, negotiate the introduction, time and discussion management and then begin right on time introducing the presenter/s and the title. The **Conference Volunteers** will be there to support with technology, presentation uploading, and managing the online delegates participation. Each presentation time allocation is strictly 40 minutes. It is expected that the presentation is no longer than 20 minutes, followed by discussion. At the end of the presentation, please thank the author/s and facilitate the discussion (if the presenter asks you to – they may want to facilitate it themselves). Please wrap up the session on time by thanking all delegates, especially the presenter/s.



**PROGRAM**  
**2025 Conference (ASERA56)**  
Deakin Downtown, Docklands (Melbourne, Australia)  
Tuesday 1<sup>st</sup> July to Friday 4<sup>th</sup> July 2025

### **Symposium Presentations**

Symposium presentation sessions are allocated a double session and may consist of three or four papers about a common theme, and they may also include a discussant. It is expected that half the time will be allocated to discussion. The **Session Chair** is the Symposium Chair.

### **Poster Presenters – Please note...**

There are four **dedicated poster presentation sessions** within the program spread out over three rooms – upstairs and on the main floor (Wadawurrung 1, Wadawurrung 2, Upstairs Creative). Poster presenters are expected to be with their poster for questions and discussion during these times. If you wish to keep your poster, please collect it at the conclusion of the conference (Friday 4<sup>th</sup> July at 12.30pm).

### **Updates to the Program**

This is our FINAL program shared via email on Monday 30<sup>th</sup> June. A daily schedule (with any last-minute updates) will be posted each day at the registration desk.

### **Dedicated Prayer Space**

Prayer Room at Southern Cross: <https://goprayer.com.au/place/southern-cross-station-prayer-room/>

### **Safe People at ASERA56**

We are committed to providing a safe and welcoming environment for all attendees. To support this commitment, we have designated "Safe People" available throughout the conference. These individuals are here to listen and provide confidential support if you experience or witness any behaviour that makes you feel uncomfortable or breaches of our Code of Conduct.

Role of Safe People:

- Offer a confidential and supportive space for discussion.
- Listen to concerns and provide guidance on next steps.
- Assist in connecting you with additional resources or support if needed.

Safe People at ASERA: *Linda Hobbs, Cristina Guarrella, Louisa Tomas Engel, Rebecca Cooper, Reece Mills, Jared Carpendale*

### **Need Help?**

Please ask our **Conference Volunteers** for support. You may also visit the registration desk or ask the conference organisers. The Deakin Downtown staff are also excellent supports. For emergency assistance, please contact **Conference Chair Dr. Amrita Kamath** ([amrita.kamath@deakin.edu.au](mailto:amrita.kamath@deakin.edu.au) or +61413451284).



## PROGRAM

**2025 Conference (ASERA56)**  
Deakin Downtown, Docklands (Melbourne, Australia)  
Tuesday 1<sup>st</sup> July to Friday 4<sup>th</sup> July 2025



# Special thanks to our reviewers!

Jan van Driel Rebecca Cooper  
Em Rochette Saeed Salimpour  
Sarika Kewalramani Linda Hobbs  
Juli Lynch Amanda Berry  
Lihua Xu Emma Stevenson  
Amanda Peters Cristina Guarrella  
Maurice Toscano Hongming Ma  
Jennifer Mansfield Judith Gnomes  
Premnadh Kurup Melinda Kirk  
John Cripps Clark George Aranda  
Connie Cirkony Shefali Wallis  
Loeurt To Kyla Adams  
Athavan Alias Anand Selvam Joel Bautista  
Ngoc Thi-Nhu Bui Azneezal Ar Rashid  
Bin Mohd Ramli Craig Sims  
Gahyoung Kim Sally Gutierrez  
Sarah Oliveira Febrina Hartanti  
Mahin Ariafakhr Carol Martinez  
Victoria Miller Karen Marangio  
Kathy Smith



**PROGRAM**  
**2025 Conference (ASERA56)**  
Deakin Downtown, Docklands (Melbourne, Australia)  
Tuesday 1<sup>st</sup> July to Friday 4<sup>th</sup> July 2025

## Special Announcements

### Publishing and Reviewing for Research in Science Education (RISE)

**Wednesday 2<sup>nd</sup> July @ 1 - 1.30pm.** Interested in publishing and reviewing for RISE? Join the co-Editors-in-Chief for an interactive session on the journal's peer review process and how to provide critical and constructive feedback to improve submission quality. Whether you're preparing to submit your own manuscripts or looking to grow as a reviewer, this session offers valuable insights to engage deeply with the science education research community. Early-career researchers and HDR students are especially welcome!

In this session, we'll discuss:

- What editors look for in submissions to Q1 academic journals
- Why become a reviewer?
- How to write effective peer reviews?
- How reviewing can improve your own research and academic writing?
- Pathways to becoming a reviewer for RISE

### ASERA56 Travel Awards Funded by the National Association for Research in Science Teaching (NARST)

NARST is a global organization of professionals committed to the improvement of science teaching and learning through research. As part of an MOU between NARST and ASERA, the NARST International Committee awards two graduate students who are NARST members a travel grants to attend our conference. This year, we welcome **Anjar Putro Utomo** and **Ronan Rock** as the recipients of the ASERA56 travel award.

### ACER Sponsored Session – Symposium

ACER selected to sponsor the Symposium in Session 8/9 - *Embedding Indigenous and First Nations Sciences in Science Education: From theory to practice.*



### Graphic Illustration by Ray Eckermann

Ray Eckermann is a well-known and highly regarded graphic illustrator who has been contracted to illustrate one presentation in each session at ASERA56. Watch him work in the **Gunditjmara 1** room. Presenters nominated themselves to participate and have committed to collaborate with Ray in the process. See the description of how Ray works later in the program – you may like to contract him to communicate your research. <https://www.smallmountains.com.au/>





**PROGRAM**  
**2025 Conference (ASERA56)**  
Deakin Downtown, Docklands (Melbourne, Australia)  
Tuesday 1<sup>st</sup> July to Friday 4<sup>th</sup> July 2025

**Fireside Chat**

**Wednesday 2nd July 2025 from 5:00pm – 7:00pm at Deakin Downtown**

The Fireside Chat runs every year at the ASERA conference. This is an informal gathering for HDRs/ECRs to network and share ideas with peers and two experienced science education academics about how to launch and maintain rewarding academic careers as part of making a meaningful contribution to the science education community in Australia, New Zealand, and beyond.

**Associate Professor Helen Georgiou** and **Dr Joe Ferguson** will host the ASERA56 Fireside Chat. They will share their research and teaching journeys as science education academics.

Drinks and appetisers will be served. Please be sure to have registered.



**Joseph Paul Ferguson** is a lecturer in science and climate change education at Deakin University. He teaches and researches in primary science and technology education as well as climate change education in both the primary and secondary education contexts. Joseph's current research explores pragmatist semiotic approaches to teaching and researching science and environmental/climate education and the use of video methodologies (including film) to undertake design-based research with teachers in schools. He is passionate about the power of theory/philosophy to inform educational practice.



**Helen Georgiou** is an Associate Professor in Science Education at the University of Wollongong, Associate Editor of Research in Science Education, and Academic Program Director of the Bachelor of Science Education. Her research spans various areas, including students' conceptual understanding and the analysis of effective teaching approaches. Currently, she is leading two major projects: one examining student writing in high school science and another exploring STEM learning in a Makerspace for teachers and preservice teachers. Helen teaches undergraduate and master's science education courses for preservice primary teachers.



**PROGRAM**  
**2025 Conference (ASERA56)**  
Deakin Downtown, Docklands (Melbourne, Australia)  
Tuesday 1<sup>st</sup> July to Friday 4<sup>th</sup> July 2025

**Conference Dinner**

**Thursday 3<sup>rd</sup> July from 6:30pm - 11:00pm at the Melbourne Cricket Ground (MCG) in the Long Room**

The dinner is a social highlight at every ASERA conference. It is an opportunity for all attendees to get together for great food, great company, and great music/dancing. *Yes, the ASERA community dances!*

The MCG is located at Yarra Park Brunton Avenue, East Melbourne, VIC 3002, and you can make your way there [via public transport \(tram and/or train\)](#). Access the MCG via Gate 2 and follow the directional signage to the Long Room. For taxis/ubers: the pickup/drop-off point is at Jolimont St & Jolimont Terrace with a short walk to Gate 2. Those planning to drive to the MCG need to register at the ASERA Registration desk prior as parking spaces at the MCG are limited.

The dinner is a three-course meal starting with a Farmers Grazing Table and Seafood platter. Local Beef, lamb, and Chicken meals with hot and cold side dishes will be served buffet style. Similarly, a wide range of desserts will be served buffet style. All dietary requests will be catered for with suitable substitutions. Drinks are included to a pre-arranged amount and then a cash bar will be offered.



Photo by Rodger Wang on Unsplash

**DJ Reviewer 2** will be *rocking our tunes!* Use [this survey](#) to assist **DJ Reviewer 2** design the playlist





**PROGRAM**  
**2025 Conference (ASERA56)**  
Deakin Downtown, Docklands (Melbourne, Australia)  
Tuesday 1<sup>st</sup> July to Friday 4<sup>th</sup> July 2025

## A Brief Guide to Melbourne

We hope that you can find some time to enjoy Melbourne. Some highlights are offered below, and you can also browse [Visit Melbourne](#).

### Melbourne Airport to CBD

#### Shuttle

SkyBus offers express services between Melbourne Airport and Southern Cross Station daily from 4am to 1am, with stops at Terminals 1, 3, and 4. Tickets are card-only, available at e-kiosks or <http://www.skybus.com.au>.

#### Taxis

Taxis are available at ranks near all terminals, with the Melbourne CBD about 30 minutes away. For safety, only use taxis from these designated ranks. Pre-booked taxis will pick you up at the north end of the Terminal 1, 2, & 3 Car Park, closest to Terminal 1. A \$4.78 (incl. GST) airport access fee is included in the fare. For more details, visit: <https://www.melbourneairport.com.au/taxis>

#### Rideshare

Rideshare pick-up locations are:

- Terminals 1, 2 & 3: Lane 3 of the forecourt
- Terminal 4: Level 2, Terminal 4 Car Park

Drop-offs can be made at:

- Public areas along Departure Drive
- Terminal 4: Transport Hub on Level 1 of the Terminal 4 Car Park

For more details, visit: <https://www.melbourneairport.com.au/rideshare>

#### Car Hire

Rental car companies are located on the ground floor of the Terminal Car Park at Terminals 1, 2, & 3, directly across from Terminal 2. You can reach each rental company via the walkways from the terminals and return cars to the Terminal Car Park at Terminals 1, 2, & 3. For more details, visit:

<https://www.melbourneairport.com.au/car-rentals>.

#### Bus Services

Public Transport Victoria (PTV) runs 5 services from Terminal 4's Ground Transport Hub. For details, visit the [PTV website](#) or the [PTV Airport Bus page](#).



Flinders Street Station

Photo by [Paul Macallan](#) on [Unsplash](#)



## PROGRAM

### 2025 Conference (ASERA56)

Deakin Downtown, Docklands (Melbourne, Australia)

Tuesday 1<sup>st</sup> July to Friday 4<sup>th</sup> July 2025

## Things to do in Melbourne

Melbourne is filled with attractions, including picturesque laneways, striking street art, lush parks, and remarkable galleries and museums, all immersed in a vibrant ambiance. Whatever your interests, there's always something exciting happening in Melbourne. See [here](#) for more information on what to do in Melbourne.

Discover historic arcades and laneways featuring exquisite dining options, stylish cafes, hidden bars, and fashion boutiques, or visit one of the city's many lush gardens. See [here](#) for more information on Melbourne's [arcades](#) and [laneways](#).

The City of Melbourne boasts nearly 480 hectares of internationally renowned parks and gardens, providing a range of open spaces, recreational opportunities, and facilities for the community. See [here](#) for more information on parks and gardens within the City of Melbourne.

Melbourne is recognised as Australia's 'sporting capital'. Experience the city's passion for sports—such as Australian rules football, cricket, soccer, and tennis—by visiting the sports precinct and the iconic Melbourne Cricket Ground (MCG). See [here](#) for more information on Melbourne's sporting culture.

Melbourne is renowned for its shopping scene, featuring boutique shops in laneways, shopping centres, historic arcades, unique stores, and vibrant markets, including the [The Queen Victoria Market](#), the largest open-air market in the Southern Hemisphere. See [here](#) for more information on shopping in Melbourne.

Head to the [Arts Precinct](#) on Southbank to take in art at the [NGV International](#) or catch a show in the [East End Theatre District](#). Witness a contemporary collision of art and architecture at [Fed Square](#), or surround yourself with digital art at [THE LUME](#) Melbourne. See [here](#) for more information on Arts and Culture in Victoria.

Melbourne is home to a state-of-the-art [aquarium](#) and award-winning [zoos](#), complemented by vast [parklands](#) brimming with native wildlife, making it easy to experience the wonders of nature. See [here](#) for more information on nature and wildlife in Victoria.



Photo by [Annie Spratt](#) on [Unsplash](#)

<https://whatson.melbourne.vic.gov.au/article/street-art-guide-to-melbourne>



## PROGRAM

**2025 Conference (ASERA56)**  
Deakin Downtown, Docklands (Melbourne, Australia)  
Tuesday 1<sup>st</sup> July to Friday 4<sup>th</sup> July 2025

### ASERA56 Platinum Sponsor



## MSET-ED

Mathematics, Science, Environment  
and Technology Education Research  
*for informed futures*

MSET-Ed is a high-performing research group with a sustained history of disciplinary and interdisciplinary research.

We operate within a vibrant education research culture at Deakin, with interdisciplinary links across Social Science, Arts and Science researchers. Some strong strands include climate change education, mathematical modelling, out of field teachers, financial mathematics, multimodal languages of science.

Our research is strongly grounded in teacher and school practice, and system curriculum innovation.

Through ARC projects and partnerships with education systems and philanthropic organisations we work to support teachers and schools for improved, future focused learning outcomes.

MSET-Ed research is theoretically and methodologically sophisticated, designed to shape the field.

#### Our research programs are:

- **Teachers and Teaching: Teacher learning and practice, leading school and system change**
- **Innovative, Contemporary Curriculum: Policy, practice, and partnerships**
- **Justice and Equity: Decolonising practices, gender equity**
- **Learners and Learning: Critical and creative reasoning and learning, modelling**
- **Methodological Innovation**

We host an active program at the doctorate and masters level producing graduate students who contribute to the field through attending to contemporary challenges and practising innovative, flexible research methodologies.

We host an annual Contemporary Approaches to Research symposium. See [here](#).

We have a range of innovative professional learning programs for teachers based on research informed practices co-designed and trialled in schools.

Find out more at <https://mset-ed-deakin.org.au/>

Deakin University CRICOS Provider Code: 00113B





**PROGRAM**  
**2025 Conference (ASERA56)**  
 Deakin Downtown, Docklands (Melbourne, Australia)  
 Tuesday 1<sup>st</sup> July to Friday 4<sup>th</sup> July 2025

**Presentations - Wednesday (2<sup>nd</sup> July 2025)**

	Wadawurrung 1	Wadawurrung 2	Gunditjmara 1	Gunditjmara 2	Upstairs Immersive	Upstairs Creative
<b>DEDICATED POSTER SESSION: 8:30 – 9:00am</b> All posters - Wadawurrung 1, Wadawurrung 2, Upstairs Creative						
<b>Session 1</b> 9:00-9:40am	<i>Expanding Horizons: Innovations in Science Outreach</i>  Linda Hobbs, Cristina Guarrella, Victoria Millar, Kyla Adams, Julia L. Hill, Maurizio	<i>Dialogic Science Teacher: A Customized Generative AI Chatbot for Fostering Scientific Argumentation and Perspective-Taking</i>  Kok-Sing Tang, Putra Buana  Chair: Mihye Won	<i>Exploring Plant Awareness for Culturally Responsive Teaching in Initial Teacher Education</i>  Emily Rochette  Chair: Peta White	<i>Outdoor STEM Education: The Trend of Education to Foster Kids' Awareness of Their Own Community</i>  Siriwan Chatmaneerungcharoen  Chair: Karen Murcia	<i>Effective Science Teacher Behaviours and Pedagogies to Promote Argumentation Skills Using Socioscientific Issues</i>  Vaille Dawson  Chair: Joe Ferguson	<i>Exploring the Evolution of Student Attitudes Towards School Science</i>  JohnPaul Kennedy  Chair: Amrita Kamath
<b>Session 2</b> 9:50 – 10:30am	Toscano, Jan Van Driel, Deya Chakraborty, Lihua Xu, Chris Speldewinde, Krissy Walsh, Janine Meadley, Samantha Bothe, Chloe Nelson, Georgie Aiuto, Jackie Bondell  Chair: Linda Hobbs	<i>Co-constructing Scientific Explanations: A Case of Student–generative AI Interactions in a Biology Classroom</i>  Sally Gutierrez, Moonhyun Han  Chair: Mihye Won	<i>Factors Influencing High Ability Students in STEM</i>  Michelle Lucas, Jae Jung  Chair: Jennifer Mansfield	<i>The Role of the Body in Conceptual Learning: Reporting from the Festival of Embodiment</i>  Russell Tytler, Magdalena Kersting, Joe Ferguson, Peta White  Chair: Karen Murcia	<i>Chemical Knowledge in Engineering Applications - Interdisciplinary Projects in Teaching-learning Laboratory Settings</i>  Janne-Marie Bothor, David-Samuel Di Fuccia  Chair: Seamus Delaney	<i>A Systematic Review of Literature on Preparing Pre-service Teachers for Engineering Integrated Science Teaching: Interventions, Outcomes, and Gaps</i>  John Ojeogwu, Frackson Mumba  Chair: Amrita Kamath
<b>MORNING TEA – 10:30 – 11:00am</b>						
<b>Session 3</b> 11:00 – 11:40am	<i>Science and Spirituality Education in the Anthropocene</i>  Sara Tolbert, Joshua S. Hoskinson, Carol	<i>Enhancing Science Learning with a UDL-Informed AI Chatbot: A Study on Grade 6 Optics</i>  Hye-Eun Chu, Juyeon Lee, Sarah Hajama, Kiano	<i>Mapping STEM Learning Trajectories: An Embedded Single Case Study of In-Service Teachers</i>	<i>The Contribution of Citizen Science to the Development of Environmental Awareness, Concern and Agency</i>  Leonie J Rennie	<i>Supporting Science Teacher Educators Through a SoTL Community</i>  Emma Stevenson, Kristen Hebden, Cristina Guarrella	<i>Differentiated Resource Use: A Preliminary Study Examining Teacher Experience and Implementation of Singapore's Revised</i>



**PROGRAM**  
**2025 Conference (ASERA56)**  
 Deakin Downtown, Docklands (Melbourne, Australia)  
 Tuesday 1<sup>st</sup> July to Friday 4<sup>th</sup> July 2025

	<b>Martinez-Camacho, Betzabe Torres Olave</b>  <b>Chair: Sara Tolbert</b>	<b>Pomente, Sonya Nichole Martin</b>  <b>Chair: Violetta Pristel</b>	<b>Tasneem Anwar, Dania Usman</b>  <b>Chair: Joe Ferguson</b>	<b>Chair: Russell Tytler</b>	<b>Chair: Cristina Guarrella</b>	<b>Melissa Neo, Aik-Ling Tan, Jina Chang, Nadiah Hana Abdul Rahmanm</b>  <b>Chair: Joonhyeong Park</b>
<b>Session 4</b> 11:50am – 12:30pm		<i>Examining Primary Student Enactment of Impactful Inquiry</i> <b>Melinda Kirk, Peta White, Jo Raphael, Joseph Ferguson</b>  <b>Chair: Violetta Pristel</b>	<i>“Should I call you ‘Mx’?”: Intersections of Queer Studies and Indigenous Science to Reimagine Pedagogies of Care</i> <b>Ronan Rock, Maria Varelas</b>  <b>Chair: Peta White</b>	<i>Sustainability, Environmental and Climate Change Pedagogies in Secondary Science Education: an Australia-China Collaboration</i> <b>Simone Blom, Junqing Zhai, Xiaomei Yan, Xufei Zhang</b>  <b>Chair: Russell Tytler</b>	<i>Enhancing Scientific Literacy Through Bilingual Argumentation: A Study on High School Science Education</i> <b>Pai-Hsing Wu, Ya-Ping Tsao</b>  <b>Chair: Sophia Tsang</b>	<i>“I Will or Will I”: Preservice Elementary Teachers’ Integrated STEM Teaching Self-Efficacy and Perceived Challenges</i> <b>Deepika Menon, Jeanna R. Wieselmann, Allison Johnson, Sumreen Asim, Sarah Haines</b>  <b>Chair: Emily Rochette</b>
<b>LUNCH: 12:30 – 1:30pm</b>						
<b>Publishing and Reviewing for Research in Science Education (RISE): 1:00 – 1:30pm</b>						
<b>DEDICATED POSTER SESSION: 1:30 – 2:00pm</b> <b>All posters - Wadawurrung 1, Wadawurrung 2, Upstairs Creative</b>						
<b>Session 5</b> 2:00 – 2:40pm	<i>Exploring Primary Teachers’ Adaptive Expertise in Interdisciplinary Mathematics and Science Teaching: Conceptual and Methodological Approaches</i>	<i>Problems with Common Current Approaches to Determining the Content of Science Curricula - and an Alternative Approach</i> <b>Richard Gunstone, Connie Cirkony, Glykeria Fragkiadaki</b>  <b>Chair: Leonie Rennie</b>	<i>Smartphone Bans are Hindering Science Education: A Threat to Technology-assisted Learning and Experimentation in Low-income Schools</i> <b>Camilo Lellis-Santos, Giovanna Tonzar-Santos</b>  <b>Chair: Deb de Ridder</b>	<i>An International Survey of High School Teachers on Their Utilisation of Chemistry-based Practical Activities – Insights into Green and Sustainable Chemistry Education</i> <b>Seamus Delaney, Madeleine Schultz</b>  <b>Chair: Carol Aldous</b>	<i>Reading Science Texts with Generative AI: An Exploration of Student-GenAI Interaction</i> <b>Putra Buana, Kok-Sing Tang</b>  <b>Chair: Ma. Hershey P. Regaya</b>	<i>Becoming a STEM Teacher: The Negotiation Process within The Indonesian Preservice Science Teacher’ STEM Teacher Identity Formation</i> <b>Anjar Putro Utomo, Gillian Roehrig</b>  <b>Chair: Jakkrapong Pinchai</b>



**PROGRAM**  
**2025 Conference (ASERA56)**  
 Deakin Downtown, Docklands (Melbourne, Australia)  
 Tuesday 1<sup>st</sup> July to Friday 4<sup>th</sup> July 2025

<p><b>Session 6</b> 2:50 – 3:30pm</p>	<p><b>Lihua Xu, Amanda Berry, Jan van Driel, Joseph Ferguson, Kennedy K. H. Chan, Wanty Widjaja, Lam Pham, Colleen Vale, Gahyoung Kim, Joseph Ferguson</b></p> <p><b>Discussant: David Treagust</b></p> <p><b>Chair: Lihua Xu</b></p>	<p><i>Context: A Powerful Variable</i> <b>Richard White</b></p> <p><b>Chair: Leonie Rennie</b></p>	<p><i>Integrated STEM in Initial Teacher Education: What is the Current State of Play?</i> <b>Samantha Bothe, Lihua Xu, Linda Hobbs</b></p> <p><b>Chair: Helen Georgiou</b></p>	<p><i>Positioning in Science Education: A Focus on Agency</i> <b>Jenny Martin</b></p> <p><b>Chair: Carol Aldous</b></p>	<p><i>Implementing an SSI-based Climate Change Program: The Implication on Secondary Students' Scientific Literacy and Agency</i> <b>Ha My Anna Mang, Hye-Eun Chu, Sonya N. Martin, Michael Cavanagh</b></p> <p><b>Chair: Ma Hershey P. Regaya</b></p>	<p><i>Understanding Knowledge Sharing in Integrated STEM Interdisciplinary Teacher Teams</i> <b>Lisa Chiavaroli</b></p> <p><b>Chair: Margarita Jimenez-Silva</b></p>
<p><b>AFTERNOON TEA: 3:30 – 4:00pm</b></p>						
<p><b>Session 7</b> 4:00 – 4:40pm</p>	<p><i>Immersive Virtual Reality for Science Education: What Do We Know?</i> <b>Mihye Won, David Treagust, Henry Matovu</b></p> <p><b>Chair: Vaille Dawson</b></p>	<p><i>Introducing a Conceptual Framework to Understand Disciplinary Expertise for Out-of-Field Science Teachers</i> <b>Jared Carpendale, Linda Hobbs</b></p> <p><b>Chair: Richard White</b></p>	<p><i>Using the Contextual Model of learning to Examine Teacher Professional Development Whilst Accompanying Science Centre Field Trips and Incursions</i> <b>Chloë Nelson, Victoria Millar, Jan van Driel</b></p> <p><b>Chair: Helen Georgiou</b></p>	<p><i>Attitudes Towards Biodiversity in Secondary School Students: The Significance of Nature Experience and Connectedness in Hong Kong</i> <b>Alan Reid, Sam Lau, Regene Choi</b></p> <p><b>Chair: Jenny Martin</b></p>	<p><i>Assessing the Quality of Pre-service Science Teachers' Engineering Design Integrated Science Units</i> <b>Frackson Mumba John Ojeogwu</b></p> <p><b>Chair: Siriwan Chatmaneerungcharoen</b></p>	<p><i>Collective Meaning-Making of Integrated STEM: A Discourse Analysis of Teacher Professional Learning Communities</i> <b>Suphanwadee Prasong, Akarat Tanak</b></p> <p><b>Chair: Lisa Chiavaroli</b></p>
<p><b>FIRESIDE CHAT: 5:00 – 7:00pm</b> Gunditjmarra 1</p>						



## PROGRAM

### 2025 Conference (ASERA56)

Deakin Downtown, Docklands (Melbourne, Australia)

Tuesday 1<sup>st</sup> July to Friday 4<sup>th</sup> July 2025

### Presentations - Thursday (3<sup>rd</sup> July 2025)

	Wadawurrung 1	Wadawurrung 2	Gunditjmara 1	Gunditjmara 2	Upstairs Immersive	Upstairs Creative
<b>DEDICATED POSTER SESSION: 8:30 – 9:00am</b> All posters - Wadawurrung 1, Wadawurrung 2, Upstairs Creative						
<b>Session 8</b> 9:00 – 9:40am	<i>Embedding Indigenous and First Nations Sciences in Science Education: From theory to practice</i>  <b>Christine Preston, Jared Carpendale, Emily Rochette, Rebecca Cooper, Karen Marangio, Connie Cirkony, Tiffany Gunning, Harry Kanasa, Eun-Ji Amy Kim, Candace Kruger, Ren Perkins, Kari Moana Te Rongopatahi, and Sara Tolbert</b>  <b>Chair: Connie Cirkony</b>  <b>ACER Sponsored Session</b>	<i>Enhancing Chemistry Learning Through Augmented Reality: Development and Evaluation of the MolecularAR Geometry Learning Tool</i> <b>Jacqueline Rose Gutierrez, Michael Uy</b>  <b>Chair: John Cripps Clark</b>	<i>Learning Brains and Genetic Determinism: wishful science in education policy</i> <b>Dorothy Smith</b>  <b>Chair: Magdalena Kersting</b>	<i>Cultivating "Little Food Citizens" Through Interdisciplinary Research Translation.</i> <b>Kathy Smith, Mandi Berry</b>  <b>Chair: Astha Saxena</b>	<i>The Complementary Roles of Visual and Written Representations in Depicting Scientific Phenomena and Theories in Science Textbook Figures</i> <b>Joonhyeong Park, Yew-Jin Lee</b>  <b>Chair: Gahyoung Kim</b>	<i>Teacher Identities Shaping the STEM "playground"</i> <b>Shefali Sharma-Wallis, Russell Tytler, Wanty Widjaja</b>  <b>Chair: Siriwan Chatmaneerungcharoen</b>
<b>Session 9</b> 9:50 – 10:30am	(Continued from Session 8)	<i>Epistemic Scaffolding of Virtual Reality-Based Inquiry Based on Reasoning Type: A Multimodal Perspective</i> <b>Jina Chang, Kok-Sing Tang, Joonhyeong Park</b>  <b>Chair: Louisa Tomas</b>	<i>Developing an Immunology Curriculum for Youth – Contributions from a Delphi Study</i> <b>Sarah Oliveira, Sally Birdsall</b>  <b>Chair: Michelle Lucas</b>	<i>Students' Behavior in Model-Based Inquiry Lessons that Promote the Construction of Complete Scientific Explanations for Gas-Related Phenomena</i> <b>Jakkrapong Pinchai, Navara Seetee</b>  <b>Chair: Vaille Dawson</b>	<i>Embodied Meta-Cognition: Supporting Teacher Awareness and Strategic Use of Embodied Resources in Science Education</i> <b>Magdalena Kersting</b>  <b>Chair: Gahyoung Kim</b>	<i>An Analysis of Interdisciplinary Contexts in Engineering Mathematics Textbooks: Implications for Curriculum Design</i>  <b>Yi-An Cho</b>  <b>Chair: JohnPaul Kennedy</b>
<b>MORNING TEA – 10:30 – 11:00am</b>						
<b>Session 10</b> 11:00 – 11:40am	<i>Symbiosis of Science and the Arts in Education Research</i>	<i>Digital Competency Development in Science Teachers: Analysis and Prediction Through the TPACK Framework</i>	<i>Queering STEM: Navigating and Resisting Cisheteronormativity in Australian Higher Education</i>	<i>Exploring Undergraduate Students' Learning Performance on Projectile Motion Concepts by</i>	<i>Exploring Lower Secondary Students' Reasoning about Newton's Third Law</i>	<b>CANCELED</b> <i>Cultural Responsiveness in Science Pedagogy: Examining Science Teachers and Learners Perspectives on the</i>



**PROGRAM**  
**2025 Conference (ASERA56)**  
 Deakin Downtown, Docklands (Melbourne, Australia)  
 Tuesday 1<sup>st</sup> July to Friday 4<sup>th</sup> July 2025

	<b>Peta White, Amanda Peters, Joseph Ferguson, Robin Bellingham, Danielle Hradsky, Michelle Tourbier, Larissa Raymond, Shelley Hannigan, Jo Raphael</b>	<b>Kittipot Konsanthia, Akarat Tanak</b>  Chair: Louisa Tomas	<b>Philip Kairns</b>  Chair: Dorothy Smith	<i>Integrating Scientific Inquiry with Immersive Virtual Reality</i> <b>Sheng-Chang Chen, Wei-Mao Hung</b>  Chair: Christine McGrail	<i>through Multiple Representations</i> <b>Gahyoung Kim, Mihye Won</b>  Chair: Christine Preston	<i>Integration of Culturally Relevant Teaching Strategies in Addressing Science Learners' Diverse Learning Style Preferences</i> <b>Sakiyiwaa Boateng</b>  Chair: Rekha Koul
<b>Session 11</b> 11:50am – 12:30pm	<b>Discussant: Russell Tytler</b>  Chair: Peta White	<i>Development of Digital Educational Games for Engaging girls in STEM in Early Childhood</i> <b>George Aranda, Sarika Kewalramani, Gerarda Richards</b>  Chair: Louisa Tomas	<i>Will I Enrol in Senior Secondary Sciences? How Schools Influence Student Choice.</i> <b>Ross Phillips</b>  Chair: Emma Stevenson	<i>Intersecting Knowledge Worlds: Describing the Cultural Interfaces Within a Socioscientific issue.</i> <b>Brent Wagner</b>  Chair: Christine McGrail	<i>Monitoring Student Meaning-Making in Human Anatomy and Physiology: The Need for Multiple Representations and Representation Construction</i> <b>Sarah Hajama, Hye-Eun Chu, David Treagust</b>  Chair: Jared Carpendale	<i>Do Makerspace Subjects Enhance STEM and Creative Self-concept?</i> <b>Kristen Hebden, Emily Cook</b>  Chair: Jacqueline Rose M. Gutierrez
<b>LUNCH: 12:30 – 1:30pm</b>						
<b>Session 12</b> 1:30 – 2:10pm	<i>Enacting Climate Change Education in School Science: Challenges, Approaches, and Successes</i>  <b>Russell Tytler, Peta White, Joseph Ferguson, Amrita Kamath, Fernanda Rezende, Shefali Sharma-Wallis</b>  Discussant: Vaille Dawson	<i>Support on Students' Conceptual Understanding of Redox Reactions: Viewing Animations Versus Critiquing Animations</i> <b>Ade Noorliza Niyamae Maurice M.W. Cheng</b>  Chair: James Davis	<i>Developing a Pedagogical Framework to Support Pre-service Teacher Learning About Planning for Practical Work in Science Education</i> <b>Jennifer Mansfield, Bronwen Lasky, Tim Smith, Michael Reiss</b>  Chair: Ross Phillips	<i>Improving High School Students' Understanding and Attitude Towards Quantum Mechanics by Integrating Cognitive Apprenticeship Model with Discipline-culture Framework for Physics Education</i> <b>Vijit V. Nautiyal, Erika Eunice P. Salvador, Xavier Romy O. Braña, Rahul Shastri, Varinder Singh, Ashish Tyagi, Bhavna Vidhani, Vinod Prasad</b>  Chair: Rebecca Harrop	<i>Exploring Online Science Tutoring for Young, Multilingual Learners of English as an Equity-focused, Material-dialogic Space</i> <b>Frederick Talaue, Raymund Sison</b>  Chair: Rahul Choudhary	<i>Climate Change Education in Indonesia's Formal Education System: Context, Developments, and Future Directions</i> <b>Desy Fajar Priyayi, Alan Reid, Karen, Marangio</b>  Chair: Solomon Mangai



**PROGRAM**  
**2025 Conference (ASERA56)**  
 Deakin Downtown, Docklands (Melbourne, Australia)  
 Tuesday 1<sup>st</sup> July to Friday 4<sup>th</sup> July 2025

<b>Session 13</b> 2:20 – 3:00pm  <b>Chair: Russell Tytler</b>	<i>A Modern Literature Review of the Use of Pre-laboratory Tasks in Science Education</i> <b>Yuqing Fang, Reyne Pullen, Shane Wilkinson, Stephen George-Williams</b>  <b>Chair: Reece Mills</b>	<i>Co-designing Transmedia as a Tool for Science Inquiry: Engaging Children in Informal Learning Spaces</i> <b>Simon Daniele, Karen Murcia, John Chappell</b>  <b>Chair: Ross Phillips</b>	<i>Teachers’ Perceptions of Parental Engagement in Primary Science Learning</i> <b>Deepa Chand, Parmeshwar Mohan, Rebecca Harrop</b>  <b>Chair: Linda Hobbs</b>	<i>Predictors of Change in Schoolgirls’ Career Interest in STEM after a STEM Enrichment Program</i> <b>Rahul Choudhary, Maria Parappilly, Richard Woodman</b>  <b>Chair: JohnPaul Kennedy</b>	<i>Delivering on its Goals? An Analysis of the New Middle School Science Curriculum in NSW</i> <b>Genevieve Firmer</b>  <b>Chair: Solomon Mangai</b>
<b>AFTERNOON TEA: 3:00 – 3:30pm</b>					
<b>ASERA AGM: 3:30 – 5:30pm</b> <b>Wadawurrung 1</b>					
<b>ASERA DINNER: 6:30 – 11:00pm</b> <b>Melbourne Cricket Ground (MCG)</b> Public transport can be used to travel to the venue – ask the registration desk for support					



<https://mcg.org.au/sitecore/content/mcc/home/my-mcc-membership/special-interest-groups/long-room-wine-and-food-society>



**PROGRAM**  
**2025 Conference (ASERA56)**  
 Deakin Downtown, Docklands (Melbourne, Australia)  
 Tuesday 1<sup>st</sup> July to Friday 4<sup>th</sup> July 2025

**Presentations - Friday (4<sup>th</sup> July 2025)**

	Wadawurrung 1	Wadawurrung 2	Gunditjmara 1	Gunditjmara 2	Upstairs Immersive	Upstairs Creative
<b>DEDICATED POSTER SESSION: 8:30 – 9:00am</b> <b>All posters - Wadawurrung 1, Wadawurrung 2, Upstairs Creative</b>						
<b>Session 14</b> 9:00 – 9:40am	<i>Enhancing the Professional Development of Early Career Academics in Science Education through an Online Community of Practice.</i> <b>Carrie Swanson</b>  <b>Chair: Jan van Driel</b>	<i>How Secondary School Teachers Implement Integrated STEM: Two Case Studies from the Lens of Critical Thinking Development</i> <b>Violetta Pristel, Vaile Dawson, Rajinder Attar Singh</b>  <b>Chair: John Cripps Clark</b>	<i>Exploring the Advantages of Rural spaces for Teaching and Learning STEM: A Scoping Review of Research Exploring How Rural Social Spaces Enable STEM Education Practices.</i> <b>Steve Murphy, Tim Johns</b>  <b>Chair: Rebecca Cooper</b>	<i>Rethinking Biology Education: Must We Begin with the Cell?</i> <b>Carol Martinez Camacho, Sara Tolbert, Mahdis Azarmandi</b>  <b>Chair: Brent Wagner</b>	<i>Exploring the Effectiveness of a Collaborative CoRe-design PLD for Senior Physics Teachers in New Zealand.</i> <b>Rebecca Harrop, Deepa Chand</b>  <b>Chair: Kok-Sing Tang</b>	<i>Awe and Wonder: Astronomy as a Gateway?</i> <b>Saeed Salimpour, Russell Tytler, Michael Fitzgerald</b>  <b>Chair: Hadis Salehi</b>
<b>Session 15</b> 9:50 – 10:30am	<i>Reshaping Science Teacher Education through Collaborative Online International Learning (COIL)</i> <b>Karen Marangio, Rebecca Cooper</b>  <b>Chair: JohnPaul Kennedy</b>	<i>Preservice Science Teachers' Epistemic Cognition during Online Searching</i> <b>Alberto Bellocchi, Reece Mills (presenting), Louisa Tomas Engel (presenting), Natasha Arthars, Subhashni Appanna, James Davis, Priscila Rebollo de Campos</b>  <b>Chair: Carrie Swanson</b>	<i>Exploring Pedagogical Challenges in Inquiry-Based Learning</i> <b>Deborah de Ridder</b>  <b>Chair: Leonie Rennie</b>	<i>Astronomy as a Context for Integrated STEM Education</i> <b>Lena Danaia, Michael Fitzgerald, Saeed Salimpour</b>  <b>Chair: Brent Wagner</b>	<i>Zooming into Discovery: Kindergarteners' Science Inquiry with Digital Microscopes</i> <b>Karen Murcia, Sarsha Mennell</b>  <b>Chair: Jay Jay Manuel</b>	<i>Scoping High School STEM Student Internships: A Global Perspective on Implementation and Effective Strategies</i> <b>Erika Eunice P. Salvador, Murray Lane, Catherine Challen, Leslie Dawes</b>  <b>Chair: Hadis Salehi</b>
<b>MORNING TEA: 10:30 – 11:00am</b>						



**PROGRAM**  
**2025 Conference (ASERA56)**  
 Deakin Downtown, Docklands (Melbourne, Australia)  
 Tuesday 1<sup>st</sup> July to Friday 4<sup>th</sup> July 2025

<p><b>Session 16</b> 11:00 – 11:40am</p>	<p><i>An Update on the ASERA Position Statement on the Future Science Education we need: Implications for Policy, Research, and Practice</i>  <b>Carol Aldous, Vaile Dawson, Linda Hobbs, Russell Tytler</b>   <b>Chair: Vaile Dawson</b></p>	<p><i>Student Wellbeing in Science Education: A Qualitative Exploration</i>  <b>Julia Hill, Jan van Driel, Wee Tiong Seah</b>   <b>Chair: Jay Jay Manuel</b></p>	<p><i>Makerspaces in Teacher Education: Fostering STEM Confidence and Engagement</i>  <b>Helen Georgiou, Maeve Stevenson</b>   <b>Chair: Amrita Kamath</b></p>	<p><i>Culturally Relevant Teaching in Indonesian Science Learning: Ethnoscience, Indigenous Knowledge, Local Knowledge, and Local Wisdom</i>  <b>Monica Prima Sari, Alan Reid, Karen Marangio</b>   <b>Chair: Sami Raut</b></p>	<p><i>Supporting Early Childhood Preservice Teachers to Effectively Integrate STEM in Their Future Teaching Practice</i>  <b>Sarika Kewalramani, Anamika Devi, Andrea Ng</b>   <b>Chair: Joe Ferguson</b></p>	<p><i>Conceptualising Entrepreneurial Science Capabilities in Secondary School Science</i>  <b>Ma. Hershey P. Regaya, James Davis, Alberto Bellocchi</b>   <b>Chair: Hadis Salehi</b></p>
<p><b>Session 17</b> 11:50am – 12:30pm</p>	<p><i>Cognitive Perspective of Understanding How High-Potential Learners in STEM Navigate the Novice-to-Expert Transition</i>  <b>Jay Jay Manuel, Hitendra K. Pillay, Senka Henderson</b>   <b>Chair: Leonie Rennie</b></p>	<p><i>Scientists, Science Outreach, and the Science-education Nexus.</i>  <b>Maurizio Toscano, David Seignior, Victoria Millar, Jan van Driel</b>   <b>Chair: JohnPaul Kennedy</b></p>	<p><i>Reflections on Research of Young Children’s Views of Science (YCVS)</i>  <b>Cristina Guarrella, John Hughes</b>   <b>Chair: Peta White</b></p>	<p><i>Examining the Representational Affordances of Young Children’s Design Artifacts</i>  <b>Christine McGrail</b>   <b>Chair: Astha Saxena</b></p>	<p><i>STEM and Environmental Sustainability: Play-based Activities in Preschools</i>  <b>Judith Gomes, Russell Tytler</b>   <b>Chair: Russell Tytler</b></p>	<p><i>Building Collective Action for Science Education in the Anthropocene: Findings and Future Directions from the Pre-Conference SEA Lab Forum</i>  <b>Sara Tolbert, Connie Cirkony, and Alan Reid</b>   <b>Chair: Amrita Kamath</b></p>

**LUNCH: 12:30 – 1:30pm**

**Conference Close**





**PROGRAM**  
**2025 Conference (ASERA56)**  
 Deakin Downtown, Docklands (Melbourne, Australia)  
 Tuesday 1<sup>st</sup> July to Friday 4<sup>th</sup> July 2025

**Presentation - Abstracts**

Presented in alphabetical order (last name) for first author only

Author		Title of presentation	Abstract
Carol	Aldous	An Update on the ASERA Position Statement on the Future Science Education we need: Implications for Policy, Research, and Practice.	This presentation provides members with an update on the progress of the ASERA Science and STEM policy working group, first introduced at the 2024 ASERA conference in New Zealand. Seizing upon a policy moment within the Australasian context, a draft white paper has been prepared for member feedback and comment. It articulates a vision, identifies a set of key issues and makes a range of recommendations. Although the scope of the recommendations is by no means exhaustive, they speak to research and practice that will inform ongoing science education policy advocacy into the future. The paper identifies three cross cutting themes of strategic significance: (1) Curriculum and Pedagogy; (2) Positioning the Sciences; and (3) Communities of Practice. Future strategic policy directions must acknowledge that the complex challenges of the 21st Century require a multi-pronged approach to science education. Science and STEM education policy must be guided by high-quality research that reflects the best contemporary practices. The ASERA research community plays a crucial role in conducting and promoting such evidence-based approaches.
Tasneem	Anwar	Mapping STEM Learning Trajectories: An Embedded Single Case Study of In-Service Teachers	This study examines the implementation of STEM education in Pakistan, where it remains an emerging field despite its global significance. Through a qualitative inquiry, this research traces the STEM Pedagogical Content Knowledge Learning Trajectories (PCK-LTs) of in-service teachers who participated in a STEM professional development (PD) course. Utilizing an embedded single case study design, the study explores how teachers' STEM Learning Trajectories evolve during and one year after the PD course, identifying the PD course features that effectively support the integration of STEM into classroom practices. The research draws on diverse qualitative data sources, including interviews with course designers and participants, along with evidence of participants' learning and STEM implementation gathered at three timeframes over a year. Findings reveal that while teachers' PCK of STEM evolved from naïve to more developed levels, significant challenges remain in achieving true integration of STEM in classroom settings. This study provides critical insights into the complexities of STEM education implementation in Pakistan and offers practical recommendations for enhancing teacher professional development and support. The implications of these findings extend to STEM educators/researchers, instructional designers, school leadership and others invested in designing and supporting effective teacher professional learning opportunities. Similarly, this case study would be interesting for the international researchers especially the ASERA conference participants who would be able to visualize the transfer and adaptation of STEM research in a unique and understudied context.
George	Aranda	Development of Digital Educational Games for Engaging Girls in STEM in Early Childhood	This study codesigned and developed digital educational games in collaboration with parents and educators for engaging girls in STEM from early childhood onwards. Recent studies address the supportive and complementary role of digital educational technology such as multimodal games to engage girls in primary and secondary schooling years in STEM education. The focus of our research is to examine parents and educator perceptions of how digital games can engage children, especially girls in STEM starting from early years learning environments in educational play-based learning contexts. Employing a multi-case study approach, focus group discussions (N=10), with a total of 15 parents and 15 teachers who either have children or teach children across age groups from birth-8 years old. Bronfenbrenner's socioecological lens guided the thematic data analysis, acknowledging that a young girl's natural learning environment comprises of parents, siblings, peers and early childhood professionals who play an essential role in the development of children's early STEM engagement. Findings reveal the essential role of the pedagogue (parents and educators) with digital technologies (games) acting as the third teacher are critical in scaffolding girls' early STEM education by capitalising on multimodal learning environments. Implications lie in designing of games that are hands-on, multimodal and allow children to engage in science and maths learning via a variety of design features, learning concepts and learning by doing/constructing/role play and gamification.



**PROGRAM**  
**2025 Conference (ASERA56)**  
**Deakin Downtown, Docklands (Melbourne, Australia)**  
**Tuesday 1<sup>st</sup> July to Friday 4<sup>th</sup> July 2025**

Alberto	Bellocchi	Preservice Science Teachers' Epistemic Cognition during Online Searching	Science teachers are increasingly using internet sources for lesson planning, science content, and designing classroom activities; however, given the prevalence of disinformation online, school students risk learning ineffective internet search strategies and integrating disinformation into their knowledge. In view of this, we contend that science teachers must be able to effectively navigate online information and develop these capabilities in their students. This study investigates the ways in which Australian preservice science teachers (n=7) engage their cognitions about knowledge and knowing when searching and evaluating online information. We address methodological limitations of past research by studying participants' enacted epistemic cognitions (i.e., their enacted cognitive processes related to forming knowledge, understanding, and generating explanations about the world or information) while completing internet search and evaluation tasks for science lesson content on socioscientific issues. We employed a qualitative concurrent think-aloud protocol and retrospective interviews to elucidate dimensions of science preservice teachers' knowledge and understanding of search and evaluation processes. This study provides a novel conceptual framework used for data analysis and empirical evidence about the cognitions—aims, value, ideals, and relied upon processes—that preservice science teachers engage when searching and evaluating online information. Implications for research and practice are discussed.
Simone	Blom	Sustainability, Environmental and Climate Change Pedagogies in Secondary Science Education: an Australia-China Collaboration	Science education is commonly considered as the place where students learn about the environment and sustainability, alongside studies of humans and society such as geography. However, there is little research that has investigated how teachers in secondary science education are implementing environmental and sustainability education including climate change education. Working as a collaborative team from China and Australia, this paper presents the finding of a study explored teachers' pedagogical approaches to sustainability, environment and climate change education in practice. Drawing on questionnaire and interview data, the study adopted a mixed-methods approach to data analysis to present the findings. While preliminary findings suggest that teachers are implementing sustainability, environmental and climate change topics in their secondary science (and geography in China) programs, there are also differences in what is regarded important pedagogically and the frequency – which may indicate value and significance – that teachers place on this content. The findings may also demonstrate that secondary science teachers' willingness to participate in surveys and interviews about their inclusion of sustainability, environment and climate change topics may be an indicator of whether or not they have included these topics in their content. We also present future considerations for research.
Samantha	Bothe	Integrated STEM in Initial Teacher Education: What is the Current State of Play?	Significant variations exist within integrated STEM units in Bachelor of Education (Primary) programs, which can lead to inconsistency in preservice teachers' knowledge and skills in STEM. In Australia, individual Initial Teacher Education (ITE) providers have the discretion of whether integrated STEM is offered in a program. There is a need to understand how an integrated STEM curriculum is designed and implemented in Initial Teacher Education in Australian universities. This presentation aims to investigate the different approaches to integrated STEM curriculum design, examining the rationale behind two institutions' approaches as well as the conditions that shaped the design of the curriculum. The Practice Architectures and Curriculum (PAC) framework, developed based on Practice Architectures Theory and curriculum theories, was used to analyse the qualitative interview data and curriculum documents. Preliminary findings suggest there are several ways in which teacher educators strike a balance between the need to strengthen preservice teachers' capacity for STEM teaching and the need to meet external requirements. Challenges encountered by teacher educators include the pedagogical tension of delivering a practical-based unit online and designing a balanced, integrated STEM curriculum to suit student needs. These insights may inform future integrated STEM curriculum design in ITE programs.
Janne-Marie	Bothor	Chemical Knowledge in Engineering Applications - Interdisciplinary Projects in	To understand the engineering applications in everyday life, students need knowledge of both scientific and engineering content. Studies have shown that many students had no exposure to engineering education at the end of their school education (Pleasants & Olson, 2019; Purzer et al., 2022). This is attributed to the fact that engineering requires the application of high-level science and mathematics and its instruction is particularly complicated (Barak et al., 2022; Honey et al., 2014; Pleasants & Olson, 2019). In a university learning environment in chemistry education with 10 pre-service science teachers, 5 interdisciplinary projects were developed and carried out with high school students in a teaching-learning laboratory aiming at the implementation of engineering



**PROGRAM**  
**2025 Conference (ASERA56)**  
**Deakin Downtown, Docklands (Melbourne, Australia)**  
**Tuesday 1<sup>st</sup> July to Friday 4<sup>th</sup> July 2025**

		Teaching-learning Laboratory Settings	in science lessons. The first experiences show that the pre-service science teachers often present the chemical content by using chemical experiments and then carry out theoretical excursions in the field of engineering. Identification of chemical content to illustrate the relevance in the functionality of engineering applications is rarely carried out. Observations indicate that the high school students find it exciting to find the scientific knowledge in the applications, a statement as to whether the networking of the areas of knowledge is successful cannot yet be made.
Carol Martinez	Camacho	Rethinking Biology Education: Must We Begin with the Cell?	In biological sciences, life is defined through the cell as its fundamental unit, establishing “cellularity” as the basis for understanding life. In contrast, other knowledge systems view life as inherently relational, emphasizing connections among diverse beings, including the non-apparent. This distinction underlines the need to rethink science education. This project explores how 'life' as a concept in biological sciences can be reimagined in science classrooms to contribute to understanding and addressing current humanitarian and environmental crises. The proposal introduces the microbiome as a scientific concept that serves as a bridge between multiple knowledge systems. The microbiome will be presented as a fundamental unity of life, highlighting its complexity and community-based nature, which reinforces the importance of context and surrounding diversity. By drawing an analogy between the cell as an individual and the microbiome as a community of humans, non-humans, and more-than-humans, this case study will examine how this perspective can help reimagine science education in the Anthropocene. To explore this approach, I will draw on interviews with scholars in Indigenous studies, biological sciences, philosophy and nature of science, Critical Theory, and Critical Pedagogies. These perspectives will provide direct insights and experiences to support its practical implementation in education.
Jared	Carpendale	Introducing a Conceptual Framework to Understand Disciplinary Expertise for Out-of-Field Science Teachers	Teaching out-of-field in science places subject-specific demands on teachers, challenging teachers’ knowledge, practice and identity. As teacher educators and researchers in science education, along with colleagues from geography, English, and mathematics education, we engaged in a collaborative and interdisciplinary research methodology to invite discussion and debate to interrogate subject distinctiveness and identify salient aspects for what out-of-field teachers need to know (thinking), do (performing) and be (acting and identity), using the notions of ‘discipline’ and Shulman’s ‘signature pedagogies’. This process led to the development of a new conceptual framework for teaching science out-of-field, signalling relationships between disciplinary ideas of knowing, doing, and being, and subject related teacher identity, inquiry (how knowledge is generated), knowledge (curriculum and content), connections (between disciplinary knowledge and between the individual and the world), and pedagogical imperatives (that drive teacher practice). Importantly, these core elements fit within the broader context of education and the disciplines, which are contested change, as they are influenced by social, cultural, and political drivers. A framework of this nature has the potential to underpin future discussion and research between subject experts and out-of-field science teachers to support boundary crossings between the familiar and unfamiliar fields of knowing, doing, and being.
Deepa	Chand	Teachers’ Perceptions of Parental Engagement in Primary Science Learning	This study explores teachers’ perceptions of parental engagement in primary science learning spaces in Fiji. It examines how teaching pedagogies influence parental engagement and identifies key enablers and barriers. Using a qualitative approach, data were collected through Talanoa, a Pacific Research Methodology (PRM), involving twelve primary school teachers, consisting of four teachers from two urban schools and four teachers from one rural school. Data were analysed thematically. Findings indicate that inquiry-based learning, culturally responsive teaching, and experiential learning enhance parental engagement. Additionally, the findings suggest that the complexity of science concepts, a content-driven curriculum, and cultural or language barriers pose challenges to parental engagement. Enablers include drawing on Pacific values of reciprocal relationships, contextualising learning for example, by emphasising topics such as environmental education or climate change relevant to the island nation. The study highlights the importance of pedagogical approaches that connect home and school learning, offering insights for teachers and policymakers to foster inclusive and culturally responsive parental engagement strategies in primary science education.
Jina	Chang	Epistemic Scaffolding of	This study aims to investigate the different types of epistemic scaffolding provided by the multimodal affordances of VR simulations, depending on the reasoning types of



**PROGRAM**  
**2025 Conference (ASERA56)**  
**Deakin Downtown, Docklands (Melbourne, Australia)**  
**Tuesday 1<sup>st</sup> July to Friday 4<sup>th</sup> July 2025**

		Virtual Reality-Based Inquiry Based on Reasoning Type: A Multimodal Perspective	scientific inquiry. The analysis examined 31 VR simulations designed for inquiry-based activities in primary digital science textbooks in South Korea. We explored the reasoning types and multimodal patterns used in each simulation. The findings reveal distinct multimodal combinations linked to specific epistemic features by reasoning type. In phenomenon-based reasoning, succinct oral, written, and visual elements typically guided the inquiry during the initial phase, while auditory, visual, and kinesthetic modes created immersive and realistic phenomena. Relation-based reasoning combined oral, written, and visual modes to facilitate the connections between different variables in virtual phenomena, while auditory and kinesthetic modes provided technical support for smooth inquiry progression. Model-based reasoning, based on scientific models (e.g., Earth's revolution and the solar system), used diverse combinations of kinesthetic, visual, and auditory modes in VR to help learners explore the structures of scientific models, with an increased use of oral, written, and visual modes for the explicit presentation of inquiry results. Based on these findings, educational implications are discussed in terms of how to design VR simulations using multimodal patterns and how to efficiently utilize their different epistemic scaffolding.
Siriwan	Chatmaneer ungcharoen	Outdoor STEM Education: The Trend of Education to Foster Kids' Awareness of Their Own Community	Introducing students to interdisciplinary STEM activities from an early age builds a strong educational foundation while fostering local community awareness. This study investigates how outdoor STEM education enhances children's understanding of their communities through hands-on learning while creating a collaborative platform for educators. Using a mixed-methods approach, the study examines how outdoor STEM education can be integrated into current educational practices, which activities best promote community awareness, and the challenges and opportunities of using local community settings as STEM learning environments. The research involved 30 science teachers from Phuket City participating in the Phuket Education Sandbox initiative for one year, covering elementary and junior high schools. Data collection included questionnaires from 176 teachers, in-depth interviews with 30 participants, and classroom observations. Findings indicate that outdoor learning environments promote nature engagement, interdisciplinary learning, and collaboration by linking STEM concepts with real-world experiences. Teachers implemented place-based learning through lessons in parks, historical sites, and neighbourhoods, fostering direct connections between education and the local community. Students' environmental awareness increased as they worked on community projects, fostering responsibility and social contribution. These findings underscore outdoor STEM education's potential to cultivate socially responsible, community-oriented citizens.
Sheng-Chang	Chen	Exploring Undergraduate Students' Learning Performance on Projectile Motion Concepts by Integrating Scientific Inquiry with Immersive Virtual Reality	Recent global education reforms have highlighted active and interdisciplinary learning through technology, leading to integrating scientific inquiry with technology as a key approach to science learning. Many science courses incorporate scientific inquiry learning to strengthen students' academic performance, cultivate scientific interests, and develop problem-solving abilities. Immersive virtual reality (VR) technology enhances scientific inquiry by simulating real-world scenarios, providing a cost-effective, repeatable environment for experiments, and fostering hands-on learning engagingly and interactively. This study aimed to develop an interactive archery activity course using immersive virtual reality and scientific inquiry to teach projectile motion concepts. It also examined students' learning performance, affective and cognitive responses (immersion, self-regulation, inquiry perception), and operational behaviors after learning the course. Seventy undergraduate students from a national university in northern Taiwan operated head-mounted display VR devices and handheld controllers to learn about the archery exploration course. During the activity, students can investigate how varying initial speeds, altitudes, and angles impact factors like horizontal range, maximum altitude, and flight time. The results indicated that integrating inquiry-based learning with immersive VR effectively enhanced students' understanding of projectile motion concepts and increased their inquiry ability. Besides, students exhibited more immersion, self-regulation, and inquiry perception after learning the course.
Lisa	Chiavaroli	Understanding Knowledge Sharing in Integrated STEM Interdisciplinary Teacher Teams	When teaching integrated STEM (iSTEM) education, possessing in-depth knowledge that spans multiple STEM disciplines is a known challenge for individual teachers. One recommended solution is that iSTEM be taught by an interdisciplinary teacher team (ITT), where teachers with different STEM expertise work together to share knowledge for teaching iSTEM. To date, research on ITTs in iSTEM education has predominantly focused on the contextual conditions that support or impede teamwork rather than the



**PROGRAM**  
**2025 Conference (ASERA56)**  
**Deakin Downtown, Docklands (Melbourne, Australia)**  
**Tuesday 1<sup>st</sup> July to Friday 4<sup>th</sup> July 2025**

			<p>content of knowledge shared within the team. Given that, this in-progress PhD study seeks to understand the kinds of knowledge iSTEM teachers share within their ITTs, how this knowledge is shared between team members, and how this sharing influences teachers' knowledge for teaching iSTEM. Individual teacher interviews, meeting observations, and ITT and individual teacher artefacts were collected from two Victorian Catholic secondary schools with established curricular and co-curricular iSTEM programs over a six-month period. Preliminary findings from thematic analysis suggest that meeting purpose, team member role, iSTEM teaching experience, and team members' relationship determine the type of knowledge shared and the degree of influence it has on an individual teacher's knowledge for teaching iSTEM.</p>
Yi-An	Cho	<p>An Analysis of Interdisciplinary Contexts in Engineering Mathematics Textbooks: Implications for Curriculum Design</p>	<p>In recent years, interdisciplinary teaching has gained increasing importance in educational reform and international assessments, such as PISA. This trend has further influenced the writing of textbook content and the design of questions. As a result, the questions in mathematics textbooks should have integrated content from various disciplines. For example, vectors can serve as graphical and symbolic representations of forces, and problems set in scientific contexts can provide students with opportunities for scientific learning. However, do the contexts of problems in mathematics textbooks truly offer learning opportunities across different disciplines? This study employs content analysis to categorize engineering mathematics textbooks based on problem contexts, including personal, engineering, social, mathematical, and scientific contexts. The study reveals two key findings. First, across all analyzed textbook versions, over 92% of the exercises are rooted in mathematical contexts, demonstrating a strong emphasis on mathematical concepts. Second, questions related to personal, engineering, social, and scientific contexts are notably scarce in all versions, with most accounting for less than 6% of the total. Based on these findings, this study suggests that textbook design should incorporate more exercises related to personal, engineering, social, and scientific contexts to better support students in applying mathematical knowledge across different fields.</p>
Rahul	Choudhary	<p>Predictors of Change in Schoolgirls' career Interest in STEM after a STEM Enrichment Program</p>	<p>To address the gender gap in STEM, we designed 1-day enrichment programs for Year 9 girls, featuring hands-on science workshops combined with role-model interventions. A modified STEM career interest survey was administered before and after the program. Additional data was collected on school sectors (public versus private) and participation selection methods (entire class versus individuals). A multivariate model was used to determine whether these factors and baseline career interest predicted changes in STEM interest. Students were either selected as an entire class cohort (N=171) or individually by teachers (N=143). According to school sectors, there were N=75 public school students and N=95 private school students. Overall career interest was <math>3.34 \pm 0.39</math> before the program and <math>3.39 \pm 0.39</math> following the program with a mean change of <math>\Delta = 0.04 \pm 0.007</math> on a 5-point Likert scale. In multivariate linear regression, baseline career interest, school type and student selection were all significant predictors of the change in career interest (N=75) (<math>\beta = 0.1</math>, 95% CI [0.175, 0.374], <math>p = 0.003</math>). This observational study suggests both school-level factors including school-sectors and student selection methods, together with individual prior interest, predict changes in schoolgirl interest in STEM as a career. It highlights the importance of prioritising public school students for bridging STEM career interest gaps.</p>
Hye-Eun	Chu	<p>Enhancing Science Learning with a UDL-Informed AI Chatbot: A Study on Grade 6 Optics</p>	<p>Primary science classrooms face challenges in addressing diverse learning needs due to special education requirements, language barriers, and socioeconomic disparities. This study examines the development and impact of an AI chatbot designed with Universal Design for Learning (UDL) principles to support inclusive education. Focusing on the Grade 6 light and optics unit, the study involved 80 students in a 10-lesson program aimed at improving conceptual understanding and attitudes toward optics and AI chatbots. Data included pre- and post-tests measuring conceptual knowledge (24 questions) and attitudes (30-item Likert scale assessing confidence, interest, and value). Results show that the UDL-AI chatbot enhanced students' conceptual understanding and attitudes, though effects varied. Findings highlight its potential to support both cognitive and affective learning. This study underscores the need for further research and broader implementation of AI-driven, UDL-informed tools to meet diverse student needs in science education.</p>



**PROGRAM**  
**2025 Conference (ASERA56)**  
**Deakin Downtown, Docklands (Melbourne, Australia)**  
**Tuesday 1<sup>st</sup> July to Friday 4<sup>th</sup> July 2025**

Lena	Danaia	Astronomy as a Context for Integrated STEM Education	Astronomy, as a gateway science, presents a unique opportunity for the authentic integration of STEM disciplines in education. This paper explores how astronomy naturally and effectively weaves together the elements of science, technology, engineering, and mathematics, providing a compelling model for integrated STEM learning. Through a series of vignettes and case studies, we illustrate how astronomy-based projects serve as exemplars of interdisciplinary STEM education. Additionally, the paper presents a conceptual framework that highlights key considerations such as curriculum alignment, assessment strategies, astronomical content knowledge, pedagogical content knowledge, and skill development. A special focus is placed on the incorporation of Indigenous and rural perspectives, showcasing how traditional and local knowledge systems can be harmoniously integrated into STEM education. By leveraging astronomy's inherent interdisciplinarity and universal appeal, and its relative accessibility compared to other content areas we argue that it provides an ideal platform for fostering meaningful, inquiry-driven STEM learning experiences that extend beyond the confines of traditional subject boundaries. Presenting for Lena Danaia
Simon	Daniele	Co-designing Transmedia as a Tool for Science Inquiry: Engaging Children in Informal Learning Spaces	This qualitative study explores an innovative approach to fostering scientific inquiry. The research engaged children aged 6-8 years through co-designed transmedia experiences in informal learning spaces within a Science Discovery Centre (SDC). Through participatory co-design with science communicators and creative teams, an eight-week program integrated physical exhibitions with a curated series of digital experiences and inquiry challenges. The aim was to promote computational and critical thinking skills through problem-solving. Using case study methodology, with the SDC as the unit of analysis, the research investigated how transmedia experiences supported intergenerational learning and science inquiry. Data collection included semi-structured interviews with children, their significant adults, and creative teams, alongside digital platform analytics and exhibition content mapping. Analysis revealed that strategically designed transmedia experiences enhanced children's engagement with science through three key mechanisms: systematic integration of physical-digital experiences, scaffolded problem-solving opportunities, and supported parent-child collaborative learning. The findings demonstrate how co-designed transmedia approaches create meaningful pathways for science inquiry while fostering critical thinking skills. This research contributes to understanding blended digital educational approaches by providing empirical evidence for effective transmedia integration in informal science learning, emphasising both the co-design process and learning outcomes.
Vaille	Dawson	Effective Science Teacher Behaviours and Pedagogies to Promote Argumentation Skills Using Socioscientific Issues	In a global society replete with mis- and dis-information, school science education has a crucial role in developing critical thinking skills, for example, developing, justifying and critiquing an argument. However, this potential has not been brought to fruition in contemporary classrooms. Reasons include curriculum and education policies, teacher beliefs and confidence, and students' expectations about science education. This presentation addresses two research questions. Firstly, what are characteristics of lower secondary science classrooms where the development of complex thinking skills is supported and reinforced? Secondly, what teacher and students' behaviours are observed in lower secondary science classrooms where students' thinking skills improve?  Qualitative data from classroom observation audio transcripts and teacher and student interviews across multiple case studies conducted in Australian science classrooms were analysed using thematic analysis. In each case, students were taught argumentation in the context of socioscientific issues. The findings revealed the importance of a collaborative safe environment where students suspend judgement, take risks and value thinking supported by teachers who select relevant and engaging contexts and model open-minded behaviours. The outcomes have implications for the design of science teacher professional development and preservice teacher education.
Seamus	Delaney	An International Survey of High School Teachers on their Utilisation of Chemistry-based Practical activities – Insights into Green	Chemistry educators worldwide integrate hands-on activities into their teaching, yet little is known about how laboratory sessions are conducted, particularly in relation to green chemistry and sustainability. To address this gap, an international survey was launched to collect baseline data from high school teachers on the types and frequency of practical activities they use, including those related to green and sustainable chemistry (GSC). The survey also gathers examples of GSC-related experiments used globally. This presentation introduces the ongoing project, supported by the IUPAC Committee on Chemical Education. It will describe the survey's design, multilingual implementation, and preliminary findings from 57 countries (available in 37 languages



**PROGRAM**  
**2025 Conference (ASERA56)**  
**Deakin Downtown, Docklands (Melbourne, Australia)**  
**Tuesday 1<sup>st</sup> July to Friday 4<sup>th</sup> July 2025**

		and Sustainable Chemistry Education	as of January 2024). A comparative analysis of Australian teachers' responses against global trends will be presented, offering insights into how they incorporate GSC into their curriculum. The discussion will explore the survey's potential impact on teaching practices, professional development, and curriculum advancements.
Yuqing	Fang	A Modern Literature Review of the Use of Pre-laboratory Tasks in Science Education	This literature review examines 69 studies on pre-laboratory activities in science courses, sourced from ERIC, Scopus, and Web of Science over the past decade (2014–2024). Specifically, it explores the extent to which digital technology has been integrated into pre-laboratory activities. A qualitative content analysis approach (deductive coding) is employed to classify different types of digital technology, assess their corresponding impacts, and identify existing gaps based on the limitations discussed in the selected studies and the data synthesized in this review. Additionally, studies on non-digital pre-laboratory activities are analyzed for comparison, offering insights into how different approaches influence students across affective, cognitive, and psychomotor domains. The findings indicate that digital technology has been predominantly utilized in pre-laboratory activities over the past decade, with its impact being most pronounced in the affective domain, particularly in the case of interactive digital technology. The primary research gaps centre around issues of underrepresentation, such as small sample sizes or the absence of control groups. This review concludes with practical recommendations and a comprehensive framework for researchers and laboratory practitioners, aiming to enhance the design, implementation, and documentation of pre-laboratory activities in tertiary and secondary science courses while identifying opportunities for further research.
Genevieve	Firmer	Delivering on its Goals? An Analysis of the New Middle School Science Curriculum in NSW	The NSW education system is undergoing a period of significant change as the entire school curriculum is overhauled. The new 7-10 science curriculum is being implemented in schools from 2025, and by 2026 all schools will be teaching from the new syllabus. Since the curriculum review was announced in 2018, there has been much discussion about what changes were needed. A key goal was to make the curriculum simpler to understand and easier to teach (NESA, 2018). The Masters Review (2020) emphasised the need to increase the emphasis on skills, application of knowledge and real-world examples, and the Legislative Council Portfolio Committee Review (2021) raised concerns about Science in Society content being too political. Content analysis methodology has been used to examine the changes that have been made to the 7-10 science curriculum in the wake of this discourse. It remains the most prescriptive in Australia. Our findings indicate that the integration of Science Inquiry Skills and real-world examples has been made more explicit in the new curriculum. The nature of Science as a Human Endeavour has also been altered. We discuss implications of these changes on teacher preparation, autonomy and professionalism, and address likely implementation support needs.
Helen	Georgiou	Makerspaces in Teacher Education: Fostering STEM Confidence and Engagement	The global emphasis on Science, Technology, Engineering and Mathematics (STEM) education has increased the focus on engineering, design, and integrated project-based learning in primary education. However, many teachers feel underprepared to teach STEM and hold less favourable attitudes toward it. Makerspaces have emerged as promising environments for democratising STEM education, with evidence of enhanced learning experiences and improved attitudes. Despite this, little attention has been given to their role in fostering engagement and accessibility for preservice teachers (PSTs).  This study presents a case study exploring PSTs' experiences completing a project-based learning assessment in a university Makerspace. Data sources include demographic information, pre- and post-test survey responses (n=98) on science and technology identity and confidence in the Makerspace, assessment artefacts and interviews with PSTs (n=4) and Makerspace facilitators (n=2). Findings highlight the positive impact of the Makerspace experience on PSTs, particularly in building confidence and improving attitudes toward STEM. However, many PSTs remain hesitant, enjoying the process but still not identifying as "STEM people." The study discusses implications for initial teacher education in addressing these challenges.
Judith	Gomes	STEM and Environmental Sustainability: Play-based Activities in Preschools	In recent decades, early childhood science education has gained increasing attention. Recognizing the importance of introducing science concepts during the early years of development helps young learners engage with the world from an informed perspective. There has also been a growing local and international emphasis on STEM education in early childhood. At the same time, fostering awareness of environmental



**PROGRAM**  
**2025 Conference (ASERA56)**  
**Deakin Downtown, Docklands (Melbourne, Australia)**  
**Tuesday 1<sup>st</sup> July to Friday 4<sup>th</sup> July 2025**

			<p>sustainability from an early age is crucial, given the pressing environmental challenges of the Anthropocene era. However, research in this area remains limited. This case study highlights the importance of developing conceptual understanding of both STEM and environmental sustainability in early childhood education. The study explores preschool teachers' practices in integrating these areas and examines how early childhood educators support young children in exploring STEM and environmental sustainability through play-based activities. This presentation gives an overview of the methodological design of this study. The study focuses on two preschools in an outer suburb of Victoria. Data will be collected through walk-and-talk audio-visual interviews conducted in the preschool settings. These interviews will capture preschool teachers' conceptual understandings of STEM and environmental sustainability, as well as their pedagogical approaches. The findings contribute to the broader literature on science education and teacher education, offering insights into effective practices for integrating STEM and environmental awareness in early childhood learning.</p>
Cristina	Guarrella	Reflections on research of Young Children's Views of Science (YCVS)	<p>Science is recognised as important for children's development of academic skills related to inquiry, problem-solving and communication (Stone, 2016, Eshach, 2011). The emphasis on literacy and mathematics in the early years has been highly documented. Therefore, research examining children's understanding of the nature of science (NOS) and scientific inquiry (SI) is critical to ensure Australian children are exposed to a broad range of high quality science experiences in their early childhood education. This is particularly relevant given the limited references to science in the early learning frameworks. Nested within the International Early Childhood Study of Young Children's Scientific Literacy, this project investigates children's understanding of NOS and SI as they commence formal schooling. Applying the Young Children's Views of Science instrument, it was found that this group of school starters generally possessed limited understandings of both NOS and SI, often referring to familiar media tropes to describe the field. This presentation will reflect on our research and discuss questions including; should science be more visible in early childhood frameworks? How does context influence the use of the YCVS tool in Australia? Are there any potential relationships between early childhood science pedagogies and testing results in PISA and TIMMS?</p>
Richard	Gunstone	Problems with Common Current Approaches to Determining the Content of Science Curricula - And an Alternative Approach	<p>As recently noted elsewhere there are two intertwined challenges that have plagued school science in many educational contexts across the globe: how best to identify what science is meaningful for all students to learn during their formal school science education, and how to keep these students engaged in the learning of this science. In the course of framing that paper, we came to think deeply about the problems arising from the continual addition of content to the school science curriculum without equivalent removal. The consequence of this addition has become known as "Curriculum Overload". It is commonly considered in regard to whole school curriculum. It has also been debated in individual subjects, at school and other levels (e.g. undergraduate medicine and pharmacy), as have the Overload's negative impact on teachers' pedagogies, students' learning, and assessment. In this presentation, we consider Curriculum Overload and these consequences in school science specifically. Then we discuss the only example of a major new science curriculum we have found over the last 7 decades of an appropriate approach to meaningful action on Overload. We will begin with brief comment about how this thinking evolved over time from a totally unrelated faculty mentoring program.</p>
Sally	Gutierrez	Co-constructing Scientific Explanations: A Case of student-generative AI Interactions in a Biology Classroom	<p>Our qualitative study explored how interacting generative AI (GenAI) such as Canva and ChatGPT mediated first-year middle school biology students to better construct scientific explanations of natural phenomena. We used various datasets such as video recordings of students' interactions with GenAI, student-generated outputs using GenAI tools, and semi-structured interviews to generate the themes that represented the students' skills developed while they satisfy the four criteria of constructing scientific explanations: relevance, conceptual framework, causal story, and appropriate level of representation. Two main themes emerged to represent these skills. First, students' co-construction of scientific explanations with GenAI led to their conceptual metacognition. In this theme, students engaged in reflective thinking in analyzing the scientific concepts provided by the GenAI such as photosynthesis, the functions of plant parts in plant growth, and the key concepts that distinguish a plant from a mushroom. Second, students developed epistemic metacognition as they co-constructed scientific explanations. In this theme, the students critically evaluated the validity of the information, such as when they reflected on whether the illustration provided by the</p>



**PROGRAM**  
**2025 Conference (ASERA56)**  
**Deakin Downtown, Docklands (Melbourne, Australia)**  
**Tuesday 1<sup>st</sup> July to Friday 4<sup>th</sup> July 2025**

			GenAI effectively conveyed the scientific process of water absorption by plant roots. Our findings highlight GenAI's role in fostering students' conceptual and epistemic metacognitive development.
Jacqueline Rose	Gutierrez	Enhancing Chemistry Learning Through Augmented Reality: Development and Evaluation of the MoleculAR Geometry Learning Tool	<p>Augmented Reality (AR) technologies have transformed education by offering immersive, interactive, and simulation-based learning experiences. However, AR remains in its developmental stage, requiring significant investment and customization to meet educational demands, particularly in resource-limited settings (Al-Ansi et al., 2023). To address these challenges, this study introduces MoleculAR Geometry, an open-access AR tool designed to enhance chemistry learning.</p> <p>AR-based learning tools improve conceptual understanding by enabling 3D molecular visualization, fostering spatial reasoning, engagement, and deeper learning. Despite their potential, accessibility and usability issues remain, especially in low-resource environments. Additionally, technical limitations often hinder effectiveness, underscoring the need for user-centered design improvements. This study examines students' experiences with MoleculAR Geometry, focusing on its usability, functionality, and educational impact. It also explores strategies for making the app freely accessible. Student feedback was gathered through usability testing, evaluating app performance, interface design, and visualization effectiveness.</p> <p>Findings indicate that interactive 3D features enhanced molecular comprehension, while immediate feedback and answer retries promoted deeper learning. However, issues such as sluggish performance, unresponsive features, and cluttered controls affected usability. Refinements in design and functionality are recommended to optimize the app. These insights guide educators and developers in integrating AR for accessible science education.</p>
Sarah	Hajama	Monitoring Student Meaning-Making in Human Anatomy and Physiology: The Need for Multiple Representations and Representation Construction	<p>Effective teaching and learning in Human Anatomy and Physiology (HAP) requires fostering deep conceptual understanding essential for medical careers. However, traditional instruction often relies heavily on multiple-choice assessments, emphasising memorisation rather than meaningful learning. This study investigates how integrating multiple representations and engaging students in representation construction enhances their meaning-making and provides insights for instructors to better monitor student learning. The Draw-and-Explain Questionnaire (DaEQ) was developed to assess 27 undergraduate HAP students' abilities to express their understanding through drawing and writing tasks. Correlation and demographic analyses revealed performance variations across different forms of representation, showing a significant negative correlation between drawing and written responses (<math>r = -0.503</math>). Demographic variables including high school HAP learning experience (<math>F = 5.04</math>, <math>\eta^2 = 0.17</math>, <math>p &lt; 0.05</math>), university HAP learning experience (<math>F = 0.04</math>; <math>\eta^2 = 0.19</math>, <math>p &lt; 0.05</math>), and university level (<math>F = 4.16</math>; <math>\eta^2 = 0.14</math>, <math>p &lt; 0.05</math>) also influenced student ability to demonstrate meaning-making through text and drawing. These findings highlight that monitoring students' conceptual development necessitates tracking their use of multiple representations. Consequently, instructional practices should intentionally integrate diverse representation strategies, particularly drawing and textual explanations, to effectively support and assess students' deeper meaning-making in HAP education.</p>
Rebecca	Harrop	Exploring the Effectiveness of a Collaborative CoRe-design PLD for Senior Physics Teachers in New Zealand.	<p>New Zealand has limited professional learning and development (PLD) opportunities for secondary school physics teachers. There is a growing number of out-of-field physics teachers, a changing curriculum and qualification framework, and limited funding available for subject-specific development. Therefore, ensuring those PLD opportunities are fit for purpose is especially important in the current climate. This presentation examines how a collaborative PLD workshop centred on Loughran's Content Representations aided the knowledge and skill acquisition for senior high school physics teachers from diverse educational backgrounds in New Zealand. Teacher development is examined through Shulman's pedagogical content knowledge (PCK), the Refined Consensus Model, and Bandura's construct of self-efficacy. Data is drawn from a broader PhD study, encompassing interviews, pre- and post-testing, and observations. Deductive thematic and descriptive statistical analyses revealed positive growth in teachers' self-efficacy, but variable growth in PCK knowledge domains between in-field and out-of-field teachers. Findings suggest that such PLD is effective for in-field</p>



**PROGRAM**  
**2025 Conference (ASERA56)**  
**Deakin Downtown, Docklands (Melbourne, Australia)**  
**Tuesday 1<sup>st</sup> July to Friday 4<sup>th</sup> July 2025**

			teachers, but out-of-field teachers could benefit from further content knowledge development before participating. The implications for policymakers, providers of PLD, and schools are discussed, specifically how to best support the knowledge acquisition of physics teachers and the potential consequences for students if such support is not provided.
Kristen	Hebden	Do Makerspace Subjects Enhance STEM and Creative Self-concept?	Makerspaces in schools have become more common in Australia over the last decade. These unique spaces involve students working on collaborative interdisciplinary projects and are taught using different pedagogies to those found in standard science and maths classes. While previous research has found that makerspaces promote student equity, a maker mindset and identity while reducing absenteeism, little is understood about how makerspace experiences influence students' broader academic self-concept. This mixed-methods study explores how participation in a makerspace subject affected students' academic self-concept. Quantitative data was collected from 76 makerspace students and 71 non-makerspace students from four high schools using the Academic Self-Description Questionnaire, followed by 3 student focus groups and 4 teacher interviews. Preliminary results show that students increased their creative self-concept after participating in makerspaces compared to students in other creative subjects. While there was no statistically significant change in students Science or Maths self-concept alone, there was an increase in overall STEM and Digital Technologies self-concept. Students were also found to have an increase in their visual arts self-concept, despite the focus of the makerspace subjects not including art. These results suggest that makerspace subjects are supporting students to recognise and develop their creativity whilst using their Science and Mathematics knowledge, making STEM more creative for them.
Julia	Hill	Student Wellbeing in Science Education: A Qualitative Exploration	Supporting student wellbeing has become a global priority within schools, yet subject-specific foci on wellbeing are lacking. This study addresses this gap by exploring science wellbeing (ScWB) through the lens of value fulfillment theory, defining ScWB as the fulfilment of students' values in science education accompanied by positive feelings (e.g., enjoyment) and functioning (e.g., engagement and relevance). Building on a previously developed ScWB framework, the current study explores the science-related values of 320 Australian Year 8 students (ages 13-14) using open-ended survey questions. Thematic analysis identified 51 instrumental values that mapped onto eight ultimate values. Students mostly valued cognitive aspects (e.g., understanding science concepts), engagement (e.g., interest in science), and relationships (e.g., teacher and peer support). While females and males demonstrated similar values hierarchies, females valued relationships significantly more often. The analysis also revealed patterns of co-occurring values, such as teacher support being valued alongside enjoyment and understanding of science. Our findings provide empirical support for a values-based ScWB framework that can guide teachers in identifying and fulfilling students' values in science classrooms, potentially enhancing enjoyment, engagement, and participation in science education.
Si-Ting	Huang	Students' Perceptions of the Most Pressing Pollution Problems: A Study in Taipei, Taiwan	As environmental pollution intensifies globally, understanding the perceptions of younger generations is crucial for enhancing educational strategies aimed at fostering environmental awareness. This study investigates the views of fifth and sixth-grade students in Taipei, Taiwan regarding the most significant pollution problems facing the planet. Students, divided into small groups, engaged in collaborative discussions on air, water, and plastic pollution, and utilizes the CoSpaces Edu platform to transform their ideas into interactive 3D models that visually represent their thoughts. The study assesses the effectiveness of teamwork and the use of digital tools in illustrating complex environmental problems. The findings reveal that a majority of students identify plastic pollution ocean pollution and air quality deterioration as their top concerns, reflecting broader societal trends and media influences. Furthermore, the use of digital tools promotes creativity and enhances their understanding of environmental problems. This research underscores the importance of integrating technology into environmental education and highlights the necessity of incorporating students' perspectives in developing effective educational materials. The insights gained from this study can inform future environmental education initiatives and inspire proactive community engagement among young learners.
Philip	Kairns	Queering STEM: Navigating and	Despite increasing diversity and inclusion initiatives, STEM higher education in Australia remains shaped by cisheteronormative norms that marginalise queer identities. This



**PROGRAM**  
**2025 Conference (ASERA56)**  
**Deakin Downtown, Docklands (Melbourne, Australia)**  
**Tuesday 1<sup>st</sup> July to Friday 4<sup>th</sup> July 2025**

		Resisting Cisheteronormativity in Australian Higher Education	study investigates how queer students and faculty navigate, resist, and reimagine these exclusionary spaces. Guided by Queer Theory, Intersectional Feminism, and Affect Theory, the research adopts a critical narrative inquiry methodology, integrating sensory ethnography and retrospective autoethnography. The study draws on interviews with 22 queer peer collaborators to explore identity negotiation, visibility management, and the affective labour required to thrive within STEM environments. Findings reveal that while institutional structures often enforce conformity and invisibility, queer individuals develop strategies of resistance, including identity assertion and the creation of supportive networks. The concept of technical-identity matrices highlights how professional expertise both constrains and empowers identity expression, while technical affect underscores the emotional toll of navigating STEM spaces. This research challenges the notion of neutrality in STEM, advocating for inclusive reforms in education that recognise diverse identities as critical to innovation. Recommendations include fostering emotionally supportive learning environments and embedding inclusive policies to transform STEM into a space where all individuals can thrive professionally and personally.
JohnPaul	Kennedy	Exploring the Evolution of Student Attitudes Towards School Science.	For many years now, there has been concern regarding students' levels of engagement with school science and their pursuit of STEM pathways. Research provides suggests various mechanisms to explain how affective factors such as self-efficacy and perceived enjoyability of science as a learning area might impact students' intentions towards, and hence enrolment in, science and related subject areas. Building on a study presented at ASERA 52, this presentation reports findings related to self-efficacy and enjoyment in school science providing evidence for the existence of distinct attitudinal trajectories over time. Utilising five years of longitudinal data from students in Years 4 to 12 attending a large multicampus school we show that students' attitudinal trajectories show both small scale variation over time and distinct turning points. Using senior course enrolment data we suggest that while some of these variations may relate to factors such as curriculum content or student gender, other changes seen might be interpretable as being "decision points" indicating a point in time that students decide to further their study of science or to disengage. This important information provides essential insights for educators in developing and targeting interventions aimed at plugging some of the holes in the STEM pipeline.
Magdalena	Kersting	Embodied Meta-Cognition: Supporting Teacher Awareness and Strategic Use of Embodied Resources in Science Education	The Science Education Network for Supporting Embodied Sense-Making (SENSES) engages teachers and researchers in co-designing embodied approaches through participatory workshops. Building on the four senses framework (Kersting et al., 2021), this study investigates how teachers develop awareness and strategically manage embodied resources in their practice. While embodied cognition has gained traction in science education, the meta-cognitive dimension remains underexplored. This parallels developments in epistemic meta-cognition (Maggioni & Parkinson, 2008) yet focuses on bodily resources. This study examines how co-design workshops foster embodied meta-cognition, addressing: How do teachers develop awareness of and strategically manage embodied resources in their teaching? Data from three workshops with seven upper-secondary science teachers includes recordings, participant documentation, and reflective interviews. Results indicate teachers progressively recognise implicit embodied elements in existing practices, integrate multiple embodied perspectives, and adapt strategies to specific learning challenges. The participatory approach supports this meta-cognitive development through shared reflections on action. Kersting, M., Haglund, J., & Steier, R. (2021). A Growing Body of Knowledge: On Four Different Senses of Embodiment in Science Education. <i>Science &amp; Education</i> Maggioni, L., & Parkinson, M. M. (2008). The Role of Teacher Epistemic Cognition, Epistemic Beliefs, and Calibration in Instruction. <i>Educational Psychology Review</i>
Sarika	Kewalraman i	Supporting Early Childhood Preservice Teachers to Effectively Integrate STEM in Their Future Teaching Practice	It is critical that teachers are equipped with Science, Technology, Engineering and Mathematics (STEM) skills and knowledge as we move into a digital future. By integrating STEM into early childhood education, we can provide young children with invaluable opportunities to build their scientific knowledge from the very start, setting them up for success in their later STEM educational journeys. However, many educators within early childhood settings find it challenging to create engaging STEM-based activities for young children. There is a scarcity of information on how teacher educators support preservice teachers in developing their STEM competence. This study examined the perspectives of early childhood preservice teachers (PSTs) regarding their



**PROGRAM**  
**2025 Conference (ASERA56)**  
**Deakin Downtown, Docklands (Melbourne, Australia)**  
**Tuesday 1<sup>st</sup> July to Friday 4<sup>th</sup> July 2025**

			confidence and pedagogical content knowledge (PCK) in integrating STEM into their teaching practice. Utilising a qualitative multi-case study approach, semi-structured interviews with 11 PSTs and a document analysis of their assignment tasks/teaching artefacts were conducted. Findings highlighted that PSTs acknowledged embedding STEM content into both theoretical classwork and practical placement enhanced their content knowledge and confidence when teaching STEM in early childhood settings. It is essential for future research to explore and expand university–preschool partnerships to create immersive STEM experiences that benefit preservice teachers and future in-service teachers in this field.
Gahyoung	Kim	Exploring Lower Secondary Students’ Reasoning about Newton’s Third Law through Multiple Representations	Understanding Newton’s Third Law and the relationship between forces and motion is fundamental in lower secondary physics education. However, many students struggle to recognize that forces always occur in pairs. Research suggests that using multiple representations—such as diagrams and written explanations—can support students’ reasoning and conceptual development in this area. This study investigates how Year 7 students (N = 14) conceptualize Newton’s Third Law through both diagrams and written explanations in the context of a balloon rocket experiment. The analysis identifies three distinct reasoning patterns that reflect students’ developing conceptual understanding: (1) Recognizing multiple forces acting on the system but overlooking the reaction force; (2) Confusing action-reaction pairs with balanced and unbalanced forces; (3) Correctly identifying action-reaction pairs but making minor representational errors. Additionally, students’ reasoning varied between representations—some demonstrated stronger understanding through diagrams, while others provided more detailed explanations in written responses. These findings highlight the importance of integrating multiple representations in science instruction to strengthen conceptual coherence. They also provide valuable insights for lower secondary science teachers, enabling them to better assess students’ reasoning and refine instructional strategies to improve students’ understanding of force and motion.
Melinda	Kirk	Examining Primary Student Enactment of Impactful Inquiry	In the face of growing socio-ecological challenges, this research seeks to foster students’ meaningful inquiry that encompasses all three strands of the science curriculum (understanding, skills and science as a human endeavour) with citizenship perspectives and generative critical and creative thinking. A micro-ethnographic study of a Year 6 community of learners’ inquiry within a larger Design-Based Research Project is presented to highlight primary students’ impactful inquiry. Students’ socially responsible inquiry that makes a difference in a matter of significance to them is delineated. Drawing on inquiry literature, curriculum and student inquiry experiences, eight key student inquiry principals that support student pursuit of science-informed transformative change are identified. Responsivity to student voice and agency to enact change is supported as students explore ideas, investigate, interpret, interrogate (identifying issues/possibilities) and infer from their shared inquiry data to innovate, implement, and inform science-grounded change in their direct community. These identified principals of impactful inquiry guide students through issue identification, solution generation, innovation implementation, and stakeholder involvement. In this way, impactful inquiry seeks to prepare students with the capacity and efficacy to pursue positive science-informed change in matters that matter to them now and into the future.
Kittipot	Konsanthia	Digital Competency Development in Science Teachers: Analysis and Prediction Through the TPACK Framework	The integration of digital technologies in science education demands robust teacher digital competencies for facilitating authentic experimental practices. While Professional Learning Communities (PLCs) serve as frameworks for teacher development, understanding of how science teachers develop Technological Pedagogical Content Knowledge (TPACK) remains limited. This study introduces a TPACK-based PLC framework to analyze trajectories of digital competency development among science teachers. Using a mixed-methods approach, we analyze data from reflective journals, PLC participation records, and technology usage logs from simulation software, data analysis tools, and online platforms. Preliminary findings indicate varied trajectories in TPACK development, revealing significant differences in how teachers integrate digital tools. While some teachers effectively incorporate technology into experimental learning, others struggle with selecting appropriate digital tools, aligning them with inquiry-based approaches, and applying them in student-centered activities. These challenges highlight the need for targeted interventions, including structured training, peer mentoring, and hands-on workshops, to address specific competency gaps. This research specifically informs the design of differentiated professional development



**PROGRAM**  
**2025 Conference (ASERA56)**  
**Deakin Downtown, Docklands (Melbourne, Australia)**  
**Tuesday 1<sup>st</sup> July to Friday 4<sup>th</sup> July 2025**

			programs that address teachers' varied TPACK developmental needs. The findings will guide science education stakeholders in creating more effective, personalized support systems that enhance teachers' capacity to leverage digital tools for inquiry-based science instruction.
Camilo	Lellis-Santos	Smartphone Bans are Hindering Science Education: A Threat to Technology-assisted Learning and Experimentation in Low-income Schools	Despite concerns regarding the negative impact of smartphones in education, students from low-income schools may be missing opportunities to engage in scientific experimentation. This study challenges the prevailing negative narrative by presenting evidence of the positive role smartphones can play as tools for conducting experiments, collecting data, and visualizing scientific concepts related to heart rate. A mixed-methods approach was employed, incorporating a quasi-experimental design with pre- and post-tests and high school student interviews. The smartphone-assisted experimentation (SAE) protocol involved measuring heart rate using smartphones at rest and after mental effort and physical exercise. Notably, 40% of students exhibited problematic smartphone use. The protocol enhanced conceptual understanding of heart rate in both laboratory-controlled conditions ( $d = 1.45$ ) and classroom settings ( $d = 1.16$ ). Students who conducted the experiment in regular public school classrooms perceived SAE as a real practical lesson (80.7%), a scientific experiment (60.9%), and an enjoyable learning experience (92.7%). No statistically significant differences were observed in conceptual understanding or perceived learning when comparing SAE to traditional heart rate experiments using expensive physiography equipment. These findings suggest that smartphones can serve as cost-effective tools for scientific experimentation in resource-limited educational settings.
Michelle	Lucas	Factors Influencing High Ability Students in STEM	This study developed and tested a new model of the factors associated with STEM career aspirations and persistence in physical science courses among high ability senior secondary students. A survey instrument was developed from previously validated items and scales and administered to a sample of 1019 high ability students in NSW, Australia. Survey response data was used to test the model which leveraged social cognitive career theory (SCCT) and expectancy-value theory (EVT). The accepted optimal model suggested achievement expectations and enjoyment in physical science have a significant association with students' perseverance in STEM pathways. We also found science capital and science identity to be positively associated with persistence intentions, with notable gender differences in these areas. Policy-makers, educators, psychologists and counsellors may use the findings to support high ability adolescents in their subject and career choices.
Ha My Anna	Mang	Implementing an SSI-based Climate Change Program: The Implication on Secondary Students' Scientific Literacy and Agency	Engaging students as active citizens with socio-scientific issues (SSIs) requires scientific literacy and agentic mindsets. However, data suggests that science education is struggling to enhance these areas, particularly towards SSIs like climate change. Adopting an integrated SSI and Science, Technology, Engineering, Arts, and Mathematics (STEAM) emphasises interdisciplinary knowledge, connections to learners' personal lives and empower their action-oriented practices. This study explores the impact of adopting SSI-based STEAM in a 'Climate Change and Us' (CCU) program on students' scientific literacy and agency. A design-based research method guided the iterative cycle program development and implementation process with experts, and preservice and inservice science teachers. The program was delivered by four science teachers to their Year 8 or 10 classes. From teachers' evaluations, reflections, and interviews on their classroom practice, the study drew findings about the impact of the implemented program. The findings indicated an improvement in students' scientific knowledge, engagement and interest in learning climate change. In addition, teachers noted an increase in students' personal and collaborative agency. This has implications for teachers wanting to implement alternative approaches that can transform science learning to foster scientific literacy and student agency in a meaningful and relevant manner.
Jennifer	Mansfield	Developing a Pedagogical Framework to Support Pre-service Teacher Learning About Planning for	Practical work is a common and engaging feature of science classrooms. During practical work students manipulate objects in the Domain of Observables (what students do, DO) to learn science concepts and skills the teacher intends (i.e., the Domain of Ideas, DI). When the two domains are not aligned, not given insufficient attention or not made explicit, practical work can be ineffective and unproductive. Given the short timeframes of initial teacher education and limited experience planning specifically for student learning through practical work on practicum, Pre-service teachers (PSTs) would benefit from targeted support when learning how to plan for practical work. In particular, when



**PROGRAM**  
**2025 Conference (ASERA56)**  
**Deakin Downtown, Docklands (Melbourne, Australia)**  
**Tuesday 1<sup>st</sup> July to Friday 4<sup>th</sup> July 2025**

		Practical work in Science Education	conceptualising what they expect students to do and learn in DO and DI respectively. The aim of this research was to make explicit key elements for practical work in DO and DI to support PST learning. A six-year intervention study took place during a biology method unit at a large university in Melbourne. PST assignments (n=272) were analysed using thematic analysis and tested using Rasch. The Practical Work Effectiveness Matrix was created and offers a pedagogical framework which makes explicit the complex and nuanced elements of planning for DO and DI to support the development of PSTs knowledge and capacity to plan for practical work.
Jay Jay	Manuel	Cognitive Perspective of Understanding How High-Potential Learners in STEM Navigate the Novice-to-Expert Transition	The Philippine Science High School (PSHS) plays a critical role in the Philippines' long-term goals in science, technology, and innovation by channeling high-potential Filipino learners into the STEM pipeline through the university STEM programs. Despite strong investments, issues with dropouts of PSHS students and attrition of PSHS graduates during the early years from STEM programs remain a pressing concern. Addressing these gaps requires a deeper understanding of the internal learning mechanism that supports learning in science education. This research examined how high-potential Filipino learners in STEM navigate the transition from novices to experts by examining their cognitive processes as they engage in complex STEM learning tasks. In this study, "novice" learners refer to those current PSHS learners in their specialization years program preparing for transitioning to university-level STEM education, while "expert" learners are PSHS graduates who have successfully transitioned to university-level STEM education. The Precursor-Action-Result-Interpretation (PARI) methodology was used to collect data and the Cognitive Task Analysis (CTA) data analysis and representation techniques was used to compare the cognitive processes of selected cohorts of PSHS novice and expert learners. The preliminary results show that expert learners demonstrate stronger metacognitive awareness and self-regulation, critical reasoning and reflection, and adaptive problem-solving strategies – cognitive behaviors linked to developing expertise. These findings inform science education practices in the Philippines aimed at developing expert learners and supporting PSHS's mission to nurture STEM professionals.
Christine	McGrail	Examining the Representational Affordances of Young Children's Design Artifacts	The purpose of this study was to investigate the role of the design artifact in early elementary learners' conceptual development when learning about force and motion as experienced in a design activity with levers. Based on three individual, informal science learning sessions, young children's science concept development was examined through video recordings, video-stimulated recall interviews, and children's design artifacts and were interpreted from a model based reasoning and representation affordances perspective. Salient information from the external source of the child's artifact was processed and represented internally as part of model-based reasoning. With the artifact as a physical representation of participants' internal models, participants themselves were able to test their own thinking and derive useful feedback from the interaction of internal and external representations. Results show that all participants demonstrated conceptual development towards more scientific conceptions of force and motion through accretion of artifact dimensions, and conceptual development changes constructed on-the-spot during artifact construction. The artifact as a physical model supplied the stimuli through salient features that helped participants home in on the aspect of the launcher system they desired to change. The findings have important implications for engineering design affordances as both an instructional approach and evaluation of student learning.
Karen	Marangio	Reshaping Science Teacher Education through Collaborative Online International Learning (COIL)	Collaborative Online International Learning (COIL) is an approach that brings students and educators from different institutions around the globe together online with the aim of enhancing the intercultural and professional learning capabilities of those involved as part of their teacher education classes. COIL offers the potential for developing pre-service science teachers (PSTs) global perspectives on secondary school science education, raising participants' awareness through dialogue with international peers, without international travel. This paper responds to the research question, to what extent does COIL reshape internationalisation in science teacher education, and what opportunities and challenges are afforded by virtual mobility? In our secondary science education unit at Monash University, we collaborated with a science educator from Hong Kong University to co-teach aspects of our courses and facilitate online real-time exchanges between our students. Data were collected across two years as pre and post unit surveys and analysed for common themes to identify the affordances of this virtual



**PROGRAM**  
**2025 Conference (ASERA56)**  
**Deakin Downtown, Docklands (Melbourne, Australia)**  
**Tuesday 1<sup>st</sup> July to Friday 4<sup>th</sup> July 2025**

			mobility opportunity. Findings signal powerful opportunities for developing PSTs' knowledge through the virtual sharing of classrooms and classroom experience, the exchange of curriculum, policy and context stories, and the development of a shared language for talking about science teaching and learning.
Jenny	Martin	Positioning in Science Education: A Focus on Agency	The presentation elaborates a program of research concerned with understanding human agency and processes of agency development in science education. As the field of science education has moved towards social, environmental, and educational justice, the conceptual tools of positioning theory have become increasingly utilised. Positioning theory draws researcher/practitioner attention to how people position themselves and others in conversational storylines as social episodes unfold. A framework of agency as self-intervention in two analytically distinct domains will be introduced: the expressive domain, concerned with self-intervention for the development of reputations or moral careers, and the practical domain, concerned with conscious involvement or commitment to collective projects, such as ecologically and socially just scientific endeavours. Data were generated from reflective journals by preservice teachers developing critical environmental literacy whilst evaluating their own consumption. The research operationalised self-intervention in terms of positioning, where grammatical markers for taking personal and collective responsibility were employed as a coding scheme. The framework provided an understanding of preservice teachers' professional agency development as a process involving repositioning, for example, as science educators and as citizens concerned with ecological justice. Implications for the use of the framework for reimagining participation and identification within science education will be discussed.
Deepika	Menon	"I Will or Will I": Preservice Elementary Teachers' Integrated STEM Teaching Self-Efficacy and Perceived Challenges	Recent reform efforts in K-12 science, technology, engineering, and mathematics (STEM) education emphasize preparing competent and confident preservice elementary STEM teachers (PSTs). This mixed-methods study investigates how PSTs' (n=465) self-efficacy in teaching integrated STEM (iSTEM) and their perceived challenges of iSTEM instruction change during semester-long science/STEM methods coursework across five universities in the U.S. Bandura's (1977) self-efficacy and Ertmer et al.'s (1999) framework of challenges guided this investigation. We investigated: 1. How does PSTs' iSTEM teaching self-efficacy change after participating in the science/STEM methods course? 2. What challenges do PSTs perceive in implementing iSTEM instruction, and whether these perceptions change from the beginning to the end of the semester? Quantitative data sources included pre-post measures using the Self-Efficacy for Teaching Integrated STEM instrument (Mobley, 2015), an open-ended questionnaire, and a demographic survey. Analysis using McNemar and t-tests revealed statistically significant positive gains in iSTEM teaching self-efficacy and a significant decrease in overall perceived challenges by the end of the semester. Qualitative content analysis revealed six categories of perceived challenges: teacher affect and experience, student-related concerns, content and curricular challenges, pedagogical challenges, support from others, and time and resources. The findings have implications for STEM teacher preparation programs and future research.
Frackson	Mumba	Assessing the Quality of Pre-service Science Teachers' Engineering Design Integrated Science Units	Current US science education reforms (National Research Council [NRC], 2012; Next Generation Science Standards (NGSS; NGSS Lead States, 2013) require teachers to integrate engineering design into science teaching. Thus, successful integration of engineering design into science teaching will largely depend on the quality of instructional materials teachers are developing for their science classrooms. In this study, 45 pre-service teachers participated in a six-week intervention on engineering design integrated science (EDIS) teaching. After the intervention, pre-service teachers created EDIS units which they taught in schools during student teaching. Forty-five (45) EDIS units were analyzed for quality using the modified STEM Integration Curriculum Assessment (STEM-ICA) tool (Guzey et al., 2016). The original tool had nine elements. After removing one element- integration of mathematics content, the modified tool had eight elements: motivating and engaging context, engineering design challenge, integration of science content, instructional strategies, teamwork, communication, performance and formative Assessment, and organization. Each element was evaluated on 0-4 scale, with zero for not present and four for excellent representation. Results show that all eight elements were represented in the units with teamwork, motivation and engaging context, engineering design challenges, and integration of science content receiving most representation. Results and implications will be discussed.



**PROGRAM**  
**2025 Conference (ASERA56)**  
**Deakin Downtown, Docklands (Melbourne, Australia)**  
**Tuesday 1<sup>st</sup> July to Friday 4<sup>th</sup> July 2025**

Karen	Murcia	Zooming into Discovery: Kindergarteners' Science Inquiry with Digital Microscopes	This presentation explores the integration of digital technologies into early childhood education through an 8-week 'stay & play' program at a metropolitan university's Centre of Excellence - Children's Technology Cove (CTC). A group of ten kindergarten children engaged with digital microscopes as part of a series of digital learning experiences designed to enhance cross-curricular learning. The research aimed to investigate how the digital tool could support young children's inquiry processes and the social construction of foundational science concepts, focusing on the nature of materials and the characteristics of living things. Children's digital photography, capturing their observations and discoveries, served as a window into their exploration and understanding. Using narrative vignettes, the presentation synthesises emerging themes from the children's experiences, highlighting how digital technologies extend their observational skills and assisted in making abstract scientific ideas tangible and meaningful. The findings highlight the potential of digital tools in fostering curiosity and deepening conceptual understanding in young learners. This research contributes to the growing body of knowledge on digital technologies in early childhood education, offering insights for educators on how such tools can enrich children's exploration of their world and scaffold their scientific thinking within a playful, inquiry-based framework.
Steve	Murphy	Exploring the Advantages of Rural Spaces for Teaching and Learning STEM: A Scoping Review of Research Exploring How Rural Social Spaces Enable STEM Education Practices.	The rural STEM education narrative is dominated by a deficit view – rural students under participate and under perform in STEM compared to metropolitan students, and rural schools struggle to staff and resource STEM classes. Despite these challenges, research is emerging that suggests rural spaces can be rich sites for learning STEM and arguably have potential advantages in STEM education compared to metropolitan sites. This scoping review identified peer-reviewed research articles reporting on how rural social spaces enabled STEM education practices. Analysis of the characteristics of this body of research shows a bias towards science education, and a stronger focus on impact on student engagement compared to achievement. We share how the elements of rural social space (industry, demography and geography) where described as enabling STEM education for rural students, either through direct interaction with these elements or through using these familiar contexts to enhance classroom learning. The body of literature also provides insights into who should drive effective STEM education in rural areas, and even into how effective STEM education should be conceived. This review highlights future opportunities to adopt an advantages driven approach to rural STEM education.
Vijit V.	Nautiyal	Improving High School Students' Understanding and Attitude Towards Quantum Mechanics by Integrating Cognitive Apprenticeship Model with Discipline-culture Framework for Physics Education	Context and Purpose: This study examines a school-initiated online STEM & Research Internship Program (SRIP) in the Philippines designed to enhance high school students' understanding of quantum mechanics (QM) and attitudes toward the subject. Theoretical Framework: We integrated the discipline-culture (DC) vision for physics education with the cognitive apprenticeship (CA) model to design and deliver a holistic QM curriculum for students. Research-based pedagogies, including flipped classroom approach, guided inquiry, games and simulations, project-based learning, and educational videos, were used to effectively implement the curriculum. Method: We used a quasi-experimental research design with a single-group pre- and post-test format and a mixed-methods approach. Twenty students (Grades 9 to 11) participated in the program. Quantitative data were collected using the Quantum Physics Conceptual Survey (QPCS), Quantum Technology Inventory (QTI), and Attitude Towards Quantum Mechanics (ATQM) survey. Qualitative data was collected from students' daily journal entries. Results and Significance: A statistically significant improvement ( $p < 0.05$ ) in students' QM knowledge and attitudes was observed, supported by qualitative findings from thematic analysis of students' daily journal entries. This study contributes to the growing knowledge on quantum science education at school level and can guide future school-led (remote) educational initiatives
Chloë	Nelson	Using the Contextual Model of Learning to Examine Teacher Professional Development Whilst	There is growing evidence that teachers may experience professional development benefits from accompanying their students on field trips to science centres or museums. This study reports on the experiences of teachers who accompanied their students on science centre field trips or incursions (in-school field trips), by examining their experiences using Falk and Dierking's (2018) Contextual Model of Learning (CML). Through semi-structured interviews, teachers detailed the professional development benefits they experienced and how personal, sociocultural and physical contexts as well as time may have influenced these benefits occurring. The qualitative analysis revealed that teachers experienced a range of intellectual, attitudinal and behavioural



**PROGRAM**  
**2025 Conference (ASERA56)**  
**Deakin Downtown, Docklands (Melbourne, Australia)**  
**Tuesday 1<sup>st</sup> July to Friday 4<sup>th</sup> July 2025**

		Accompanying Science Centre Field Trips and Incursions	professional development benefits, as well as improved relationships with their students. This paper focuses on the sociocultural context of the CML. Teachers reported participating in a variety of sociocultural interactions that assisted in facilitating these benefits occurring including participating alongside their students in learning activities as well as observing science centre professionals teaching their students. Whilst field trips and incursions are organised for the benefits of students, they are also able to have an impact on teachers. Therefore, accompanying students on field trips should also be valued as an important informal learning contribution to teachers' overall professional development.
Melissa	Neo	Differentiated Resource Use: A Preliminary Study Examining Teacher Experience and Implementation of Singapore's Revised Primary Science Curriculum	Teachers play a key role in utilising curriculum resources (CR) to engage students, promote active learning, achieve curriculum goals and more. In 2023, Singapore's Ministry of Education introduced an integrated suite of CR (ISCR) with the revised primary science syllabus. This study explored the perceived usefulness of the ISCR of 809 grade 3 and 4 teachers through a landscape survey in 2023-2024. Preliminary findings revealed that resource utilisation is influenced by teachers' intended purpose and years of teaching experience. The textbook and teaching learning guide were primarily employed for lesson planning, while the activity book and SPARKLE Kits (science activity resource kits) were preferred for classroom enactment. Experienced teachers differentiated their usage of the CR, reporting greater overall utility. They were more likely to adapt and customise CR and create additional resources to align with specific classroom needs. Conversely, novice teachers perceived all ISCR as equally beneficial for planning and enactment, expressing a higher demand for additional supplementary resources. These findings highlight the impact of teaching experience on resource perception and application, informing the development of targeted professional development workshops and initiatives that can enhance pedagogical strategies and optimise resource utilisation to support effective syllabus implementation.
Ade Noorliza	Niyamae	Support on Students' Conceptual Understanding of Redox Reactions: Viewing Animations Versus Critiquing Animations	Animations are valuable tools in chemistry education as they offer dynamic visualizations of submicroscopic processes. Yet, how best to use them for learning requires further study. This study investigates how animations can best support students' conceptual understanding of redox reactions by comparing two approaches: viewing a single animation versus comparing and critiquing multiple animations with varying accuracy. Fourteen first-year chemistry undergraduate students in Aotearoa, New Zealand, participated in this study. Qualitative content analysis of students' responses during the activity, post-activity questions, and follow-up interviews revealed that students who viewed a single animation demonstrated a more comprehensive understanding of submicroscopic events, including ion distributions, electron transfer, and connections between macroscopic changes and submicroscopic processes. These findings suggest that a focused, singular visual may be more effective in facilitating the understanding of complex redox processes. Irrespective of the approaches, a Likert-scale survey showed that all but one student found studying redox reactions easier than expected and preferred animations for understanding complex topics. These findings contribute to the broader discussion on effective multimedia use in science education and have important implications for instructional design, particularly in creating learning materials that bridge the gap between macroscopic observations and submicroscopic processes in chemistry.
John	Ojeogwu	A Systematic Review of Literature on Preparing Pre-service Teachers for Engineering Integrated Science Teaching: Interventions, Outcomes, and Gaps	In the United States, science education reforms advocate for teaching science using the engineering design process, but many science teachers lack preparation in engineering. To address this, science teacher education programs have started preparing pre-service teachers (PSTs) in engineering design integrated science (EDIS) teaching. However, little is known about the structure of interventions and tasks for learning used to prepare PSTs in EDIS teaching. We examined research studies on preparing PSTs in EDIS teaching for variations in their structures, tasks for learning, and outcomes, using a framework that has components for preparing PSTs to teach science using engineering design. Results show that most interventions were integrated into science teaching method courses and field experiences, with longer interventions leading to better outcomes. Most studies reported PSTs' increased understanding of the engineering design process, EDIS instructional planning, and self-efficacy for teaching engineering. However, some tasks for learning, such as providing tools to evaluate EDIS instruction and the influence on student learning, supporting PSTs in examining their beliefs about EDIS teaching, and understanding how to teach engineering design in diverse classrooms, were



**PROGRAM**  
**2025 Conference (ASERA56)**  
**Deakin Downtown, Docklands (Melbourne, Australia)**  
**Tuesday 1<sup>st</sup> July to Friday 4<sup>th</sup> July 2025**

			understudied. Implications for science teacher preparation, science and engineering teaching and learning, and areas for future research will be discussed.
Sarah	Oliveira	Developing an Immunology Curriculum for Youth – Contributions from a Delphi Study	Vaccine hesitancy is adversely influencing people’s health. The contemporary increase in vaccine increase is particularly prevalent in New Zealand teenagers, possibly due to the infodemic. Their social media engagement elicits informational cascades that can entice them into believing mis- and disinformation about vaccines, eroding their trust in scientific evidence. Using a Delphi approach, this study sought the opinions of 16 experts to determine the content of an immunology curriculum for teenagers. Immunologists, virologists, physicians, medical writers, advisors and educators were surveyed as expert informants. In a 3-phase iterative survey, these experts recommended the inclusion of four main areas for teaching an immunology curriculum: the immune system, vaccination, mis- and disinformation, and pedagogical advice/strategies. Findings suggest that secondary teachers should aspire to only teach basic immunology and vaccination and explicitly teach myths about vaccines. Using a variety of pedagogical tools and strategies to engage learners in immunology along with verified resources for a complicated topic were also recommended.
Joonhyeong	Park	The Complementary Roles of Visual and Written Representations in Depicting Scientific Phenomena and Theories in Science Textbook Figures	Figures in science textbooks play a critical role in representing scientific concepts, phenomena, and processes. Although many studies have investigated figures as visual representations, there has been a lack of understanding of how visual and written modes of representation within a figure complement each other in conveying information. To address this gap, this study compared figures in lower secondary science textbooks from Singapore and South Korea, focusing on the roles of each mode and their complementary relationships. Using an analytic framework that was developed, 335 figures from both two regions were analysed with a focus on physics topics. It was found that the primary role of visual components in figures from Singaporean textbooks was to depict realistic phenomena or examples whereas among Korean textbooks they were used to juxtapose phenomena with their visualised scientific theories. Across both regions, the dominant role of written components within figures was to connect scientific phenomena with relevant terms and concepts. Another important role was to label scientific phenomena using everyday language rather than targeted scientific terms. Based on these findings, we discuss the complementary roles of visual and written representations within figures in science textbooks with consideration of differences in local pedagogical practices.
Ross	Phillips	Will I Enrol in Senior Secondary Sciences? How Schools Influence Student Choice.	In Australian Senior Secondary schools, students are faced with a broad range of subject options, with Sciences being among the most frequently chosen. My PhD research investigates the role of schools in shaping these subject choices. Through semi-structured interviews with staff members from schools in suburban Melbourne, I analysed the transcripts using Bourdieu’s concept of the social field. Additionally, I examined publicly available enrolment data and school records to further understand how school practices influence student decisions. The analysis revealed several key insights: schools reinforce a long-standing hierarchy of subjects; segregation within school populations can impact subject selection; and even teachers’ employment interests affect the conditions under which students choose their subjects. The findings suggest that students’ decisions to study Science subjects are shaped by the particular context of their school. These findings have broader implications for Science enrolment patterns, educational equity, and resource allocation in schools.
Jakkrapong	Pinchai	Students’ Behavior in Model-Based Inquiry Lessons that Promote the Construction of Complete Scientific Explanations for Gas-Related Phenomena	Scientific explanation is a key competency that needs to be promoted in science teaching and learning. Model-based inquiry (MBI) is a learning approach that can support students in constructing scientific explanations (SE). However, constructing complete scientific explanation (CSE) is particularly challenging for students with medium to low academic abilities. Knowledge on how to support these students in constructing CSE or what specific behaviors in MBI contribute to effective scientific explanations is limited. This qualitative study was designed to investigate student behaviors that contribute to the CSE in MBI lessons. Data were collected from 38 eleventh-grade students at an extra-large public school in Bangkok, Thailand, through five MBI lesson plans focused on the topic of gases. SE quizzes were collected and triangulated with classroom observations and MBI worksheets. Inductive content analysis was used to identify patterns and themes of behaviors that led to the construction of CSE. The finding indicated that students’ behaviors contributing to CSE included: constructing and revising models, writing evidence from investigations,



**PROGRAM**  
**2025 Conference (ASERA56)**  
**Deakin Downtown, Docklands (Melbourne, Australia)**  
**Tuesday 1<sup>st</sup> July to Friday 4<sup>th</sup> July 2025**

			connecting evidence to answer driving questions, and sharing explanation in class discussions. This finding might be a guideline for science teachers to engage students in these behaviors in MBI instruction to promote the development of CSE.
Suphanwadee	Prasong	Collective Meaning-Making of Integrated STEM: A Discourse Analysis of Teacher Professional Learning Communities	Teachers' understanding of integrated STEM education significantly influences its successful implementation, yet little is known about how teachers collectively construct this understanding through professional discourse. This study explores how secondary school teachers develop their conceptualization of STEM education through collaborative dialogue within Professional Learning Communities (PLCs). Through critical discourse analysis of PLC discussions among science, mathematics, and technology teachers, we examined how their collective discourse shapes their interpretation and implementation of STEM integration. The analysis revealed three key discourse patterns: (1) negotiation of STEM terminology and pedagogical approaches, (2) collaborative interpretation of cross-disciplinary connections, and (3) contextual adaptation of STEM practices based on shared classroom experiences. These discourse patterns illuminate how teachers collectively construct their understanding of STEM education and translate this understanding into local teaching practices. The findings inform the development of a professional development framework that leverages teacher discourse as a mechanism for deepening STEM understanding and enhancing implementation in local contexts.
Violetta	Pristel	How Secondary School Teachers Implement Integrated STEM: Two Case Studies from the Lens of Critical Thinking Development	Critical thinking is an important skill to develop in school. Integrated STEM curricula approaches may assist development of students' critical thinking abilities. However, many teachers seem reluctant to use an integrated approach due to lack of implementation guidelines. An interpretive case study methodology was used to explore secondary school teachers' approaches to developing critical thinking in integrated STEM projects. Two teachers who taught integrated STEM projects in Western Australia secondary schools were interviewed pre/post project and three classroom observations were conducted during each project. The interviews concentrated on teachers' thoughts on implementation approaches, teaching strategies, assessment and how students' critical thinking may have been developed. Classroom observations focused on teaching strategies to promote critical thinking and interdisciplinary teaching practices. Interview and observation data were analysed individually using thematic analysis and then compared. It was found that integrated STEM projects implemented by the two teachers shared similar pedagogy however the degree of open-endedness and the nature of integration of STEM curriculum differed. How the teachers developed critical thinking differed depending on how science and mathematics concepts were integrated within the engineering design process. These findings provide insight into how different integrated STEM curriculum may influence critical thinking development.
Desy	Priyayi	Climate Change Education in Indonesia's Formal Education System: Context, Developments, and Future Directions	Indonesia is one of the most vulnerable countries in the world to climate change impact. The Indonesian government has also taken the initiative to address the impacts of climate change. However, Indonesia's climate policies and targets have been rated as critically insufficient to date, such that Indonesia's emissions are rising rather than falling. More action must be taken to address these issues in various spheres, including via climate change education (CCE). Through document analysis and curriculum mapping, this narrative review discusses Indonesia's climate change risks, the historical development of CCE initiatives, the relevant agencies involved, and the integration of CCE into the national curriculum. It identifies that while CCE initiatives have been ongoing for years, some obstacles have emerged, including limitations in teacher training, resource allocation, and regional implementation disparities. Looking forward, we propose strategic directions for strengthening Indonesia's CCE through enhanced teacher professional development, contextual CCE framework development, and stronger coordination between educational institutions and climate action stakeholders. This review contributes to science education by illuminating how CCE shares science education's core aims to address global challenges, including climate change.
Buana	Putra	Reading Science Texts with Generative AI: An Exploration of	The integration of generative artificial intelligence (GenAI) in education has gained traction, yet its role in supporting students' reading of science texts remains underexplored. This study investigates how high school students in Indonesia interact with GenAI while engaging with science texts in a problem-based learning context. The objective of this study is to understand what students seek to gain from using GenAI while reading science texts. Using design-based research, students used a GenAI-based



**PROGRAM**  
**2025 Conference (ASERA56)**  
**Deakin Downtown, Docklands (Melbourne, Australia)**  
**Tuesday 1<sup>st</sup> July to Friday 4<sup>th</sup> July 2025**

		Student-GenAI Interaction	chatbot, Chat with Docs, to read scientific texts related to electromagnetism and propose solutions for a fictional city. Thematic analysis of students' chat logs, interviews, and classroom observations revealed three key themes about what students seek to gain from using GenAI while reading scientific articles: summarizing and simplifying complex information, explaining scientific concepts, and exchanging ideas and feedback. Findings suggest that students leveraged GenAI not only to enhance comprehension but also as a dialogic partner for discussion and critical engagement with texts. This study highlights the potential of GenAI to foster deeper learning by transforming reading activity into a more dialogic process.
Dinda Karunia	Putri	Examining the Implementation of Ethno-STEM and Technology in Science Learning to Enhance Critical Thinking Skills in Primary School Students	This study aims to examine the application of an Ethno-STEM approach integrated with technology to improve critical thinking skills for science learning in primary school. In the 21st century, critical thinking is essential for preparing students to face global challenges and technological advancements. The Ethno-STEM approach, which combines traditional knowledge with modern science, offers great potential for improving students' understanding of scientific concepts in a contextual and relevant way. This study employs a descriptive qualitative approach with a study case design, involving 10 teachers and 20 students from a primary school in Bojonegoro Regency, Indonesia. Data were collected through interviews, observations, and questionnaires to understand teachers' and students' experiences regarding the integration of Ethno-STEM and technology in learning. The results indicate that although teachers recognize the importance of using technology in education, challenges such as lack of facilities, teacher training, and Ethno-STEM application knowledge persist. The study found that learning based on local wisdom enhances students' understanding of science but requires continuous teacher training and the provision of adequate technological resources. The study recommends further integration of technology, local wisdom, and STEM to create more interactive and effective learning, ultimately developing students' critical thinking skills.
Azneeal Ar	Rashid	Enhancing Science Teachers' Pedagogical Practices through Lesson Study in Technology-Integrated Inquiry-Based Learning: A Participatory Action Research Study	The integration of technology into inquiry-based science education is essential for fostering critical thinking, scientific inquiry, and student engagement. However, challenges such as insufficient teacher preparation, limited professional development, and systemic inequities continue to hinder effective implementation. Addressing these barriers is critical to advancing equitable, high-quality science education. This study investigates how Lesson Study, within a Critical Participatory Action Research (CPAR) framework, enhances science teachers' pedagogical practices in technology-integrated inquiry-based learning. Guided by Technological Pedagogical Content Knowledge (TPACK), Vygotsky's Sociocultural Theory, and Mayer's Cognitive Theory of Multimedia Learning (CTML), the study explores the interplay between teacher collaboration, technological proficiency and inquiry-driven instruction. Using a qualitative research design, 12 secondary science teachers participated in Lesson Study cycles involving collaborative lesson planning, classroom implementation, peer observation, and reflective analysis. Data from classroom observations, reflective journals, semi-structured interviews and surveys were analyzed using thematic analysis. Findings indicate significant improvements in teachers' confidence, pedagogical adaptability, and the co-development of inquiry-based digital learning materials. Despite challenges such as time constraints and technological disparities, collaborative professional learning facilitated sustainable instructional change. This study provides a scalable model for integrating Lesson Study into science teacher education, contributing to international discussions on technology-enhanced teaching, inquiry-based learning, and equitable professional development in science education.
Ma. Hershey P.	Regaya	Conceptualising Entrepreneurial Science Capabilities in Secondary School Science	Entrepreneurial science capabilities (ESC), as adopted in this research, refer to integrating entrepreneurial capabilities into science education. Entrepreneurial capabilities include identifying opportunities, fostering creativity, mobilising resources, and managing risk to create value in real-world contexts. ESC is important because it intentionally connects scientific knowledge with real-world applications through entrepreneurial capabilities. Current research shows that although teachers see the potential of entrepreneurial capabilities to make science education more relevant in real-world applications, there are difficulties in integrating them into lessons due to teachers' lack of conceptual understanding of entrepreneurial capabilities. Consequently, ESC has been adopted sporadically and at a slow pace. This study explores how Filipino secondary school science teachers conceptualise ESC, informed by a training workshop and reflected in their teaching practices, while examining enabling



**PROGRAM**  
**2025 Conference (ASERA56)**  
**Deakin Downtown, Docklands (Melbourne, Australia)**  
**Tuesday 1<sup>st</sup> July to Friday 4<sup>th</sup> July 2025**

			and constraining factors influencing this conceptualisation. Using a qualitative interpretive approach, data from eight physics teachers were collected through workshop activity sheets, co-designed lesson plans, and semi-structured interviews. Preliminary thematic analysis suggests that entrepreneurial capabilities can be integrated into physics teaching through entrepreneurial problem validation, reflection questions, and student-driven solutions to real-world problems. Teachers' conceptualisation of ESC is influenced by their understanding of entrepreneurial capabilities, topic to teach, learning outcomes, teaching strategies, and time allocation.
Alan	Reid	Attitudes Towards Biodiversity in Secondary School Students: The Significance of Nature Experience and Connectedness in Hong Kong	International research suggests a significant pattern in adults' conservation willingness: it is routinely shaped by childhood nature experiences and connectedness. However, such studies typically rely on datasets from Western, Educated, Industrialized, Rich, and Democratic (WEIRD) settings. Moreover, willingness is seldom understood in terms of the effects of childhoods experienced in densely populated urbanized lifeworlds. To address these gaps, we have investigated human-nature relationships among children in Hong Kong. Study 1 conducted a survey-based cross-sectional study with 200 school students to examine how their experiences influenced pro-environmental and pro-biodiversity attitudes. Initial results indicate that nature connectedness, but not nature experience, is positively associated with pro-environmental beliefs. Higher affective attitudes towards biodiversity were also associated with live experience with wild animals, but not nature experience more broadly. Building on discrepancies observed in Study 1 concerning the particular species that produced variations in attitudes, a follow-up investigation, Study 2, has compared students' affective attitudes (n=133) towards eleven species to understand factors that led to Study 1's outcomes. Logistic regression found that live experience, knowledge, aesthetic appeal, and flagship species were significant predictors of positive affective attitudes. Findings from both studies highlight the importance of authentic experience in fostering biophilia among children into adulthood.
Leonie J	Rennie	The Contribution of Citizen Science to the Development of Environmental Awareness, Concern and Agency	The PISA 2025 Science Framework includes, for the first time, "science identity" as one component of its science assessment framework. Science Identity is described by elements in three clusters: Science Capital & Epistemic Beliefs; Science Capital: Attitudes and Dispositions; and Environmental Awareness, Concern and Agency. In terms of agency, PISA asks "to what extent do young people acknowledge that science is core to providing solutions to these [environment] crises and to what extent do they see themselves as having any agency to engage with and act on issues at the personal, local, and global levels?" Citizen science projects involve people of all ages in science activities, at minimum, by the collection of data, but possibly also in the design and implementation of science projects. In this presentation, I use my personal experience of participation in a citizen science program, run via iNaturalist, to show that data collection can lead to interaction with scientists and contribute to the systematic building of environmental knowledge at the personal, local, and global levels. Building on educational research, I show how citizen science projects can translate to classroom-led activities that provide school students with opportunities to develop environmental awareness, concern and agency.
Deborah	de Ridder	Exploring Pedagogical Challenges in Inquiry-Based Learning	This paper provides an in-depth analysis of the pedagogical approaches that expert teachers use to guide senior secondary students to develop inquiry questions and develop science investigation methods in inquiry-based learning (IBL) in NSW Australia schools. In the literature, educators report challenges in assisting students to develop inquiry questions and investigation methods. This paper discusses contemporary practices employed by expert teachers, based on an in-depth analysis of the teaching strategies observed in a Grounded Theory Design study. The teaching strategies of four expert teachers were analysed using two established typologies: regulation practices and levels of guidance. The expert teacher participants offered a comprehensive and differentiated range of guidance strategies to support their students. While questioning practices between teachers and students were predominant, a wide array of differentiated teaching strategies was also utilised. The findings of this study have significant implications for enhancing pedagogical skills in Inquiry-Based Learning (IBL), highlighting the importance of making informed pedagogical choices. Additionally, the results suggest that striking a balance between explicit instruction and student independence is essential for effective pedagogical practice in IBL.



**PROGRAM**  
**2025 Conference (ASERA56)**  
**Deakin Downtown, Docklands (Melbourne, Australia)**  
**Tuesday 1<sup>st</sup> July to Friday 4<sup>th</sup> July 2025**

Emily	Rochette	Exploring Plant Awareness for Culturally Responsive Teaching in Initial Teacher Education	<p>Plant awareness disparity (Parsley, 2020) refers to a discrepancy in knowledge and understanding of the importance of plants in the environment and human affairs. Science educators play an important role to build plant awareness through culturally responsive teaching promoting the achievement of the United Nations Sustainable Development Goals. Scholarship exploring plant awareness disparity in the context of initial teacher education, however, seems to be an emergent research endeavour warranting attention.</p> <p>This presentation introduces a research project examining a native plant garden as an alternative teaching space. The study, in its pilot phase, employs a constructivist grounded theory methodology (Charmaz, 2014) exploring how pre-service, secondary science teachers' plant awareness can be fostered toward preparing them to implement culturally responsive curriculum materials. The research question is: To what extent can a native plant garden foster approaches building the professional capacity of pre-service, secondary science teachers to implement culturally responsive learning experiences? The significance of the study is discussed through the research literature. The pedagogical design and purpose of the garden are presented and the research design explained. Two data collection tools, personal meaning making maps and collaborative interactive discussions (Giardiello et al., 2014), are then explored and emergent themes discussed.</p>
Ronan	Rock	“Should I call you ‘Mx’?”: Intersections of Queer Studies and Indigenous Science to Reimagine Pedagogies of Care	<p>This theoretical exploration uses autoethnography as research design to ground and explore the intersections between Indigenous science and technology studies in conjunction with feminist, queer, and trans studies. The critical perspectives that underly these diverse fields of scholarship offers opportunities for ways science and science education can be done that do not recapitulate harm for minoritized learners and teachers. Using multimodal autoethnographic vignettes in the praxis of one White trans educator both contextualizes the theoretical conceptualization and provides examples of application. Several wonderings about what doing intersectional and gender inclusive science education could look like have emerged. Reimaginings include the potential for using spectrum logics in classroom lessons, and the use of storytelling and embodied narratives to create and share cultural and scientific knowledge. Both Indigenous science ways and queer theory disavow binary logics in favor of spectrum thinking, which more accurately reflects the world around us from the dual nature of photons to the evolution of eukaryotic cells. Storytelling (Indigenous Science) and embodiment (feminist studies) provide novel ways to engage in science. This contributes to a growing body of culturally- and gender-expansive way of knowing, doing, and learning science as an alternative to western settler-colonial science.</p>
Saeed	Salimpour	Awe and Wonder: Astronomy as a Gateway?	<p>Astronomy in addition to the awe and wonder possesses a unique curiosity piquing characteristic. This has led to it being often described as a “Gateway Science” whereby students who are exposed to astronomy in school are enticed to pursue science, and more specifically subjects like Physics, in senior grades. The validity of this statement, which is a ubiquitous viewpoint amongst some astronomy education and public outreach personnel, is based only on anecdotal evidence and there has been no empirical research investigating this notion. This presentation highlights the development and validation of multi-construct survey which explores whether astronomy is perceived as a gateway science by students. In addition, this presentation presents preliminary results from the Astronomy as a Gateway Science (AGS) survey, which was administered to over 300 students in Years 9-12 in Australia and Sweden which presents some interesting questions and some stark differences to consider with regards to student attitudes towards topics in Astronomy. The results show that not all topics are considered interesting by students, and there are differences between student groups.</p>
Erika Eunice P.	Salvador	Scoping High School STEM Student Internships: A Global Perspective on Implementation and Effective Strategies	<p>High school STEM internship programs are essential for equipping students with foundational skills for future STEM careers, preparing them for both higher education and the workforce. However, incomplete or inadequate program documentation in the literature may limit program improvement between cycles and adoption across similar contexts. This scoping review, conducted in accordance with the PRISMA-ScR extension for scoping reviews, investigates the aims, key characteristics, and effective strategies of high school STEM internships globally. It characterises relevant studies in terms of geographical location, specific STEM field focus, program participants, and study findings. Additionally, it explores program elements such as timelines, student selection and orientation, site development, student and site monitoring, administrative and</p>



**PROGRAM**  
**2025 Conference (ASERA56)**  
**Deakin Downtown, Docklands (Melbourne, Australia)**  
**Tuesday 1<sup>st</sup> July to Friday 4<sup>th</sup> July 2025**

			support structures, post-internship evaluation and documentation, and community engagement strategies. By mapping commonalities and contextual variations, we provide actionable insights for educators, policymakers, and industry partners seeking to enhance work-integrated learning in science education. Strengthening high school STEM internship programs through evidence-based design maximises their potential to improve student learning outcomes, career readiness, and interest in STEM fields. This study highlights the evolving role of internships amidst technological and educational shifts, offering guidance for the future development of these programs.
Monica Prima	Sari	Culturally Relevant Teaching in Indonesian Science Learning: Ethnoscience, Indigenous Knowledge, Local Knowledge, and Local Wisdom	As a nation rich in cultural diversity and ethnicity, Indonesia offers abundant resources for science learning. Decentralization of education since the implementation of the 2006 curriculum has opened room for teachers to use local culture in their teaching. With the government initiatives in 2020 to use the Culturally Relevant Teaching (CRT) approach, more studies have been found to incorporate ethnoscience, indigenous knowledge, local knowledge, and local wisdom in science learning. Despite the positive impacts described in the papers of such incorporation, there is still no distinction among these terms as they are often used interchangeably. This scoping review aimed to explore the ways each term is used within international and Indonesian contexts, including their use in science learning. Following the PRISMA guidelines, four electronic databases were reviewed: Scopus (n = 397), ProQuest Education Collection (n = 638), Web of Science (n = 501), and SINTA (n = 512), yielding a total of 2060 papers. The findings highlight the trends of how each concept is incorporated into science learning, identify a literature gap, and the challenges and possibilities for future use to support culturally relevant teaching in science learning.
Shefali	Sharma-Wallis	Teacher Identities Shaping the STEM "Playground"	It is well established that a teacher's academic background significantly contributes to the construction and development of their teacher identity. Teachers of STEM Education invariably have backgrounds in individual STEM disciplines, but an integrated approach to STEM comes with demands, as there is technically no formal qualification to become an integrated STEM teacher, nor is there a defined STEM curriculum. Therefore, the opportunities available through STEM education heavily rely on the interpretation of STEM practices adopted by the teacher. Yet, despite the link between teacher identity and teacher efficacy, the relationship between STEM teacher identity and STEM classroom practices has received limited attention. This PhD project explores the influence of disciplinary identity on teachers' perceptions and practices of integrated STEM. Framed by a case-study research design and qualitative, phenomenological methodology, the findings from this project indicate that teachers' general teacher identities could play a complex role in guiding their STEM practices. Moreover, the absence of formal STEM curriculum guidelines has enabled participating teachers to use their STEM classroom as a space to expand their practice beyond their disciplinary prescriptions. This has implications for how we think about teacher roles and teacher agency within the curriculum.
Dorothy	Smith	Learning Brains and Genetic Determinism: Wishful Science in Education Policy	Humans may be thought of as biocultural creatures, able to be shaped by their environment within the constraints of their nature. Children are cultured in schools and each act of education represents a choice to shape the future adult in a particular direction; each deprivation is a choice to restrict development. In this presentation I compare in education policy in England and Australia. In England, genetics has been used to deny access to educational resources to children who are living with generational poverty; in Australia, policy documents treat children as disembodied brains whose learning should be optimized. In both jurisdictions the proponents of these views draw upon science to support their positions, and their uses of science go largely unremarked. Wishful science is science that is vulnerable to wishful thinking. In both England and Australia, the expression of wishful science as policy creates idealized learners, idealized children and, by extension, idealized humans. I consider the consequences of the expression of wishful science in education policy for science education.
Kathy	Smith	Cultivating "Little Food Citizens" Through Interdisciplinary	As academics are increasingly encouraged to translate their research for community impact, understanding the new skills this work requires of both researchers and their industry/community partners is critical. This session shares insights from an interdisciplinary research translation initiative aimed at bridging the gap between academic research and actionable initiatives to promote responsible food production and consumption. The project developed a novel translation model, integrating



**PROGRAM**  
**2025 Conference (ASERA56)**  
**Deakin Downtown, Docklands (Melbourne, Australia)**  
**Tuesday 1<sup>st</sup> July to Friday 4<sup>th</sup> July 2025**

		Research Translation.	research from RMIT's Food Waste CRC, STEM Education, and public pedagogies, supported by collaboration with industry partners such as ACMI (digital creation), the Little Food Festival, and the Stephanie Alexander Kitchen Garden Foundation (public outreach). Citizen science and digital storytelling in school-based and public education spaces were utilised to cultivate 'little food citizens'—young people who understand food waste issues and explore solutions for its reduction. Students captured their ideas in digital stories, showcased at the Little Food Film Festival at Fed Square, Melbourne. The session will discuss the challenges of the research translation process, including developing an approach with stakeholders to co-create sustainable solutions with students and families. While key outcomes included enhancing children's food waste literacy and guiding digital storytelling practices, the findings also offer valuable insights into how research translation can inspire meaningful community change.
Emma	Stevenson	Supporting Science Teacher Educators Through a SoTL Community	Teacher educators play an important role in the development of science teachers, shaping the knowledge, skills and dispositions of future teachers and influencing the quality of instruction and learning experiences that students receive in schools and early childhood settings. Yet many teacher educators enter the profession with limited experience in higher education teaching. With few tailored professional development experiences existing for teacher educators, this project investigated the impact of a Scholarship of Teaching and Learning (SoTL) Community on science teacher educator professional growth. This study employed a collaborative self-study methodology and brought together a diverse group of teacher educators at varied career stages to examine their professional growth within a SoTL community. Through thematic analysis of participant reflections and group discussion, this research uncovered key supports that highlight the complex process of teacher educator development and the role that a SoTL community can play in this. This presentation will reveal and discuss the three primary themes of belonging, trust and purposeful reflection, emphasising the significance of supportive communities in nurturing the professional development of science teacher educators. Furthermore, the research offers insight into the design and implementation of effective professional development programs in higher education.
Carrie	Swanson	Enhancing the Professional Development of Early Career Academics in Science Education Through an Online Community of Practice.	Transitioning into academia from practice can be challenging. Working in Initial Teacher Education [ITE] adds another layer of complexity as Early Career Academics [ECAs] must manage the academic requirements of the Teaching Council and University, as well as their enhancing their domain specific knowledge, research capabilities and teaching practice. To support the development of five geographically isolated ECAs in Science Education in ITE, an online community, which met monthly, was formed by a senior academic. Research was undertaken by two members of the community to explore how participating in this online Community of Practice supported our development as Early Career Academics [ECAs] in the science domain in ITE. Data generated from semi-structured interviews was examined thematically using Wenger's (2018) Community of Practice conceptual framework, and collated under his three categories of community, domain and practice. Findings identify the importance of someone acting as a broker and inviting new ECAs to join the community and fostering personal relationships between the members. Belonging to the online community enabled the members to build their identities as science academics, as their connections were broadened and experiences shared. The community provided a safe environment to share science practice and research trajectories.
Frederick	Talau	Exploring Online Science Tutoring for Young, Multilingual Learners of English as an Equity-focused, Material-dialogic Space	This paper explores science learning in online remedial tutoring for young, multilingual learners of English as an equity-focused, material-dialogic space. One-on-one interactions between a volunteer student tutor and a Grade 6 learner via Zoom provide an interesting case study of the assemblages of material and digital resources for sensemaking. This study is part of a larger project to examine digitally mediated pedagogies that could productively address the learning gap exacerbated by the pandemic among public elementary pupils from low-income communities. Using various data sources, including Zoom recordings of tutorial sessions, student artifacts, tutor case reports, and recordings of online debrief meetings with tutors, we examine interactive relations between materials, bodies, and languaging (English, Filipino, gestures, etc.) and the dynamic changes within them. The instruction happened over six one-hour sessions over two weeks during the summer break. Using a storytelling method, we found, among others, that learning impasses are surpassed when the mutually intelligible transformation of material resources into digital resources is accomplished to support sensemaking. We will discuss during the presentation the



**PROGRAM**  
**2025 Conference (ASERA56)**  
**Deakin Downtown, Docklands (Melbourne, Australia)**  
**Tuesday 1<sup>st</sup> July to Friday 4<sup>th</sup> July 2025**

			implications for teachers' productive use of tools in online contexts while fostering dialogic pedagogy and truly giving space to pupils' voices to express their learning.
Kok-Sing	Tang	Dialogic Science Teacher: A Customized Generative AI Chatbot for Fostering Scientific Argumentation and Perspective-Taking	The integration of generative artificial intelligence (GenAI) in education offers new opportunities to transform science teaching and learning. This study explores how a customized GenAI chatbot called Dialogic Science Teacher can foster scientific argumentation and perspective-taking in science education. Grounded in Bakhtin's theory of heteroglossia highlighting the interplay of multiple voices and perspectives in discourse, the study repositions GenAI as a dialogic partner that facilitates co-construction of knowledge rather than providing authoritative information. Through a design-based research intervention, Dialogic Science Teacher was developed with pedagogical instructions that aligned with dialogic learning principles. Several high school students then engaged with the chatbot to revisit previously learned science concepts. The findings show that Dialogic Science Teacher promoted richer and more interactive discussions compared to standard GenAI tools, which typically provide monologic and factual responses. In particular, students engaged in deeper scientific reasoning, perspective-taking, argumentation, and creative thinking when addressing complex scientific questions. These interactions illustrate a shift from passive knowledge acquisition to active and reflective learning. The study highlights the potential of GenAI to transform classroom discourse by encouraging argumentation and perspective-taking, and offering insights into the design of AI-driven educational tools that align with dialogic pedagogical approaches in science education.
Sara	Tolbert	Building Collective Action for Science Education in the Anthropocene: Findings and Future Directions from the Pre-Conference SEA Lab Forum	This presentation synthesizes key findings and emergent themes from the <i>Science Education in the Anthropocene Impact Lab (SEA Lab)</i> pre-conference forum held at ASERA 2025. The interactive forum brings together researchers, educators, and practitioners to explore the critical question: How do we reimagine and collectively enact a science education that can address the complex realities and challenges of the Anthropocene? Participants at the pre-conference forum will have engaged in rich dialogue about current challenges, innovative approaches, and transformative possibilities for science education. This presentation will share the key themes, insights, and questions that emerge from these conversations, analysing how they inform our understanding of science education's role in addressing the Anthropocene's polycrisis. Drawing from the diverse perspectives to be shared during the pre-conference forum, we will present findings about the individual and collective insights that emerged from the group, including proposed strategies and identified priorities for the field. Building on these insights, we will outline a framework for ongoing collaboration that includes potential partnerships, shared projects, and concrete next steps for developing a sustained research and practice network. We invite conference participants—whether you attended the pre-conference forum or not—to join this growing collective working toward science education transformation in the Anthropocene.
Maurizio	Toscano	Scientists, Science Outreach, and the Science-education Nexus.	The last two decades have witnessed the proliferation of programs internationally aimed at promoting interactions between scientists and the public. This science 'engagement' movement has been the subject of a study by Weingart et al. (2021) who examined the academic and policy literature concerned with science engagement. They recognised five characteristic motivations that have driven engagement: democratization, education, legitimation, innovation, and inspiration. Significantly, much of science engagement has taken the form of science outreach, which typically occurs in formal school settings. That such scientist-public interactions involve young people and schools raises questions about the relationships between outreach programs, scientists and their motivations, and the complex ecosystem of schooling (students, teachers, material settings, community, and so on). This paper reports in a qualitative study of 14 scientists who developed/delivered outreach programs across Australia. Scientists' accounts of outreach (from semi-structured interviews) were analysed using Weingart et al.'s (2021) categories of engagement motivations. A family resemblance approach was also applied (Irzik & Nola, 2022) to ascertain what was characteristic of outreach across the science-education nexus. The results suggest the educational contexts particular to outreach programs draw out scientists' differing attitudes towards science education.
Russell	Tytler	The Role of the Body in Conceptual	There is growing recognition of the crucial role of the body in learning science. Studies of gesture, haptics, role plays, and visuo spatial actions characterise the body, our senses and actions as part of the material-embodied semiotic systems that underpin



**PROGRAM**  
**2025 Conference (ASERA56)**  
**Deakin Downtown, Docklands (Melbourne, Australia)**  
**Tuesday 1<sup>st</sup> July to Friday 4<sup>th</sup> July 2025**

		Learning: Reporting from the Festival of Embodiment	the abstracted meanings that we characterise as conceptual learning. In this session we report on the deliberations and insights from the Festival of Embodiment which involved activities and perspectives from a range of disciplines including: theoretical accounts; art and technology embodied communication; role plays and situated drama; haptic modes; cognitive science perspectives; diagramming with the body; and reading through the body. The questions underpinning the festival were: How do our bodily experiences shape understanding of abstract scientific concepts; what can cognitive/neuroscience tell us about the role of the body in learning science; how might arts-based approaches enhance embodied science education and communication; and what are innovative ways to translate embodied principles to STEM teacher education. The session will be interactive in sharing insights generated at the <i>Festival</i> .
Anjar Putro	Utomo	Becoming a STEM Teacher: The Negotiation Process within The Indonesian Preservice Science Teacher' STEM Teacher Identity Formation	The influence of policies calling for integrated STEM education worldwide, including Indonesian policymakers, has shifted expectations for K-12 science teachers. These complex shifts, mainly for preservice teachers, necessitate identity negotiation. Hence, this study aims to investigate to what extent an Indonesian preservice science teacher can smoothly develop their STEM teacher identity through STEM education professional learning. This study employed a hybrid narrative (analysis of narrative & narrative analysis) single case study design to emerge STEM teacher identity components and their interaction within the identity negotiation process under the proposed preservice STEM teacher identity formation framework, enriching the story of Indonesian preservice STEM teacher identity development. Only four out of eight components emerged as the main components interacting within the identity negotiation process: competence, task perception, performance, and self-efficacy. These four components gradually grew over the professional learning session, indicating STEM teacher identity development. However, the preservice teacher felt anxious about fulfilling her rooted self-image that existed before professional learning was conducted. Subconsciously, she experienced false assimilation, driving her to self-sabotage of her potential development of STEM teacher identity. Thus, a bridging session in between conceptual and practical sessions that identify and consolidate self-image into the STEM education framework is necessary.
Brent	Wagner	Intersecting Knowledge Worlds: Describing the Cultural Interfaces Within a Socioscientific Issue.	This paper reports on an investigation into the ways a group of 10 senior high school biology students used mātauranga Māori (Māori knowledge) and biological science concepts to justify their position on the socio-scientific issue of the use of 1080 poison to control mammalian predators – an issue of scientific and cultural importance in Aotearoa New Zealand. This paper demonstrates how mātauranga Māori knowledge and biological science knowledge can co-exist within English-medium secondary school Level 3 biology. A triadic epistemic agency conceptual framework was developed to analyse students' written assessment papers and transcriptions of their follow-up interviews. In addition to detailed representations of the theoretical space identified by Martin Nakata (2007) as the locale of the learner, the findings identified three distinctive cultural interfaces occupied by the students: conflicted, parallel, and, connected. The existence of these interfaces highlights how epistemic learner agency brings together cultural and biological science worlds. The creation of learning opportunities for culturally and linguistically diverse learners to apply agentic processes to the use of knowledge from Western science and non-Western epistemologies validates the life-world experiences and knowledge worlds of learners with the potential to enhance teaching and learning.
Richard	White	Context: A Powerful Variable	Context is a powerful determinant of what happens in education, but data bases such as ERIC show that until 2000 studies of its effect on teaching and learning were almost non-existent, and in later years uncommon. This paper uses examples from the author's teaching experience and from published and unpublished studies to illustrate how three aspects of context – physical conditions, administrative arrangements, and perceptions of social purpose – can affect what happens. Directions for research are suggested.
Mihye	Won	Immersive Virtual Reality for Science Education: What Do We Know?	Immersive Virtual Reality (VR) offers unique learning opportunities, enabling students to engage with abstract scientific concepts and conduct virtual science practicals in innovative ways. This presentation synthesizes insights from two forthcoming book chapters, drawing on our research and existing studies to examine VR's educational affordances, challenges, and future directions. Most VR applications in science education leverage two key affordances—3D visualisation and embodied interaction—to support conceptual learning. VR-based practicals are often valued for improving



**PROGRAM**  
**2025 Conference (ASERA56)**  
**Deakin Downtown, Docklands (Melbourne, Australia)**  
**Tuesday 1<sup>st</sup> July to Friday 4<sup>th</sup> July 2025**

			conceptual understanding, but they remain limited in replicating tactile lab techniques. Many current implementations follow prescriptive, step-by-step instructions, offering little room for exploratory learning or collaborative knowledge construction. Notably, students with stronger content knowledge and prior VR experience tend to benefit more, highlighting the need for pedagogical strategies that support students with diverse learning needs. Despite its potential, VR's large-scale adoption faces significant challenges, including technical constraints, resource demands, and pedagogical design limitations. Addressing these challenges require more innovative approaches, as well as integration with emerging technologies such as mixed reality and AI. This presentation provides a critical lens on the affordances and limitations of immersive VR in science education, offering strategies for effective integration and future research directions.
Pai-Hsing	Wu	Enhancing Scientific Literacy Through Bilingual Argumentation: A Study on High School Science Education	This study investigates the impact of a bilingual scientific argumentation course on high school students' scientific literacy, learning motivation, and cross-linguistic expression. Conducted at a Taipei high school, the study involved 12 tenth-grade students participating in an 18-hour micro-course focused on scientific argumentation. The course was designed to integrate bilingual instruction with hands-on inquiry-based learning. The current study adopted the mixed method, utilizing a single-group pretest-posttest design with item-response theory and qualitative analysis techniques. Data collection included pre-and post-tests, classroom observations, and student interviews. Findings indicate that students' scientific literacy significantly improved in 1.14 logits, as evidenced by statistical analysis ( $t = 4.354, p < .001$ ). Moreover, students exhibited an increased interest in science learning, even those initially uninterested. The bilingual approach facilitated students' ability to articulate scientific concepts in both languages, supporting their confidence in using academic English. Classroom observations further revealed that students became more comfortable with scientific argumentation and inquiry. Overall, this research underscores the benefits of integrating bilingual education in science learning, promoting scientific literacy and cross-linguistic communication. The findings suggest that structured bilingual argumentation courses can enhance students' engagement and comprehension in science learning.
Chokchai	Yuenyong	Grade 11 Student's Creativity and Innovation Competency in Electrical Circuit STEM Education Unit	The research aimed to enhance students' competency in creativity and innovation by engaging them in designing LED light signs to promote the Khon Kaen Geopark. The participants were 25 Grade 11 students from a secondary school in Khon Kaen Province, Thailand. Methodology regarded interpretive paradigm. Students' competencies in creativity and innovation, specifically in applying knowledge of electrical circuits, were interpreted based on their ability to think creatively, collaborate with others, and implement innovative ideas. Data collection tools included students' worksheets, interviews, and classroom observations. Rubric was used to assess students' competencies in creativity and innovation, categorizing their abilities based on how they designed the LED lights for various purposes. Key considerations in their designs included calculating the current for the lightbulbs, determining the quantity and resistance of lightbulbs, and choosing appropriate types of electrical circuits. The findings revealed that the majority of students demonstrated a good level of ability in "thinking creatively" and "working creatively with others," and an excellent level in "implementing innovation." The discussion will address students' application of electrical circuit knowledge in relation to the prototypes of LED light signs they created.



**PROGRAM**  
**2025 Conference (ASERA56)**  
 Deakin Downtown, Docklands (Melbourne, Australia)  
 Tuesday 1<sup>st</sup> July to Friday 4<sup>th</sup> July 2025

**ASERA56 Welcome Event Sponsor**



# Research for the future of education

The Centre for Research for Educational Impact (REDI) at Deakin University is one of Australia’s leading centres of educational research and is ranked in the top five in Australia.

REDI works not just *on* education, but *for* education — partnering with educators, communities, governments, and international agencies to ensure its real-world impact resonates in classrooms, communities, and policy arenas in Australia and beyond.

REDI members are leaders in the Australian education research community and welcome partnerships and collaborations.

Consider partnering with us, and commend our vibrant research community to your postgraduate scholars.



Diversity and social justice in education



Education, governance and policy for sustainable societies



Learners in a digital world



STEM education for sustainable futures

[redi.deakin.edu.au](http://redi.deakin.edu.au)

Deakin University CRICOS Provider Code: 001138





**PROGRAM**  
**2025 Conference (ASERA56)**  
 Deakin Downtown, Docklands (Melbourne, Australia)  
 Tuesday 1<sup>st</sup> July to Friday 4<sup>th</sup> July 2025

**ASERA56 Welcome Event Sponsor**



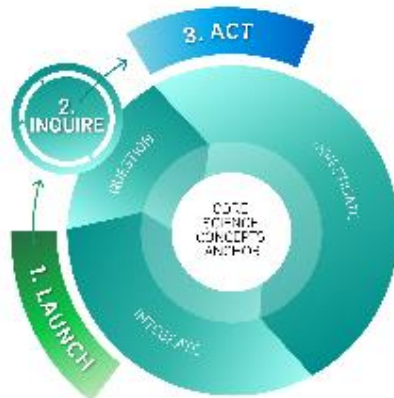
**Australian Academy of Science Education** delivers evidence-based education programs to support effective science and mathematics teaching and learning in Australian schools

**Interactive teaching sequences with just-in-time professional learning**

*Embedded advice and support while you prepare and as you teach*



**LIA Framework**



**Launch > Inquire > Act**

*A flexible framework for teaching science to spark curiosity in your students*

**Classroom-ready data**

*Real-world data from Australian research that is ready to use for different ages and stages*





**PROGRAM**  
**2025 Conference (ASERA56)**  
 Deakin Downtown, Docklands (Melbourne, Australia)  
 Tuesday 1<sup>st</sup> July to Friday 4<sup>th</sup> July 2025

### Symposia Presentations and Abstracts

Each symposium detailed with the title, overarching abstract and then details of each presentation including Discussant where named.

#### Expanding Horizons: Innovations in Science Outreach

Wednesday 2<sup>nd</sup> July – Wadawurrung 1 – Session 1 and 2

Science outreach programs are prolific in Australia and internationally with an estimated 50% of active scientists participating in some kind of science outreach. In an effort to understand the benefits of science outreach on student outcomes science education research is needed to ensure this investment realises its potential for student outcomes. This symposium showcases innovative science outreach programs and research conducted by members of the Australasian Science Education Research Association (ASERA). The first presentation synthesises the international and identifies conceptual fragmentation within the corpus of literature and propose a unified definition of 'science outreach' to facilitate future, high-quality research. The second presentation uses ecological systems theory to map the interconnected educational ecosystem created by the GALS outreach program for girls and their teachers to understand beliefs and cultural shifts that occurred. The third presentation explores the influence of outreach in rural Australian schools, investigating the value of the community relationships fostered. Together, these diverse presentations highlight innovative work that expands the horizons of science outreach. They offer insights into defining outreach, engaging underrepresented groups, understanding impacts in unique contexts, and innovating science teaching through outreach. This symposium advances the field by sharing Australian innovations with the international community.

<p><b>Paper 1 Systematic Review of Science Outreach</b>          Cristina Guarrella; Julia L. Hill; Victoria Millar; Maurizio Toscano; Jan van Driel; Deya Chakraborty</p> <p>This systematic review presents the first comprehensive analysis of international science outreach research, seeking to understand the aims and characteristics of science outreach and develop a unified conceptual and operational definition through a synthesis of the literature the quality of research in the field. A total of 86 publications were reviewed, revealing little conceptual clarity surrounding the term</p>	<p><b>Paper 2 See the STEM Girl in Context: Interconnections between STEM Identity, Female Leadership ildentity and Visibility</b>          Linda Hobbs, Lihua Xu, Chris Speldewinde, Krissy Walsh, Janine Meadley, Samantha Bothe</p> <p>Women remain underrepresented in science, technology, engineering and mathematics (STEM) fields and leadership roles. An ongoing challenge is that role models and successful STEM women and girls can be 'hidden in plain sight'. Girls As Leaders in STEM (GALS) is an outreach program for girls in Years 5-8 (ages 10-14) offered by universities in Victoria, Australia. Taking an</p>	<p><b>Paper 3 Influence of Science Outreach in Rural Australia</b>          Victoria Millar, Maurice Toscano, Jan van Driel, Chloë Nelson, Georgie Aiuto, Jackie Bondell</p> <p>Science outreach has become prolific in recent years. Many science organisations now run science outreach that puts contemporary science into schools as part of their science engagement activities. While such programs are common, research that has sought to understand the longer-term influence of science outreach on how young people identify with science is rare. This research reports on some early findings from a longitudinal study of the influence of science outreach, with a focus on one outreach</p>	<p><b>Paper 4 Einstein-First: Teaching Modern Physics in Schools</b>          Kyla Adams</p> <p>Einstein-First is leading the conversation in Australia about rethinking physics education. Over the decades, our understanding of physics has grown from understanding gravity as curved space and light as photons to advances such as gravitational wave astronomy. We are developing education resources for teachers to put our modern understanding of physics into schools across Australia for students aged 8-16. Einstein-First has been developing novel</p>
--	---	---	---



**PROGRAM**  
**2025 Conference (ASERA56)**  
**Deakin Downtown, Docklands (Melbourne, Australia)**  
**Tuesday 1<sup>st</sup> July to Friday 4<sup>th</sup> July 2025**

<p>'science outreach'. Two studies explicitly defined science outreach, while others used related terms to describe what science outreach may include. Analysis of science outreach program characteristics highlighted hands-on experimentation as the dominant pedagogy reported in the literature, with university-based providers typically targeting secondary students. Fostering science learning was identified as a key aim of science outreach, along with longer-term aspirations such as increasing participation in science at university or future science careers. Methodologically, quantitative approaches were most common, however, studies varied in quality, with over a third of publications describing or evaluating science outreach programs without addressing specific research questions. High-quality studies were predominantly university-led and published in education journals. This review illuminates challenges hindering systematic research and highlights opportunities to develop rigorous, theory-driven research aligned with the intended outcomes of science outreach programs.</p>	<p>ecological approach to learning, the GALS program involves teams of girls solving STEM industry-inspired problems and creates opportunities for them to experience innovative research and university campus and people, making a university degree a real possibility. Using Bronfenbrenner's ecological systems theory, this paper explores the STEM learning ecosystem created by GALS and asks the question, what outcomes arise as a result of the interconnections created by GALS? The analysis focuses on interconnections that arise relating to STEM identity, female leadership identity, and visibility. Our analysis interrogates how the program raises the visibility of girls and their STEM activities in their communities. Data is used to map the ecosystem and interconnections between systems that arise from the mediating effect of the GALS program to describe the benefits and shifting cultures arising from enabling the 'STEM girl in context'.</p>	<p>program attached to an international science research project on Dark Matter that has a laboratory in rural Australia. The tendency in rural Australian schools, to have lower participation in science and less resourcing than their urban counterparts make rural schools an important setting given the aim of many science outreach programs is to improve the engagement of young people with science. In three rural secondary schools participating in the outreach program and located close to the science laboratory, focus groups were conducted with 37 students aged between 13 - 16 years old and interviews were undertaken with six science teachers. Results reveal the value of the laboratory and associated outreach for the local communities and their relationship with science.</p>	<p>teaching approaches for primary and secondary schools. Initial implementations found that 11-year-old students enjoyed the content and learnt core concepts such as gravity as curved space and light as photons. Later, extended programs found that students aged 14 to 16 still found the science interesting and could learn derived concepts such as 'photon probability can be described by phasors'. Recently, we have shifted from researcher-led programs to teacher-led ones. Results from physics classes with 14–15-year-old students found that teacher-led programs had similar outcomes to researcher-led programs, without the teachers participating in a focused professional development course. In this talk the Einstein-First methods of instruction, teacher training processes and long-term effects (for students, tertiary education and the future workforce) will be presented. Einstein-First is now focusing on developing and evaluating outcomes from teacher training courses.</p>
---	---	---	--



## PROGRAM

### 2025 Conference (ASERA56)

Deakin Downtown, Docklands (Melbourne, Australia)

Tuesday 1<sup>st</sup> July to Friday 4<sup>th</sup> July 2025

### Science and Spirituality Education in the Anthropocene

Wednesday 2<sup>nd</sup> July – Wadawurrung 1 – Session 3 and 4

This symposium confronts the artificial separation between scientific and spiritual ways of knowing in education. The presentations reveal how ontological commitments to (post)positivism, colonial epistemologies, and purely rationalistic representations exclude spiritual dimensions of existence from science education. The papers bring together philosophical perspectives with concrete cases where scientific understanding transcends purely technical approaches: scientists sacrificing themselves to protect biodiversity; challenges to medical stigma through embodied protest; redefining scientific concepts to uphold community practices; and reconceptualising personhood as a boundary object between knowledge systems. These examples demonstrate how attention to spiritual dimensions of being can enrich comprehension and ethical engagement in the Anthropocene. The symposium also examines how science education's emphasis on a single worldview often creates onto-epistemological shibboleths that foreclose non-dominant knowledge systems--forms of epistemological and pedagogical violence. Methodologically, the papers propose specific interventions: critical spiritual pedagogies that humanise scientific education; multiple knowledge systems approaches paired with epistemological faith; and an aesthetics of personhood that nurtures relationships between human and more-than-human beings. Together, these works challenge science education's aesthetic boundaries, advocating not for replacing scientific understanding with spiritual ones, but for recognising both as essential for developing ethical relationships in the Anthropocene.

<p><b>Paper 1 Science Education is Spiritual Education</b> Joshua S. Hoskinson</p> <p>Science education often adheres to the a priori epistemological and metaphysical commitments of Western science itself, which emphasizes a postpositivist approach to attaining scientific knowledge that is independent of context and subjective human experience. This approach to science education, although essential for understanding the nature and process of Western science, tends to present the scientific worldview as the premier, singular perspective on understanding natural phenomena. Thus, in turn, this approach to science education may insinuate that the cosmological implications of Western science are the best and only answers to life's biggest questions. These questions are matters concerning the human spirit, or the essence of inner existence and the</p>	<p><b>Paper 2 Challenging the Divide: Rethinking Science Education through the Entanglement of Science and Spirituality</b> Carol Martinez-Camacho</p> <p>Debates stemming from Modernity, Coloniality, and Science, Technology, and Society (STS) studies have challenged the traditional notions of objectivity and secularity in science. In science education, these discussions have led to the inclusion of the Nature of Science (NOS) in curricula, aiming to provide a more accurate understanding of the scientific onto-epistemology while preserving its epistemological legitimacy. However, teaching NOS often requires maintaining a strict separation between scientific knowledge and spirituality, despite scholarship demonstrating significant connections between the two. This tension poses a challenge for educators seeking to incorporate such relationships into the</p>	<p><b>Paper 3 The Madness of Love: Science Education through Simone Weil's Philosophy</b> Betzabe Torres Olave</p> <p>This paper examines the meaning and necessity of beauty in science education, arguing that encountering beauty establishes foundations for justice to emerge. Drawing upon Simone Weil's philosophy, I propose moving away from technocapitalist desires toward a science of love, care, and collective flourishing, where attention to our losses and the afflictions of this world are in themselves forms of beauty. Central to this approach is a dimension of spirituality grounded in Weil's mysticism, which I use to expand critical pedagogies through three cases: scientists who starved protecting plant seeds during WWII, an Italian immunologist challenging HIV transmission myths through embodied protest, and Chilean scientists redefining water concepts to preserve</p>	<p><b>Paper 4 Science, Spirituality, and Aesthetics: A Case Study of Personhood</b> Sara Tolbert</p> <p>This paper explores how reconceptualising science education through an aesthetics of personhood might create generative intersections between scientific, spiritual, and sacred ways of knowing. We revisit the contentious history of personification in science education, arguing that debates about its pedagogical value reflect deeper assumptions about human-nature relationships and what counts as legitimate knowledge. Drawing on philosophy, Indigenous knowledge systems, feminist science studies, and emerging scientific fields, we propose a relational notion of personhood in science education that acknowledges the autonomous existence of human and more-than-human beings while recognising their interconnected relationships. Rather than viewing</p>
---	---	---	--



**PROGRAM**  
**2025 Conference (ASERA56)**  
**Deakin Downtown, Docklands (Melbourne, Australia)**  
**Tuesday 1<sup>st</sup> July to Friday 4<sup>th</sup> July 2025**

<p>incorporeal self, and therefore relate to the spiritual dimension of human experience. The cosmological implications of Western science often result in the development of cultural shibboleths and the Othering of those students whose worldviews are not congruent with the scientific worldview, which is a form of pedagogical violence. This talk seeks to identify that science education actively considers matters of the human spirit, and therefore science education is a form of spiritual education, and explores how the application of critical spiritual pedagogies to the science classroom can realise a humanising scientific education.</p>	<p>science classroom. This study investigates the potential of designing and implementing pedagogical tools based on a multiple knowledge systems approach, alongside the concept of epistemological faith, to explore the entanglement of knowing, being, and spirituality in science education. By bridging these perspectives, the research aims to reimagine science education as a space where the boundaries between scientific and spiritual ways of knowing are opened, fostering a more dialogical and transformative understanding of science.</p>	<p>community practices. Weil argued that attention towards beauty is a practice of the "madness of love". Such practice stands in tension with contemporary science education's purely rationalistic representations and universalising tendencies. This paper argues that such tension enriches science education by connecting it more deeply to the real. Through embodied actions like a protest kiss, choosing to starve, and preserving community meanings, we see how the madness of love can release us from restrictive science paradigms while nurturing those that lead toward beauty and justice at the service of world's necessities.</p>	<p>personification merely as a pedagogical tool, we position it as a boundary object that can help bridge multiple knowledge systems, including those that recognise the spiritual dimensions of relationships within nature. This reframing carries significant implications for how we might address current ecological challenges. By nurturing students' spiritual and sacred connections to nature alongside their scientific understanding, we can foster the kind of deep ethical engagement needed for agency in the Anthropocene. This approach acknowledges that different ways of knowing have essential roles in supporting students' sustainable and ethical relationships with the natural world.</p>
---	--	---	---



**PROGRAM**  
**2025 Conference (ASERA56)**  
 Deakin Downtown, Docklands (Melbourne, Australia)  
 Tuesday 1<sup>st</sup> July to Friday 4<sup>th</sup> July 2025

**Exploring Primary Teachers' Adaptive Expertise in Interdisciplinary Mathematics and Science Teaching: Conceptual and Methodological Approaches**

Wednesday 2<sup>nd</sup> July – Wadawurrung 1 – Session 5 and 6

Interdisciplinary approaches to mathematics and science teaching have been advocated based on the premise that it enables students' deeper learning of both subjects. Planning for and enacting interdisciplinary sequences requires teachers to develop adaptive expertise - the ability to recognise deep interconnections of disciplinary knowledge and practices, while being flexible and adaptable moving beyond routine strategies in responding to the dynamic challenges and complexities encountered in classrooms. This symposium brings together four papers from an ARC project on primary teachers' adaptive expertise in interdisciplinary mathematics and science teaching to explore both conceptual and methodological approaches. Paper 1 offers a scoping review of research on teacher adaptive expertise (TAE) in the context of teaching and teacher education. Paper 2 investigates the use of a video questionnaire as a tool for characterising TAE in interdisciplinary teaching. Paper 3 explores TAE from the lens of practice architectures to identify the conditions that shaped the teachers' interdisciplinary teaching practices. Finally, Paper 4 examines the affordances of 360 cameras in capturing classroom interactions for the purpose of exploring TAE, from the perspectives of the teacher, researchers, and technicians involved in the project.

**Discussant: Prof. David Treagust**

<p><b>Conceptualising and Developing Teacher Adaptive Expertise in Education: A Scoping Review</b>          Amanda Berry, Lihua Xu, Kennedy K. H. Chan</p> <p>Teaching is an inherently complex and unpredictable enterprise, requiring teachers to adapt to diverse student needs and ever-changing demands. To navigate these challenges, teachers need to develop adaptive expertise - the ability to flexibly apply knowledge and skills in novel and changing situations. While previous reviews have explored adaptive expertise in different professional fields, limited attention has been given to its application in the context of teaching and teacher education. Synthesising empirical research published between 2009 and 2024, this scoping review traces the development of teacher adaptive expertise literature,</p>	<p><b>Investigating Teacher Adaptive Expertise in Interdisciplinary Mathematics and Science teaching using a Video-stimulated Questionnaire</b>          Jan van Driel, Colleen Vale, Gahyoung Kim</p> <p>The shift from disciplinary to interdisciplinary approaches requires teachers to become adaptive experts who can apply professional knowledge flexibly, innovatively and creatively in such teaching situations. The aim of this paper is to analyse primary teachers' adaptive expertise related to teaching interdisciplinary mathematics and science. The research questions were: 1) How can primary teachers' adaptive expertise be characterised? 2) What are the similarities and differences between experienced and less experienced teachers? A video stimulated questionnaire which included six video excerpts of authentic interdisciplinary lessons was developed to measure teachers'</p>	<p><b>Developing Teacher Adaptive Expertise in Interdisciplinary Mathematics and Science teaching from the lens of Practice Architectures Theory</b>          Lihua Xu, Wanty Widjaja, Lam Pham</p> <p>Embracing an interdisciplinary approach in mathematics and science teaching requires teachers to develop adaptive expertise that entails a deep understanding of the interconnections between knowledge and practices in both disciplines, while being flexible and adaptable when encountering novel situations in classrooms. This study explores how primary teachers perceived and enacted the interconnections of mathematics and science through practices of co-planning, co-teaching, and co-reflecting on a lesson sequence on the topic of heart rate. It also examines the conditions that enabled and constrained such practices. Drawing on Practice Architectures Theory (PAT), this</p>	<p><b>Methodological Affordances and Constraints of 360° Video for Exploring Adaptive Expertise: Teacher, Technician, and Researcher Perspectives</b>          Joseph Ferguson, Jan van Driel, Lam Pham</p> <p>We currently live in an age saturated with digital technology of various forms, which have permeated all aspects of education research. In particular, we are experiencing an explosion in the use of video/audio machines to 'capture' in increasing detail the goings-on in classrooms. In this presentation we report on the use of 360-video by a team of education researchers, video/audio technicians, and primary teachers to investigate adaptive expertise in the interdisciplinary science and mathematics classrooms of five primary schools in Victoria, Australia. Through the use of narrative inquiry to generate and analyse three different perspectives - education researchers, video/audio technicians, and STEM teachers -</p>
--	--	---	---



**PROGRAM**  
**2025 Conference (ASERA56)**  
**Deakin Downtown, Docklands (Melbourne, Australia)**  
**Tuesday 1<sup>st</sup> July to Friday 4<sup>th</sup> July 2025**

<p>identifying novel problems and challenges addressed in the studies, and exploring both theoretical and methodological approaches to characterising teacher adaptive expertise. Findings indicate a great diversity in how teacher adaptive expertise is conceptualised and studied across different educational contexts. It has been framed as a psychological, social, political, or cultural construct, reflecting its complex and multidimensional nature. The review emphasises the importance of exploring discipline-specific aspects of teacher adaptive expertise and strengthening its connection with research on teacher pedagogical content knowledge and teacher noticing to stimulate scholarly discussions and advance research in teacher education.</p>	<p>adaptive expertise (Vale et al. 2024). Fifteen teachers from five primary schools in Victoria (Australia) completed the survey before their participation in an intervention. Descriptive data analysis included comparing respondents' scores on multiple-choice items (MC) with their verbal explanations (VE), both of which were scored on a scale from 1-4, where 1 = low AE and 4 = high AE. Average score of the teachers on the MC was 2.92, compared to 2.60 for the VE. Experienced teachers scored slightly higher, both on the MC and VE, compared to inexperienced teachers: 2.94 versus 2.84 (MC), and 2.66 versus 2.38 (VE). More detailed findings will be presented.</p>	<p>study analysed video recordings of the lesson sequences, along with pre and post-lesson sequence reflections by teachers from two primary schools, to identify shifts from routine to adaptive ways of sayings, doings and relatings. The results highlight how teachers balanced the depth of disciplinary knowledge required for an interdisciplinary sequence and the need to cater for their student cohorts. The results also show how teachers' dispositions, practice traditions, and contextual factors shaped the shift from routine to adaptive expertise in interdisciplinary teaching.</p>	<p>we argue that the affordances and constraints of 360-video for exploring adaptive expertise are most comprehensively appreciated and actioned by a team that functions as an integrated, as opposed to fragmented, unit. It is only in drawing on the insights of these three different, but complementary, perspectives that we might be able to harness the potential of 360-video for the good of studying the integration of mathematics and science in meaningful ways. In doing so, we can reimagine our 360-video methodologies as the genuine joint effort of researchers, video/audio technicians, and STEM teachers.</p>
--	--	---	---



**PROGRAM**  
**2025 Conference (ASERA56)**  
 Deakin Downtown, Docklands (Melbourne, Australia)  
 Tuesday 1<sup>st</sup> July to Friday 4<sup>th</sup> July 2025

**Embedding Indigenous and First Nations Sciences in Science Education: From Theory to Practice**

Thursday 3<sup>rd</sup> July – Wadawurrung 1 – Session 8 and 9

Worldwide, there are increasing calls to incorporate First Nations perspectives in K-12 science education. Science educators in school and university settings have an important role in developing their own confidence and capability to undertake this work. Given that most science educators are trained in ‘Eurocentric’ science and have a non-Indigenous background this work presents important considerations. In this symposium, we bring together four paper presentations that highlight the complexities, challenges and opportunities in this space, from practical approaches to paradigm shifts. We begin by highlighting stories of practice in Initial Teacher Education (ITE) for Science, featuring the application of two-lenses approaches to bring together different worldviews and how this informs the implementation of practical activities. We then turn to examples of how this work can be undertaken in appropriate ways by non-First Nations educators, as well as in collaboration with key stakeholders. Our final presentation challenges us to reconsider the need for broader reform, and the implications of pluriversal science education.

*NOTE: This Symposium presentation has been sponsored by ACER as an acknowledgement of research into and about inclusivity.*

<p><b>Stories of Practice in Initial Teacher Science Education</b>          Christine Preston, Jared Carpendale, Emily Rochette, Rebecca Cooper, Karen Marangio, Connie Cirkony</p> <p>Science teacher educators who work within initial teacher education programs have a critical role in supporting pre-service teachers to develop their knowledge, confidence, and capability to teach science in culturally appropriate ways. An international group of non-Indigenous university science teacher educators from Australia, Canada, and New Zealand have come together to share our stories of practice of how we have embedded First Nations perspectives in our primary and secondary science education units. In this paper presentation, we relate four stories practices through a narrative inquiry method. Two stories focus on the application of two-lenses to</p>	<p><b>Science in Higher Education: A Model to Guide the Iof First Nations Australians' Science in Curriculum.</b>          Tiffany Gunning, Connie Cirkony</p> <p>There are a growing number of imperatives and drivers of the inclusion of First Nations histories and cultures in Australia (e.g., Universities Australia Indigenous Strategy, Universities Accord, National Science and Research Priorities). However, the role of science in early colonial segregation policies has not been forgotten by those impacted, and there remains much work to be done, particularly by non-First Nations tertiary science educators. With a grant from the Australian Council of Deans of Science (ACDS), our team of First Nations and non-First Nations educators seeks to address these imperatives through developing a framework for embedding First Nations Australian histories and</p>	<p><b>Community, Universities and Schools: The Triple Threat We Need to Indigenise the Curriculum</b>          Harry Kanasa, Eun-Ji Amy Kim, Candace Kruger, Ren Perkins</p> <p>In 2024, Griffith University announced a university-wide push to indigenise the curriculum across all schools and programs, with the express purpose of integrating aboriginal histories, knowledges, cultures and technologies. Within the school of EPS, a committee was formed of Indigenous and other academics who are currently integrating indigenous knowledges or who have an expressed an interest in doing so. In this paper presentation, we explore the highs and lows, the enablers and barriers, we’ve encountered as the committee responsible for indigenising the curriculum in our initial teacher education programs. Data (researcher reflective logs, meeting transcripts and interviews) will be collected</p>	<p><b>Rethinking Knowledge Politics in Science Education Reform</b>          Kari Moana Te Rongopatahi, Sara Tolbert</p> <p>Recent curriculum reforms in Aotearoa New Zealand have moved in the direction of bringing together mātauranga Māori and classical science in science education, reigniting debates about what constitutes 'legitimate knowledge' in science classrooms. While public discourse often characterises these reforms as either threatening scientific rigour or simply integrating Indigenous knowledge into existing frameworks, both perspectives miss crucial epistemological considerations. This paper presentation critically examines how current approaches to 'integration' risk re-colonising Indigenous knowledge systems by subjecting them to validation through dominant scientific frameworks. Drawing from research with secondary science teachers implementing multiple knowledge systems approaches, we argue that meaningful reform requires moving beyond</p>
---	--	---	--



**PROGRAM**  
**2025 Conference (ASERA56)**  
**Deakin Downtown, Docklands (Melbourne, Australia)**  
**Tuesday 1<sup>st</sup> July to Friday 4<sup>th</sup> July 2025**

<p>bring together different worldviews, and how these approaches can be applied to practical hands-on activities and assessment. Two stories focus on the use of native plants and gardens, demonstrating the cultural significance of plants and how it prompts deeper and ongoing conversations about positionality, cultural responsiveness and ways to embed Indigenous perspectives in teaching and assessment. This work offers three key considerations for all science teacher educators: Focusing on whose knowledge is privileged, what counts as scientific knowledge, and how this complex space can be navigated in authentic and respectful ways.</p>	<p>cultures in science curricula in higher education. The aim of this framework is to help educators better understand how they can navigate developing their own learning material and lessons, lessening educator anxiety and removing hurdles to creating important and meaningful First Nations science learning for our students. In this paper presentation, we discuss the guiding principles underpinning the framework. We then demonstrate how to apply this framework to worked examples from different science disciplines, illustrating how scientific conceptual learning can be enriched by the rich, deep knowledges of First Nations Australians in ways that are meaningful and respectful.</p>	<p>and analysed, using Cultural Historical Activity Theory as the theoretical lens, to answer the research question: What are the enablers and barriers teaching teams face when attempting to decolonise/indigenise the curriculum? A key component of this work is the collaborative model we're developing where our key stakeholders (community and schools) are integral to forming and shaping that work. We propose this model to encourage other universities to work with their indigenous communities and schools to provide a hyper-localised curriculum that is both salient and relevant for their local context.</p>	<p>simplistic integration models toward what Jane Gilbert calls a "substantial reset" of science education. This reset involves recognising how transdisciplinary approaches incorporating both mātauranga Māori and classical (dominant) science can enhance students' understanding of complex socio-ecological challenges while developing their epistemic agency. We discuss preliminary findings from a collaboration with high school science teacher leaders in which mātauranga Māori and science are taught together, maintaining the integrity of distinct knowledge systems while creating opportunities for productive dialogue between them. This work contributes to broader conversations about the growing importance of pluriversal science education.</p>
---	---	--	---



**PROGRAM**  
**2025 Conference (ASERA56)**  
Deakin Downtown, Docklands (Melbourne, Australia)  
Tuesday 1<sup>st</sup> July to Friday 4<sup>th</sup> July 2025

ASERA56 Session Sponsor

## Transforming learning systems so everyone can succeed



As one of the world's leading educational research centres, ACER's mission is to create and promote research-based knowledge, products and services that can be used to improve learning.

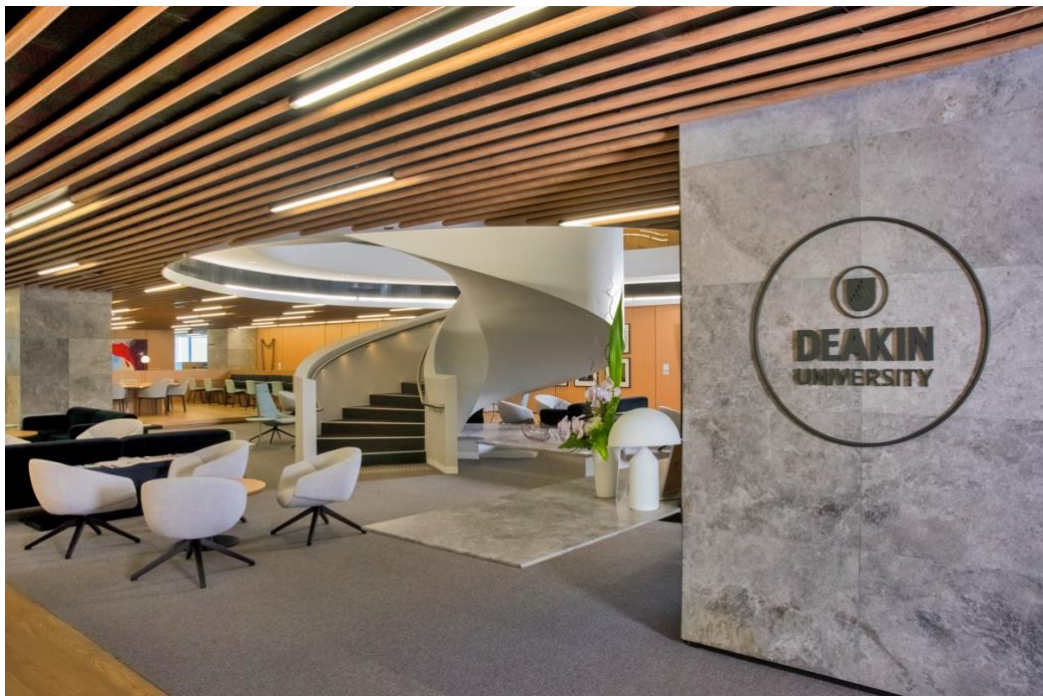
Explore our research, assessments, professional learning and more at [www.acer.org](http://www.acer.org)



Australian Council for Educational Research



Deakin Downtown – our conference venue





**PROGRAM**  
**2025 Conference (ASERA56)**  
 Deakin Downtown, Docklands (Melbourne, Australia)  
 Tuesday 1<sup>st</sup> July to Friday 4<sup>th</sup> July 2025

**Symbiosis of Science and the Arts in Education Research**

Thursday 3<sup>rd</sup> July – Wadawurrung 1 – Session 10 and 11

Symbiosis indicates a close and long-term interaction and is a useful metaphor describing the relationship between science and the Arts, especially in education and research. In this symposium we present three discrete research projects that each apply arts-based strategies to engage their respective participants in science education. The three presentations include: 1: PhD research exploring STEM policy and its application in schools applying arts-based data collection strategies that deepened and enriched the findings from participants, 2: ARC funded ‘Enacting Climate Change Education’ project exploring student agency in science education through a Climate Fiction writing pedagogy as part of a biodiversity unit focussed on Bees, and 3: Local Government funded research prioritising various arts-based methods (drama pedagogy and artistic design and construction) that enable futuring and futures thinking where everyday applications of science are foregrounded. Our findings demonstrate that the integration of science and art-based education fosters transformative learning opportunities. Drawing on arts-based research methodologies enriches science education research by enabling multiple perspectives and promoting diverse ways of thinking. This symbiotic approach ultimately leads to deeper and more innovative research insights, while expanding learning opportunities in science education by inviting new ways of thinking and communicating.

**Discussant: Russell Tytler**

<p><b>Critical Policy Analysis Diffracted Through Arts-based Research</b></p> <p>Amanda Peters, Peta White, Jo Raphael</p> <p>The government imperative of STEM education is recognised through STEM education policy shaping STEM education in schools. To gain insight into and tease out the complexities, critical analysis of STEM education policy within the Victorian context was deepened through an arts-based research approach. In this presentation, the synergies afforded through arts-based research and diffracting methodologies are discussed. In particular, greater dexterity within research to disrupt and think differently to evoke potential transformation within STEM education. Firstly, STEM education policy was disrupted through poststructural critical policy analysis, probing unexamined assumptions and silences within policy. To move beyond a researcher perspective, and reveal the impact of policy in practice, diverse stakeholder perspectives were revealed through an arts-based research approach within a focus group. A diffractive analysis of the findings of the critical policy analysis and the stakeholder perspectives</p>	<p><b>Save Bees: Young People’s CliFi as Normative Myths of the Future</b></p> <p>Joseph Ferguson, Peta White</p> <p>We co-designed a teaching and learning sequence with a specialist primary science teacher at a Victorian government school unpacking the biodiversity crisis of the Anthropocene with a focus on Bees. Year 6 students learned about bee anatomy, bee habitat, diversity of native and introduced bee species, and various relationships between bees and humans. We applied Climate Fiction (CliFi) as an arts-based methodology to elicit young people’s considerations about their futures. We thematically analysed through a pragmatist framing and, in this presentation, offer selected examples of bee CliFi. We argue that these narratives of the future express how society ought to value bees (aesthetics) and how society ought to conduct ourselves towards bees (ethics) to realise more desirable futures for all. Students primarily generated dystopian views of bee futures in adopting a human perspective, but ever present were some glimmers</p>	<p><b>Artefacts of the Future</b></p> <p>Shelley Hannigan, Robin Bellingham, Danielle Hradsky, Michelle Tourbier, Larissa Raymond, Jo Raphael, Peta White</p> <p>Artefacts of the Futures is an innovative, transdisciplinary project that engages students and teachers with science-informed, arts-based futuring. Futuring is an active, creative and often collaborative approach to thinking about and planning for preferred futures. Combining contemporary science understandings with arts-based pedagogies engenders powerful opportunities for developing young peoples’ sustainability, agency, and futures literacy. Artefacts of the Future is offered as a teaching and learning sequence and artefact-making project that supports primary and secondary students and teachers to engage with socio-ecological challenges through design and futuring. Our research asks how such transdisciplinary approaches can enable young people to comprehend the complexity of the current human-induced climate polycrisis and generate connections with sustainable lifestyles and practices at the personal and community level. We collected student-created artefacts and analysed the</p>
--	---	---



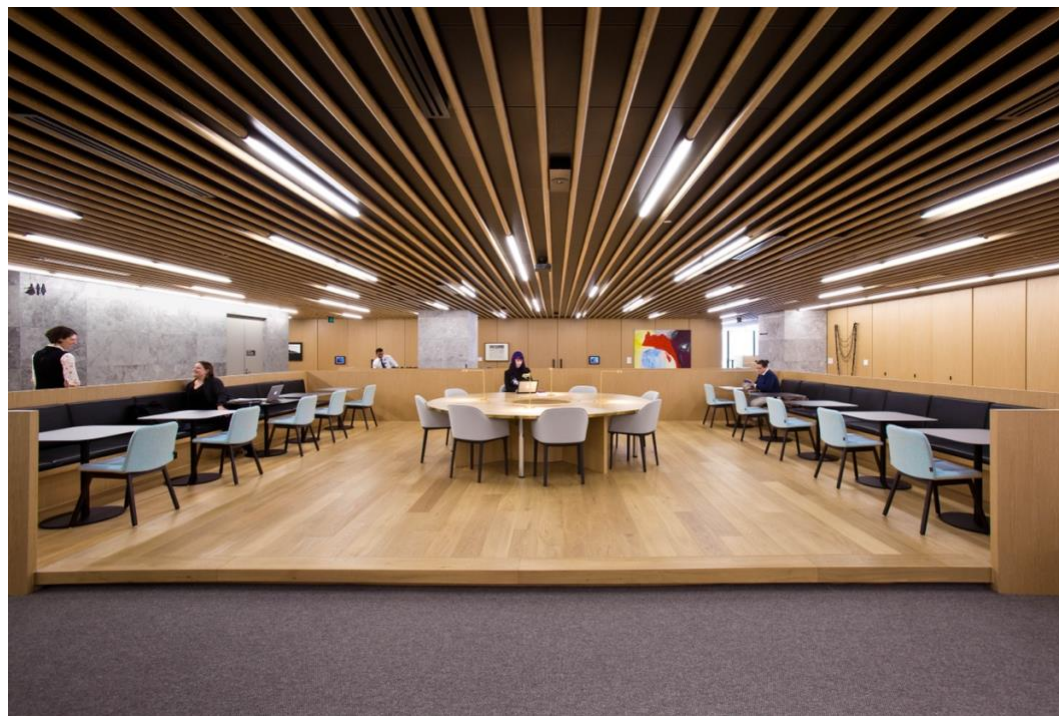
**PROGRAM**  
**2025 Conference (ASERA56)**  
**Deakin Downtown, Docklands (Melbourne, Australia)**  
**Tuesday 1<sup>st</sup> July to Friday 4<sup>th</sup> July 2025**

ensued, surfacing shifting power relations. Underlying resistance to STEM education emerged creating openings to consider alternate ways of viewing STEM education. To critically question my own understanding of STEM education, an arts-based inspired autoethnographic approach of letter writing was enacted. The creative analytic artform enabled freedom to disturb my connection to STEM education and engage differently with the findings, to encounter STEM education anew.

of hope for a more positive outlook that embraced a more-than-human perspective. We propose that the speculative possibilities of CliFi as an artistic genre empowered these young people to call for our Western societies to re-learn how to live (appropriately) in ecosystems. We suggest that the art-based CliFi methodology enables futures thinking and forms an important practice in climate change education.

artefacts for themes and 'hidden utopias' to understand the utopian imaginaries at play. Findings from project iterations demonstrate the importance of collaboration between disciplines, ages/generations, and institutions, as well as opening new possibilities for enhancing student and teacher agency and finding ways to generate socio-ecological change. Grounding the learning with contemporary climate science research and development has been an important innovation and results in strengthened clarity about potential sustainable futures.

**Deakin Downtown – our conference venue**





**PROGRAM**  
**2025 Conference (ASERA56)**  
 Deakin Downtown, Docklands (Melbourne, Australia)  
 Tuesday 1<sup>st</sup> July to Friday 4<sup>th</sup> July 2025

**Enacting Climate Change Education in School Science: Challenges, Approaches, and Successes**

Thursday 3<sup>rd</sup> July – Wadawurrung 1 – Session 12 and 13

The symposium reports approaches and findings from the international ARC Discovery project: Enacting Climate Change Education - Building student and teacher agency through representing scientists’ practices in classrooms. The three presentations will explore approaches to embedding climate change education in the science curriculum, the ways contemporary science research and practices are mobilised in learning sequences, and findings to date concerning student awareness, agency and attitudes including valuing more-than-human perspectives. The first presentation outlines the project’s methodology and overall design and intent, leading to a case description involving the embedding of climate change education into a whole year upper primary school curriculum and the subsequent student outcomes. The second paper discusses the different approaches needed to engage Year 10 students involving strategies based around case studies and futures scenarios. The third paper outlines an upper primary learning sequence on bees, showing how students were supported through the science to shift their aesthetic framing of bees, a relational shift aligned with Climate Change Education (CCE) advocacy.

**Discussant: Vaile Dawson**

<p><b>Shaping a Climate-change Focused Science Curriculum at Upper Primary School</b></p> <p>Russell Tytler, Amrita Kamath</p> <p>This presentation describes the international project: Enacting Climate Change Education which has a focus on science curriculum redesign to develop students’ ‘Agency in the Anthropocene’ in line with the PISA 2025 Science Framework. We outline our approach to the generation of learning sequences using a co-design based research (DBR) methodology that includes activities linking science educators, researchers and teachers in exploring the situating of contemporary science content in socio-ecological challenge contexts. We report on the nature and findings from a collaboration developing -whole year Climate Change Education (CCE) embedded science program for years 5&amp;6. We describe the structure of different learning sequences to explore how CCE can be productively embedded in most topics and discuss the variety of activities through which student agency is a focus, including the generation of futures scenarios, design tasks and controversy explorations. We present findings from interviews, and a reflective survey,</p>	<p><b>Agency and Planning for Year 10s (case study and scenarios)</b></p> <p>Peta White, Fernanda Rezende, Shefali Sharma-Wallis</p> <p>The Enacting Climate Change Education (ECCE) project engages with students from years 5 – 10. Initial approaches to the year 10 cohort indicated that students were often disinterested in discussing climate change. We interpreted this as possibly being due to: 1) eco-anxiety and feeling despondent about their ability to influence change; 2) that young people are not experiencing climate “change” as the climate emergency has been a constant backdrop to their lives; and 3) they may be influenced by family perspectives. Alerting to the possibility that we failed to engage these year 10 students in the pedagogy and focus of the materials we designed, we changed strategy. Our interviews with students and teachers revealed interest in local socio-ecological challenges around diverse topics, so we expanded this into the development of a case-study/future-focused scenario structure. Specific competencies are developed through case studies with a local, often socio-ecological, focus involving contemporary science and engineering input. The thinking is then brought together to inform decision making and action in a relevant (local) scenario</p>	<p><b>Bees and Values about Kin</b></p> <p>Fernanda Rezende, Joseph Ferguson, Russell Tytler, Peta White</p> <p>This study explores how Year 6 students’ engagement with bee science, blending Western scientific knowledge and First Nations’ perspectives, led to a shift in how they valued and conducted themselves towards bees in the context of human-induced climate change. Undertaken in an Australian government school in collaboration with a primary science specialist teacher, the learning sequence focused on bee anatomy, habitat, species diversity, and the human-bee relationship. The research is significant as it examines how integrating scientific and aesthetic learning can foster students’ ethical relationships with the natural world through shifts in values. Using thematic and narrative analysis, we explored interview data to investigate how students’ engagement with scientific knowledge and skills during the learning sequence influenced their relationships with bees. Findings suggest that students began to relate to bees with greater care and compassion, reflecting a biophilic shift in their values. We</p>
--	---	---



**PROGRAM**  
**2025 Conference (ASERA56)**  
**Deakin Downtown, Docklands (Melbourne, Australia)**  
**Tuesday 1<sup>st</sup> July to Friday 4<sup>th</sup> July 2025**

indicating students' views about their engagement with learning in CCE activities over the year, demonstrating the relevance of the agenda to students' wider concerns.

that privileges critical thinking and individual and collective agency. In this presentation, we will discuss examples of this approach.

argue, by sharing selected examples of students' reflections on their learning experiences, that engaging students both scientifically and aesthetically can nurture their biophilic connection to nature and cultivate more respectful relationships with the more-than-human.

**Deakin Downtown – our conference venue**





**PROGRAM**  
**2025 Conference (ASERA56)**  
 Deakin Downtown, Docklands (Melbourne, Australia)  
 Tuesday 1<sup>st</sup> July to Friday 4<sup>th</sup> July 2025

**Poster Presentations and Abstracts**

Posters have been themed across three rooms (Wadawurrung 1, Wadawurrung 2, Upstairs Creative). Two hours of dedicated poster sessions are scheduled throughout the program (Wednesday 8.30 – 9am, Wednesday 1 – 2pm, Thursday 8.30 – 9am, Friday 8.30 – 9am). Posters may include a QR code to a short video overview to hear the author/s present an overview.

**Posters - Wadawurrung 1**

<p>Kaylee Laub</p>	<p>Speculative Designs that Support Teaching and Learning Climate Change in a Middle School Classroom</p>	<p>This study explores how integrating speculative design into a middle school climate change unit can address critical gaps in instruction and student engagement. While climate change is introduced in grade 6 under the Next Generation Science Standards (NGSS), it is predominantly taught at the high school level through traditional and standardized methods. This study investigates how a seventh-grade teacher co-designed and implemented a two-week unit using speculative design to foster creativity and justice-oriented learning and how students conceptualize more livable and just futures through their speculative designs. Drawing on the framework of speculative education, the analysis will focus on the teacher’s design considerations, pedagogical choices, and students’ engagement with speculative design by examining how this practice fosters critical thinking and collaborative learning to envision possible futures. The anticipated outcomes will highlight the voices of underrepresented students, offering insights into their visions for equitable and sustainable futures. By positioning students as creators rather than mere consumers of knowledge, this study will investigate the conjecture that transformative pedagogical practices cultivate imagination and support students’ agency in addressing climate change. Ultimately, this research contributes to the discourse on climate change education, emphasizing the need for inclusive and innovative approaches in formal learning environments.</p>
<p>Peter Rillero, Margarita Jimenez-Silva, Katherine Short-Meyerson, Mila Rosa Lbrea-Carden, and Kim Rillero</p>	<p>Our Plot of Sunshine: Cultivating Science Capital Through Culturally Responsive Family Garden Education</p>	<p>Can garden-based STEM education strengthen science identity in underrepresented communities? This research explores a family-centered program that combines gardening with STEM learning for fifth and sixth grade girls and their parents. The "Our Plot of Sunshine" initiative builds on theories of Science Capital and Community Cultural Wealth to create an engaging learning environment that honors families' cultural knowledge while building science understanding. Our study followed nineteen families through a 7-week program implemented across two urban sites, measuring changes in science identity, career interests, and program engagement. A repeated measures analysis of the pre, mid, post, and delayed post (three months after the program) survey data revealed statistically significant gains in participants' science identity and career aspirations that persisted beyond program completion. While overall program engagement trended positive, these changes did not reach statistical significance. Notably, parents reported even higher satisfaction with program elements than their daughters, though engagement was strong across both groups. The program's emphasis on cultural responsiveness and bilingual learning emerged as key strengths. These results demonstrate how garden-based education, when designed to embrace family participation and cultural assets, can create powerful STEM learning experiences for underrepresented young women.</p>
<p>Samiksha Raut, Daniel Mendoza, Sarah Adkins, Jeffrey Morris, Jay Bhatt</p>	<p>Service-learning Curriculum Increases Climate Change Awareness</p>	<p>National efforts to reform undergraduate education have highlighted the need to relate abstract concepts in biology to real-world examples, especially for non-majors who may undervalue scientific processes. We therefore decided to introduce a module titled "Climate Change, Sustainable Practices and Plastic Pollution," utilizing such high-impact practices as service-learning. This module involved connecting the course objectives with three hours of community service. Our mixed methods approach across two different course iterations (n=117) indicated that at the end of the course, non-majors were significantly more likely to agree with all the statements on an open-ended pre- and post-survey about civic engagement and sustainable practices, as adapted from Dauer and Forbes (2016). Focus group and free response data confirmed that students valued service-learning and connected the experience to both learning objectives and their everyday lives. We therefore recommend service-learning as an active engagement tool to teach concepts related to global climate change and environmental pollution.</p>



**PROGRAM**  
**2025 Conference (ASERA56)**  
**Deakin Downtown, Docklands (Melbourne, Australia)**  
**Tuesday 1<sup>st</sup> July to Friday 4<sup>th</sup> July 2025**

<p>Margarita Jimenez-Silva, Peter Rillero, Katherine Short-Meyerson</p>	<p>Transforming Science Education through Community Cultural Wealth: Impacts on Latina Girls and Families</p>	<p>Culturally and linguistically responsive science education can enhance students' scientific understanding, develop their science abilities, and foster a strong science identity while simultaneously drawing upon and strengthening Community Cultural Wealth (CCW). We report findings from an informal science education program for 10- to 12-year-old Latina girls and their parents. Two seven-week programs (one Rocketry and one Gardening), built on community knowledge and resources. This study included 41 families in two U.S. urban locations. A repeated measures analysis of the pre-, mid-, post-, and delayed post (three months after the program) survey data focused on CCW revealed statistically significant gains (<math>p &lt; .05</math>). For parents, there were significant gains from the pre-survey to the delayed post-survey in their aspirational, familial, social and navigational capital. This was critical for supporting their daughters' interest in science, better understanding how to help them, and making connections with other families and community resources. For the girls, there were significant increases in their social and linguistic capital. The girls grew in their understanding of the value of having diverse science teams and became increasingly committed to developing their bilingualism. This research highlights the importance and impact of engaging in culturally and linguistically responsive science education.</p>
<p>Pei Hsin Chen, Shin Cheng Yeh</p>	<p>Enhancing Elementary School Students' Climate Change Literacy through Issue-based Board Games: A Case Study of Food Production CEO</p>	<p>This study explores the effectiveness of board games in climate change education, focusing on their impact on elementary students' knowledge, attitudes, and behavioral intentions related to food production and other economic activities. An issue-based board game, "Food Production CEO", was designed and applied to enhance students' understanding and responsive actions to climate change. Climate change threatens global food security, and the current educational methods for young students have explored its complexity. We reviewed the literature to examine food consumption and production and their connections to climate change. The board game and accompanying lesson plans were then designed with the help of some climate and education experts. Experiments were conducted in the six-grader classes on climate change using the board game as the teaching tool. Pre- and post-class surveys were then carried out, and data were analyzed to determine the changes in their knowledge, attitude, and behavioral intentions. This study's innovation lies in incorporating food-related economic activities into decision-making in the era of climate change. Role-playing and scenario simulations offered students a comprehensive learning experience. The results showed that issue-based board games effectively make abstract concepts tangible, boosting students' motivation and engagement.</p>
<p>Witsanu Suttiwan, Chokchai Yuenyong, Peter Charles Taylor, Elisabeth Lily Taylor</p>	<p>Science Teachers' Pedagogical Content Knowledge for Organising Transformative Learning and Sustainable Development in School Setting</p>	<p>As education pins towards sustainable development, science teachers play a crucial role in shaping transformative learning experiences that integrate environmental, social, economic, and other considerations. This paper aims to study and construct the theoretical framework of science teachers' pedagogical content knowledge (PCK) for organizing transformative learning and sustainable development (TLSD) in school settings. Methodology was a qualitative study involving documentary synthesis, expert dialog decisions with experienced science educators to develop framework for PCK for TLSD. The findings clarified (1) what kinds of teachers' knowledge about transformative learning and sustainable development and (2) the framework of examining science teachers' pedagogical content knowledge in organizing transformative learning and sustainable development in a school setting (PCK for TLSD). We hope that this framework will help science teachers develop their own learning activity planning and use them to promote responsibility for future citizenship.</p>
<p>Shiho Miyake</p>	<p>Awareness of Three Key Environmental Issues Among Japanese Undergraduate Students</p>	<p>People's interest in environmental issues suggests contemporary context that should be developed in science education. This study surveyed 157 Japanese undergraduate students on three environmental key issues: biodiversity conservation, Sustainable Development Goals (SDGs), and endangered species. It assessed their familiarity, perceived importance, and engagement in personal actions. They responded on a 5-point scale. Endangered species had the highest recognition (<math>M=4.50</math>, <math>SD=0.52</math>). The most important issue was the SDGs (<math>M=3.90</math>, <math>SD=1.25</math>). Regarding personal actions, the SDGs also received the highest response (<math>M= 3.53</math>, <math>SD=1.38</math>), while biodiversity conservation had the lowest (<math>M=2.69</math>, <math>SD=1.48</math>). These results indicate high awareness of SDGs in terms of recognition, importance, and actionable steps, whereas biodiversity conservation remains largely overlooked. Although endangered species were well recognized, the student struggled to identify concrete actions to protect them. The SDGs were likely the most well-known among students because they have been widely publicized through accessible media, such as TV programs, commercials, and online news. Additionally, the 17 SDGs are recognized as actions that individuals should take. In contrast,</p>



**PROGRAM**  
**2025 Conference (ASERA56)**  
**Deakin Downtown, Docklands (Melbourne, Australia)**  
**Tuesday 1<sup>st</sup> July to Friday 4<sup>th</sup> July 2025**

		biodiversity and endangered species are rarely featured in such media, indicating lower recognition and limited translation into concrete actions. These findings highlight the need for education on specific conservation actions through easily accessible media, particularly for undergraduate students, focusing on biodiversity and endangered species.
Carmen Fernandez, Artur Aldi	Identifying Realist Philosophy of Chemistry in Electrochemistry Content Present in Brazilian High School Textbooks	Philosophy of Chemistry (P.C.) is a new research field through which many contributions to science education have been made. Realist philosophy is one of the main topics in the field, comprehending discussions about the nature of science and the interpretation of reality and of scientific knowledge. Aiming to explore the potential of P.C. for science education, we propose the following research question: how realist philosophy permeates the electrochemistry content as presented in Brazilian high school textbooks? The sample of the study considered the seven science textbook collections that were selected by Brazilian government through educational public policies (Programa Nacional do Livro Didático 2021) to be distributed in public education. The chapters related to electrochemistry were identified and analyzed through direct qualitative analysis. Both text and images were read and interpreted to identify realist meanings or patterns. It was found that realist philosophy is at the core of scientific knowledge as it is taught through the textbooks. This is manifested, for example, in the way submicroscopic entities are treated in visual models and in the way phenomena are explained. This reveals the need for teachers to be philosophically prepared, and certifies the importance of P.C. in chemistry teacher education.
Yuuri Kimura	The Science Learning Environment of Parents at Home Shaped by their Children's Interests and Expectations	Informal science education environments are especially important for Japanese adults who have left school and have had very few opportunities to learn science. However, little research has been done on science education at home, one aspect of informal science education, especially adults' science learning. If we can support adults' science learning at home, it may become possible for them to learn about science more regularly in their daily lives. Previous studies of amateur scientists have shown that some people begin scientific practices themselves due to children. Therefore, this study focused on how the adults' science learning environment is shaped by their children at home. This study aimed to investigate the impact of a child who has become interested in insects on his parents in a single family. Data were collected through semi-structured interviews and group interviews. The interviews showed that the father became obsessed with raising and collecting insects, triggered by his child's interest. Also, the mother who dislikes insects accepted her child's expectations and tried to coexist with insects. In the process, the parents learned about ecology and types of insects. These results suggest that children's interests and expectations may create a science learning environment for parents at home.
Vijit V. Nautiyal, Erika Eunice P. Salvador	Prevalence of Misconceptions About the Nature of Science Among High-Achieving Secondary School Students and the Impact of History of Science-Based Instruction on Students' Views about NOS	Context and Purpose: This study (a) examined high-achieving secondary school students' views about the nature of science (NOS) from a meritocratic, science- and research-focused high school in the Philippines; and (b) evaluated the effect of a history of science (HOS)-based teaching strategy on participants' misconceptions about NOS. Method: A quasi-experimental pre-and post-test design with mixed-methods data analysis was used. Twenty students participated, and their NOS knowledge was assessed using the Views About the Nature of Science Form-B (VNOS-B) questionnaire. The intervention involved a HOS-based quantum mechanics (QM) course. VNOS Analysis and Scoring Rubric (VAScor) was used to analyse the students' responses. Results: Pre-test results indicated "well-informed" views on empirical, inferential, creative, imaginative, and theory-laden aspects of NOS. However, misconceptions or "naïve" views on other aspects, namely, "myth" of the scientific method, the tentative NOS, and the relationship between scientific laws and theories, were prevalent. Teaching QM through a HOS-informed approach improved students' QM knowledge but had minimal effect on their perceptions of NOS. Significance: Our findings challenge the intuitively appealing assumption that incorporating HOS in science education necessarily improves students' NOS views. Explicit discussions through contextualised teaching of NOS aspects may be necessary to address deeply rooted misconceptions about NOS.
Chi Tuen Fung, Jame Davis	Infusing School Science Curriculum with Entrepreneurial Capabilities	Antifragility is a property of complex systems, enabling systems to learn, grow and prosper under conditions of disorder and uncertainty. In contrast, fragility is a property of systems that can only learn, grow and prosper in conditions of order and stability, such as many contemporary societies that embrace modernity. We challenge the fragility of contemporary thinking about science education that tends to treat risk as predictable, thereby enabling a sense of foreseeability into the needs of future educational outcomes. By adopting antifragility as our frame of reference we illustrate how science education could be more risk-responsive by infusing key human capabilities for promoting antifragility. Risk-responsive human capabilities are also entrepreneurial, and for this reason our focus in this study is to explore a foundational



**PROGRAM**  
**2025 Conference (ASERA56)**  
Deakin Downtown, Docklands (Melbourne, Australia)  
Tuesday 1<sup>st</sup> July to Friday 4<sup>th</sup> July 2025

		<p>conceptual framing of antifragility and how it may be operationalised through an entrepreneurial framework to transform systems for science teaching and learning. Our investigation is grounded in a re-analysis of a previously published case study of entrepreneurial STEM education project-learning in a Hong Kong school. The Hong Kong context enables us to illustrate antifragile and entrepreneurial concepts in a science curriculum. We make recommendations for further research and opportunities for collaboration in science education research.</p>
--	--	--



**PROGRAM**  
**2025 Conference (ASERA56)**  
**Deakin Downtown, Docklands (Melbourne, Australia)**  
**Tuesday 1<sup>st</sup> July to Friday 4<sup>th</sup> July 2025**

**Posters - Wadawurrung 2**

<p>Wei-De Wang, Su-Chi Fang (presenting)</p>	<p>A Study of High School Science Teachers' Instructional Design Experience in Inquiry and Practice Course: Insights from the Interconnected Model of Professional Growth</p>	<p>The latest educational reform in Taiwan has implemented a new required course named Scientific Inquiry and Practice, aiming to provide students with opportunities to conduct interdisciplinary scientific inquiry through practice. With no textbook available, science teachers encounter the challenge of independently designing and developing an entirely new course. To understand the complex factors influencing teachers' successful experience in instructional design, this study employed a qualitative case study approach to explore the professional growth experiences of five teachers from the same senior high school in developing the Scientific Inquiry and Practice course. Data collection includes in-depth teacher interviews and a collection of lesson plans and teaching materials. The Interconnected Model of Professional Growth (Clarke &amp; Hollingsworth, 2002) is used to analyze teachers' experiences in designing and developing the new course. The preliminary results show that co-teaching partnership is critical in shaping teachers' professional growth in course design and implementation. The collaboration between teachers A1 and A2 fostered a positive shift in A1's perspective and approach to designing and implementing the Inquiry and Practice course, thereby boosting her confidence in instructional practices. Also, teacher professional development programs provided limited support for the enhancement of teachers' expertise in curriculum design and implementation.</p>
<p>Sheng-Chang Chen, Pei-Jia Wu</p>	<p>Exploring Undergraduate Students' Problem-solving Processes and their Eye Movement Behaviors in Different Types of Electromagnetic Concepts</p>	<p>Problem-solving is a key element of 21st-century skills; thus, training students to have those skills is an important goal in science education. It is a cognitive process that involves identifying a problem, using relevant knowledge or concepts from the organization, and developing specific strategies to obtain an answer. This study aimed to explore undergraduate students' problem-solving and visual attention performance among different types of electromagnetic concept problems. Ninety-one undergraduate students majoring in physics were recruited for this study. Sixteen problems were designed using particle or non-particle electromagnetic concepts, whether involving Newtonian mechanics or not. All participants had to solve conceptual electromagnetic or calculation problems using computers and handwriting boards. An eye-tracker was adopted to record their eye movement behaviors during their problem-solving and interview them after finishing all problems. The results showed that students scored higher on particle concept problems than non-particle concepts and performed better on problems without Newtonian mechanics than those with Newtonian mechanics. Students also devoted more attention to non-particle concept problems involving Newtonian mechanics than particle concept problems with Newtonian mechanics. Teaching electromagnetism should emphasize non-particle concepts and help students connect Newtonian mechanics with electromagnetism.</p>
<p>Solomon Mangai, Kim Nichols, Gwendolyn Lawrie</p>	<p>Promoting Undergraduate Students' Productive Creative Thinking around Chemistry Concepts using Real-World Contexts in a Dialogic Context</p>	<p>This study explores promotion of productive creative thinking in first year undergraduate chemistry students at the submicroscopic level using real-world contexts and collaborative dialogic approaches. A design-based research framework is utilised to inform the iterative design of teaching interventions with collection of student work and interviews. The first cycle involved design of an intervention, informed by theoretical perspectives and empirical research, accounting for students' prior learning and cohort size. Adjustments were required to foster creative thinking and engagement. In the second cycle, the nature of the prompts and scaffolding was adjusted and audio recordings of peer discourse was collected. Thematic analysis is informed by inquiry behaviours, bisociation, Simonton's chance configuration theory and Torrance's creativity test measures. Outcomes revealed flaws in task design with limited opportunities for exploration of creative thinking due to simple yet non-creative or complex yet creative relatable real-world applications. Creative responses were not achieved as the intervention failed to scaffold creative but divergent productive thinking. Second iteration outcomes revealed more creative, out-of-the-box, insightful, and instinctive responses due to improved task scaffolding. Students struggled to comprehend prompts regarding physical/chemical conditions of corrosion prevention. The study seeks to provide theoretical contributions on strategies for productive creative thinking in chemistry.</p>



**PROGRAM**  
**2025 Conference (ASERA56)**  
**Deakin Downtown, Docklands (Melbourne, Australia)**  
**Tuesday 1<sup>st</sup> July to Friday 4<sup>th</sup> July 2025**

Ya Chun Chen, Hsuan Han Su	Effects of Asynchronous Online Discussion Integrated with Reflective Scaffolding on Scientific Creativity of Senior High School Students	Developing students' scientific creativity helps promote their academic achievement, interest in science-related careers, and the ability to use scientific methods and creative thinking to solve daily-life problems. Reflection and peer discussion help students develop more comprehensive and complete solutions, playing an important role in the creative problem-solving process. This study aimed to examine senior high school students' performance of scientific creativity in asynchronous online discussions integrated with reflective scaffolding. The participants include experimental (integrated with reflective scaffolding) (N=46) and comparison groups (without reflective scaffolding) (N=63). The teaching intervention was eight weeks in total. The Scientific Creativity Problem-Solving Test (SCPST) includes six open-ended items and three dimensions: Generate diverse ideas, Generate creative ideas, and Evaluate and improve ideas. The ANCOVA results show that the experimental group significantly outperforms the comparison group in the SCPST total score and the three dimensions ( $p < .001$ ). The paired sample t-test results indicate that the experimental group students got significantly higher scores on the SCPST post-test in total scores and the three dimensions than in the pre-test scores ( $p < .05$ ). For the comparison students, only the scores of the SCPST post-test in the dimension of Generate creative ideas were significantly higher than the pre-test scores.
Majeda Almkhtar, Seamus Delaney, Linda Hobbs	Developing a Transformative Data Science Education Framework for Australian Schools	Data Science Education (DSE) is essential for equipping students with the skills to improve a deeper appreciation for learning, foster responsible and active citizenship, and prepare them for the workforce demands of the 21st century. Teachers play a fundamental role in facilitating meaningful engagement with data science, yet the Australian curriculum does not explicitly position DSE as a distinct learning area. This limits both student preparation for a data-driven world and teachers' ability to integrate DSE effectively. This study examines the current state of DSE internationally and in Australian primary and secondary schools and develops a transformative data science framework to support its integration. It employs sociocultural and transformative learning theories, alongside the SOLO taxonomy, to guide teachers in planning and integrating transformative DS learning experiences into their classrooms. Using a mixed-methods approach, the study includes a systematic review, a teacher survey (n=36), and a Delphi study with six experts. Data triangulation revealed five key characteristics of an effective TDS framework: data science content knowledge, student engagement, student capabilities, transformative learning environment and pedagogical effectiveness, and DS resource accessibility. The adoption of the TDS framework within the Australian curriculum will strengthen teachers' confidence and capacity to effectively implement transformative DSE, fostering student engagement and developing essential data skills for the 21st century.
Iliia Sholin	The Role of Competitions in Science Education: A Case study of Hydrogen-Powered RC Car Races	Participation in competitions enhances students' ability to conduct independent research, a key component of science education. This paper examines a competition featuring a six-hour race of electric radio-controlled car models powered by hydrogen fuel cells. Each team had a limited total energy reserve – comprising batteries and hydrogen – to be used during the race. This limitation, uncommon in traditional RC car racing, encouraged participants to undertake extensive research and engineering work. The author has organized more than ten such races, typically featuring 20–35 teams, with most participants being secondary school students. In some cases, teams submitted applications describing their preparation process. The author collected a dataset of 172 team application documents, which were analyzed based on the extent to which knowledge and skills from school science courses were applied to race preparation. A notable outcome of this analysis is the significant number of original experiments described in the applications. These experiments covered mechanical, thermal, and electrical phenomena. Participants planned and conducted these experiments, applying the results to improve their race preparation. Notably, there is a clear positive correlation between the teams' experimental skills (as assessed from the application documents) and their performance in the race.
Sung-Tao Lee, Yu-Yun Nien	The Communication Pattern Analysis of COVID-19 Science News in Taiwan	The purpose of this research is to understand the reported research type, framework and writing characteristics of COVID-19-related research science news in Taiwan during pandemic period. The three questions guided this research were: (1) What are the main research news categories can be found? (2) What are the possible narrative frameworks can be constructed? and (3) Is there any news writing pattern existed? A qualitative methodology was used to do the analysis, and both the frameworks of "Claim-Evidence-



**PROGRAM**  
**2025 Conference (ASERA56)**  
**Deakin Downtown, Docklands (Melbourne, Australia)**  
**Tuesday 1<sup>st</sup> July to Friday 4<sup>th</sup> July 2025**

		Reasoning" and "scientific inquiry elements" were combined to go through the coding processes and the science news related to the COVID-19 reported on the top three popular media websites were collected for analysis. The results revealed that the research news related to COVID-19 can be divided into five major research types, namely "vaccine", "infection", "virus", "epidemic prevention", and "medications". In addition, the narrative frameworks were dominated by "academic sources", "results", "phenomena" and "non-academic sources". Finally, the news writing pattern were characterized by both "evidence (E)" and "claim (C)" elements, and limited "reasoning (R)" element with uncertainty was presented. The implications for both science education and science communication will be further discussed.
Hadis Salehi Gahrizsangi, Sarika Kewalramani, Gerarda Richards	Play, Learn, Discover: Fun Biology for Early Learners	In early childhood and early primary education, science is often overlooked due to the perception that learning science is less essential for young children than acquiring numeracy and literacy. This undervaluation results in science being sidelined in favour of subjects deemed more critical for children's overall learning. The teaching of biological science, in particular, lacks engagement and interactivity, leading to limited student interest and participation. Despite the ability of interactive multimodal tools, including non-digital (manual), digital and robotic tools, to spark children's curiosity about science subjects, early childhood and early primary educations still lack effective gamified and multimodal resources in biological science education. This gap reinforces the need to design and integrate innovative teaching methods into biological science to make it more interactive and engaging for young learners. Through the perspective of social semiotics theory, this research suggests possible methods to create interactive, gamified and visually rich biological science content that captures students' attention and improves their comprehension. I argue that incorporating these approaches can revolutionize biological science teaching, making it more dynamic, inclusive and memorable.
Meng-Tzu Cheng	Designing an Effective Digital Identification Key for Ants and Myrmecophiles	Species identification fosters inquiry skills and biodiversity awareness in science education. Ants, with their diversity, accessibility, and complex social behaviors, provide an engaging yet challenging subject for identification due to subtle species differences. To support this process, we developed Ant and their Friends (AntFID), a digital identification key that helps students compare observed ant characteristics with suggested species while exploring ant-myrmecophile relationships. This study evaluates its usability and learning effectiveness by comparing an experimental group using AntFID with a control group relying on Internet searches. We recruited 63 non-science major college students through an advertisement on the institution's electronic bulletin board and social media, then randomly assigned them to the experimental (N=31) or control group (N=32). Results show that AntFID users performed significantly better in ant identification and myrmecophile data retrieval tasks. While both groups improved in knowledge assessments, the experimental group outperformed the control. Only the experimental group showed significant skill development, and users reported a positive learning experience, rating the app's usability as "good" and well-aligned with iOS human-computer interface design standards.
Sophia Tsang, Rory McNab	Preparing Professionals: Authentic Assessment in the Age of Artificial Intelligence	In preparing our students for their future careers, we often try to emulate professional tasks when we write assignments. Due to the recent rise of generative artificial intelligence, most actively practicing educators have not been employed in workplaces that incorporate artificial intelligence into their processes, though. To ensure that we are designing appropriate class activities and assessments for our atmospheric & climate sciences, earth sciences, environmental sciences, and physical geography classes, we surveyed professionals in these fields to understand how they are or are not using generative artificial intelligence in their workplaces. Only professionals based in Australia were eligible to participate since generative artificial intelligence practices may vary from one culture to the next. We present our results and initial ideas about how to address these findings in our tertiary classroom here. While we realise that this professional practice will continue to evolve, we believe this represents current practices well enough for our classes in the short term.
Dylan P. Williams, Barbara Villa-Marcos, Lakshmi Sisodia, Mariam Mahomed,	Spectroscopy Unlocked: An Escape Room Activity for Introductory Chemistry Courses	Games have proven to be effective methods of supporting active learning and many different gamified approaches have been explored. "Spectroscopy Unlocked" is a spectroscopy-based escape room has been co-developed by undergraduate students and academics educational research project. This escape room facilitates the development of inter-professional, teamwork, communication and problem-solving skills in a format that familiarises students with the laboratory. "Spectroscopy Unlocked" is designed for post-



**PROGRAM**  
**2025 Conference (ASERA56)**  
**Deakin Downtown, Docklands (Melbourne, Australia)**  
**Tuesday 1<sup>st</sup> July to Friday 4<sup>th</sup> July 2025**

		16/foundation level and focuses on the basic principles of nuclear magnetic resonance, infrared spectroscopy, thin layer chromatography and mass spectrometry. The tasks consist of a combination of short laboratory experiments, structure determination activities as well as code-breaking and problem-solving games. Students work in groups of up to four members and have up to two hours to complete the escape room. Each activity includes instructions on how to use the required equipment and/or perform the specific technique. The solution for each task provides participants with clues to find the instructions for the next activity. The game was tested on 24 foundation level STEM students at the University of Leicester. A post-activity questionnaire was completed by students and showed that 92% of students agreed that the escape room supported their learning and 100% found the activity enjoyable.
Meng-Wei Lin, Chih-Cheng Hung	Exploring Social Work Learners' Perceptions of Collaborative Learning and Critical Thinking Dispositions with ChatGPT- and Mind Mapping-Integrated Program Planning	The potential of ChatGPT to enhance learning garner significant attention; however, research on combined effects of mind mapping and ChatGPT in collaborative learning remains limited. This study examines the integration of ChatGPT, with and without mind mapping, and its effects on learners' perceptions of collaborative learning and critical thinking dispositions. Forty-eight social work students at a Taiwan private university participated in a "program planning" project, where they designed services based on a needs analysis for clients. ChatGPT was employed as a brainstorming tool, supplemented by mind mapping to facilitate information organization across planning phases. Quantitative and qualitative data were collected via pre-, mid-, and post-test assessments measuring students' perceptions of collaborative learning and critical thinking dispositions, as well as feedback on their attitudes. Results indicated significant improvements in students' perceptions of collaboration, learning motivation, and self-efficacy in peer interactions and collaborative skills from pre- to mid-test following the integration of ChatGPT. Notably, further significant enhancements were observed from mid- to post-test with the addition of mind mapping. Furthermore, both critical openness and reflective skepticism demonstrated improvement. The inclusion of mind mapping improved the organization of the planning process, leading to enhanced outcomes in collaborative learning perceptions and critical thinking dispositions.
Siridhara Soottanon	Enhancing Primary School Student' Computational Thinking in the STEM Education Unit	The research aimed to clarify Grade 2 students' computational thinking competency in the Materials STEM Education Unit. Target group included primary students who were studying in Nakhon Phanom University Demonstration School. The STEM unit was developed through design thinking. Students' computational thinking competency was interpreted via students' tasks and unstructured interviews. Students' computational thinking competency, then, was categorized into three levels including very good, good, and poor. The rubric of these categories was developed based on 4 elements of computational thinking including 1) decomposition, 2) pattern recognition, 3) abstraction, and 4) algorithm design. The findings revealed that there were 4 students who held a very good level of computation thinking competency and 5 students who held a good level of computation thinking competency. These findings indicated that lower primary school students also could do science and mathematics practicing and computational thinking for designing solutions of simple problems of social or human need.
Suren Mendis, Kathy Mills, Laura Scholes	Digital Literacy Through the Years - A Critical Review of Frameworks and Curriculum Changes in Light of Teacher Perspectives	The term digital literacy has come to replace ICT capabilities in most Australian State and Territory curriculum frameworks. However, the term itself had existed in research discourse for many years prior to its uptake in an Australian context. The term has also undergone many stages of rebranding, resulting in a diverse array of perspectives around what constitutes a digitally literate individual. But how do teachers feel about the changing landscape of digital literacy? What skills do they consider to be intrinsic to being digitally literate, particularly in science education? This article details the origins of the term digital literacy and the evolving nature of digital literacy frameworks in light of social and contextual changes. It also critiques models which have previously been used to evaluate the digital proficiencies of teachers and students, and explores the perspectives of teachers in changing the discourse around digital literacy. It is vital to accurately represent teachers perspectives of digital literacy to ensure that curriculum documents and evaluative frameworks reflect the lived realities of teachers and students.



**PROGRAM**  
**2025 Conference (ASERA56)**  
 Deakin Downtown, Docklands (Melbourne, Australia)  
 Tuesday 1<sup>st</sup> July to Friday 4<sup>th</sup> July 2025

**Posters - Upstairs Creative**

<p>Kanisorn Tonseenon, Chokchai Yuenyong</p>	<p>Existing Ideas of Developing Professional Development Programs for Enhancing Pre-service Science Teachers' Organizing STEM Education in Schools</p>	<p>This paper aimed to clarify existing ideas of developing professional development programs for enhancing pre-service science teachers' organizing STEM education in schools. Methodology regarded interpretive paradigms. Participants included three members of the UDRU school internship program committee. The UDRU school internship program committee's vision of enhancing pre-service science teachers' organizing STEM education in schools was collected by questionnaire and interview. The questionnaire is called "the open-ended questionnaire of committee and pre-service teacher perceptions of STEM education (TP-STEM UDRU)". The interview was carried out to further probe after the TP-STEM UDRU questionnaire. Data analysis was categorized to develop the themes of UDRU school internship program committee's vision of enhancing pre-service science teachers' organizing STEM. Then, the occurring themes could provide assumptions of valuable insights for improving teacher preparation programs and ultimately enhancing STEM education in schools. The findings revealed some assumptions of developing professional development programs for enhancing pre-service science teachers' organizing STEM education in schools. These assumptions included 1) knowledge of science curricula and STEM education practicing standards, 2) knowledge of students' understanding of science, 3) knowledge of instructional strategies, 4) knowledge of assessment, 5) orientation of teaching science, 6) contextual knowledge, and 6) self-efficacy.          Keywords: STEM education, professional development, pre-service teacher</p>
<p>Carmen Fernandez</p>	<p>Pedagogical Residency Program as a Space for Developing Pedagogical Content Knowledge in Pre-service Chemistry Teachers</p>	<p>The teaching profession requires a deep and multifaceted understanding that goes beyond subject expertise. Effective teaching depends on the integration of content knowledge, pedagogy, curriculum, student understanding, and assessment—collectively known as Pedagogical Content Knowledge (PCK). PCK consists of three domains: collective (cPCK), acquired through formal training; personal (pPCK), reflecting a teacher's theoretical grasp; and enacted (ePCK), the practical application of knowledge in the classroom, which evolves through interactions with students and other educators. A Brazilian teacher education program aims to immerse pre-service teachers in their future professional environment under the guided supervision of both school teachers and university faculty. This initiative seeks to develop teaching knowledge while also providing continuous professional development for in-service teachers and university educators. Over 18 months, weekly meetings were recorded, bringing together pre-service teachers, school teachers, and university faculty to reflect on classroom activities and plan new actions. These recordings were transcribed and analyzed using thematic content analysis to explore the integration of teaching knowledge. The findings reveal an idiosyncratic development of pedagogical content knowledge and reinforce the importance of this program within the Brazilian educational context.</p>
<p>Takuya Ochi, Goh Kakihara</p>	<p>Relationships Between Beliefs and Pedagogical Content Knowledge of Teachers who Engage in Interdisciplinary Lessons Including STEM/STEAM</p>	<p>As represented by STEM/STEAM, cross-disciplinary learning has been gaining more importance. Therefore, we need to consider how teachers who engage in STEM/STEAM lessons perceive interdisciplinary learning. In this study, we address the relationships between beliefs and pedagogical content knowledge of teachers who engage in interdisciplinary lessons, including STEM/STEAM. We conducted interviews with two teachers who engaged in interdisciplinary lessons collaboratively. One teacher's teaching subject was biology and the other's was history. The interviews lasted 30-60 minutes and focused on the following aspects: interdisciplinary lessons that they had previously conducted; differences between interdisciplinary lessons and ordinary lessons that they teach; and feedback to their teaching subject derived from collaborative lessons across the framework of the subjects. We analysed the data qualitatively and our findings were as follows: the teachers had high inquisitiveness not limited to their teaching subjects and tried to learn content that they were interested in from daily life; they recognised that authentic learning should not be limited to subject frameworks.</p>
<p>Phatsaraporn Sahakit</p>	<p>Enhancing Elementary Student Teachers' Scientific Inquiry Skills through Community-Based Laboratory Tools: A Case Study of the KRU-Rak Thin</p>	<p>Teacher shortages in Thailand remain a persistent issue, especially in small schools in remote areas where long-term teacher positions are often unfilled. This leads to limited educational opportunities for students. To address this, the study aims to develop a program that prepares elementary teachers with strong scientific inquiry skills, enabling them to connect classroom learning with real-life experiences. The program operates under the KRU-Rak Thin Program, which trains teachers to return to and serve their</p>



**PROGRAM**  
**2025 Conference (ASERA56)**  
**Deakin Downtown, Docklands (Melbourne, Australia)**  
**Tuesday 1<sup>st</sup> July to Friday 4<sup>th</sup> July 2025**

	Closed-System Teacher Production Program	hometown communities. This research employs a mixed-methods approach, combining quantitative and qualitative data. The target group includes 67 students from Elementary and Early Childhood Education programs. A professional development program was designed to train these students in integrating community-based tools with scientific methods and contextual learning. The program emphasizes inspiring teachers through the use of local community contexts. The study spans two years, during which students designed learning strategies in an elementary science course and collaborated with destination schools under the KRU-Rak Thin Program. The resulting data helped refine lesson plans to align with local school contexts. Research findings were gathered through assessments of scientific inquiry skills, interviews, focus group discussions, and evaluations of teaching practices. The analysis highlights the effectiveness of combining scientific methods and engineering design in teacher preparation. The findings also underscore the value of collaborative teacher production processes in addressing the educational needs of diverse student populations and fostering community engagement through income-generating projects.
Rekha Koul, Rachel Shffield	STEM Learning and Cultural Immersion for PNG Teachers in Australia	The presentation reports on a project wherein 30 teachers and teacher educators from Papua New Guinean (PNG) were provided with a unique opportunity to enhance their STEM (Science, Technology, Engineering, and Mathematics) teaching skills while immersing themselves in Australian educational and cultural environments. Participating teachers are enrolled in a 12 weeklong course, Graduate Certificate in STEM Education funded under Australia Awards. Data generated for the project is at various touch points e.g. through pre-study survey, post-study surveys, focus group interviews and weekly Check-in surveys. Pre-study survey focuses on participants beliefs of their efficacy before they start their learning journey and post-study survey on their perceptions of their efficacy and competency in the areas of technology, research, leadership, and STEM pedagogy. The weekly check-ins explore their experiences through a rating scale of 1 to 10 and asking them to consider their challenges and wins. One of the course outputs aims to meet PNG participant's learning and developmental needs, resulting in a new skill and/or qualification. Through hands-on workshops, collaborative learning with Australian educators, and exposure to innovative STEM methodologies, it is expected participants develop new strategies to enrich their own classrooms. The cultural immersion component fosters cross-cultural understanding, equipping teachers with broader perspectives that enhance their teaching practices and leadership. This initiative ultimately aims to strengthen STEM education in PNG by empowering teachers with global insights and best practices.
Pai-Hsing Wu	Teachers' Perspective on The Pictorial Representation of Textbook Exercise Item	Literacy-oriented teaching has recently been increasingly valued in educational reform and international competitions, such as PISA and TIMSS. This, in turn, drives the text writing of textbooks and the design of exercise items. Thus, multiple representations have been integrated into developing exercise items in science textbooks. For example, as a pictorial representation, the carbon dioxide and temperature graph could provide an opportunity to make a calm statement about climate change trends. However, how do teachers at the teaching site view these exercise items? This study interviewed 40 high school teachers (20 novice and 20 experienced teachers). The findings indicated that high school science teachers generally agree that exercise items with graphic representations can assess students' scientific literacy, e.g., inquiry abilities. However, although novice teachers generally believe that pictorial representation can help with concept learning, such exercise items are less relevant regarding students' performance on high-stakes testing. Regarding the washback effect of this test-led teaching, they believe that students should exercise more. Therefore, teachers' perceptions may affect their usage of textbooks.
Anastasia Lonshakova, David Blair, David Treagust	The Model of Educational Reconstruction as a Framework for the Development of Maths for Einstein's Universe.	Modern science and technology rely on quantum mechanics and relativity, yet these topics are largely absent from middle school curricula. The Maths for Einstein's Universe program was designed to enhance understanding of these concepts by integrating relevant mathematics with interactive learning methods. The Model of Educational Reconstruction (MER) was used to develop and iteratively improve a program over successive trials. The program introduces concepts typically excluded from the school curriculum to students aged 7-14 years. Iterative cycles of improvement based on assessments, interviews and stakeholders' feedback are presented. From trial-to-trial results show significant improvement in students' understanding of powers of ten and two, vectors, estimation, and curved space geometry. Initially, only 50% of students



**PROGRAM**  
**2025 Conference (ASERA56)**  
**Deakin Downtown, Docklands (Melbourne, Australia)**  
**Tuesday 1<sup>st</sup> July to Friday 4<sup>th</sup> July 2025**

		<p>answered correctly on powers of ten, but after refining teaching methods, scores increased to 86-95%. Multiplication with powers of ten rose from below 50% to 95%. Student engagement also rose, with positive responses increasing from 78% to 100%. Teacher confidence, a key aspect of MER, also improved. Initially, only 50% felt prepared, but after training, 88% reported confidence in teaching these concepts. Overall, MER's approach proved highly effective in developing a program that makes modern science concepts and relevant mathematics more accessible for middle school students.</p>
Tasneem Anwar, Athar Osama	In-Service Teachers' Productive Struggle in Developing Pedagogical Design Capacity for Holistic Science Teaching	<p>This qualitative case study explores the immersive engagement of grade 4-8 in-service science teachers from all across Pakistan in a multi-year professional development (PD) program using an adapted Understanding by Design (UbD) planning tool. The PD focused on Holistic Science Teaching (HST) - a pedagogical framework that situates science within a broader context of knowledge and society while preserving the Nature of Science (NOS) in relation to history, religion, ethics, philosophy and the humanities without conflating them. The case study examines shifts in teachers' pedagogical design capacity as they ideate, design and re-design unit plans for Holistic Science Teaching. These shifts are accompanied by productive struggle, as the teachers engage in sensemaking processes to internalize and apply HST principles. Data sources included teachers' artifacts from the PD, and their Holistic Science Teaching unit plans. The findings reveal three distinct teacher responses to the PD resources: 1). Some offloaded the unit plans with minimal integration of HST principles, 2). Others adapted the PD resources to modify their instructional approach to HST, and 3) A few improvised, successfully integrating PD resources to design contextually rich HST unit plans. These results underscore the critical role of productive struggle in teacher learning and curriculum design, particularly when engaging with newer pedagogical frameworks like Holistic Science Teaching. Additionally, sustained and iterative opportunities for offloading, adapting and improvising unit plans serve as catalysts for this transformative process. This study provides contextual insights for practitioners and researchers interested in the 'Teacher as Designer' PD model emphasizing the development of disciplinary and interdisciplinary connections in science education.</p>
Astha Saxena	Understanding the Role of STEM Teachers in Building Understanding about NOS (Nature of Science) Among Students - Transforming the Landscape of Science Education in Developing Countries	<p>STEM teachers play a pivotal role in building Nature of Science (NOS) understanding among their learners. Teachers' beliefs, knowledge and their own understanding about NOS directly influences their scientific thought as well as pedagogy. The present paper presents a literature review to understand the ways in which STEM teachers can contribute toward enhancing students' understanding of NOS. The study also presents a baseline survey of the pre-service and in-service STEM teachers about their perceptions and understanding of NOS. In order to assess their understanding about NOS a standardized scale termed Reconceptualized Family Resemblance Approach to Nature of Science (RFN) developed by Kaya et. al. (2018) was used. The objective of this survey is to compare and analyse the differences in the understanding about NOS between pre-service STEM teachers (who have undertaken a course on pedagogy which included a component on Nature of Science) and in-service STEM teachers. The quantitative data collected was subjected to various statistical analysis procedures to determine the comparative understanding of pre-service and in-service teachers about NOS and draw conclusions. The study has implications for teacher education programmes, STEM teachers, science education scholars and curriculum developers.</p>
Erika Eunice P. Salvador, Murray Lane, Catherine Challen, Leslie Dawes	Understanding Stakeholder Needs in High School STEM Internships: Enhancing Work-Integrated Learning for Science Education	<p>Stakeholder contributions and needs are essential for high school STEM internship success, yet research aligning the needs of students, teacher coordinators, and mentors remains scarce. Using Stakeholder Theory as a lens, this study identifies key stakeholder needs, explores their contributions to program sustainability, and provides insights for enhancing work-integrated learning in science education. Data were collected through focus group interviews with students, teacher coordinators, and mentors from a selective STEM high school and a national public high school in the Philippines, alongside document analysis of internship policies and forms. Method and source triangulation enabled a comprehensive exploration of stakeholder perspectives. A hybrid inductive-deductive thematic analysis revealed key stakeholder needs: students sought new knowledge, specialised equipment, hands-on experience, and structured mentorship; mentors valued student curiosity, interest alignment, and streamlined multi-cycle processes; teacher coordinators emphasised industry partner openness, operational support, and curriculum alignment. Identifying intersections across</p>



**PROGRAM**  
**2025 Conference (ASERA56)**  
**Deakin Downtown, Docklands (Melbourne, Australia)**  
**Tuesday 1<sup>st</sup> July to Friday 4<sup>th</sup> July 2025**

		stakeholder needs, we recommend coordinated stakeholder efforts to enhance program outcomes. Findings suggest that strengthening stakeholder involvement, supported by national and school-level policies, optimises STEM internships as a model of work-integrated learning in science education. This approach supports efforts to better prepare students for specialised STEM research, post-secondary work, and tertiary education pathways.
Hermína Manlea, Vaille Dawson, Tanya Fitzgerald, Tejinder Kaur	Climate Change Education in Undergraduate Physics in Indonesia	Although best practice climate change education models such as the “bicycle model” have been proposed, there are a lack of studies that examine the actual impact of climate change education in undergraduate physics in Indonesia. The aim of this study was to measure the impact of students’ climate science understanding, thinking skills, identity, values, worldview, actions, motivation and participation, hope and future intentions. Informed by a mixed method research approach, pre- and post- questionnaires were administered to 36 Environmental Physics students at a public university, with a lecturer involved in the research. Descriptive stats, paired t-tests, and Wilcoxon sign-rank tests were used to analyze the pre- and post- questionnaires. The newly designed climate change unit improved students’ climate change knowledge, motivation, and personal agency in addressing climate change. While it had limited effects on value orientations, behavioral change, or global-level perceptions, it enhanced emotional engagement, moral and scientific understanding, and views on personal responsibility. Students also reported stronger connections with their lecturer and greater awareness of climate-related careers, though shifts in adaptation, mitigation, and broader societal responsibility were limited. The findings and outcomes of this study may be applicable to Environmental Physics units in other countries affected by climate change.
Sayuri Tanabashi, Shiko Shiraiwa, Suzie Thomas	Dark Heritage Explores Science and Ethics Education for Peace in Tokyo	Science learners in primary, secondary, or higher education represent the future of the scientific community. Beyond STEM subject-specific education, it is essential to incorporate the elements of ethics and peace into the science curriculum to raise awareness of the potential misuse of research findings. Learning and providing scientific knowledge and technologies come with great responsibility. To date, the authors use the Daigo Fukuryu Maru Exhibition Hall as a case study of learning material for science and ethics education. The Daigo Fukuryu Maru, a ship exposed to radiation is one of the nuclear weapon-related dark heritages in Japan along with the Hiroshima Peace Memorial Museum and the Nagasaki Atomic Bomb Museum. Interviews were conducted with visitors and curators to gather insights on the relationship between science and ethics and on the subject of peace. The findings revealed that despite lacking direct knowledge or experience of war, university students demonstrated a strong interest in the concept of peace. However, most of them had not critically considered the relationship between science and peace. primary and secondary schools, students lacked opportunities to explore this type of relationship since visits to peace museums have not been sufficiently integrated into Tokyo’s educational curricula.

THANK YOU  
& SAFE TRAVELS HOME!