Dear Colleagues,

We are delighted to welcome you to the 2019 ESERA conference in Bologna, Italy, August 26-30, 2019. It is a great honor for us to hold the most important conference on science education that we have in Europe. The first and last time that ESERA was organised in Italy was more than twenty years ago, in 1997, in Rome.

The theme we have chosen for this edition is “The beauty and pleasure of understanding: engaging with contemporary challenges through science education.”

We chose this theme for several reasons. The first is that Bologna is considered one of the most beautiful universities in the world due to its historical buildings. We hope that the beauty of the surroundings will inspire our research and create a pleasant context for the discussions during the conference. The second reason is that we think that beauty can be engine of transformation, change and authentic engagement in an increasingly complex world.

Climate change, multiculturalism, the flourishing of new interdisciplinary disciplines (like cognitive neuroscience, artificial intelligence, digital humanities), and the problematic nature of socio-scientific issues in a digital and post-truth era are just a few examples of the contemporary challenges that we will discuss during the conference. As science educators, we believe that understanding is the preferred way to address these challenges, but we also think that they are so deep and novel that they necessitate collectively searching for new narratives, languages and forms of beauty.

For all these reasons, we hope the theme can be intellectually stimulating, contributing to the creation of an overarching layer of reflection and infusing our discussions with a visionary spirit, projected into the future.

Inspired by the conference theme, we have selected four plenary presentations and a panel. Following the custom of previous years, the additional parallel sessions will include symposia, oral presentations, interactive poster sessions and workshops, organised according to the eighteen strands that characterise the richness of the research in the ESERA community.

Together with the Scientific and the Local Organising Committee, we are looking forward to seeing you in Bologna. We are working to create the conditions for a thoughtful and inspirational scientific environment, enriched by social events that will allow you to discover the magical atmosphere of the historical centre of Bologna.

Enjoy the conference!

Olivia Levrini
ESERA 2019
Conference President

Giulia Tasquier
ESERA 2019
Conference Manager
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General Conference Information

CONFERENCE VENUE
The ESERA 2019 Conference will take place at “Bologna Congressi” from 26 to 30 August 2019. Conference sessions will take place in the “Palazzo dei Congressi”, at Piazza della Costituzione 4, Bologna.

BUILDINGS
There are three buildings used during the conference:
- Centro Congressi
- Sala Maggiore
- Centro Servizi Fiera di Bologna

Getting to and from the Conference Venue
“Bologna Congressi”

BUSES
For the ESERA meeting the conference organisation has duplicated the bus runs during the following hours, from 08.00 to 9.30 and from 17.00 to 19.00.

Bologna Centre and Bologna Central train Station are just 15 minutes away from Palazzo dei Congressi and they are connected by bus lines from the Centre (San Pietro bus-stop) or Stazione Centrale to the entrances of Piazza Costituzione and Viale Aldo Moro.

Remember to visit the link on the conference website and check the August schedule of buses.

BUS LINES TO/FROM the Conference Venue

BUS N 28
To PALAZZO DEI CONGRESSI:
Departure from Via Indipendenza n. 7
(SAN PIETRO bus-stop)
every 7 minutes
From PALAZZO DEI CONGRESSI:
(FIERA PALAZZO DEI CONGRESSI bus stop) bus going to STAZIONE CENTRALE

BUS N 35
To PALAZZO DEI CONGRESSI:
STAZIONE CENTRALE Bus-stop, Viale Pietramellara on the side of the station
every 10 minutes
From PALAZZO DEI CONGRESSI:
FIERA PALAZZO DEI CONGRESSI bus stop, bus going to STAZIONE CENTRALE

BUS N 38
To PALAZZO DEI CONGRESSI:
STAZIONE CENTRALE Bus-stop, Viale Pietramellara on the side of the station
every 30 minutes
From PALAZZO DEI CONGRESSI:
FIERA A. MORO bus stop

TAXI:
COTABO: 051.372727
CAT: 051.4590
Please Note: The taxi rank is under a white gazebo just outside the Congress entrance in Piazza Costituzione.

VENUE CAR PARKING
If you will reach the conference venue by car and require parking during the event, it’s possible to park in “Piazza della Costituzione” Parking.

For information:

WIFI
Wireless Internet access is freely available throughout
Wifi: esera
Password: esera2019

REGISTRATION AND INFORMATION DESK
The registration desk is located on the ground floor of “Sala Maggiore”.

All attendees must be registered and are required to wear their official conference badge at all times.

Care should be taken with these tickets as replacements cannot be issued.

Registration Desk Opening Times:

08.00 – 19.00 Monday 26 August
08.00 – 19.00 Tuesday 27 August
08.30 – 17.00 Wednesday 28 August
08.30 – 18.00 Thursday 29 August
08.30 – 14.00 Friday 30 August

CATERING
Lunch and Coffee breaks will take place in the Lunch Area placed in the First Floor of Sala Maggiore building.

BAR AND RESTAURANT
There is a bar in Centro Congressi, serving light food and beverages throughout the day (not open in the evenings) and a Bar in the Centro Servizi area.

TOURS
Tour are available to purchase from the Bologna Welcome desk and on the link on the website.
Social Events

WELCOME RECEPTION

- Date: 26 August 2017
- Location: Palazzo dei Congressi - Piazza della Costituzione, 4, 40128 Bologna
- Time: 18.30 – 21.00
- Dress Code: Smart/Casual

The Welcome Reception will be held on Monday in the Palazzo dei Congressi from 18.30 -21.00. All delegates are invited to attend the conference Welcome Reception. A cocktail with snacks will be served. During the reception the juggling show - Dreamy physics – by Federico Benuzzi will be performed.

ECR RECEPTION

- Date: 27 August 2017
- Location: Palazzo Isolani - Via Santo Stefano, 16, 40125 Bologna
- Time: 19:30
- Dress Code: Casual

The ECR Reception will be held at Palazzo Isolani on Tuesday from 19.30. This reception is in honour of the Early Career Researchers and their supervisors to encourage informal communication about career options and future development. The ESERA Board and the Local Organising Committee extend an invitation to all delegates to this reception but booking must have been done at the time of registration. Light food and drinks will be served.

DINNER AT PALAZZO RE ENZO

- Date: 29 August 2019
- Location: Palazzo Re Enzo - Piazza del Nettuno, 1/C, 40125 Bologna
- Time: 20:00 – 23:30
- Ticket Price: € 60.50 vat included
- Dress Code: Casual/cocktail (after five)

Delegates can purchase tickets to attend the Dinner at Palazzo Re Enzo. A limited number of tickets are still available to purchase from the conference registration desk until 11.30 am on Tuesday, 27 August.
 Organisation of the Conference

STEERING COMMITTEE
Olivia Levrini (Conference President), Department of Physics and Astronomy, Alma Mater Studiorum – University of Bologna
Giulia Tasquier (Conference Manager), Department of Physics and Astronomy, Alma Mater Studiorum – University of Bologna
Elena Consolini, Professional Unit Support and Coordination of the Activity and Internationalization Strategies, Alma Mater Studiorum – University of Bologna
Antonello Piombo, Department of Physics and Astronomy, Alma Mater Studiorum – University of Bologna

LOCAL ORGANISING COMMITTEE
UNIVERSITY PERSONNEL:
Eleonora Barelli, Department of Physics and Astronomy, Alma Mater Studiorum – University of Bologna
Laura Branchetti, Department of Mathematical, Physical and Computer sciences – University of Parma
Alessia Cattabriga, Department of Mathematics, Alma Mater Studiorum – University of Bologna
Michael Lodi, Department of Computer Science and Engineering, Alma Mater Studiorum – University of Bologna
Barbara Pecori, Department of Physics and Astronomy, Alma Mater Studiorum – University of Bologna
Giovanni Ravaioli, Department of Physics and Astronomy, Alma Mater Studiorum – University of Bologna
Sara Satanassi, Department of Physics and Astronomy, Alma Mater Studiorum – University of Bologna
Niccolò Vernazza, Department of Physics and Astronomy, Alma Mater Studiorum – University of Bologna

ADMINISTRATIVE SUPPORT:
Maria Giovanna Piazza, Department of Physics and Astronomy, Alma Mater Studiorum – University of Bologna
Luana Izzo, Department of Physics and Astronomy, Alma Mater Studiorum – University of Bologna

INTERNATIONAL SCIENTIFIC COMMITTEE
Olivia Levrini, Department of Physics and Astronomy, Alma Mater Studiorum – University of Bologna
Giulia Tasquier, Department of Physics and Astronomy, Alma Mater Studiorum – University of Bologna
Tamer Amin, Department of Education, American University of Beirut
Laura Branchetti, Department of Mathematical, Physical and Computer sciences – University of Parma
Mariana Levin, Department of Mathematics, Western Michigan University

The main responsibility for the review process and the scientific programme of the ESERA 2019 conference rests with an international committee of experienced science education researchers. This committee, besides the members listed above, comprises of the members of the ESERA Executive Board and the Strand Chairs.

ESERA EXECUTIVE BOARD
Constantinos Constantinou (President), University of Cyprus
Marianne Achiam (Member), University of Copenhagen
Sibel Erduran (Member), University of Oxford
Mariona Espinet (Member), Autonomous University of Barcelona
Bob Evans (Member), University of Copenhagen
Ellen Henriksen (Secretary), University of Oslo
Olivia Levrini (Co-opted member – Conference 2019), University of Bologna
Gjalt Prins (Treasurer), University of Utrecht
Dimitris Stavrou (Co-opted member – Summerschool 2019), University of Crete

PROFESSIONAL CONFERENCE ORGANIZER (PCO): EGA WORLDWIDE
Claudia M. Golinelli (Supervisor)
Carla Bugli (Project Manager)
Ariella Neustadt (Software Service manager)
Claudia D’Angiolo (Registration manager)
## Esera Research Strands

<table>
<thead>
<tr>
<th>STRAND</th>
<th>Strand Title</th>
<th>Description</th>
<th>CHAIRS</th>
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<tr>
<td>1</td>
<td>Learning Science: Conceptual Understanding</td>
<td>Theories, models, and empirical results on conceptual understanding, conceptual change and development of competences; methodology for investigating students’ processes of concept formation and concept use; strategies to promote conceptual development.</td>
<td>Strand Chairs: Odilla Finlayson &amp; Anna De Ambrosis</td>
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<td>3</td>
<td>Science Teaching Processes</td>
<td>Relations between teaching practices and students’ cognitive and affective development, design of teaching interventions. Research based intervention and its role for curriculum planning, instructional paths and learning outcomes. Laboratory-based practice. Video studies in science education.</td>
<td>Strand Chairs: Sabine Fechner &amp; Roald Verhoeff</td>
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<td>6</td>
<td>Nature of Science: History, Philosophy and Sociology of Science</td>
<td>The implications of nature of science, its history, philosophy, sociology and epistemology, for science education. The significance of models and modelling for science education as reflected in the particular importance attached to the use of metaphors, analogy, visualization, simulations and animations in science.</td>
<td>Strand Chairs: Ebru Kaya &amp; Veli-Matti Vesterinen</td>
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## Esera Research Strands

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<tr>
<th>STRAND</th>
<th>Scientific Literacy and Socio-scientific Issues</th>
<th>CHAIRS</th>
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<td>8</td>
<td>Teaching about scientific literacy, science and citizenship education, science and media education, information literacy, informal reasoning and critical thinking, decision making, debates on socio-scientific issues (SSI), discourse communities, social dimension of science and technoscientific practices, public engagement in science, schools’, students’ and teachers’ engagement in socio-scientific issues.</td>
<td>Strand Chairs: Antti Laherto &amp; Eliza Rybska</td>
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<th>STRAND</th>
<th>Environmental, Health and Outdoor Science Education</th>
<th>CHAIRS</th>
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<td>9</td>
<td>Ecological and Environmental Education, Education for Sustainable Development, environmental health, health education and health promotion. Lifestyles and attitudes towards health and the environment. Developing and evaluating the impact of programmes and experiences outside classrooms, including those organized by institutions other than schools.</td>
<td>Strand Chairs: Albert Zeyer &amp; Justin Dillon</td>
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<th>STRAND</th>
<th>Science Curriculum and Educational Policy</th>
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<td>10</td>
<td>Curriculum development. Reform implementation, dissemination and evaluation. International comparison studies such as TIMSS and PISA. Evaluation of schools and institutions. Policy and Practice issues: local, regional, national, or international issues of policy related to science education.</td>
<td>Strand Chairs: Jim Ryder &amp; Andreas Redfors</td>
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<th>STRAND</th>
<th>Evaluation and Assessment of Student Learning and Development</th>
<th>CHAIRS</th>
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<td>11</td>
<td>Development, validation and use of standardized tests, achievement tests, high stakes tests, and instruments for measuring attitudes, interests, beliefs, self-efficacy, science process skills, conceptual understandings, etc.; authentic assessment, formative assessment, summative assessment; approaches to assessment. Monitoring student learning and implications for teaching.</td>
<td>Strand Chairs: Mathias Ropohl &amp; Lukas Rokos</td>
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<th>STRAND</th>
<th>Cultural, Social and Gender Issues in Science and Technology Education</th>
<th>CHAIRS</th>
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<td>12</td>
<td>Equity and diversity issues: Sociocultural, multicultural, bilingual, racial/ethnic, gender equity studies and science education for the special needs.</td>
<td>Strand Chairs: Lucy Avraamidou &amp; Marisa Hernandez</td>
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# Esera Research Strands

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<th>STRAND</th>
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<th>Description</th>
<th>CHAIRS</th>
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<tr>
<td>13</td>
<td>Pre-service Science Teacher Education</td>
<td>Professional knowledge of teachers, pre-service teacher preparation, instructional methods in pre-service teacher education, programs and policy, field experience, relation of theory with practice, and issues related to pre-service teacher education reform.</td>
<td>Strand Chairs: Maria Evagorou &amp; María Ruth Jimenez Liso</td>
</tr>
<tr>
<td>14</td>
<td>In-service Science Teacher Education, Continued Professional Development</td>
<td>In-service science teacher education, teachers as lifelong learners; methods, innovation and reform in professional development; evaluation of professional development practices, reflective practice, teachers as researchers, and action research.</td>
<td>Strand Chairs: Manuela Welzel-Breuer &amp; Claudio Fazio</td>
</tr>
<tr>
<td>15</td>
<td>Early Years Science Education</td>
<td>Emergent science, science pedagogy and learning in the early years, cognitive resources for science learning, early years science and technology curriculum, innovative teaching practices in the early years, children’s learning, preschool science, early years teacher education in science.</td>
<td>Strand Chairs: Christina Siry &amp; Bodil Sundberg</td>
</tr>
<tr>
<td>16</td>
<td>Science in the Primary School</td>
<td>Procedural skills in science, science investigations, science teaching and learning sequences.</td>
<td>Strand Chairs: Federico Corni &amp; Anna Spyrtou</td>
</tr>
<tr>
<td>17</td>
<td>Science Teaching at the University Level</td>
<td>University pedagogy. Teaching and learning at the university level.</td>
<td>Strand Chairs: Jenaro Guisasola &amp; Paula Heron</td>
</tr>
<tr>
<td>18</td>
<td>Methodological Issues in Science Education Research</td>
<td>Aspects of epistemology, ontology and axiology.</td>
<td>Strand Chairs: Marianne Odegaard &amp; Shulamit Kapon</td>
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</table>
The ESERA 2019 International Scientific Committee (ESERA Executive Board and Strand Chairs) would like to acknowledge the contributions of all the additional reviewers who have evaluated submissions for the conference. We thank you for your efforts in sustaining the good quality research that is associated with ESERA.

Acher Andres, Germany
Afonso Ana, Portugal
Agorram Boujemaa, Morocco
Almeida António, Portugal
Amin Tamer, Lebanon
Anastácio Zélia, Portugal
Antink-Meyer Allison, United States
Avraamidou Lucy, Netherlands
Ayotte-beaudet Jean-Philippe, Canada
Balck Christel, Belgium
Baptista Mónica, Portugal
Barelli Eleonora, Italy
Bartošch Ilse, Austria
Battaglia Onofrio Rosario, Italy
Becu-robinault Karine, France
Bencze John Lawrence, Canada
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Besson Ugo, Italy
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Bøe Maria Vetlesen, Norway
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Castellani Tommaso, Italy
Cetin-Dindar Ayla, Turkey
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Cheng Maurice M.W., New Zealand
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Collins Larry, United States
Constantinou Costas, Cyprus
Constantinou Marina, United Kingdom
Cooper Rebecca, Australia
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Correia Catarina, United Kingdom
Cowie Bronwen, New Zealand
Cross David, France
Dajani Majida, Palestinian Territory, Occupied
Daugbjerg Peer, Denmark
De Ambrosio Anna, Italy
De Cock Mieke, Belgium
De Luca Roberto, Italy
Delaval Marine, Switzerland
Delen Ibrahim, Turkey
Delerieuxs Alice, France
Demkanin Peter, Slovakia
Devetak Iztok, Slovenia
Di Paola Benedetto, Italy
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Dionne Liliane, Canada
Dohn Niels, Denmark
Domezéch Calvet Ana Maria, Spain
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Duschl Richard, United States
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Elks Ingo, Germany
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Eister Doris, Germany
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Evans Bob, Denmark
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Fazio Claudio, Italy
Ferreira Johan, South Africa
Feser Markus Sebastian, Germany
Finlayson Odilla, Ireland
Fonseca Maria João, Portugal
Fooladi Erik, Norway
Forissier Thomas, Guadeloupe (French)
Fortas David, Israel
Fridberg Marie, Sweden
Galano Silvia, Italy
Gallezot Magali, France
Galvão Cecília, Portugal
Gandolfi Haïra, United Kingdom
Garcia Paulo Sérgio, Brazil
Garcia-Romano Leticia, Argentina
Gatt Suzanne, Malta
Georgiou Yiannis, Cyprus
Giamellaro Michael, United States
Giliberti Marco, Italy
Girault Isabelle, France
Godec Spela, United Kingdom
Goedhart Martin, Netherlands
Goes Luciane, Brazil
Gonsalves Allison, Canada
González García Pia José, Spain
Gresch Helge, Germany
Grimalt-Alvarez Carmen, Spain
Guilfoyle Liam, United Kingdom
Guisasola Jaren, Spain
Gunstone Richard, Australia
Gut Christoph, Switzerland
Habig Sebastian, Germany
Hadjigeorgiou Angela, Cyprus
Häglee Jörn J., Germany
Halkia - Theodoridou Krystalla, Greece
Hamdan Hiba, United Kingdom
Hardman Mark, United Kingdom
Harms UTE, Germany
Harrison Chris, United Kingdom
Haskel-Ittah Michal, Israel
Heeg Julian, Germany
Heinemann Birte, Germany
Henriksson Ellen Karoline, Norway
Henriksson Ann-Catherine, Finland
Hernández Maria Isabel, Spain
Heron Paula, United States
Hettmannsperger Rosa, Germany
Hillier Judith, United Kingdom
Holmqvist Mona, Sweden
Hung Chia-Hui, Taiwan
Itoh Minoru, Japan
Johannsen Bjørn Friis, Sweden
Justi Rosaria, Brazil
Kalaitzidaki Marianna, Greece
Kalogiannakis Michail, Greece
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Kind Vanessa, United Kingdom
Koch Alexander, United States
Kollai Vasiliis, Greece
Kolste Stein Dankert, Norway
Komorek Michael, Germany
Korfiatis Konstantinos, Cyprus
Krabbe Heiko, Germany

Reviewers for Esera 2019
EU STEM Education Project Posters

The ESERA 2019 conference hosts a corner where posters concerning actual “EU STEM Education Projects” are displayed for the whole week.

The aims of this exposition are to let the community know about recent EU projects, offer a chance to discuss about ongoing researches as well as to foster connections among the community for new future projects.

Lunch or coffee break time can be good informal moments along the whole week for having rich and fruitful exchanges at the ‘EU STEM Education Project Posters’ corner.

- A Community Shared Approach to a M.ED. Program on Integrative STEM
  Noa Ragonis, Tili Wagner, Daphne Goldman, Osnat Dagan Beit Berl College, Israel

- Aligning Written Explanations with Design Reasoning in Elementary Engineering Classrooms
  Patricia C. Paugh, Ph.D., University of Massachusetts Boston, Department of Curriculum & Instruction, 100 Morrissey Boulevard, Boston, MA 02125 USA

- Artist – Action Research to Innovate Science Teaching
  Ingo Elks (coordinator), Nadja Belova, University of Bremen, Germany (co-coordinator); Marika Kapanadze (co-coordinator), Ilia State University, Tbilisi, Georgia

- Botstem - Robotics and STEM Education for Children and Primary Schools
  Ileana M. Greca (coordinator) Universidad de Burgos, Burgos, Spain; Andreas Redfors, Björn Cronquist, Marie Fridberg Kristianstad University, Sweden

- Cell Explorers: STEM Engagement in Schools Delivered by Higher Education Institutions
  Muriel Grenon, Shane Mc Guinness Biochemistry, School of Natural Sciences, National University of Ireland Galway, Galway, Ireland

- Chemical Symbolic Language as a Social Semiotic Resource
  Ollie Hunter Secondary school chemistry teacher at Benenden School, Kent, UK and EdD student at the University of Cambridge Faculty of Education, UK

- Development of Common Approaches to Involvement Youth into Science and Technical Sphere - Be Tech!
  Trond Einar Persen, Municipality of Alta (Lead Partner), Norway

- Go-Lab Platform – Learning by Inquiry
  Ton de Jong University of Twente

- I See – Inclusive STEM Education to Enhance the Capacity to Aspire and Imagine Future Careers
  Olivia Levrini Alma Mater Studiorum – University of Bologna
LET'S GO STEM: ITS INFLUENCE ON PHYSICS' LEARNING, INTEREST AND MOTIVATION
Mónica Baptista and Sofia Freire, Instituto de Educação da Universidade de Lisboa (IEUL); Horácio Fernandes, Instituto Superior Técnico (IST); Rui Agostinho, Faculdade de Ciências das Universidade de Lisboa (FCUL); Carla Morais, Faculdade de Ciências da Universidade do Porto (FCUP)

MASDIV - SUPPORTING MATHEMATICS AND SCIENCE TEACHERS IN ADDRESSING DIVERSITY AND PROMOTING FUNDAMENTAL VALUES
Prof. Dr. Katja Maas, International Center of STEM Education (ICSE) at the University of Education, Freiburg
Sabine Mickler

MINDS ON HANDS ON STEM GOES ON ERASMUS+ PROJECT
Mrs Helen Paju Head of Studies in Juhan Liivi nim Alatskivi Kool; Mr Hilmi Dogan Yeniköy Ortaokulu, Science teacher

INCLUSME (INTERCULTURAL LEARNING IN MATHEMATICS AND SCIENCE EDUCATION)
Katja Maas University of Education Freiburg, Germany, Dita Betere

MULTICO – CAREER-BASED SCENARIOS PROMOTING STUDENTS’ CAREER AWARENESS AND THEIR INTEREST IN SCIENCE
Tuula Keinonen University of Eastern Finland, School of Applied Educational Science and Teacher Education

RAS200: MAKING SPACE PROGRAMME
Adriana Cardinot, Andy Shearer School of Physics, National University of Ireland Galway

ROBOCOOP – ROBOTICS EDUCATION DRIVEN BY INTERREGIONAL COOPERATION
Wilfried Lepuschitz, Practical Robotics Institute Austria (PRIA)
Georg Jäggle

ACIN
Nina Bratkova, Centrum vedecko-technickych informacci SR (CVTI ST), Ao.Univ.Prof. Dipl.-Ing. Dr.techn. Markus Vincze, Institut für Automatisierungs- und Regelungstechnik, Technische Universität Wien (ACIN); Richard Balog, PhD. Slovak University of Technology Bratislava (STU); Caroline Jäckl, Stadtshulrat Wien (SSR)

SENSOSCIENCE: REACHING STEM OBJECTIVES THROUGH THE INQUIRY
Castillo-Hernández, Francisco; Jiménez-Liso, María Rut; Martínez-Chico, María; López-Gay, Rafael University of Almeria

THE "BE STEMATIC!" PROJECT: MODEL OF THE IDENTIFICATION OF STEM GIFTED AND TALENTED STUDENTS IN SCHOOL
Josip Burusic Institute of Social Sciences, Zagreb, Croatia

SCIENCE EDUCATION FOR ACTION AND ENGAGEMENT TOWARDS SUSTAINABILITY (SEAS)
Erik Knain, University of Oslo, Norway
# Local Conference Support Team

<table>
<thead>
<tr>
<th>Name</th>
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<tbody>
<tr>
<td>Bergna Beatrice</td>
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<tr>
<td>Boldrini Eugenia</td>
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<td>Bulgarelli Cecilia</td>
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<td>Caramaschi Martina</td>
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<td>Mulazzi Martina</td>
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<td>Quadrelli Nicolò</td>
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<td>Sicignano Mario</td>
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<td>Spada Roberta</td>
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<td>Tomba Lorenzo</td>
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<td>Tovaglari Eleonora</td>
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<td>Varrassi Lorenzo</td>
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<td>Veronesi Federica</td>
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# Strand Chair and SIG Co-Ordinators Meeting

<table>
<thead>
<tr>
<th>Date/Time</th>
<th>Meeting</th>
<th>Room</th>
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<tbody>
<tr>
<td>Monday 26</td>
<td>Strand Chairs meeting</td>
<td>D2</td>
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<tr>
<td>18.30 – 19.30</td>
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<tr>
<td>Monday 26</td>
<td>SIG Coordinators meeting</td>
<td>D3</td>
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<td>18.30 – 19.30</td>
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# SIG Business Meetings

<table>
<thead>
<tr>
<th>Date/Time</th>
<th>SIG</th>
<th>Room</th>
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<tbody>
<tr>
<td>Tuesday 27</td>
<td>SIG 1: Early Years Science</td>
<td>B1</td>
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<tr>
<td>18.30-19.30</td>
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<tr>
<td>Tuesday 27</td>
<td>SIG 2: Video based research of teaching and learning processes</td>
<td>B2</td>
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<tr>
<td>18.30-19.30</td>
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<tr>
<td>Tuesday 27</td>
<td>SIG 3: Science education in out-of-school contexts</td>
<td>B3</td>
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<tr>
<td>18.30-19.30</td>
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<tr>
<td>Tuesday 27</td>
<td>SIG 4: Science</td>
<td>Environment</td>
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<td>18.30-19.30</td>
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<tr>
<td>Tuesday 27</td>
<td>SIG 5: Science Identities</td>
<td>B5</td>
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<td>18.30-19.30</td>
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<tr>
<td>Tuesday 27</td>
<td>SIG 6: Languages &amp; Literacies in Science Education</td>
<td>B6</td>
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<td>18.30-19.30</td>
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## Pre-Conference Workshops

Workshops will have a maximum of 40 participants each

<table>
<thead>
<tr>
<th>N°</th>
<th>TITLE OF THE WORKSHOP</th>
<th>ORGANISERS</th>
<th>LOCATION</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>Building the Community from Within: The Learning Assistant Model as a Mechanism for Creating Collaborative Classrooms and Recruiting STEM Teachers</td>
<td>Hagit Kornreich-Leshem, STEM Transformation Institute, Florida International University, Miami, FL, USA&lt;br&gt;Laurie S. Langdon, Learning Assistant Program, University of Colorado Boulder, Boulder, CO, USA&lt;br&gt;Eleanor W. Close, Department of Physics, Texas State University, San Marcos, TX, USA</td>
<td>Conference centre Room B4</td>
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<tr>
<td>2</td>
<td>Enriched Skeleton Mindmap for learning about developments in STEM education for future teachers</td>
<td>Elise Quant, Eindhoven School of Education, Eindhoven University of Technology</td>
<td>Conference centre Room B1</td>
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<tr>
<td>3</td>
<td>Futurizing Science Education: the I SEE project</td>
<td>I SEE project partnership (<a href="https://iseeproject.eu/partners/">https://iseeproject.eu/partners/</a>)</td>
<td>Conference centre Room B2</td>
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<tr>
<td>4</td>
<td>Multicultural Science Education: What is it? Why do we need it? What does it look like?</td>
<td>Katie Wade-Jaimes, University of Memphis&lt;br&gt;Rachel King Askew, University of Memphis</td>
<td>Conference centre Room B3</td>
</tr>
<tr>
<td>5</td>
<td>New perspectives for Research on Early years Science</td>
<td>Coral Campbell, Faculty of Arts and Education, Deakin University&lt;br&gt;Estelle Blanquet, ESPE d’Aquitaine, University of Bordeaux</td>
<td>Conference centre Room A1</td>
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<td>6</td>
<td>RADIOLAB: an interdisciplinary project for improving awareness about radon exposure</td>
<td>Vera Montalbano, University of Siena and INFN Pisa</td>
<td>Conference centre Room B5</td>
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<td>7</td>
<td>ScienceIEnvironmentIHealth –Towards a Science Pedagogy of Complex Living Systems</td>
<td>Albert Zeyer, Bern University of Applied Science, Department of Health Professions&lt;br&gt;Regula Kyburz-Graber, University of Zurich, Institute of Education&lt;br&gt;Alla Keselman, Two Democracy Plaza, Suite 510</td>
<td>Conference centre Room B6</td>
</tr>
<tr>
<td>8</td>
<td>The challenges involved in reviewing papers and proposals for high impact journals and conferences</td>
<td>María Pilar Jiménez-Aleixandre, Universidad de Santiago de Compostela, Spain&lt;br&gt;Knut Neumann, Leibniz-Institute for Science and Mathematics Education (IPN), Germany&lt;br&gt;Sibel Erduran, University of Oxford, United Kingdom</td>
<td>Conference centre Room B7</td>
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Pre-Conference Workshops

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<tr>
<td>9</td>
<td>Understandings of Scientific Inquiry; Learning to Score and Administer Valid and Reliable Instruments (Views about Scientific Inquiry and Young Children Views about Science)</td>
<td>Judith S. Lederman, Illinois Institute of Technology</td>
<td>Conference centre Room A2</td>
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<td>Norman G. Lederman, Illinois Institute of Technology</td>
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<td>Selina L. Bartels, Valparaiso University</td>
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<td>Juan Jimenez-Pavez, Illinois Institute of Technology</td>
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<td>10</td>
<td>Writing research for publication in science education</td>
<td>Sherry A. Southerland, Florida State University</td>
<td>Conference centre Room D2</td>
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<td></td>
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<td>John Settlage, University of Connecticut</td>
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<tr>
<td>11</td>
<td>SIG3: Science education in out-of-school contexts</td>
<td>Emily Dawson, Department of Science &amp; Technology Studies at University College London, UK</td>
<td>Fondazione Golinelli</td>
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<td></td>
<td>The beauty and pleasure of understanding in out-of-school settings: engaging with ethical research challenges.</td>
<td>Melissa Glackin, Education, Communication and Society, King’s College London, UK</td>
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<td>Patricia Patrick, Counseling, Foundations and Leadership, Columbus State University, USA</td>
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Conference Session Formats

SYMPOSIA
A symposium is a group of four presentations on a common topic, together with a Chairperson and Discussant. The symposium contributors are from at least three countries. Symposia are scheduled in sessions of 120 minutes which include the introduction of the chair, four individual presenters and the discussant. Each presenter has 20 minutes and the discussant has 10 minutes. This will leave 5 minutes for discussion after each presentation and 10 minutes for open discussion at the end moderated by the session chairperson.

ORAL PRESENTATION
Single oral presentations are scheduled in sessions of 90 minutes with four individual presenters or in sessions of 120 minutes with five presentations. Papers are grouped by strand and each session has a title that indicates the common treads. The presentation format allows for 15 minutes of individual presentation time followed by a discussion moderated by the session chairperson.

INTERACTIVE POSTER PRESENTATION
Poster sessions are scheduled for 75 minutes. Each poster presentation will include a graphic presentation of a research study on visual display of size A0 (0.841m x 1.189m) in portrait (vertical) format. A short oral introduction of you and the title of your posters for each poster is given to an audience gathered as a group (1 minute at maximum, in front of the poster and without any slides support). After the authors’ brief introduction, an in-depth discussion between them and the audience follows in the area of the poster displays.

ICT DEMONSTRATIONS AND WORKSHOPS
ICT demonstrations and Workshops are scheduled for 75 minutes. The precise format and requirements are listed under each workshop.
Guidance for Chairpersons

For all sessions, Chairpersons are asked to do two key things:
- act as the Master of Ceremonies for the session and maintain the scheduled timekeeping
- act as enabler of interaction and discussion – this is one of the most important aspects of a research conference, so please foster active discussion.

At the beginning of your session, please ensure that all the presentations are uploaded, introduce yourself to the group, and remind them of the timings. You will have three coloured cards with 5 minutes (white), 2 minutes (yellow) and STOP (red) written on them so that you can give the presenters a clear indication of the time left.

Each room will also have a student host and you can ask him/her to facilitate the session and help with uploading the presentations and staying within the allocated time.

Specific details for different session types are outlined below:

CHAIRING SYMPOSIA
Your role is to manage the smooth flow of the symposium. Introduce the presenters and discussant, and check everyone knows the timing. Each presenter has 20 minutes and the discussant has 10 minutes. This will leave 5 minutes for discussion after each presentation and 10 minutes for open discussion at the end. It is your responsibility to facilitate this. You will be given three colored cards with 5 minutes (white), 2 minutes (yellow) and STOP (red) written on them so that you can give the presenters a clear indication of the time left.

CHAIRING SINGLE ORAL PRESENTATIONS
Your role is to manage the timing of the presentations and check that all runs smoothly. Introduce yourself to the presenters and encourage them to upload their presentations before the session begins. Remind them of the timing: this format allows for 15 minutes of individual presentation time followed by a 5 minutes discussion for each paper. There should be around 10 minutes at the end of the four (or five) presentations for general questions and discussion. You will be given three colored cards with 5 minutes (white), 2 minutes (yellow) and STOP (red) written on them so that you can give the presenters a clear indication of the time left.

CHAIRING INTERACTIVE POSTER SESSIONS
Your role is to make the poster sessions a vibrant opportunity for exchanging research. If presenters have not already done so, encourage them to put up their posters on the boards. Each presenter has 1 minute to present him/herself and the topic of the poster in front of an audience gathered as a group. After the authors’ brief introduction, an in-depth discussion between them and the audience follows in the area of the poster displays. Poster sessions are scheduled for 75 minutes. As Chairperson, you will need to explain how the session runs as it may be unfamiliar to some delegates. You will also need to manage the timing and coordinate a fruitful discussion for each poster.
SCIENTIFIC PROGRAMME
Invited Speakers

OPENING CEREMONY

THE BEAUTY AND PLEASURE OF UNDERSTANDING – WORDS OF INTRODUCTION.

It will be a special pleasure for me to introduce the topic of the conference. I will point to the special connection of this topic with the location of the conference. The "beauty and pleasure of understanding" reflects my own preferred way of engaging with science education, where newcomers to scientific culture strive to reach the essential meaning of science as a human endeavor. I will very briefly refine this “slogan” by mentioning three different types of the subject matter that induce interest in science and the desire for understanding through considering scientific knowledge as a special culture. This perspective suggests curricular implications for cultivating the perception of beauty and pleasure that one experiences in science class when one understands.

Igal Galili
The Hebrew University of Jerusalem, Israel

Igal Galili is currently Professor Emeritus of Science Education at the Amos de-Shalit Science Teaching Center in the Faculty of Mathematics and Natural Sciences of the Hebrew University of Jerusalem, Israel. He studied physics twice, in Russia and Israel, and graduated in theoretical physics at the Hebrew University of Jerusalem. He learned physics education research in post docs in San Diego and Berkeley. His research interests include the structure of students’ knowledge of physics and the structure of physics knowledge, conceptual knowledge of physics, nature of scientific knowledge and its representation in education and art. His research products include the paradigm of Discipline-Culture and the corresponding to it Cultural Content Knowledge. Those specify the role of the history and philosophy of science for the meaningful learning of science. His research papers, textbooks, learning materials resulted these activities.

PLENARY - MONDAY 26TH

ON TIME AND WATER

During the next 100 years we expect to see a fundamental change of all the elements of water on our planet. Many glaciers will melt and the sea levels will rise at a faster rate than has been seen before. Acidification will bring the oceans to a pH level not seen in 30 million years. Patterns of rain and snow will change dramatically in most areas. We could say that nature is not changing in geological speed anymore but entering human speed. This extreme shift is larger than any metaphor or any words or language we are used to. Just like the huge gravity of a black hole makes it invisible, you could say that this issue is so large that it swallows all words and meaning. We hear words like “climate change” but for most people they are just white noise, 99% of the real meaning is not included in our imagination. To describe a black hole you look at the surrounding galaxies and to understand these issues Andri weaves a web of stories from mythology, to his grandmother’s honeymoon on Europe’s largest glacier, to our understanding of our intimate time. We are faced with the almost impossible task of cutting carbon emissions to zero in 2050 according to newest studies. The question is – are we too late to do something? What can actually be done in 30 years? This calls for nothing less than a new scientific revolution, projects on the scale of the Manhattan project, new paradigms and a new approach to almost everything done in the 20th century. This huge narrative should be a source of motivation for all science studies in the next decades.

Andri Snær Magnason
writer, Iceland

Andri Snær Magnason is an Icelandic writer born in Reykjavik. He is a writer of fiction, non-fiction, poetry, plays and documentary films. His book LoveStar won the Philip K. Dick special citation in 2014 and Le Grand prix de l’Imaginaire in France 2016. and his children’s book, The Story of the Blue Planet was the first children’s book to win the Icelandic literary award and has been published in 32 languages. His book Dreamland, a Self Help Manual for a Frightened Nation has contributed to a new energy policy in Iceland and the vision of the Highland National Park in the Central Highlands of Iceland. Andri Snær Magnason ran for president in Iceland in 2016 and came third in the election.
WHERE ARE WE? SYNTHESSES AND SYNERGIES IN SCIENCE EDUCATION RESEARCH AND PRACTICES

One of the grand projects of research in science education is to understand conceptual change. By conceptual change, I mean the process by which a student’s intuitive understanding of the natural world—the understanding that they gain through interaction with the world and other people—is transformed by formal instruction in science. The purpose of this talk will be to provide a sense for where we are, as a field, in this grand project, and to chart a path toward consensus. In the first part of this talk, I will describe what I believe are the main impediments to finding consensus. There are, of course, disagreements among researchers. But the real difficulties, I will argue, arise from misalignments between research programs that go beyond straightforward disagreements. For example, in some cases, researchers are addressing different target phenomena; in other words, when they talk about “conceptual change,” they are not even talking about the same thing. In the second part of the talk, I will attempt to chart a way forward. I will argue that, first, there is already a sort of proto-consensus emerging, one that recognizes that some researchers are talking about elements, while others are talking about ensembles of those elements. I will also argue that the field, as a whole, suffers from a sort of ontological slippage. Our theoretical entities—such as the notion of “concept”—should gain precision from the way they are situated in our larger theories. But when we use terms such as “concept,” we often do so, tacitly, against a backdrop of shifting theoretical frameworks. Finally, I will argue that a particular type of empirical work is necessary to push us toward a consensus view of conceptual change. This empirical work should be focused on the sensitivity of people to properties of scientific explanations, such as their consistency and adequacy.

Bruce Sherin  Northwestern University United States

Bruce Sherin is recognized for his work on conceptual change in science. His early research focused on continuities between children’s understanding of the natural world and expert understanding of science. Of particular note with respect to this program is his work on the understanding of physics equations. In that work, he showed how the understanding of physics equations is grounded in a vocabulary of informal and intuitive conceptions. More recently, he has begun to apply computational techniques to the type of text analysis employed by researchers in the Learning Sciences and education more broadly. In addition, with Miriam Sherin, he has explored the use of novel technologies for the study of teacher cognition. He is currently a Professor in Northwestern University’s School of Education and Social Policy, which is located in the US, in Evanston, Illinois.
EMBODIED COGNITION: FROM NEUROSCIENCE TO SCIENCE EDUCATION

Research on embodied cognition has shifted our perspective on cognitive representations and processes. This research has begun to challenge the long-standing assumption that higher level cognition (such as concept representation, reasoning and planning) is best understood in terms of abstract representations and computational processes. Instead, evidence from neuroscience now suggests that even so-called “higher level” cognition implicates perceptual and motor systems. This session examines this evidence and explores the implications of this shift in perspective on the nature of cognition for understanding science learning and instruction.

Corrado Sinigaglia University of Milan, Italy

Corrado Sinigaglia is Full Professor of Philosophy of Science. He has been at University of Milan since 2001 when he was appointed as Assistant Professor there. Before that he studied at the Husserl-Archives of Leuven (1992-1993), at the Ecole Normale Superieure of Paris (1994), and at the University of Genova (1995-1999), where he obtained his PhD in Philosophy of Science. His main fields of research are: Cognitive neuroscience and philosophy of mind. He is currently working on the role of motor processes and representations in joint action.

Tamer Amin (discussant), American University of Beirut, Lebanon

Tamer Amin is an Associate Professor of Science Education and Chair of the Department of Education at the American University of Beirut, Lebanon. He obtained his Ph.D. in Developmental Psychology from Clark University, USA. His primary research interest is the development of scientific understanding and reasoning, drawing on the theoretical perspectives of conceptual change and embodied cognition. His work on embodied cognition explores the relevance of the cognitive linguistic theory of conceptual metaphor for understanding science learning and instruction. He has co-edited (with F. Jeppsson and J. Haglund, 2015) a special issue in the International Journal of Science Education on “Embodied Cognition and Conceptual Metaphor in Science Learning” and (with O. Levrini, 2018) Converging Perspectives on Conceptual Change: Mapping an Emerging Paradigm in the Learning Sciences, Routledge.
Invited Speakers

PLENARY - THURSDAY 29TH

SOCIOSCIENTIFIC-ISSUES: SEARCHING FOR NEW PERSPECTIVES
A paramount commitment of science education is to enable students to tackle societal, real-life issues by making decisions that are informed by science. This commitment has been the basis of the notion of socio-scientific issues (SSI), which has developed into an important strand of science education research. Despite a range of documented benefits of SSI – such as improving students’ learning of content, developing interest, and improving students’ argumentation competencies – it is a widespread finding that it is profoundly difficult to change teaching practice into one that regularly harbours high quality SSI-teaching. We discuss the notion of SSI – both from the perspective of its historical development and from the perspective of its present manifestation in curricula and policy documents – and we will focus on the new perspectives of socioscientific issues and point to how some of the most persistent challenges for the uptake of SSI-teaching can be alleviated.

Maria Evagorou University of Nicosia, Cyprus

Maria Evagorou is an Associate Professor in Science Education at the Department of Education, University of Nicosia, and also the Associate Head of the Department of Education. Her research focuses on exploring and enhancing students’ and pre-service teachers’ argumentation especially in socio-scientific issues. She was the scientific coordinator for the PreSEES project (Preparing Science Educators for Everyday Science). She was the local PI for the Engage Project (FP7) focusing on including responsible research and innovation in school activities, and is currently the PI for the DIALLS project (Horizon2020) aiming to promote dialogue and argumentation. Before returning to Cyprus, Maria has worked as a researcher at the Center for Informal Learning and Schools (CILS) at King’s College London, and as a Lecturer at King’s College London.

Jan Alexis Nielsen University of Copenhagen, Denmark

Jan Alexis Nielsen is Associate Professor and Head of Section at the Department of Science Education at the University of Copenhagen, Denmark. His research focuses on the understanding and assessment of generic competences. He has investigated students’ socioscientific argumentation and teachers’ beliefs about teaching socioscientific issues. He has also worked closely with teachers to build assessment frameworks for inquiry and innovation competence. Over the past 12 years, he has participated in a range of international and national projects related to inquiry and/or socioscientific issues. He is the strand co-coordinator of the Scientific Literacy and Socio-scientific Issues Strand for ESERA.
Invited Speakers

PANEL: SCIENCE EDUCATION IN MULTICULTURAL AND MULTILINGUAL CONTEXTS

This panel seeks to promote more reflective and agentic approaches to science teacher preparation and science education research that could help establish equitable and socially just education for everyone. Through the voices of five science education scholars from different parts of the globe and with diverse cultural backgrounds, gender expression and theoretical frameworks, we will instigate a conversation about the complexity of science education in today’s schools. We will also encourage audience participants to reflect on and discuss the following questions: (a) In what ways are our specific science education contexts culturally and linguistically diverse? (b) What research methodologies are appropriate to capture the complexity of the identified culturally diverse classrooms? (c) How can we expand the representation of cultural diversity in schools, ethnicity of scholars, and diversity of scholarship in science education research publications? (d) In what ways can we influence policies related to language learning and use, equitable access and success in education, and research funding for science education? (e) How can we promote more attention to the need of increasing the contextualization of research data in science education research to enhance the impact of research on teacher practice and on student learning? (f) How can we establish more meaningful collaborations with all stakeholders throughout research projects to make science education research more culturally and socially relevant? Drawing from the experiences of the panellists in multicultural and multilingual science education contexts, we will encourage the audience participants to self-reflect on the ways they could promote equity, diversity and social justice in science education practice and research to address the increasing need of providing multiple opportunities for access and success in science for everyone.

Mariona Espinet (ORGANIZER AND CHAIR) Universitat Autònoma de Barcelona, Spain

Mariona Espinet is an associate professor of Science Education at the Autonomous University of Barcelona, in Catalonia, Spain. She earned a PhD in Science Education at the University of Georgia, Athens, USA thanks to a Fulbright-La Caixa scholarship. At present, she teaches science and environmental education in pre-service and in-service pre-school and primary teacher education programs, as well as research courses offered at the master and doctoral levels. She is the coordinator of the Doctorate in Education in Didactics of Science and Mathematics at UAB, and the coordinator of two research groups Gresc@ (Education for Sustainability, School and Community) and SGR ACELEC (School Science Activity: Languages, Tools and Contexts). She is member of the ESERA Board and co-founder of the ESERA SIG on Languages and Literacies in Science Education. Her research and innovation interests are strongly interdisciplinary and focus on science education for sustainability, classroom discourse and critical literacy in multilingual science learning environments, and community learning in school agroecology. Her most recent international publishing activity related to the theme of this panel is to co-edit the International Journal of Science Education Special Issue on Language issues in Science Education in Multilingual Societies to appear in 2019.

Saouma BouJaoude (SPEAKER) American University of Beirut, Lebanon

Saouma BouJaoude completed a doctorate in curriculum and instruction/science education in 1988 at the University of Cincinnati, USA. He is presently professor of science education and director of the Center for Teaching and Learning at the American University of Beirut. His research interests include evolution education, teaching science in multilingual settings, curriculum and teaching methods, and the nature of science. BouJaoude has published in international journals such as the Journal of Research in Science Teaching, Science Education, International Journal of Science Education, Journal of Science Teacher Education, the Science Teacher, Science & Education, Research in Science Education, and School Science Review, among others. Additionally, he has presented his research at local, regional and international education conferences. BouJaoude is presently an associate editor of the Journal of Research in Science Teaching.
Invited Speakers

SONYA N. MARTIN (SPEAKER) Seoul National University, Korea

Sonya N. Martin is an Associate Professor in Science Education at Seoul National University in Korea where she also leads the Sociocultural Approaches to Science Education Equity (SASEE) lab. Sonya holds a bachelor’s degree in Biology from Bryn Mawr College and two master’s degrees in Elementary Education and in Chemistry Education from the University of Pennsylvania in the United States. She also holds a doctoral degree in Science Education from Curtin University in Australia. Her research focuses on expanding learning opportunities and improving achievement for culturally and linguistically diverse students and for students with special education needs while also supporting the professionalization of science teachers so they can be positioned to effectively support all students to learn science. She collaborates with colleagues in Korea, Taiwan, Singapore, and Australia to explore how language and culture shape teacher and student interactions in science classrooms and she also conducts research on how English-language hegemony in academic publishing marginalizes non-native English scholars in science education. She is a co-founder and co-editor of the journal Asia-Pacific Science Education (APSE) and serves on the editorial board of several journals including Cultural Studies of Science Education (CSSE) and Research in Science Education (RISE).

AUDREY MSIMANGA (SPEAKER) University of the Witwatersrand, Johannesburg, South Africa

Audrey Msimanga is the Academic Head of Postgraduate in the School of Education at the University of the Witwatersrand in Johannesburg, South Africa. Her interest is in understanding the role of teacher education in preparing student teachers to teach science in socio-economically diverse and multilingual contexts. At the micro level Dr Msimanga explores the role and dynamics of classroom interaction in the teaching and learning of science, specifically how science teachers and students talk; how talk helps students make sense of science; what talk reveals about student scientific reasoning; the role of silence and language in science learning.

ALBERTO J. RODRIGUEZ (SPEAKER) Purdue University, United States

Alberto J. Rodriguez is the Mary Endres Chair in Elementary Education and Professor of Cross-Cultural Science Education in the Department of Curriculum and Instruction at Purdue University. His research focuses on the use of sociotransformative constructivism (STC) as a theoretical framework that merges critical cross-cultural education tenets (as a theory of social justice) with social constructivism (as a theory of learning). Dr. Rodriguez recently received the Innovations in Research on Diversity in Teacher Education Award from the American Educational Research Association (AERA), Division K (Teaching and Teacher Education, 2017). He also received the Kappa Delta Pi – Teaching and Teacher Education Research Award from AERA in 2000, and the New Mexico State University's Award for Exceptional Achievements in Creative Scholarly Activity in 2002.

Dr. Rodriguez’s work has been published in various journals. His article, Strategies for counterresistance: Toward sociotransformative constructivism and learning to teach science for diversity and for understanding (1998), was selected for the Multicultural Science Education, Equity and Social Justice special issue of the Journal of Research in Science Teaching (JRST).
Monday 15:00 - 16:30

15:00 - 16:30  OP01 - STRAND 3 - INQUIRY-BASED SCIENCE TEACHING  
Room A1
Chairperson(s): Elizabeth Lewis

TEACHING AND LEARNING ITERATION THROUGH OPEN-ENDED INVESTIGATIONS
Lynda Dunlop; Maria Turkenburg; Kerry Knox; Judith Bennett
University of York

REFLECTION AND INQUIRY-BASED TEACHING: EXPLORING REFLECTIVE PRACTICES IN BEGINNING SECONDARY SCIENCE TEACHERS.
Ana Margarita Rivero1; Elizabeth Lewis2
1Seattle University; 2University of Nebraska-Lincoln

EXPLORING VIEWS OF SPANISH MIDDLE, HIGH SCHOOL STUDENTS AND PRE-SERVICE SCIENCE TEACHERS ABOUT SCIENTIFIC INQUIRY
Juan Jimenez3; Soraya Hamed4; Judith Lederman5; Norman Lederman6
3Illinois Institute of Technology; 4University of Seville

PREDICTORS OF INQUIRY-BASED SCIENCE TEACHING
Elizabeth Lewis1; Lyrica Lucas1; Amy Tankersley4; Elizabeth Hasseler1; Ana Rivero2; Brandon Helding3
1University of Nebraska-Lincoln; 2Seattle University; 3Boulder Learning, Inc.

15:00 - 16:30  OP02 - STRAND 3 - MODELS AND ARGUMENTATION IN SECONDARY BIOLOGY EDUCATION  
Room A2
Chairperson(s): Niklas Schneeweiß

FOSTERING SCIENTIFIC REASONING WITH MODELS OF BIOLOGICAL PROCESSES USING LESSON STUDY
Susanne Jansen1; Marie-Christine Knippe1; Wouter van Jooldingen2
1Utrecht University; 2Utrecht University - Freudenthal Institute

A MODEL-BASED LEARNING ABOUT MITOSIS: THE ROLE OF MITOTIC SPINDLE THROUGH DIGITAL STORYTELLING
Tamara Esquivel Martín; Beatriz Bravo Torija; José Manuel Pérez Martín; Noelia Sánchez Sánchez
Universidad Autónoma de Madrid

TEACHING BIOLOGY WITH EDUCATIONAL ESCAPE ROOMS: IMPACT ON SUBJECT KNOWLEDGE AND SKILLS
Georgios Villias
University of Cambridge, Faculty of Education

DESCRIBING LEVELS OF ORGANISATION IN BIOLOGY AND SCIENCE EDUCATION — A CRITICAL REVIEW OF LITERATURE
Niklas Schneeweiß, Harald Gropengießer
Leibniz University Hanover

15:00 - 16:30  OP03 - STRAND 2 - ANALYSING EMOTIONS, ENGAGEMENT AND PARTICIPATION  
Room B1
Chairperson(s): John Connolly

DIAGNOSIS OF EMOTIONS AND ATTITUDES TOWARDS STEM AREAS IN SECONDARY SCHOOL STUDENTS
Guadalupe Martínez-Borreguero; Milagros Mateos-Nuñez; Francisco Luis Naranjo-Correa
University of Extremadura

LIVING ANIMALS IN THE CLASSROOM: AN ANALYSIS ON EMOTIONS AND INTEREST
Lisa Virtbauer; Jörg Zumbach
Universität Salzburg

ACADEMIC EMOTIONS TOWARDS A PRACTICE OF MICROBIOLOGY ANTICIPATE LEARNING OUTCOMES IN PRE-SERVICE TEACHERS
Rocio Esteban Gallego; José María Marcos Merino, Jesús A. G. Ochoa de Alda
University of Extremadura

STUDENTS’ SELF-EFFICACY BELIEFS AND PARTICIPATION IN SECONDARY SCHOOL PHYSICS LESSONS
John Connolly
UCL Institute of Education
15:00 - 16:30  OP04 - STRAND 2 - VALUES AND WISDOM IN STUDENTS AND EXPERTS  Room B2
Chairperson(s): Alexandra Stöckert

BIODIVERSITY VALUES OF SECONDARY SCHOOL STUDENTS
Rafael Gil de Castro; Caio de Castro e Freire; Marcelo Tadeu Motokane
University of São Paulo

EXPLORING WISDOM OF SCIENCE: CAN WISDOM BE LEARNED FROM SCIENCE?
Insook Lim; Jinwoong Song
Seoul National University

HOW DO EXPERTS ARTICULATE THE INTRINSIC VALUE OF CHEMISTRY?
Katherine Aston
King’s College London

ENVIRONMENTAL VALUES AND TECHNOLOGY PREFERENCES OF UNIVERSITY BEGINNERS
Alexandra Stöckert; Franz X. Bogner
University of Bayreuth

15:00 - 16:30  OP05 - STRAND 6 - STUDENTS’ PERCEPTIONS  Room B3
Chairperson(s): Minjoo Lee

NOT JUST DO SCIENCE INQUIRY, UNDERSTAND IT! PERCEPTIONS OF MIDDLE SCHOOL STUDENTS ABOUT ASPECTS OF SCIENCE INQUIRY.
Einat Ben Eliyahu1; Ortz Ben Zvi Assarak2; Judith S. Lederman2
1Ben Gurion University of the Negev; 2Illinois Institute of Technology

STUDENTS VIEWS ABOUT SCIENCE AND SCIENTISTS
Anne Freitas1; Michele Medeiros1; Marcelo Motokane2
1Postgraduate Program in Science Teaching, University of São Paulo; 2University of São Paulo

CHARACTERIZATION OF STUDENTS’ SCIENTIFIC EPSTEMOLOGICAL CONCEPTIONS AND DEVELOPMENT OF A MULTI-DIMENSIONAL INSTRUMENT FOR THE ASSESSMENT
Cristina Sousa1; João C. Paiva1; Isabel Chagas2; João C. Paiva1; Isabel Chagas2; Isabel Chagas2
1Faculdade de Ciências, Universidade do Porto; 2Instituto de Educação, Universidade de Lisboa, Portugal; 3Faculdade de Ciências, Universidade do Porto & CIQUP

EPISTEMIC AGENCY IN STUDENT-LED RESEARCH PROJECT: FOCUSING ON THE R&E PROGRAM IN KOREA
Minjoo Lee
Daejeon Science High School for the gifted

15:00 - 16:30  OP168 - STRAND 8 - EPISTEMIC ASPECTS OF SSI  Room B4
Chairperson(s): Athina Koutsianou

UNDERGRADUATES’ EPISTEMIC CAUTION FOR EVALUATING SOCIO-SCIENTIFIC KNOWLEDGE CLAIMS
Won Jung Kim; Alicia Alonzo
Michigan State University

EPISTEMIC CONCERNS ON STUDENTS’ USE OF ARGUMENTS ON PSEUDOSCIENCES
Jordi Domènech-Casal; Carolina Sepulveda; Anna Marbà-Tallada
Universitat Autònoma de Barcelona

ANALYZING EPSTEMOLOGICAL, ONTOLOGICAL AND AXIOLOGICAL COMMITMENTS IN STUDENTS’ SPEECHES AS THEY DISCUSS ON MEDICINES AND SELF-MEDICATION
Bruna Herculano da Silva Bezerra; Edenia Maria Ribeiro do Amaral
Federal Rural University of Pernambuco

EXPLORING ASPECTS OF PRE-SERVICE PRIMARY TEACHERS’ EPISTEMIC COGNITION WHILE DEALING WITH A SOCIO-SCIENTIFIC ISSUE: A THINK-ALOUD STUDY
Lida Desikou1; Athina Koutsianou2; Anastassios Emvalotis2
1University of Patras, Department of Primary Education; 2University of Ioannina, Department of Primary Education
15:00 - 16:30   OP07 - STRAND 9 - TEACHERS’ CONCEPTIONS AND WILLINGNESS TO TAKE ACTION   Room B5

Chairperson(s): Anthoula Maidou

**EVALUATING ENVIRONMENTAL BEHAVIOUR OF PRE-SERVICE PRIMARY SCIENCE TEACHERS**

Anat Abramovich1; Shirley Miedjensky2; Avi Assor3
1Gordon Academic College of Education; 2Oranim Academic College; 3Educational & School Psychology Program, Education Department, Ben-Gurion University

**PRE-SERVICE TEACHERS UNDERSTANDING OF CLIMATE CHANGE MITIGATION AND THEIR WILLINGNESS TO TAKE ACTION**

Sakari Tolppanen1; Jingoo Kang2; Anna Claudelin3
1University of Eastern Finland; 2LUT University

**IN-SERVICE TEACHERS’ CONCEPTION OF GLOBAL WARMING, POLLUTION AND OZONE LAYER: A SOUTH AFRICAN CASE STUDY**

Headman Hebe
University of South Africa

**INTRODUCING PRE-SERVICE EARLY CHILDHOOD TEACHERS TO EDUCATION FOR SUSTAINABLE DEVELOPMENT USING SOCRATES’ HOUSE**

Anthoula Maidou1; Katerina Plakitsi1; Hariton Polatoglou2
1University of Ioannina; 2Aristotle University of Thessaloniki

15:00 - 16:30   OP08 - STRAND 12 - STUDENT’S POSITIONING AND STEM CAREER ASPIRATIONS   Room B6

Chairperson(s): Hennes Alberding

**WHAT YOU WEAR CAN MAKE A DIFFERENCE IN ELEMENTARY STUDENTS’ PERCEPTIONS OF STEM CAREERS**

Tammy Lee1; Gail Jones2; Katherine Chesnutt3; Sarah Carrier4; Lauren Madden5; Emily Cayton6; Megan Ennes7
1East Carolina University; 2N.C State University; 3N.C. State University; 4College of New Jersey; 5Campbell University

**SECONDARY SCHOOL STUDENTS POSITIONING THEMSELVES IN RELATION TO SCIENCE**

Tuula Keinonen; Anssi Salonen; Sirpa Kärkkäinen; Anu Hartikainen-Ahia; Kari Sormunen
University of Eastern Finland

**KOREAN HIGH SCHOOL STUDENTS’ CAREER INTEREST IN STEM THROUGH THE STEAM R&D PROJECT**

Yohan Hwang1; Kongju Mun2; Sung-Won Kim3
1Chungnam National University; 2Seoul National University; 3Ewha Womans University

**CAREER ORIENTATION IN THE FIELD OF FOOD CHEMISTRY FOR SECONDARY SCHOOL STUDENTS**

Hennes Alberding; Verena Pietzner
Carl von Ossietzky Universität Oldenburg

15:00 - 16:30   OP09 - STRAND 12 - GENDER ISSUES AND PHYSICS   Room B7

Chairperson(s): Judith Hillier

**REPOSITIONING THE GENDER GAP IN UK PHYSICS: MAPPING PATHWAYS TO SUCCESS**

Jaimie Miller-Friedmann
University of Oxford

**SCIENCE OUTREACH TO PROMOTE PHYSICS TO GIRLS: AN INVESTIGATION INTO THE IMPACT OF A SCHOOL VISIT PROGRAMME**

Grainne Walsh1; Vincent Casey2; Michael Cauchi3; Aaron Cusack1; Yvonne Kavanagh1; Maria Quinn1; Ian Clancy1
1University of Limerick; 2IT Carlow

**BRINGING GIRLS CLOSER TO SCIENCE: GENDER INCLUSIVE STRATEGIES IN PHYSICS’ CLASSES**

Camila Manni Dias do Amaral
Universidade Federal do Rio de Janeiro

**DO WOMEN-ONLY SPACES IN PHYSICS STILL MATTER?**

Judith Hillier; Jaimie Miller-Friedmann
University of Oxford
INTEGRATING CONFIDENCE ASSESSMENT TO EXPLORE SENIOR HIGH SCHOOL STUDENTS’ IDEAS ABOUT ELECTRIC CIRCUIT MODELS: A COMPARISON OF SCIENCE AND NON-SCIENCE MAJORS
Shian-Jang Wang; Jing-Wen Lin
National Taiwan University of Science and Technology

DRAWING MENTAL MODELS OF STATIC ELECTRICITY: WHAT WE CAN GAIN
Constantina Stefanidou1; Anastasia Ferentinou1; Konstantina Tsalapati2
1National and Kapodistrian University of Athens; 2University of Thessaly

DEALING WITH THE RECTILINEAR PROPAGATION OF LIGHT: A COUNTER-INTELLUTION EVOLUTION FROM PRIMARY SCHOOL TO UNIVERSITY
Estelle Blanquet1; Violette Blé2; Claire Darraud1; Audrey Garnier3; Fabienne Goldfarb4; Manuela Miron5; Fernanda Thevenot1; Eric Picholle1
1LACES ESPE d’Aquitaine Université de Bordeaux (France); 2ESPE d’Aquitaine (France); 3ESPE d’Aquitaine; 4Laboratoire Amé Cotton Université Paris Sud (France); 5University of Iasi (Romania); 6Inphyni UMR7010 CNRS-Université de Nice Sophia-Antipolis membre Université Côte d’Azur (France)

PRIMARY TEACHERS STUDENTS’ UNDERSTANDING OF ELECTROMAGNETIC INDUCTION
Jan Andersson1; Gunnar Jonsson2
1Karlstad University, Department of engineering and physics; 2Mälardalen University, UKK, Physics

Biodimod: A Dialogic Process of Making Sense of Biodiversity Through Modelling-Based Teaching in Secondary Education
Gonzalo Bermudez1; Karen Gimena Cisnero2; Lía Patricia García3; Ana Lia De Longhi2
1Universidad Nacional de Córdoba - National Scientific and Technical Research Council; 2Universidad Nacional de Córdoba, Facultad de Ciencias Exactas, Físicas y Naturales; 3Universidad Nacional de Córdoba, Facultad de Ciencias Exactas, Físicas y Naturales. IPEM, Min. de Ed

A Study of the Effects of an Inquiry-Based Workshop on Engineering Undergraduates Modelling Skills
Onofrio Rosario Battaglia; Claudio Fazio
University of Palermo - Dipartimento di Fisica e Chimica

Integrating Scientific Practices into the Context of Daily Life. Assessments Carried Out by Students
Verónica Muñoz-Campos; Antonio-Joaquín Franco-Mariscal; Ángel Blanco-López
University of Málaga

Development of a Competency-Based Curriculum for Science Education in Demmark
Jan Selberg1; Tomás Hojgaard2
1University of Copenhagen; 2University of Aarhus

Network Analysis of Changes to an Integrated Science Course Curriculum over Time
Jesper Bruun1; Ida Viola Kalmar Andersen2; Julie Houggaard Overgaard2
1Department of Science Education, University of Copenhagen; 2Roskilde Gymnasium

Preparing for the Unpredictable: Developing Korea Science Education Standards (KSES) for the Next Generation
Jinwoong Song1; Yong Jae Joun2; Yeon-A Son3; Jun Ki Lee4; Phil Seok Oh5; Suk-Jin Kang6; Youngsun Kwak7; Jeong Woo Son8; Dae Hong Jeong9; Hyuk Ihm10; Hyun Jeung Lee11; Donggeon Kim12; Jiyeon Na13; Sang Soo Kim14; Sung choon Park1; Jong-Hoon Do15
1Seoul National University; 2Gongju National University of Education; 3Dankook University; 4Chonbuk National University; 5Gyeongin National University of Education; 6Jeonju National University of Education; 7Korea National University of Education; 8Gyeongsang National University; 9Munjeong High school; 10Ongok elementary school; 11Changdeok Girl’s Middle school; 12Chunchon National University of Education; 13Seowon University

Descriptive Analysis of the ISIS Primary School Science Curriculum
Marie-Hélène Bruyère1; Patrice Potvin2; Olivier Arvias;3 Marianne Bissonnette1; Chrine Chamsine4; Mohamed Amine Mathou1; Vivek Venkatesh2
1Université du Québec à Montréal (UQAM); 2Concordia University
WHAT TYPES OF WRITTEN FEEDBACK DO UNDERGRADUATE CHEMISTRY STUDENTS GIVE EACH OTHER?
Yew Jin Lee; Peter Lee; Norman Lim; Timothy Tan
Nanyang Technological University

FORMS AND FUNCTIONS OF ON-THE-FLY FORMATIVE ASSESSMENT IN PHYSICS INQUIRY
Pasi Nieminen; Markus Hähköniemi; Jouni Viiri
University of Jyväskylä

ILLUSTRATING THE APPLICATION OF INTERACTIONS ON THE FLY IN SCIENCE TEACHING USING CONCEPT MAPS
Michalis Livitziis; Nicos Papadouris; Constantinos Constantinou
University of Cyprus

BENEFITS AND BARRIERS: A CASE STUDY OF IMPLEMENTING PEER ASSESSMENT IN LOWER SECONDARY SCHOOL PHYSICS
Laura Ketonen; Jouni Viiri; Pasi Nieminen
University of Jyväskylä

LEARNING WITH FRICTION — A GEOGEBRA SIMULATION IN PHYSICS
Lorena Solvang; Jesper Haglund
Karlstad University

STRUCTURED VS. OPEN SIMULATION-BASED SCIENCE LEARNING ENVIRONMENT — WHAT IS THE DIFFERENCE FOR LEARNING AND ENGAGEMENT FOR DIFFERENT-AGED STUDENTS?
Antti Lehtinen; Markus Hähköniemi; Pasi Nieminen
University of Jyväskylä, Department of Teacher Education

LEARNING NEWTONIAN MECHANICS WITH AN INTRINSICALLY INTEGRATED EDUCATIONAL GAME
Anne van der Linden; Wouter van Joolingen; Ralph Meulenbroeks
Freudenthal Institute, Utrecht University

MEANINGFUL LEARNING AFTER USING MULTIPLE MEDIATIONS TO TEACH BOHR ATOM IN SECONDARY SCHOOL IN BRAZIL
Agostinho Serrano; Savana Anjos Freitas
Universidade Luterana do Brasil

EXPLANATORY POWER OF EXPLANATIONS - TRACKING PRE-SERVICE TEACHERS’ CONCEPTUAL DEVELOPMENT DURING DC-CIRCUIT TASKS
Terhi Mäntylä1; Tommi Kokkonen2
1Tampere University; 2University of Helsinki

EXAMINING THE EFFECTS OF SCIENCE TEACHER’S EPISTEMOLOGICAL BELIEFS ABOUT LANGUAGE IN CLIL SCIENCE CLASSROOMS
Laura Tagnin1; Laura Tagnin1; Mäire Ni Riordáin2; Mary Flaming1
1National University of Ireland, Galway; 2University College Cork, Cork, Ireland

DISCOURSE ANALYSIS OF BRAZILIAN STUDIES ON SCIENCE EDUCATION: AN INVESTIGATION OF SCIENTIFIC ARTICLES
Samuel Schnorr; Mauricio Pietrocola
University of São Paulo

VIDEO ANNOTATIONS TO ANALYSE THE CAPACITY TO ARGUE AND COUNTERARGUMENT BY PRE-SERVICE EARLY CHILDHOOD TEACHERS ON WATER CONSUMPTION
Maria de la Paz Domínguez-Crespo; Daniel Cebrián-Robles; Antonio-Joaquín Franco-Mariscal; Angel Blanco-López
Malaga University
### OP16 - STRAND 15 - MODELING AND REPRESENTATION IN EARLY CHILDHOOD SCIENCE

**Chairperson(s): Spyros Kollas**

**THE ROLE OF MULTIMODAL EDUCATIONAL MATERIAL IN UNDERSTANDING SCIENTIFIC (BIOLOGY) CONCEPTS**
Kiki Tsoukala
University of Thessaly - Department of Early Childhood Education

**INVESTIGATION OF THE IMPACT OF HAPTIC FEEDBACK ON PRE-SCHOOL STUDENTS’ UNDERSTANDING IN THREE SCIENCE DOMAINS**
Marinos Papaevripidou; Ivoni Pavlou; Eleftheria Panteli; Zacharias Zacharia
University of Cyprus

**MODELING-BASED LEARNING IN EARLY CHILDHOOD SCIENCE EDUCATION**
Loucas Louca¹; Zacharias Zacharia²
¹European University Cyprus; ²University of Cyprus

**CASE STUDIES OF COLLABORATIVE MODEL-BASED REASONING FOR CONCEPTUAL CHANGE IN PRESCHOOL CHILDREN**
Spyros Kollas; Eleni Sakellaridi
National and Kapodistrian University of Athens

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### OP17 - STRAND 18 - DESIGNING AND VALIDATING METHODS AND TOOLS

**Chairperson(s): Stefan Hartmann**

**DESIGN AND VALIDATION OF A TEACHER SURVEY ON SPECIAL NEEDS SCIENCE EDUCATION**
Tang Wee Teo
National Institute of Education, Nanyang Technological University, Singapore

**AN ALTERNATIVE TO STEBI-A: VALIDATION OF THE T-STEM SCIENCE SCALE**
Art Rachmatullah¹; Alonzo Alexander¹; Alana Unfried¹; Eric Wiebe¹
¹North Carolina State University; ²California State University Monterey Bay

**DESIGN AND VALIDATION OF A QUESTIONNAIRE FOR SURVEY RESEARCH ON SCIENCE TEACHER EDUCATORS’ PEDAGOGY AND PRACTICE IN RELATION TO INCLUSION**
Todd Milford¹; Christine Tippett¹; Karen Goodnough¹; Saiqa Azam¹
¹University of Victoria; ²University of Ottawa; ³Memorial University of Newfoundland

**INVESTIGATING THE VALIDITY AND RELIABILITY OF A SCIENTIFIC REASONING TEST FOR PRE-SERVICE TEACHERS**
Stefan Hartmann¹; Dirk Krüger²; Annette Upmeier zu Belzen¹
¹Humboldt-Universität zu Berlin; ²Freie Universität Berlin

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### OP18 - STRAND 13 - LEARNING AND TEACHING INQUIRY

**Chairperson(s): Alexander Buessing**

**HOW DO TEACHERS CHOOSE INSTRUCTIONAL MATERIAL FOR INQUIRY-BASED SCIENCE EDUCATION?**
Marco Longhitano; Judith Arnold; Rachel Schwager; Lennart Schalk
PH Schwyz

**FROM VAPOR TO ICE; FEATURES OF PST SOCIAL SCIENTIFIC LANGUAGE DURING INQUIRY-BASED LEARNING**
Kristin Elisabeth Haugstad; Unni Eikeseth
NTNU - Norwegian University of Science and Technology

**HOW TO USE LANGUAGE IN IMMERSIVE ARGUMENT-BASED INQUIRY: A META-SYNTHESIS OF RESEARCH ON SCIENCE WRITING HEURISTIC APPROACH FROM 2000-2018**
Jee Suh¹; Brian Hand¹; Ying-Chih Chen¹
¹University of Alabama; ²University of Iowa; ³Arizona State University

**PRE-SERVICE TEACHERS’ PSYCHOLOGICAL DISTANCE TOWARDS ENVIRONMENTAL AND HEALTH SOCIO-SCIENTIFIC ISSUES**
Alexander Buessing; Susanne Menzel
Didactics of Biology, Osnabrück University
15:00 - 16:30  OP19 - STRAND 13 - PEDAGOGICAL CONTENT KNOWLEDGE I  Room G2

Chairperson(s): Doras Sibanda

 THE IMPACTS OF AN INITIAL TRAINING PROGRAM IN THE DEVELOPMENT OF CHEMISTRY TEACHER’S KNOWLEDGE
Keysy Nogueira; Carmen Fernandez
University of Sao Paulo

EXPLORING THE RETENTION OF TSPCK BY CHEMISTRY GRADUATE BEGINNING TEACHERS
Elizabeth Mavhunga; Josephat Mheso
Wits University

DEVELOPMENT OF PRE-SERVICE CHEMISTRY TEACHERS’ TECHNOLOGICAL PEDAGOGICAL CONTENT KNOWLEDGE
Ayla Cetin-Dindar1; Yezdan Boz2
1Bartin University; 2Middle East Technical University

POST GRADUATE CERTIFICATE IN EDUCATION STUDENTS’ TOPIC SPECIFIC PEDAGOGICAL KNOWLEDGE (TSPCK) ON PARTICULATE NATURE OF MATTER
Doras Sibanda2; Marissa Rollnick2
1University of kwaZulu Natal; 2Marang Centre, School of Education, Wits University, South Africa

15:00 - 16:30  OP20 - STRAND 13 - CHALLENGES OF PRE-SERVICE TEACHER EDUCATION  Room G3

Chairperson(s): Da Yeon KANG

TEACHING CHEMISTRY INCLUSIVELY - ARE WE PREPARED?
Katharina Gross
University of Vienna

A 360 VIEW OF A SECONDARY SCIENCE TEACHERS EDUCATION PROGRAM: RECRUITING AND PREPARING WELL-STARTED TEACHERS
Julie Luft; Paula Lemons; Dorothy Y. White; Elana Worth; Julia Przybyla-Kuchek; Blake Whitt
University of Georgia

PRE-SERVICE TEACHER PREPARATION FOR WORKING IN RURAL SCHOOL
Natália Demeshkant; Katarzyna Potyrała; Karolina Czerwiec
Pedagogical University of Cracow

EXAMINING STRUCTURES AFFECTING KOREAN TEACHERS’ AGENCY TO TEACH SCIENCE TO CULTURALLY AND LINGUISTICALLY DIVERSE STUDENTS: IMPLICATIONS FOR TEACHER EDUCATION PROGRAM
Da Yeon KANG1; Hye-Eun CHU2; Hojung KIM1; Seung-Urn CHOE1; Sonya MARTIN1
1Seoul National University; 2Macquarie University

15:00 - 16:30  OP21 - STRAND 14 - ACTION RESEARCH AND PROFESSIONAL LEARNING COMMUNITIES I  Room G4

Chairperson(s): Helena Berglund

USING PRACTICAL WORK EFFECTIVELY IN THE SCHOOL SCIENCE LABORATORY: A TEACHER TRAINING PROGRAMME BASED ON THE LEARNING COMMUNITY APPROACH
Marta Carli; Ornella Pantano
Department of Physics and Astronomy, University of Padova

“WE WANT TO CONTINUE!”: FACTORS THAT CONTRIBUTE TO MAINTAIN A SCIENCE TEACHER LEARNING COMMUNITY IN TIME
Corina Gonzalez Weill1; Maria Isabel Reyes2; Andoni Arenas1; Lilian Vergara1; Francisca Sánchez2; Ignacio Rojas1; Paulina Bravo1; Felipe Acuña1
1Pontificia Universidad Católica de Valparaíso; 2Universidad de Playa Ancha, Valparaíso, Chile; 3UCL Institute of Education

ADOPTION OF UNIVERSAL DESIGN FOR LEARNING (UDL) IN SCIENCE: AN ACTIVITY THEORY PERSPECTIVE
Karen Goodnough
Memorial University of Newfoundland

DEVELOPING BIOLOGY EDUCATION THROUGH COLLABORATION BETWEEN TEACHERS
Helena Berglund
Department of educational science, Lund University
15:00 - 16:30 OP22 - STRAND 17 - REASONING AND MODELLING SKILLS AT UNIVERSITY LEVEL

Chairperson(s): Vera Montalbano

THE OBSTACLE OF A MISLEADING MATHEMATICAL LEGITIMACY: DISCUSSING THE IRREVERSIBLE EXPANSION OF AN IDEAL GAS WITH BEGINNING TEACHERS
Laurence Viennot
Université Paris Diderot, Matière et Systèmes Complexes UMR 7057

THE DEVELOPMENT OF UNDERGRADUATES’ MECHANISTIC EXPLANATIONS OF GENETIC ENVIRONMENT INTERACTION
Michal Haakel-Ittah1; Ravit Golan Duncan2; Anat Yarden1
1Weizmann Institute of Science; 2Rutgers

INFLUENCE OF CONTEXT ON THE ARCHITECTURE OF STUDENT-GENERATED MODELS IN AN UNDERGRADUATE INTRODUCTORY BIOLOGY COURSE
Joelyn de Lima; Tammy Long
Michigan State University

RECOVERY OF MATHEMATICAL INADEQUACIES AND DEVELOPMENT OF TRANSVERSAL SKILLS FOR PHYSICS AND MATHEMATICS STUDENTS
Vera Montalbano
University of Siena

15:00 - 16:30 OP23 - STRAND 16 - STEM IN PRIMARY SCHOOL

Chairperson(s): Edna Tan

TRANSNATIONAL STEM MAKERSpaces: a NEW APPROACH TO LEARNING
Rekha Koul; Rachel Sheffield
Curtin University

ANALYSIS OF THE LEVEL OF KNOWLEDGE AND COMPETENCE OF PRIMARY SCHOOL PUPILS IN STEM AREAS
Milagros Mateos-Núñez; Guadalupe Martinez-Borreguero; Francisco Luis Naranjo-Correa
University of Extremadura

THE DEVELOPMENT OF INTEREST FOR STEM SCHOOL SUBJECTS AND STEM CAREERS DURING PRIMARY SCHOOLING
Josip Burusic1; Toni Babarovic1; Marija Sakic Velić1; Leila Selimbegovic1; Dubravka Glasnovic Gracin3
1Ivo Pilar Institute of Social Sciences, Zagreb, Croatia; 2Université de Poitiers, Département de psychologie, Poitiers, France; 3University of Zagreb, Faculty of Teacher Education, Zagreb, Croatia

ENGINEERING FOR SUSTAINABLE COMMUNITIES: TOOLS IN SUPPORT OF EQUITABLE AND CONSEQUENTIAL MIDDLE SCHOOL ENGINEERING.
Edna Tan; Angela Calabrese Barton; Aërin Benavides
University of North Carolina at Greensboro

15:00 - 16:30 OP24 - STRAND 17 - PROBLEM SOLVING AT UNIVERSITY LEVEL

Chairperson(s): David Woitkowski

USING A HYBRID OF ARGUMENTATION AND PROBLEM SOLVING PROMPTS TO FACILITATE UNDERGRADUATES’ PROBLEM SOLVING PERFORMANCE AND CONFIDENCE
Carina Rebello; Yuri Piedrahita Uruena
Purdue University

ABSTRACTION IN DYADIC CHEMISTRY PROBLEM SOLVING
Jessica Karch; Hannah Sevian
University of Massachusetts Boston

INVESTIGATING GROUP-SPECIFIC DIFFERENCES IN SOLVING MECHANISTIC PROBLEMS IN ORGANIC CHEMISTRY
Nicole Graulich1; Julia Eckhard2; Marc Rodemer2; Sascha Bernholt2
1Justus-Liebig University; 2Christian-Albrechts-Universität Kiel

SURVEYING UNIVERSITY STUDENTS’ PROBLEM SOLVING SKILLS IN REALISTIC SETTINGS
David Woitkowski
Universität Paderborn
### OP189 - STRAND 4 - INNOVATION AND ENGINEERING IN ONLINE AND ICT-RICH ENVIRONMENTS

**Chairperson(s): Eleni Kyza**

INVESTIGATING STUDENTS’ ACTIONS AND DISCUSSIONS WHEN EXPERIMENTING WITH PHYSICAL AND VIRTUAL MANIPULATIVES IN SCIENCE  
George Olympiou; Zacharias Zacharia; Tasos Hovardas  
University of Cyprus

UNPACKING THE PROMISES OF THE MAKER MOVEMENT IN STEM EDUCATION: THE DEVELOPMENT OF SCIENTIFIC AND ENGINEERING PRACTICES THROUGH TINKERING  
Cristina Simarro; Elizabeth McGregor; Digna Couso; Mark Winterbottom  
CRECIM, Universitat Autònoma de Barcelona (UAB); Faculty of Education, Cambridge University

MOOCS AS CHANGE AGENTS FOR PROMOTING INNOVATIVE THINKING AMONG SCIENCE AND ENGINEERING STUDENTS  
Abeer Watted; Miri Barak  
Al-Qasemi Academic College of Education; Technion - Israel Institute of Technology

THE USE OF TECHNOLOGY TO PROMOTE HIGH SCHOOL CHEMISTRY STUDENTS’ CONCEPTUAL UNDERSTANDING ABOUT NANOTECHNOLOGY AND UNDERSTANDING OF RRI  
Panayiotis Stylianou; Eleni Kyza; Yiannis Georgiou  
Cyprus Ministry of Education and Culture; Cyprus University of Technology

### MONDAY 17:00 - 18:30

#### OP163 - STRAND 3 - SCIENCE, IMAGINATION AND ART  

**Chairperson(s): Ann Mutvei**

THE NARRATIVE INSIDE: TEACHING PHYSICS WITH A NARRATIVE-BASED APPROACH  
Michele Canducci; Silvia Demartini  
Department of Education and Learning (DFA), University of Applied Sciences and Arts of Southern Switzerland

SCIENCE AND ART: AN INTEGRATED EDUCATIONAL PATH ON COLOUR VISION  
Claudia Daffara; Nicola De Manincor; Francesca Monti; Luca Perlini  
Dept of Computer Science, Univ of Verona; Dept of Cultures and Civilizations, Univ of Verona

THE LEARNING SCIENCE THROUGH THEATER INITIATIVE AS A BEST PRACTICE - CREATIVITY-ENRICHED INQUIRY BASED APPROACHES  
Eleni Georgakopoulou; Zacharoula Smyrnaiaou; Menelaos Sotiriou; Sofoklis Sotiriou  
National and Kapodistrian University of Athens; Science View; Research and Development Department, Ellinogermaniki Agogi

IMAGINATION; WHERE SCIENCE FORMULATE DIFFERENT HYPOTHESIS AND EXPLANATIONS HELPING THE UNDERSTANDING OF THE LANGUAGE AND SOUL OF CHEMISTRY  
Ann Mutvei; Ulrika Tobieson  
School of Natural Sciences, Technology and Environmental Studies, Södertörn University; Södertörn University

#### OP164 - STRAND 3 - FOSTERING INQUIRY-BASED LEARNING  

**Chairperson(s): Gábor Z. Orosz**

FOSTERING SCIENTIFIC PRACTICES THROUGH EXPLICIT INSTRUCTION - IS IT HAPPENING? AN ANALYSIS OF INQUIRY-BASED INSTRUCTION IN GERMAN CLASSROOMS  
Andreas Vorholzer; Verena Petermann  
Justus Liebig University Gießen

CHARACTERIZATION OF LEARNING CHALLENGES LINKED TO INQUIRY-BASED PRACTICAL WORK: A SYSTEMATIC LITERATURE REVIEW  
Fru Akurma; Estelle Gaigher; Jenna Koenen  
University of Pretoria; Technical University of Munich

A SECONDARY ANALYSIS OF THE ASSOCIATION BETWEEN INQUIRY-BASED SCIENCE TEACHING PRACTICES AND NORWEGIAN STUDENTS’ SCIENTIFIC LITERACY IN PISA 2015  
Fredrik Jensen; Marit Kjœrmli; Erik Knain  
Department of Teacher Education and School Research, University of Oslo
INQUIRY-BASED LEARNING IN A CHEMISTRY CLASS WITH 9TH GRADERS
Gábor Z. Orosz¹; Erzsébet Korom²
¹Doctoral School of Education, University of Szeged, Hungary; MTA-SZTE Science Education Research Gro; ²Institute of Education, University of Szeged, Hungary; MTA-SZTE Science Education Research Group

17:00 - 18:30  OP165 - STRAND 2 - REASONING AND CRITICAL SKILLS  Room B1
Chairperson(s): Yustika Syabandari

CRITICAL THINKING DISPOSITION IN SCIENCE RESEARCH APPRENTICESHIP PROGRAM FOR HIGH SCHOOL STUDENTS
Yehudit Judy Dori¹; Edy Merchi¹; Irit Sasson¹
¹Technion, Israel Institute of Technology; ²Tel-Hai College, Upper Galilee

THE ROLE OF METALANGUAGE IN DEVELOPING METACOGNITION OF SCIENTIFIC EXPLANATION
Kok-Sing Tang
Curtin University

THE NECESSITY OF BEING AWARE OF ANOMALOUS DATA - CONCEPTUAL DEVELOPMENT WITHIN PEER COLLABORATION
Julian Heeg; Sarah Hundertmark; Johanna Kanne; Sascha Schanze
Leibniz Universität Hannover – Institute for Science Education

EXAMINING THE RELATION OF GENDER AND TRACK IN HIGH SCHOOL STUDENTS' ATTITUDE TOWARD CONVERGENCE
Yustika Syabandari¹; Rahmi Qurota Aini¹; Ai Nurlaelasari Rusmana¹; Minsu Ha¹; Jun-Ki Lee¹; Sein Shin¹
¹Rangwon National University; ²Chonbuk National University; ³Chungbuk National University

17:00 - 18:30  OP166 - STRAND 2 - OUT-OF-SCHOOL LEARNING  Room B2
Chairperson(s): Michaela Marth

ANALYSIS OF A MONITORED VISIT TO A PALEONTOLOGY MUSEUM IN BRAZIL
Marcelo Pereira; Valéria Cristina Bedin Nogueira; Rafael Gil de Castro; Marcelo Tadeu Motokane
Universidade de São Paulo

EVALUATING THE COGNITIVE EFFECTIVENESS OF OUT-OF-SCHOOL LEARNING: A PRETEST-POSTTEST RESEARCH DESIGN
Norá Füz; Erzsébet Korom
University of Szeged, Institute of Education

MIXED-METHODS APPROACH FOR INVESTIGATING LEARNING PROCESSES IN A SCIENCE OUT-OF-SCHOOL LAB
Sönke Janssen; Gunnar Friege
Leibniz Universität Hannover

TECHNOLOGY INTEREST IN A STUDENT-CENTERED INTERVENTION ABOUT BIONICS
Michaela Marth; Franz X. Bogner
University of Bayreuth

17:00 - 18:30  OP167 - STRAND 6 - LEARNING ABOUT SCIENCE AND SCIENTISTS  Room B3
Chairperson(s): Constantinos P. Constantinou

THE DEVELOPMENT OF “NATURE OF SCIENCE” REPRESENTATIONS WITHIN AN INTERNSHIP IN LABORATORIES
Vincent VOISIN¹; Juliane MIOT²
¹Laboratoire ERCAÉ, Université d’Orléans; ²Université d’Orléans

DO STUDENTS GAIN SCIENTIFIC INQUIRY KNOWLEDGE BY PARTICIPATING IN A SCHOOL GARDEN INQUIRY UNIT?
Carmen Carrion; Renee Schwartz
Georgia State University

AESTHETIC ENCOUNTERS IN A COLLEGE MICROBIOLOGY LAB
Sarah El Halwany; Larry Bencze
OISE, University of Toronto
INVESTIGATION OF CONNECTIONS BETWEEN UNDERSTANDING SCIENCE CONCEPTS AND APPRECIATION OF THE NATURE OF SCIENCE
Maria Charalambous, Nicos Papadouris; Constantin P. Constantinou
University of Cyprus

17:00 - 18:30  OP06 - STRAND 8 - STUDENTS’ UNDERSTANDING OF BODY AND HEALTH  Room B4
Chairperson(s): Pei-Ling Lin

CONCEPTUAL CHANGE IN SOCIOSCIENTIFIC ISSUES: LEARNING OF OBESITY
Jessica Shuk Ching Leung1; Maurice Man Wai Cheng1
1The University of Hong Kong; 2The University of Waikato

DEBATING ABOUT ORGAN TRANSPLANTATION: SCIENTIFIC MODELS AND ETHICAL CONCERNS
Isabel Pau-Custodio; Conxita Márquez
Universitat Autònoma de Barcelona

WHAT CAN MAKE US SLIM? MEDIA USAGE INFLUENCE PARTICIPANT’S SCIENTIFIC LITERACY IN MEDIA
Pei-Ling Lin; Chun-Yen Chang
Science Education Centre, National Taiwan Normal University

“THE BRAIN NEEDS NUTRITION” STUDENTS METAPHORICAL LANGUAGE ABOUT FOOD DEGRADATION AND NUTRITIONAL UPTAKE ON A NATIONAL TEST
Alma Jahic Pettersson1; Kristina Danielsson2; Carl-Johan Rundgren3
1Department of Social and Welfare Studies. Technology and Science Education Research; 2Department of Swedish; 3Department of Mathematics and Science Education

17:00 - 18:30  OP169 - STRAND 9 - ENGAGING WITH SUSTAINABILITY I  Room B5
Chairperson(s): Daniel Olsson

DEVELOPING A SUSTAINABLE SCHOOL: THE ROLE OF SCIENCE TEACHERS AS CHANGE AGENTS
Birgitte Bjønness; Astrid Sinnes
Norwegian University of Life Sciences

WHAT STUDENTS THINK AND DO FOR AN ALTERNATIVE FUTURE THREE YEARS AFTER A SCIENCE-INFORMED ENERGY COURSE
Shih-Yeh Chen; Shiang-Yao Liu
National Taiwan Normal University

DEVELOPMENT AND VALIDATION OF AN INSTRUMENT FOR MEASURING STUDENTS’ SUSTAINABILITY COMPETENCES
Eva-Maria Waltner1; Werner Rieß2
1University of Education Freiburg; 2University of Education Freiburg, Department of Biology and Pedagogy of Biology

EFFECTS OF GREEN SCHOOLS IN TAIWAN ON STUDENTS’ SUSTAINABILITY CONSCIOUSNESS
Daniel Olsson1; Niklas Gericke1; Tzuchau Chang2
1Department of Environmental and Life Sciences, Karlstad University; 2Graduate Institute of Environmental Education, National Taiwan Normal University, Taiwan

17:00 - 18:30  OP170 - STRAND 9 - THE PEDAGOGY OF ENVIRONMENTAL EDUCATION I  Room B6
Chairperson(s): Wisam Sedawi

EXPLORING GREEK PRIMARY STUDENTS’ INTENTION OF CONSUMING SEASONAL, ORGANIC, LOCAL FRUITS
Athanasia Papadopoulou; Dimitrios Charalampous; Alexandros Georgopoulos; George Malandrakis
Aristotle University of Thessaloniki

THE EFFECTS OF GARDENING ON STEM IDENTITY FOR UNDERREPRESENTED YOUTH
Rita Hagevik1; Kathy Trundle1
1The University of North Carolina at Pembroke; 2Utah State University

THE ROLE-PLAYING GAME AS AN INNOVATIVE DIDACTIC PROPOSAL TO PROMOTE ATTITUDES AND VALUES FOR THE ENVIRONMENT IN HIGH SCHOOL SCIENCE STUDENTS
Erika Gonzalez-Sanchez; Vito Brero; Maria del Carmen Acebal
University of Malaga
EXPLORING ENVIRONMENTAL IDENTITY THROUGH PLACE-BASED EDUCATION AND INTERGENERATIONAL SOCIAL DISCOURSE
Wisam Sedawi; Orit Ben-Zvi Assaraf
Ben Gurion University of the Negev

17:00 - 18:30 OP171 - STRAND 12 - IDENTITIES, BELONGINGNESS AND ENGAGEMENT IN STEM Room B7
Chairperson(s): Eva Silfver

(DIS)EMBODIED MASCULINITY AND THE MEANING OF (NON)STYLE IN PHYSICS AND COMPUTER SCIENCE AND ENGINEERING EDUCATION
Andreas Ottemo1; Allison Gonsalves2; Anna Danielsson3
1University of Gothenburg; 2McGill University; 3Uppsala University

THE ‘BEYONCÉ GIRLS’ AND THE SHIFTING ENGAGEMENT WITH SCIENCE ACROSS HOME, SCHOOL AND THE SCIENCE MUSEUM
Spela Godec
UCL Institute of Education

UNDERGRADUATE SCIENCE MAJORS’ IDENTITY WORK IN THE CONTEXT OF A SCIENCE OUTREACH PROGRAM: UNDERSTANDING THE ROLE OF SCIENCE CAPITAL
Allison Gonsalves; Alexandre Cavalcante; Hailey Iacono
McGill University

UAE CHILDREN’S PERCEPTIONS OF SCIENTISTS AND THEIR WORK: THE ‘DRAW A SCIENTIST’ TEST
Martina Dickson
Emirates College for Advanced Education

THE OUTSIDER WITHIN: GIFTEDNESS AND GEEKINESS AS POTENTIAL SIGNIFIERS OF BELONGING IN SCIENCE EDUCATION
Eva Silfver; Anna Danielsson
Department of Education

17:00 - 18:30 OP172 - STRAND 1 - MODELING, STRUCTURE AND FUNCTION Room C1
Chairperson(s): Erlina Erlina

REPRESENTATIONS OF STUDENTS ABOUT THE INTERNAL STRUCTURE OF A CARBONATED DRINK. PRELIMINARY STUDY
Joaquín Cañero-Arias; Ángel Blanco-López; José María Oliva-Martínez; Isabel María Cruz-Lorite
1University of Málaga; 2University of Cádiz

USING MODELING PERSPECTIVE TO SOLVE REAL-LIFE PHYSICS PROBLEMS VIA MATHEMATICAL MODELING
Tugba Yuksel; Demet Baran Bulut
Recep Tayyip Erdogan University

DEVELOPING BIOMIMETICS STEM ACTIVITY QUERYING THE RELATIONSHIP BETWEEN STRUCTURE AND FUNCTION IN ORGANISMS
Hürlü DOĞAN; Ayşe SAVRAN GENCER; Kadir BİLEN
1Yeniköy Ortaokulu; 2Pamukkale University; 3Alaattin Keykubat University

SHAPE OF MOLECULE CARDS (SOMCARDS) AND MOLECULAR MODEL BUILDING (MMB) TO ENHANCE STUDENT’S UNDERSTANDING OF MOLECULAR GEOMETRY
Erlina Erlina; Chris Cane; Dylan Williams
1Department of Chemistry Education, Faculty of Teacher Training and Education, Universitas Tanjungpur; 2GENIE-CETL Department of Genetics, University of Leicester, UK; 3Department of Chemistry, University of Leicester, UK

17:00 - 18:30 OP173 - STRAND 5 - TEACHING AND LEARNING ABOUT ELECTROMAGNETISM Room D1
Chairperson(s): Daniele Buongiorno

TEACHING THE CONTINUOUS SPECTRUM OF THE STARS WITHIN PHYSICS COURSES: A MODULE AND THE STUDENTS’ LEARNING OUTCOMES
Ioannis Kardaras; Maria Kallery
Department of Physics, Aristotle University of Thessaloniki

DEMONSTRATING THE ROLE OF TRANSDUCTION IN THE TEACHING AND LEARNING OF SCIENCE: THE CASE OF STUDENTS LEARNING ABOUT MAGNETIC FIELD
John Airey; Trevor Volkwyn
1Department of Mathematics and Science Education Stockholm University; 2Department of Physics, Uppsala University
CONCRETENESS FADING IN LEARNING FARADAY’S LAW
Tommi Kokkonen\textsuperscript{1}; Lennart Schalk\textsuperscript{2}
\textsuperscript{1}University of Helsinki, Department of Physics; \textsuperscript{2}PH Schwyz

DESIGN-BASED RESEARCH METHODS TO DEVELOP AN EDUCATIONAL PROPOSAL ON OPTICAL SPECTROSCOPY FOR SECONDARY SCHOOL STUDENTS
Daniele Buongiorno; Marisa Michelini
University of Udine

17:00 - 18:30 OP174 - STRAND 10 - COMPARATIVE STUDIES IN CURRICULUM Room D2
Chairperson(s): Eva Lundqvist

AN ASSESSMENT FRAMEWORK FOR HIGHER EDUCATION IN PHYSICS: OUTCOMES OF THE CALOHEE PROJECT
Ornella Pantano
Department of Physics and Astronomy, University of Padova

A COMPARISON OF THE EXTENT TO WHICH INDOONESIAN AND SOUTH AFRICAN SCIENCE TEACHERS PREFER THE CITIZENSHIP-CENTRED IDEOLOGY FOR SCHOOL SCIENCE
Lindelani Mnguni\textsuperscript{1}; Ahmad Zaky El Isami\textsuperscript{2}
\textsuperscript{1}University of South Africa; \textsuperscript{2}Universitas Sultan Ageng Tirtayasa

A COMPARATIVE SURVEY REFERRING TO SCIENCE TEACHING AND LEARNING IN TWELVE COUNTIES
Rachel Mamlok-Naaman; Ron Blonder
Weizmann Institute of Science

TEACHING TRADITIONS IN TEACHERS’ TALK ABOUT SCIENCE EDUCATION IN SWEDEN, ENGLAND AND FRANCE
Eva Lundqvist; Malena Lidar
Department of Education, Uppsala University

17:00 - 18:30 OP175 - STRAND 11 - ASSESSING STUDENTS ACHIEVEMENTS Room D3
Chairperson(s): Pascale Montpied

IDENTIFICATION AND DEVELOPMENT OF SCIENTIFIC TALENTS OF LOWER ELEMENTARY STUDENTS IN SOUTH KOREA
Soo-Young Lee\textsuperscript{1}; Youngseok Jhun\textsuperscript{1}; Kapsu Kim\textsuperscript{1}; Yoonkyung Seo\textsuperscript{2}; Hae-Ae Seo\textsuperscript{2}
\textsuperscript{1}Seoul National University of Education; \textsuperscript{2}Busan National University

SCIENTIFIC METHODS IN HIGH STAKES CHEMISTRY EXAMINATIONS: DIVERSITY OR DISPARITY?
Alison Cullinane\textsuperscript{1}; Sibel Erduran\textsuperscript{2}; Stephen Wooding\textsuperscript{1}
\textsuperscript{1}Department of Education; \textsuperscript{2}University of Oxford; \textsuperscript{3}AQA

EXPLORING PHYSICS TEACHERS’ ASSESSMENT PRACTICES - A STUDY ABOUT THE ROLE OF LANGUAGE
Markus Sebastian Feser; Dietmar Höttecke
Universität Hamburg - Physikdidaktik

STATISTICALLY DETECTED PATTERNS ASSOCIATING SPECIFIC VARIABLES CHARACTERIZING PISA-SCIENCE ITEMS ARE INTERFERING SIGNIFICANTLY WITH FRENCH POPULATION/ SUBPOPULATIONS SCORES.
Pascale Montpied\textsuperscript{1}; Mylene Duclos\textsuperscript{2}; Florence Le Hebel\textsuperscript{1}; Valerie Fontanieu\textsuperscript{4}
\textsuperscript{1}Centre National de la RechercheScientifique; \textsuperscript{2}University Lyon 2 (LEL doctorat); \textsuperscript{3}University Lyon 2; \textsuperscript{4}Ecole Normale Superieure

17:00 - 18:30 OP176 - STRAND 4 - SIMULATIONS AND EDUCATIONAL GAMES IN PHYSICS II Room E2 - Italia
Chairperson(s): Marta Koc Januchta

USING SMARTPHONES AND TABLETS AS EXPERIMENTAL TOOLS IN PHYSICS LESSONS: EFFECTS ON LEARNING AND MOTIVATION AT SECONDARY SCHOOL LEVEL
Alice Gasparini; Marine Delaval; Andreas Müller
University of Geneva

EVALUATION OF A FEEDBACK-SUPPORTED LEARNING APP TO PROMOTE STUDENTS’ UNDERSTANDING OF PCR AND GEL ELECTROPHORESIS DURING HANDS-ON EXPERIMENTATION
Markus Bergmann; Angela Sandmann; Christine Florian
Duisburg-Essen University
PROMOTING SCIENTIFIC UNDERSTANDING FOR LOW-SKILLED COMPREHENDERS THROUGH ANIMATED MULTIMODAL TEXTS
Maximiliano Montenegro\textsuperscript{1}; Alejandra Meneses\textsuperscript{1}; Len Unsworth\textsuperscript{2}; Soledad Véliz\textsuperscript{1}; Pablo Escobar\textsuperscript{1}; Marion Garolera\textsuperscript{1}; María Paz Ramirez\textsuperscript{1}
\textsuperscript{1}Pontificia Universidad Católica de Chile; \textsuperscript{2}Australian Catholic University

ASKING QUESTIONS TO ENGAGE WITH BIOLOGY: INVESTIGATING STUDENTS’ INTERACTION AND LEARNING WITH AN AI-BASED TEXTBOOK
Marta Koc-Januchta\textsuperscript{1}; Konrad Schönborn\textsuperscript{1}; Lena A. E. Tibell\textsuperscript{1}; Vinay K. Chaudhri\textsuperscript{2}; Craig Heller\textsuperscript{3}
\textsuperscript{1}Department of science and technology, Linköping University; \textsuperscript{2}Independent Consultant; \textsuperscript{3}Biology Department, Stanford University

17:00 - 18:30  OP177 - STRAND 7 - LOCATING SCIENTIFIC THINKING, CRITICAL THINKING AND ARGUMENTATION IN SCIENCE CURRICULA

Chairperson(s): Sarah Hayes

5TH, 6TH, 7TH GRADERS’ UNDERSTANDINGS ABOUT SCIENTIFIC INQUIRY: AN INTERTWINED PBL & HOS APPROACH
Ferah Ozer\textsuperscript{1}; Nihal Dogan\textsuperscript{2}
\textsuperscript{1}Bogazici University; \textsuperscript{2}Abant Izzet Baysal University

LOOKING BACKWARDS TO MOVE FORWARDS: CHANGING OPPORTUNITIES FOR ARGUMENTATION IN BRITISH SCIENCE CURRICULA SINCE 1989
Liam Guilfoyle; Judith Hillier; Ann Childs
University of Oxford

PROMOTING ARGUMENTATION THROUGH OUTREACH IN POST-PRIMARY SCIENCE CLASS
Laurie Ryan; Peter Childs; Sarah Hayes
University of Limerick

SCIENCE EDUCATION AS THINKING: THE BEAUTY OF SCIENTIFIC THINKING AND CRITICAL THINKING
Maria-Antonia Manassero-Mas\textsuperscript{1}; Angel Vazquez-Alonso\textsuperscript{2}
\textsuperscript{1}University of the Balearic Islands; \textsuperscript{2}University of Balearic Islands

17:00 - 18:30  OP178 - STRAND 15 - LEARNING ABOUT BIOLOGY AND HEALTH IN EARLY CHILDHOOD SCIENCE

Chairperson(s): Lisa Borgerding

YOUNG CHILDREN’S REASONING ABOUT VARIATION WITHIN POPULATIONS IN THE CONTEXT OF A PROBLEM-EXPLORING TASK
Corinne Jegou\textsuperscript{1}; Marida Ergazaki\textsuperscript{2}; Julie Gobert\textsuperscript{1}; Alice Delserieys\textsuperscript{1}
\textsuperscript{1}Aix-marseille université; \textsuperscript{2}University of Patras (Greece)

MY HEART IS HAPPY: AN EXPERIENCE WITH EARLY CHILDHOOD EDUCATION CHILDREN TO TEACH THEM HOW TO TAKE CARE OF THEIR HEARTS
Esther Cascarosa; Beatriz Mazas Gil; Ester Mateo González
University of Zaragoza

PRESCHOOL CHILDREN’S IDEAS ABOUT BIOLOGICAL ADAPTATION DURING A SUMMER SCIENCE CAMP
Lisa Borgerding; Fatma Kaya
Kent State University

17:00 - 18:30  OP179 - STRAND 18 - METHODOLOGICAL ISSUES IN SCIENCE EDUCATION RESEARCH - PERSPECTIVES ON ISSUES OF AFFECT AND ATTITUDES

Chairperson(s): Anni Loukomies

A SYSTEMATIC REVIEW OF SCIENCE EDUCATION ATTITUDE INSTRUMENTS PSYCHOMETRIC PROPERTIES
Radu Bogdan Tomáš\textsuperscript{1}; Norman G. Lederman\textsuperscript{2}; Jesús Ángel Meneses Villagrá\textsuperscript{1}
\textsuperscript{1}Universidad de Burgos; \textsuperscript{2}Illinois Institute of Technology

THE STRANGE CASE OF CREATIONISTS THAT ACCEPT EVOLUTION: METHODOLOGICAL CONSIDERATIONS
Anna Beniermann\textsuperscript{1}; Dittmar Graf\textsuperscript{2}
\textsuperscript{1}Humboldt University of Berlin; \textsuperscript{2}Institute of Biology Education
IS IT TIME TO RE-EXAMINE THE DOMINANT NARRATIVE IN PRIMARY SCIENCE?
Hellen Remnant
Canterbury Christ Church University

INSTANT VIDEO BLOGGING AS A METHOD FOR EXPLORING SCIENCE-RELATED ACADEMIC EMOTIONS
Anni Loukomies1; Kalle Juutilainen; Jari Lavonen2
1University of Helsinki, Vikki teacher training school; 2University of Helsinki, Faculty of education

17:00 - 18:30  OP118 - STRAND 13 - TEACHER IDENTITY AND SELF-UNDERSTANDING
Room G1
Chairperson(s): Dekant Kiran

TEACHER IDENTITY: WHAT THE COMPONENTS OF THE INSTITUTIONAL TUITION PROGRAM FOR TEACHING INITIATION (PROGRAMA INSTITUCIONAL DE BOLSAS DE INICIAÇÃO A DOCÊNCIA - PIBID) IN A UNIVERSITY (SP-BRAZIL) UNDERSTAND BY THAT CONCEPT.
Gustavo Leme; Magda Pechliye
Presbiteriana Mackenzie University

WHAT IT TAKES TO BE A GOOD SCIENCE TEACHER? PROJECT-BASED LEARNING AS AN IMPETUS FOR STUDENT-TEACHERS’ PROFESSIONAL GROWTH
Dina Tsybulsky; Yulia Muchnik-Rozanov
Technion Israel Institute of Technology

PRE-SERVICE ELEMENTARY TEACHERS’ RECOGNITION OF SELF-UNDERSTANDING AND CHANGE CAPACITY RELATED TO SCIENCE EDUCATION
Yong Jae Jung1; Heekyong Kim2; Kwanghee Jo3; Jaehyeok CHOI4
1Gongju National University of Education; 2Kangwon National University; 3Chosun University; 4Chonnam National University

ANTECEDENTS OF PRESERVICE SCIENCE TEACHERS’ SCIENCE TEACHING EFFICACY BELIEFS
Dekant Kiran
Tokat Gaziosmanpasa University

17:00 - 18:30  OP181 - STRAND 13 - PEDAGOGICAL CONTENT KNOWLEDGE II
Room G2
Chairperson(s): Isabel Zudaire

PEDAGOGICAL CONTENT KNOWLEDGE ABOUT REDOX REACTIONS: A CROSS-LEVEL STUDY
Luciane Goes1; Carmen Fernandez2
1Postgraduate Program in Science Teaching, University of São Paulo; 2Institute of Chemistry - University of São Paulo

CONSTRUCTING PROFICIENCY LEVELS FOR PRE-SERVICE PHYSICS TEACHERS’ PEDAGOGICAL CONTENT KNOWLEDGE
Dustin Schiering; Stefan Sorge; Knut Neumann
IPN

LAND USE CHANGE AND FUTURE SPATIAL DEVELOPMENT: AN EDUCATIONAL RECONSTRUCTION OF GEOSPATIAL CK AND PCK FOR PRE-SERVICE PRIMARY SCHOOL TEACHERS
Karin Huser1; Kai Niebert2; Norman Backhaus3; Sibylle Reinfried4
1Universität Zürich; 2Pädagogische Hochschule Zürich; 3Universität Zürich; 4emeritus

PRESERVICE BIOLOGY TEACHERS’ PROFESIONAL KNOWLEDGE FOR GENETICS INSTRUCTION
Isabel Zudaire; Irantzu Uriz; Maria Napal
Public University of Navarra

17:00 - 18:30  OP182 - STRAND 13 - AFFECT AND EMOTION IN PRE-SERVICE TEACHER EDUCATION
Room G3
Chairperson(s): Carolina Pipitone

ASSESSING EMOTIONS AND TASK VALUES TOWARDS THE INTEGRATIVE USE OF MATHEMATICS IN BIOLOGY
José María Marcos Merino; Rocío Esteban; Jesús A. G. Ochoa de Alda
University of Extremadura

PRIMARY PRE-SERVICE TEACHERS’ EMOTIONS AND INTERESTS ABOUT INSECTS
Borja Gómez Prado1; Blanca Puig Mauriz2; Maria Evagorou3
1Universidade de Santiago de Compostela; 2Universidade Santiago de Compostela; 3University of Nicosia
## 17:00 - 18:30  OP183 - STRAND 14 - ACTION RESEARCH AND PROFESSIONAL LEARNING COMMUNITIES II  Room G4

**Chairperson(s): Majken Korsager**

**JAPANESE LESSON STUDY AS A FORM OF ACTION RESEARCH TO IMPROVE DISCIPLINE LITERACY IN SCIENCE AND MATH**  
Irina Falls; Rita Hagevik  
University of North Carolina at Pembroke

**EXPLORING TEACHER’S BELIEFS AND ATTITUDES TOWARDS TEACHING PHYSICS DURING A LESSON STUDY INTERVENTION.**  
Estelle Gaigher; Ayodele Ogegbo  
University of Pretoria

**TEACHER KNOWLEDGE EXCHANGES AND TRANSFORMATIONS DURING COLLABORATIVE CORE DESIGN**  
Jared Carpendale; Anne Hume  
1Monash University; 2University of Waikato

**TEACHERS ON THE “MATH AND SCIENCE TRAILS” (MAST) TO BECOME REFLECTIVE PRACTITIONERS**  
Majken Korsager; Maria Gaare Dahl; Berit Reitan  
Norwegian Centre for Science Education, University of Oslo

## 17:00 - 18:30  OP184 - STRAND 14 - DEVELOPMENT OF REFLECTIVE PRACTICE  Room G5

**Chairperson(s): Corina González-Weil**

**EXPLORE SECONDARY SCIENCE TEACHER BELIEFS AND PRACTICES THROUGH REFLECTIVE PRACTICE**  
Preethi Titu; Gillian Roehrig; Joshua Ellis  
1University of Minnesota; 2Florida International University

**INTERDISCIPLINARY REFLECTIVE TOOL ON SCHOOL SCIENCE AND MATHEMATICS**  
Georgios Kritikos; Andreas Moutsios-Rentzos; Vasileia Pinnika; Fragkiskos Kalavasis  
University of the Aegean

**EARLY CHILDHOOD AND PRIMARY TEACHERS’ EXPECTATIONS OF REFLECTIVITY IN SCIENCE EDUCATION**  
Ana Moncada-Arce  
Universidad de O’Higgins

**LESSON STORIES: TEACHER REFLECTION AND RESEARCH TOOL FOR SCIENCE TEACHING**  
Camilo Henríquez-Miranda; Corina González-Weil; Paolina Bravo  
1Pontificia Universidad Católica de Valparaíso; 2UCL Institute of Education

## 17:00 - 18:30  OP185 - STRAND 16 - MICRO AND MACRO SCALE SCIENCE IN PRIMARY SCHOOLS  Room G6

**Chairperson(s): Sinem Güçhan Özug**

**WHAT IS CITY AIR MADE OF? AN ANALYSIS OF PUPILS’ CONCEPTIONS OF CLEAN AND POLLUTED AIR FROM THE MODEL MATTER PERSPECTIVE**  
Èlia Tena; Digna Couso  
CRECIM-UAB

**A TEACHING APPROACH ABOUT NANOSCALE SCIENCE AND TECHNOLOGY CONTENT: EVALUATION OF PRIMARY SCHOOL STUDENTS’ LEARNING**  
George Peikos; Anna Spyrtou; Dimitris Pnevmatikos; Penelope Papadopoulou  
University of Western Macedonia, Greece

**INTRODUCING IRANIAN PRIMARY CHILDREN TO ATOMS AND MOLECULES**  
Fatima Baji; Carole Haeusler  
1Ahvaz Jundishapur University of Medical Sciences, Ahvaz, Iran; 2University of Southern Queensland
THE EXAMINATION OF QUESTIONING METHODS ON YOUNG CHILDREN’S CONCEPTUAL UNDERSTANDING OF ASTRONOMY
Sinem Güçhan Özgül¹; Mesut Saçkes²; Berrin Akman²
¹Balikesir University; ²Hacettepe University

17:00 - 18:30  OP186 - STRAND 17 - FIRST YEAR UNIVERSITY COURSES  Room G7
Chairperson(s): Elina Laurila

“WHAT I KNOW AND HOW DO I KNOW WHAT I KNOW?” - THE DEVELOPMENT OF PHARMACY STUDENTS’ CONCEPTUAL AND EPISTEMOLOGICAL UNDERSTANDING DURING THE FIRST STUDY YEAR
Ilona Södervik; Nina Katajavuori; Leena Hanski
University of Helsinki

SCAFFOLDING RESEARCH-LIKE LABORATORY PROJECTS FOR FIRST YEAR SCIENCE AND TECHNOLOGY STUDENTS
Rikke Frøhlich Hougaard; Birgitte Lund Nielsen
Aarhus University

NARRATIVES AND EXPECTATIONS: FIRST-YEAR STUDENTS’ TRANSITION INTO HIGHER EDUCATION
Andrea Fransiska Møller Gregersen; Lars Ulriksen
Department of Science Education, University of Copenhagen

THE EFFECTS OF THE FIRST LABORATORY COURSE ON THE PRACTICAL AND SCIENTIFIC REPORTING SKILLS OF CHEMISTRY STUDENTS
Elina Laurila; Piia Nuora
University of Jyväskylä

17:00 - 18:30  OP187 - STRAND 17 - PRACTICAL WORK AND ENGAGEMENT AT UNIVERSITY LEVEL  Room G8
Chairperson: Marina Constantinou

PRACTICAL EXERCISES IN UNIVERSITY MECHANICS
Jesper Haglund; Jan Andersson; Marcus Berg
Department of Engineering and Physics, Karlstad University

SCAFFOLDING AFFECTIVE ENGAGEMENT IN COLLEGE: THE CASE OF AN LA-SUPPORTED COLLEGE BIOLOGY COURSE
Haquit Kornreich-Leshem¹; Sat Gavassa-Becerra²; Laird Kramer³
¹STEM Transformation Institute, Florida International University; ²Department of Biological Sciences, Florida International University; ³Department of Physics, STEM Transformation Institute, Florida International University

HOW DO STUDENTS USE THE ACTIVE LEARNING ACTIVITIES AVAILABLE TO THEM IN A UNIVERSITY CHEMISTRY COURSE?
Mildrid Kyte; Matthias Gregor Stadler
University of Bergen

DOES PRACTICAL WORK, WORK? A LOOK INTO UNDERGRADUATE BIOLOGY EDUCATION
Marina Constantinou; Ian Abrahams
University of Lincoln
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<td>09:00 - 11:00</td>
<td><strong>Symposium 28 - CRITICAL AND ACTIVIST-ORIENTED SCIENCE EDUCATION: ATTUNEMENTS TO CONTEXTS</strong></td>
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<td><strong>TEACHING POWER RELATIONS IN SOCIOSCIENTIFIC ISSUES: TOWARDS ACTIVISM IN SCIENCE EDUCATION</strong></td>
<td>Maid Zouda; Sarah El Halwany; Minja Milanovic; Nadia Qureshi; Zoya Padamsi; John Bencze</td>
<td>OISE, University of Toronto</td>
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|              | **FOSTERING STUDENTS’ UNDERSTANDING OF SOCIOSCIENTIFIC ISSUES AND THEIR WILLINGNESS TO TAKE ACTION: USE OF RESEARCH-BASED SSI INSTRUCTION** | Yunhee Choi; Hyunju Lee
1Soongmoon Middle School, Seoul, South Korea; 2Ewha Womans University, Seoul, South Korea |
|              | **FINDING A ‘GOOD’ PLACE: A ‘PLEASURABLE’ IMPLEMENTATION OF NEW SCIENCE PEDAGOGY** | Minja Milanovic; Sarah El Halwany; Nadia Qureshi; Zoya Padamsi; Majd Zouda; John Bencze | OISE, University of Toronto |
|              | **INTERNATIONAL PRESERVICE TEACHER COLLABORATIONS: CONCEPTIONS OF, AND ORIENTATIONS TO, ACTIVISM IN SCIENCE EDUCATION** | Lyn Carter; John Bencze
1Australian Catholic University, Melbourne; 2OISE, University of Toronto |

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<td>09:00 - 11:00</td>
<td><strong>Symposium 47 - SCIENCE (b) EDUCATION: CONTRIBUTIONS FROM HISTORY, PHILOSOPHY AND SOCIOLOGY OF SCIENCE</strong></td>
<td>Kostas Kampourakis; Discussant: Igal Galili</td>
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<td>Chairperson(s): Kostas Kampourakis; Discussant: Igal Galili</td>
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<td><strong>RECONSIDERING THE MEANING OF CONCEPTS IN BIOLOGY EDUCATION</strong></td>
<td>Kostas Kampourakis</td>
<td>University of Geneva</td>
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|              | **EPISTEMIC CORE OF CHEMISTRY IN TEACHER EDUCATION: PRACTICAL APPROACHES AND EMPIRICAL EVIDENCE** | Sibel Erduran; Ebru Kaya
1University of Oxford; 2Bogazici University |
|              | **THE RELEVANCE OF NATURE OF SCIENCE PERSPECTIVES IN SCIENCE TEACHING AIMING FOR SOCIAL JUSTICE** | Lena Hansson; Hagop A. Yaccubian
1Kristianstad University; 2Lebanese American University |
|              | **WORLDVIEWS, PHILOSOPHY AND SCIENCE EDUCATION**                         | Michael Reiss                                                                | UCL Institute of Education  |

| Time          | Symposium                                                                 | Chairperson(s): Edvin Østergaard; Discussant: Elizabeth Cavicchi              |
|--------------|---------------------------------------------------------------------------|--------------------------------------------------------------------------------|----------------------------|
| 09:00 - 11:00| **Symposium 05 - AESTHETICS AS SENSING AND UNDERSTANDING: A CRITICAL INQUIRY INTO POTENTIALS AND CHALLENGES OF AN AESTHETICS-ORIENTED SCIENCE EDUCATION** | Edvin Østergaard                                                               |
|              | Chairperson(s): Edvin Østergaard; Discussant: Elizabeth Cavicchi          |                                                                                |                            |
|              | **HOW TO CARE WITH POLAR BEARS AND JACQUES RANCIERE: AN EXPLORATION OF POLITICAL AESTHETICS IN SCIENCE EDUCATION** | StevenAlsop                                                                  | Faculty of Education and Department of Science and Technology Studies |
|              | **TASTE IN SCIENCE AND TRANSDISCIPLINARY EDUCATION**                     | Erik Fooladi                                                                 | Dep. of science and mathematics, Volda University College |
|              | **THE BEAUTY THAT EMERGES WITHIN AESTHETIC LEARNING PROCESSES OPENS THE POSSIBILITIES FOR A DEEPER UNDERSTANDING AND KNOWLEDGE OF SCIENCE** | Ulrika Tobieson; Ann Mutvei
Södertörns University |
|              | **BEING A LISTENER. EXPLORING AND UNDERSTANDING SOUND**                   | Edvin Østergaard                                                              | Norwegian University of Life Sciences |

**TUESDAY AUGUST 27**
09:00 - 11:00 Symposium 06 - DIVERSITY OF APPROACHES TO COGNITIVE ACCELERATION IN SCIENCE AND MATHEMATICS EDUCATION Room B2

Chairperson(s): Reuven Babai, Geneviève Allaire-Duquette; Discussant: Anita Backhouse

TONGAN TEACHERS’ PERCEPTIONS ON IMPLEMENTING A COGNITIVE ACCELERATION IN MATHEMATICS EDUCATION PROGRAM
David Treagust; Teukava Finau; Mi hye Won
Curtin University, Australia

EXPLORING AND CATEGORISING SMALL GROUP TALK IN CASE LESSONS
Alan Edmiston¹; Geneviève Allaire-Duquette²
¹University of Brunel & Let’s Think Charity, UK; ²Tel Aviv University, Israel

LEARNING TO TEACH THROUGH QUESTIONING AMONG PRE-SERVICE ELEMENTARY TEACHERS
Jean-Philippe Ayotte-Beaudet¹; Alexandra Auclair²
¹University of Sherbrooke, Canada; ²University of Quebec in Montreal, Canada

AN INTERVENTION OF SEVERAL CASE LESSONS SIGNIFICANTLY ACCELERATES STUDENTS’ INQUIRY ABILITIES
Reuven Babai; Adi Mor Yosef
Tel Aviv University, Israel

09:00 - 11:00 Symposium 07 - UPCOMING RESEARCH IN SCIENCE IDENTITIES Room B3

Chairperson(s): Henriette Holmegaard, Louise Archer; Discussant: Justin Dillon

“IT’S LIKE HAVING TO GO BACK INTO THE CLOSET EVERY DAY”: A NARRATIVE INQUIRY EXAMINING THE IMPACTS HETERNORMATIVITY AND HETEROSEXISM HAVE ON THE EXPERIENCES OF GAY MEN IN STEM MAJORS
David Paul Steele
University of Georgia

DOING FIELDWORK IN GEOLOGY: PROCESSES OF NEGOTIATIONS AND IDENTITY
Rie Hjørnegaard Malm
University of Oslo

A COMPARISON OF GENDER IDENTITY CONSTRUCTION FOR ELITE FEMALE BIOScientISTS AND PHYSICISTS IN THE UK
Jaimie Miller-Friedmann
University of Oxford

POSITIONS IN DISCOURSE: A CRITICAL REWORKING OF IDENTITY PERSPECTIVES IN PHYSICS EDUCATION RESEARCH
Anders Johannson
University of Uppsala

09:00 - 11:00 Symposium 08 - TEACHERS UNDERSTANDING OF LANGUAGE AND LITERACY AS A KEY FOR INCLUSIVE SCIENCE EDUCATION (ISE) Room B4

Chairperson(s): Anders Jakobsson; Discussant: Russell Tytler

TEACHERS’ REFLECTIONS ON SCIENCE EDUCATION FROM A LANGUAGE PERSPECTIVE
Anders Jakobsson¹; Clas Olander¹; Maaike Hajer²
¹Malmö University; ²Utrecht University

PHYSICS TEACHERS’ DESIGN PROCESS FOR CONTEXTUALIZING LANGUAGE-BASED PHYSICS ACTIVITIES IN MULTILINGUAL MAINSTREAM CLASSES
Maria Kouns
Malmö University

A DESIGN FOR LANGUAGE SENSITIVE TEACHER EDUCATION IN SCIENCE AND TECHNOLOGY
Gerald Van Dijk
Utrecht University

REALIZING INCLUSIVE TEACHING IN PRIMARY SCIENCE CLASSROOMS: TEACHERS’ DEVELOPMENT ACROSS THREE NATIONAL CONTEXTS
Jantien Smits¹; Anne Bergliot Øyehaug²; Maria Kouns³; Elwin Savelbergh⁴; Maaike Hajer⁵
¹Utrecht University; ²Faculty for teacher education and pedagogy, Hamar; ³Malmö University
Symposium 09 - THE QUESTION OF RESPONSIBILITY IN SCIENCE|ENVIRONMENT|HEALTH  Room B5

Chairperson(s): Alla Keselman; Discussant: Albert Zeyer

HEALTH EDUCATION IN SCHOOL — A PARADOX OF RESPONSIBILITY?
Claes Malmberg; Anders Urbas
Halmstad University

CREATING PEDA戈GIES FOR SUSTAINABILITY IN CHILE THROUGH CHEMISTRY EDUCATION: BENEFITS AND CHALLENGES FROM TEACHERS’ PERSPECTIVES
Denise Quiroz Martinez
University College, London

WHAT KNOWLEDGE DO STUDENTS NEED IN ORDER TO FORM DECISIONS CONCERNING PREVENTIVE HEALTH ACTIONS? THE EXAMPLE OF SUGAR CONSUMPTION AND TYPE II DIABETES
Julia Arnold; Leah Kahl
University of Applied Sciences and Arts Northwestern Switzerland

THE IMPACT OF SCIENTIFIC KNOWLEDGE ON UNIVERSITY STUDENTS’ RISK PERCEPTION OF A CONTROVERSIAL HABIT
Benedikt Heuckmann; Finja Krüger
University of Muenster

Symposium 10 - CONNECTING THE EPISTEMIC DOTS: ADDRESSING EPISTEMIC ISSUES IN VARIOUS LEVELS OF SCIENCE EDUCATION  Room B6

Chairperson(s): Frauke Voitle; Discussant: Richard Duschl

“REAL SCIENCE IS MORE DIFFICULT”: INTRODUCING AND EXPLORING STUDENTS’ CLASSROOM-SPECIFIC EPISTEMIC BELIEFS ABOUT SCIENCE
Frauke Voitle1; Nele Kampa2; Irene Neumann1; Julia Schwanevedel1; Kerstin Kremer1
1Leibniz Institute for Science and Mathematics Education (IPN) at Kiel University; 2Humboldt-Universität zu Berlin

EPISODETIC ACTIVITIES In BIOLOGY INSTRUCTION: USING A GENERIC FRAMEWORK OF SCIENTIFIC REASONING AND ARGUMENTATION
Tobias Dorfner; Christian Förtsch; Michael Germ; Birgit J. Neuhaus
Ludwig-Maximilians-Universität München

COMPARING SCIENCE AND EDUCATION STUDIES: THE ROLE OF EPISTEMIC BELIEFS IN THE ACCEPTANCE OR REJECTION OF EDUCATION STUDIES AS PROFESSIONALLY USEFUL
Liam Guilfoyle1; Orla McCormack2; Sibel Erduran1
1University of Oxford; 2University of Limerick

EXPLORING TEACHERS’ UNDERSTANDINGS OF THE EPISTEMOLOGICAL DIMENSIONS OF SCIENCE AFTER PARTICIPATION IN RESEARCH
Shannon G. Davidson
Florida State University

Symposium 11 - COMPARING THE CONTEXTS TO UNDERSTAND SCIENCE  Room B7

Chairperson(s): Thomas Forissier; Discussant: Alain Stockless

CONTEXT EFFECT BASED LEARNING PRINCIPLE AND EXPERIMENTAL MODALITIES
Thomas Forissier1; Alain Stockless2; Jacqueline Bourdeau3
1Université des Antilles; 2UQAM; 3TELUQ

COGNITIVE ELEMENT ANALYSIS IN LEARNERS’ DRAWINGS
Claire Anjou1; Frédéric Fournier1; Thomas Forissier1; Audur Palsdottir3
1Université des Antilles; 2UQAM; 3University of Iceland

ELABORATION OF A MODELING TOOL FOR THE CONTEXT EFFECTS BASED TEACHING
Roger Nkambou1; Claire Anjou1; Yves Mazabraud3; Valéry Psyché1; Wafa Fennani1
1UQAM; 2Université des Antilles; 3TELUQ

CONTEXT EFFECTS IN COLLABORATIVE LEARNING: VERBAL AND NON-VERBAL INDICATORS
Lionel Pevo1; Chloé Le Bail1; François-Xavier Bernard1; Michael Baker1; Françoise Detienne1; Jordan Gonzalez2
1ESIEA; 2Telecom Paristech; 3Université Paris Descartes
## Invited Symposium 02 - GIREP - DISCIPLINE-BASED EDUCATIONAL RESEARCH to Improve Active Learning at University

Chairperson(s): Marisa Michelini; Discussant: Robert Evans

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<td><strong>Innovating Physics Teaching and Learning in the Bio-Area Degrees</strong></td>
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<td>Daniele Buongiorno; Marisa Michelini; Alberto Stefanel</td>
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<td>Physics Education Research Unit. Department of Mathematics, Computer Science, Physics. University of Udine, Italy</td>
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<td><strong>Guiding and Assessing Students' Work in Project Laboratory</strong></td>
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<td>Sergei Faletič; University of Ljubljana, Slovenia</td>
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<td><strong>&quot;Intentional Teaching&quot;: Using Students’ Ideas as the Basis for Teaching Physics</strong></td>
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<td>Paula Heron; University of Washington, Seattle, USA</td>
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<td><strong>The Role of Exercises in Learning. Examples by Research in Engineering Degree</strong></td>
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<td>Jenaro Guisasola; Kristina Zuza; Paulo Sarriugartewickman; Department of Applied Physics. University of the Basque Country</td>
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## Invited Symposium 03 - SIG 2 - Validity in Video-Based Research of Teaching and Learning Processes

Chairperson(s): Andreas Vorholzer; Discussant: Claudia von Aufschnaiter

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<td><strong>Validity in Qualitative Video-Based Research — The Use of the Documentary Method in Science Education</strong></td>
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<td>Helge Gresch; Westfälische Wilhelms-Universität Münster</td>
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<td><strong>A Type of Validation for a Multi-Scales Approach of Science Videoded Classroom Practices</strong></td>
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<td>Andrée Tiberghien¹; Patrice Venturini²</td>
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<td>¹Centre national de la recherche scientifique, laboratoire ICAR / Ecole Normale Supérieure de Lyon; ²Université Toulouse Jean Jaurès</td>
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<td><strong>A Question of Credibility: Analysing Video with Students</strong></td>
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<td>Kathrin Ottel-Cass; University of Graz</td>
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<td><strong>Coding Scientific Quality in Videotaped Inquiry Processes: Validity of Data Interpretation</strong></td>
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<td>Joé Weber; Rüdiger Tiemann; Annette Upmeier zu Belzen; Humboldt-Universität zu Berlin</td>
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## Invited Symposium 04 - SIG 3 - A 21st Century Perspective on Dioramas

Chairperson(s): Doris Ash; Discussant: Emily Dawson

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<td><strong>How Diorama Provoke Questions Concerning Life, Death, Self and Other</strong></td>
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<td>Dawn Sanders; Univ of Gothenborg</td>
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<td><strong>How Dioramas Mediate Cultural Conflict: ‘What Was and What Can Be’</strong></td>
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<td>Doris Ash; UC Santa Cruz</td>
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<td><strong>Dioramas and Disconnectedness from Nature</strong></td>
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<td>Annette Scheersoi; University of Bonn</td>
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<td><strong>Talking About Evolution with Natural History Dioramas</strong></td>
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<td>Jesús Piqueras¹; Marianne Achiam²</td>
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<td>¹Stockholm University; ²Univ. of Copenhagen</td>
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09:00 - 11:00 Invited Symposium 05 - SIG 6 - RESEARCH TRADITIONS ON LANGUAGES AND LITERACIES IN SCIENCE EDUCATION

Room D3

Chairperson(s): Kristina Danielsson; Discussant: Brian Hand

CONTENT AND LANGUAGE INTEGRATED LEARNING (CLIL) AND SECOND LANGUAGE ISSUES IN SCIENCE EDUCATION
Angel M.Y. Lin
Faculty of Education, Simon Fraser University

TOWARDS A PEDAGOGICAL CONTENT KNOWLEDGE FOR LITERACY IN SCIENCE
Jonathan Osborne
Graduate School of Science Education, Stanford University

PRACTISING THE LITERACIES OF SCIENCE: STUDENTS CONSTRUCTING REPRESENTATIONS
Vaughan Prain; Russell Tytler
Deakin University

METALANGUAGE FOR DESCRIBING AND ANALYZING MULTIMODAL DISCOURSE OF SCIENCE
Kok-Sing Tang
Curtin University

09:00 - 11:00 Invited Symposium 01 - THE INTERPLAY BETWEEN EDUCATIONAL DESIGNS AND DEVELOPING THEORIES OF LEARNING

Room E2 - Italia

Chairperson(s): Mariana Levin, United States; Discussant: Richard Noss

MAINTAINING DRAGGING IN A DYNAMIC GEOMETRY ENVIRONMENT: THE INTERPLAY BETWEEN A PSYCHOLOGICAL MODEL AND TASK DESIGN
Anna Baccaglini-Frank
University of Pisa

TEACHERS’ AND RESEARCHERS’ SHARED ACTIVITIES AS A WAY TO DEVELOP LOCAL THEORIES OF LEARNING
Kalle Juuti; Jari Lavonen
University of Helsinki

LOCAL THEORIES IN STEM EDUCATION: A CRITICALLY PHENOMENOLOGICAL PERSPECTIVE
Pratim Sengupta; Marie-Claire Shanahan; Miwa Takeuchi
University of Calgary

PATTERNS OF THEORY BUILDING WITHIN AND FOR INSTRUCTIONAL DESIGN
Andrea A. diSessa
University of California, Berkeley

09:00 - 11:00 Symposium 51 - A MATURE EXAMINATION OF JUVENILE TECHNOLOGIES IN SCIENCE EDUCATION

Room F1

Chairperson(s): Karolina Broman, Sascha Bernholt; Discussant: Pernilla Nilsson

TEACHING CHEMISTRY WITH ONLINE DATABASES
Ron Blonder¹; Inbal Tuvi-Arad²
¹Weizmann Institute of Science; ²The Open University of Israel

EXAMINATION OF MASSIVE NUMBER OF STUDENTS’ PERCEPTION OF SUCCESSFUL MOOCS
Anat Cohen
Tel Aviv University

LEARNING WITH EXPERIMENTS AND COMPUTER SIMULATIONS: A COMPARATIVE STUDY ON LEARNING PROCESSES IN THE STUDENT LABORATORY
Johanna Krüger¹; Tim Höfler²; Ilka Parchmann²
¹Kiel Science Outreach Campus, KiSOC; ²IPN, Kiel

APPLICATION OF DIGITAL TOOLS IN CHEMISTRY EDUCATION - VIRTUAL REALITY, AUGMENTED REALITY AND GAMIFICATION
Karolina Broman¹; Eva Mårell-Olsson²
¹Umeå University; ²Umeå university
09:00 - 11:00  Symposium 38 - REPRESENTATIONAL PLURALISM IN SCIENCE EDUCATION, PHILOSOPHY AND PSYCHOLOGY  
Room F2
Chairperson(s): Michel Bélanger; Discussant: Patrice Potvin

TENSIONS BETWEEN SCIENCE AND INTUITION ACROSS AGE, EDUCATION AND CONTEXT  
Andrew Shtulman  
Occidental College

COGNITIVE PLURALISM: MODELS IN AND OF SCIENTIFIC UNDERSTANDING  
Stephen Horst  
Wesleyan University

CONCEPTUAL PROFILES: A MODEL TO HANDLE THE PLURALISM OF MEANINGS IN SCIENCE TEACHING  
Eduardo Mortimer1; Charbel Nino El-Hani2; Edenia Maria Ribeiro do Amaral3  
1Universidade Federal de Minas Gerais; 2Universidade Federal da Bahia; 3Universidade Federal Rural de Pernambuco

EMERGENT PROPERTIES OF REPRESENTATIONAL COMPLEXES  
Michel Bélanger  
Université du Québec à Rimouski

09:00 - 11:00  Symposium 03 - NEW MATERIALISM AND ITS IMPLICATIONS FOR SCIENCE EDUCATION RESEARCH METHODOLOGY -I  
Room F3
Chairperson(s): Lindsay Hetherington

ENTANGLING METHODS: IMPLICATIONS OF NEW MATERIALIST THEORY FOR MIXED METHODS IN STE(A)M EDUCATIONAL RESEARCH  
Lindsay Hetherington  
University of Exeter

BEYOND DICHOTOMIES/BINARIES: 21ST CENTURY POST HUMANITIES ETHICS FOR SCIENCE EDUCATION USING A BARADIAN PERSPECTIVE  
Kate Scantlebury  
University of Delaware

HOW MATTER COMES TO MATTER IN THE DIFFRACTIVE ANALYSIS: SCIENTIFIC PHENOMENA AS CO-CREATORS OF KNOWLEDGE PRODUCTION  
Anna Gunther-Hanssen  
Uppsala Universiteit

MODULATING STORIES: STUDENT PRODUCED KNOWLEDGE CREATIONS  
Kathrin Ottel-Cass  
Aalborg Universiteit

09:00 - 11:00  Symposium 13 - UNVEILING SCIENTIFIC PRACTICES IN PRE-SERVICE TEACHER EDUCATION: A FOCUS ON CHALLENGES, POTENTIALITIES, STRATEGIES AND TOOLS  
Room G1
Chairperson(s): MARIA MARTINEZ CHICO; Discussant: MARIA PILAR JIMENEZ ALEXIANDRE

SCIENTIFIC PRACTICES TO DEVELOP A BALANCED MODEL OF ENERGY IN PRE-SERVICE SECONDARY SCHOOL TEACHER EDUCATION  
Macarena Soto1; Digna Couso2  
1University of Santiago de Compostela; 2Autonomous University of Barcelona

INQUIRY-BASED PRACTICES TO TRAIN PRE-SERVICE TEACHERS: POTENTIALITIES TO DEVELOP THE TEACHING COMPETENCY  
M. Rut Jiménez-Liso; Maria Martinez Chico; Rafael López-Gay; Francisco J. Castillo Hernández  
University of Almería

UNRAVELLING PRE-SERVICE TEACHERS’ PEDAGOGICAL DESIGN CAPACITY AND PEDAGOGICAL CONTENT KNOWLEDGE FOR INQUIRY-BASED LEARNING  
Marios Papaevripidou; Maria Irakleous; Zacharias C. Zacharia  
University of Cyprus

PRESERVICE ELEMENTARY TEACHERS’ VIDEO ANALYSIS OF SCIENCE TEACHING  
Carla Zembal-Saul  
Penn State University
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<td>A DRAMA-BASED APPROACH TO ENGAGE SECONDARY STUDENTS IN ENVIRONMENTAL ISSUES</td>
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<td>Roald Verhoeff</td>
<td>Freudenthal Institute for Science and Mathematics Education, Utrecht University, Utrecht</td>
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<td>THE ROLE OF SCIENCE IN DRAMAS OF SUSTAINABILITY</td>
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<td>Marianne Odegaard</td>
<td>University of Oslo</td>
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<td>IDENTIFYING CRITICAL EPISODES IN TEACHING SCIENCE USING ROLE-PLAY</td>
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<td>Martin Braund</td>
<td>Cape Peninsula University of Technology</td>
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<td>PEDAGOGIC PRINCIPLES THAT AFFORD PARTICIPATIVE INQUIRY OPPORTUNITIES: DRAMATISING FROM A SCIENTISTS’ CONTEXT.</td>
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<td>Debra McGregor</td>
<td>Oxford Brookes University</td>
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<td>Symposium 15 -GLOBAL PERSPECTIVES ON SCIENCE TEACHER COMPETENCIES:</td>
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<td>Chairperson(s): Christine Tippett; Discussant: Wayne Melville</td>
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<td>A CANADIAN CROSS-FACULTY EDUCATION COMPARISON: PROGRAM STRUCTURES AND PRACTICES TO FOSTER TEACHER CANDIDATE PROFESSIONAL LEARNING</td>
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<td>Karen Goodnough(^1); Xavier Fazio(^2); Saïqa Azam(^3)</td>
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<td>1Memorial University; 2Brock University</td>
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<td>PREPARING “COMPETENT” SCIENCE TEACHERS IN AUSTRALIA: STANDARDS AND ASSESSMENTS</td>
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<td>Patricia Morrell; Jodie Miller</td>
<td>The University of Queensland</td>
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<td>STANDARDS FOR SCIENCE TEACHER PREPARATION IN THE UNITED STATES</td>
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<td>Patricia Morrell(^1); Meredith Park Rogers(^2); Eric Pyle(^3); Gillian Roehrig(^4); William Veal(^5)</td>
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<td>1The University of Queensland; 2Indiana University; 3James Madison University; 4University of Minnesota; 5College of Charleston</td>
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<td>MODELLING IN STEM: THE TALE OF TWO COUNTRIES IN CENTRAL ASIA</td>
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<td>09:00 - 11:00</td>
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<td>INTEGRATING DIFFERENT MODELING APPROACHES TO INVESTIGATE COMPLEX PHENOMENA</td>
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<td>Tom Bielik(^1); Sharon T. Levy(^2); Ravit Golan-Duncan(^3)</td>
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<td>1CREATE for STEM at Michigan State University; 2University of Haifa; 3Rutgers University</td>
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<td>MAKING SENSE OF STUDENTS’ STATIC EQUILIBRIUM MODELS</td>
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<td>Lynn Stephens; Steven Roderick</td>
<td>The Concord Consortium</td>
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<td>USING MODELS FOR SCIENTIFIC INQUIRY IN 10TH GRADE CHEMISTRY CLASSES. RESULTS OF A QUANTITATIVE STUDY.</td>
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<td>Marvin Rost; Rüdiger Tiemann</td>
<td>Humboldt-Universitaet zu Berlin</td>
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<td>THE ROLE OF EXPERIMENT STRUCTURE TO SUPPORT SCIENTIFIC MODELS AND ARGUMENTS</td>
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<td>Ibrahim Delem(^1); Ayse Buber(^2); Gul Unal Coban(^2)</td>
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<td>1Usak University; 2Dokuz Eylul University</td>
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### TUESDAY 09:00 - 11:00

**Symposium 17 - MEASURING AND FACILITATING STUDENTS’ INQUIRY SKILLS**  
Room G5  
Chairperson(s): Martin Schwichow, Andrea Moeller; Discussant: Andreas Nehring

**Disciplines versus sub-skills: What influence students’ performance in an interdisciplinary control of variables test?**  
Martin Schwichow¹, Martina Brandenburger¹, Silke Mikelskis-Seifert¹, Johanna Kranz², Andrea Moeller²  
¹PH Freiburg; ²University of Vienna

**What matters more for learning during inquiry-learning: scientific reasoning or cognitive skills?**  
Anita Stender¹, Martin Schwichow², Hendrik Haertig¹  
¹Universität Duisburg-Essen, Physikdidaktik; ²PH Freiburg

**Performance assessment of experimental competences in science**  
Angela Bonetti¹, Christoph Gut¹, Livia Murer¹, Susanne Metzger², Maik Walpuski³  
¹Zurich University of Teacher Education; ²University of Applied Sciences and Arts Northwestern Switzerland; ³University of Duisburg-Essen

**Enhancing students acquisition of scientific inquiry skills through testing?**  
Johanna Kranz¹, Tobias Tempel², Andrea Moeller²  
¹Austrian Educational Competence Center Biology (AECCB), University of Vienna, Austria; ²Psychology and Diagnostics, Ludwigsburg University of Education, Germany

### TUESDAY 13:45 - 15:00

**INTERPRETATION AND UTILIZATION OF WRITTEN FEEDBACK COMMENTS BY ELEMENTARY SCHOOL STUDENTS WORKING ON SCIENCE INVESTIGATION TASKS**  
Evangelia Irakleous  
University of Cyprus

**The relationship between teachers’ pedagogical content knowledge and student learning in electrostatics**  
Ernest Mazibe; Estelle Gaigher; Corene Coetzee  
University of Pretoria

**Teachers’ pedagogical practices in integrated contexts of education: the case of study visits to science museums — first results**  
Vanessa Souza, Vitor Bonifácio; Ana V. Rodrigues  
University of Aveiro

**STEM education in Denmark: challenges and prospects for implementation**  
Nina Waadegaard  
Department of Science Education, University of Copenhagen

**Assessment of pre-service teachers’ scientific reasoning in the context of modeling and investigation tasks**  
Pantelitsa Karnavou¹, Costas P. Constantinou¹, Christiana Th. Nicolaou²  
¹University of Cyprus; ²Cyprus Ministry of Education and Culture

**Creativity in primary science education**  
Maren Fredagsvik  
University of Southeast Norway

**The success of failure: understanding students’ perspectives on failure in science and science education**  
Sandhya Krishnan  
The University of Georgia

**Learning cutting-edge research science topics via school visits to research centers**  
Kalliopi Giannakoudaki; Dimitris Stavrou  
University of Crete

**Nanoscale phenomena and concepts: learning and teaching issues in primary school**  
George Peikos; Anna Spyrtou  
University of Western Macedonia, Greece
REASONING ON AND REASONING IN TEACHING SITUATIONS WITH EXPERIMENTAL EVIDENCE DEVIATING FROM EXPECTATION
Christoph Holz; Susanne Heinicke
Westfälische Wilhelms-Universität Münster

EMPIRICAL STUDY OF THE EFFECTIVENESS OF TWO PROFESSIONAL DEVELOPMENT FORMATS FOR TEACHERS ON “DISCOVERY EXPERIMENTATION”, A SCIENTIFIC INQUIRY APPROACH
Arne Bewersdorff; Armin Baur; Markus Emden
1University of Education Heidelberg; 2Zurich University of Teacher Education

STRUCTURAL CHARACTERISTICS OF LEARNING OPPORTUNITIES IN TEACHER TRAINING PROGRAMS AND THEIR EFFECTS ON PRE-SERVICE PHYSICS TEACHERS’ PROFESSIONAL KNOWLEDGE
Dustin Schiering; Stefan Sorge; Knut Neumann
IPN

TEACHERS’ COLLECTIVE AGENCY THROUGH SELF-ORGANISING COMMUNITIES WITHIN THE PRAXIS OF SCIENCE EDUCATION: A FREIREAN APPROACH TO SCIENCE EDUCATION RESEARCH
Betzabe Torres
University of Bristol

IMPROVING BIOLOGY AND CHEMISTRY PRE-SERVICE TEACHERS’ USE OF EXTERNAL REPRESENTATIONS THROUGH FEEDBACK
Büsra Tonyali; Mathias Ropohl; Julia Schwanewedel
3University of Duisburg-Essen; 4Humboldt University of Berlin

FLIPPED CLASSROOM — A RESEARCH PROJECT BETWEEN HIGH HOPES AND LACKING EVIDENCE
Lars-Frederik Weiβ
Institute for Didactics of Mathematics and Physics

13:45 - 15:00 SP05 - SUMMER SCHOOL 2019
Room A2
Chairperson(s): Robert Evans

DESIGNING A TEACHING-LEARNING SEQUENCE ABOUT ELECTROMAGNETIC RADIATION FOR GRADE EIGHT
Sarah Zloklikovits; Martin Hopf
University of Vienna

ENHANCING STUDENTS’ INTEREST IN SCIENCE AND STEM CAREERS: THE ROLE OF CAREER-BASED SCENARIOS
Irene Drymiotou
University of Cyprus

DEVELOPMENT AND EVALUATION OF A TEACHING UNIT IN PARTICLE PHYSICS TO PROMOTE STUDENTS’ CRITICAL THINKING
Farahnaz Sadidi; Gesche Pospiech
Technische Universität Dresden, Faculty of Physics, Physics Education

INVESTIGATING TEACHERS’ BELIEFS IN TRINIDAD AND TOBAGO: A CASE OF INQUIRY-BASED LEARNING ADOPTION IN THE PRIMARY SCIENCE CLASSROOM
Ainsley Carnarvon
University of Aberdeen

WHAT COUNTS AS SCIENTIFIC ARGUMENT? LANGUAGE IDEOLOGIES AND THE ENGAGEMENT OF MULTILINGUAL STUDENTS IN DISCOURSE
Emily Reigh
Stanford University

EXPLORE THE PRESENTATION OF CLIMATE CHANGE IN AQUARIUM EXHIBITS.
Jenn Idema; Kristy Daniel
Texas State University

CHILD LEADERS OF SCIENCE: NAVIGATING THE HIGH SEAS OF POSSIBILITY
Carole Kenrick
University College London Institute of Education

UNFOLDING CHILDREN’S SCIENCE LEARNING JOURNEYS BY USING ARTEFACTS IN INTERVIEWS
Stine Mariegaard; Stine Mariegaard
University of Southern Denmark

PLANTS ARE BORING, THEY ALL LOOK THE SAME
Amélie Tessartz; Jonathan Hense; Annette Scheersoi
Biology Education, University of Bonn
**CHARACTERISATION OF SCIENCE CONTENT INTEGRATION IN HIGH SCHOOL STEM PROJECTS**  
Miquel Pérez-Torres; Conxita Márquez; Digna Couso  
Autonomous University of Barcelona

**UNDERSTANDING & ENHANCING STUDENTS’ EPistemological Beliefs ABOUT MODELS IN SCIENCE THROUGH MODELLING PROCESSES**  
Stavros Koukioglou; Dimitrios Psillos  
Aristotle University of Thessaloniki Faculty of Education School of Primary Education

**INVESTIGATING UPPER SECONDARY STUDENTS’ DIFFICULTIES IN EVALUATING EXPERIMENTAL DATA**  
Steffen Brockmüller; Mathias Ropohl  
University of Duisburg Essen

**NATURE OF SCIENCE THROUGH PROBLEM-BASED LEARNING: EFFECTS ON SCIENCE EPistemological CONCEPTIONS AND STUDENTS’ PERFORMANCE**  
Cristina Sousa¹; João C. Paiva²; Isabel Chagas³  
¹Faculdade de Ciências, Universidade do Porto; ²Faculdade de Ciências, Universidade do Porto & CIQUP - Centro de Investigação em Química da Universi; ³Instituto de Educação, Universidade de Lisboa, Portugal.

**EMPIRICAL INVESTIGATION OF STUDENTS’ MOTIVATIONAL QUALITIES IN CONTEXT OF BIOLOGY LEARNING**  
Lisa-Maria Kaiser; Nadine Großmann; Matthias Wilde  
Bielefeld University

**BEYOND THE BACHELOR’S DEGREE – LEGITIMATE CHOICES AND IMAGINED FUTURES**  
Katia Kromann Nielsen  
Department of Science Education, University of Copenhagen

**STUDY CULTURE AND STUDY PRACTICES OF FIRST-YEAR UNIVERSITY STUDENTS**  
Andrea Fransiska Møller Gregersen  
Department of Science Education, University of Copenhagen

**DEVELOPING LEARNERS’ INTEREST IN INSECTS AS A WAY OF COUNTERING THE BIODIVERSITY CRISIS**  
Julian Kokott; Jonathan Hense; Annette Scheersoi  
Biology Education, University of Bonn

**DEVELOPMENT AND EVALUATION OF AN ONLINE LEARNING ENVIRONMENT PROVIDING BUG-RELATED FEEDBACK FOR GENERAL CHEMISTRY COURSES**  
Florian Trauten; Carolin Eitemüller; Maik Walpuski  
University of Duisburg-Essen

**YOUNG CHILDREN’S CONCEPTIONS OF ENERGY**  
Franziska Detken  
Zurich University of Teacher Education

**INVESTIGATION OF THE IMPACT AN INTERTWINED PBL & HOS APPROACH ON TURKISH MIDDLE SCHOOL STUDENTS’ PROBLEM SOLVING SKILLS, SCIENTIFIC INQUIRY, CRITICAL AND CREATIVE THINKING**  
Ferah Ozer¹; Nihal Dogan²  
¹Bogazici University; ²Abant Izzet Baysal University

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**13:45 - 15:00 Workshop 01 - LET THE LIONS HEART ROAR AS THE IMAGINATION CRYSTALIZES AND MANIFESTS ITSELF AND ITS EXPERT KNOWLEDGE**  
Room B1

Chairperson(s): Ulrika Tobieson

**LET THE LIONS HEART ROAR AS THE IMAGINATION CRYSTALIZES AND MANIFESTS ITSELF AND ITS EXPERT KNOWLEDGE**  
Ulrika Tobieson; Ann Mutvei  
Södertörns University

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**13:45 - 15:00 Workshop 02 - BUILDING POWERFUL TEACHER PROFESSIONAL DEVELOPMENT TO LEVERAGE WHY HOW AND WHAT LEVEL THINKING TO MOTIVATE SHIFTS IN PEDAGOGY**  
Room B2

Chairperson(s): Joseph Sunshine

**BUILDING POWERFUL TEACHER PROFESSIONAL DEVELOPMENT TO LEVERAGE WHY, HOW, AND WHAT LEVEL THINKING TO MOTIVATE SHIFTS IN PEDAGOGY**  
Joseph Sunshine; Andre Botello  
Chicago Public Schools
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<td>13:45 - 15:00</td>
<td>Workshop 03 - A PLAY-CENTRIC APPROACH TO SCIENCE EDUCATION</td>
<td>Adriana Cardinot</td>
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<td>Workshop 04 - EMPLYING CURIOSITY-DRIVEN VIDEO-BASED DISCOURSE TO FACILITATE</td>
<td>Avraham Merzel</td>
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<td>Workshop 05 - PROFESSIONAL DEVELOPMENT FOR ICT-BASED TEACHING</td>
<td>Kai-Mikael Jää-Aro</td>
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<td>Workshop 06 - TEACHING COSMOLOGY AND GENERAL RELATIVITY IN HIGH SCHOOL:</td>
<td>Alice Gasparini</td>
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<td>EFFECTS ON PHYSICS LEARNING AND EXAMPLES OF ACTIVITIES FOR PUPILS</td>
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<td>Chairperson(s): Alice Gasparini</td>
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<td>Workshop 07 - UNDERSTANDING COMPLEX BIOLOGICAL PROCESSES THROUGH EMBODIED</td>
<td>C.L. Geraedts</td>
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<td>13:45 - 15:00</td>
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<td>Iva Stuchliková</td>
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WHAT STUDENTS’ REPORTS OF SCIENTIFIC PHENOMENA TELL US ABOUT THEIR CONCEPTS OF FORCE AND MOTION?
Katharina Gierl; Patrick Löffler; Alexander Kauertz
University of Koblenz-Landau

IMPLEMENTATION OF THE PRE-LEARNING STRATEGY IN CHEMISTRY EDUCATION
Snjezana Smerdel
Faculty of Science, University of Split, Croatia

TEMPORAL LAG SEQUENTIAL ANALYSIS AS A METHOD TO INVESTIGATE DIFFERENCES BETWEEN SCAFFOLDED AND NON-SCAFFOLDED GROUPS’ INQUIRY-BASED LEARNING PROCESSES
Joni Lämsä; Raija Hämäläinen; Pekka Koskinen; Jouni Viiri; Joonas Mannonen
University of Jyväskylä

SUPPORTING SCIENCE TEACHERS TEACHING OUTSIDE THEIR SCIENCE SPECIALISM
Doreen Mizzi
University of Malta

REPRESENTATIONS AS TOOL IN THE FORCE CONCEPT CONSTRUCTION IN PRE-SERVICE PRIMARY TEACHER TRAINING
Angela García-Llado; Marina Castells; Mercè Garcia-Mila
Universitat de Barcelona

USING CASE-BASED LEARNING SCENARIOS TO FOSTER PRE-SERVICE CHEMISTRY TEACHERS’ DIAGNOSTIC ABILITIES REGARDING STUDENTS’ CONCEPTIONS
Julian Heeg; Sascha Schanze
Leibniz Universität Hannover - Institute for Science Education

CHEMISTRY TEACHING AND LEARNING DURING PRIMARY — SECONDARY TRANSITION IN ENGLAND. AN EXPLORATION OF HOW THE STATUTORY CURRICULUM IS INTERPRETED, ENACTED AND EXPERIENCED.
Elizabeth Coppard
Oxford Brookes University

BUILDING OF INTERPERSONAL COMMUNICATION SKILLS OF NEW GENERATION STUDENTS EMPLOYING RESPONSIBLE RESEARCH AND INNOVATION
Audrius Ivanauskas
Vytautas Magnus University

MODELLING TEACHERS’ CONTENT KNOWLEDGE IN PARTICLE PHYSICS
Michaela Oettle; Silke Mikelskis-Seifert
University of Education Freiburg

INVESTIGATING THE EFFECT OF FORMATIVE ASSESSMENT DESIGN ACTIVITIES ON SENIOR BIOLOGY STUDENT TEACHERS’ PEDAGOGICAL CONTENT KNOWLEDGE AND LEARNING PROGRESSIONS ON MODERN GENETICS
Nazli Ruya Taskın
Balikesir University

THE ADEQUATE USE OF PHYSICS KNOWLEDGE IN EXPERIMENTAL ENVIRONMENTS
Vanessa Schad; Eva Cauet; Alexander Kauertz; Jochen Scheid
University of Koblenz-Landau

STUDENTS’ LEARNING PROCESSES OF SCIENTIFIC INQUIRY KNOWLEDGE AND ABILITIES
Jörn J. Häglele
Justus-Liebig-Universität Gießen

ENERGY TRANSITION TO RENEWABLES - RECONSTRUCTION OF STUDENTS’ AND SCIENTISTS’ CONCEPTIONS FOR SCIENCE EDUCATION
Sybille Hübner
University of Hildesheim

A SELF-STUDY ON DEVELOPMENT OF STUDENTS IN STEM CAREERS BY ENRICHED APPLICATIONS WITHIN HISTORY OF SCIENCE
İsmail Dönmez; Mehmet Fatih TAŞAR
1Muş Alparslan University; 2Gazi University
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<td>Workshop 08 - UNDERSTANDING AND IMPROVING INTEGRATED STEM INSTRUCTION THROUGH AN OBSERVATION PROTOCOL</td>
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<td>UNDERSTANDING AND IMPROVING INTEGRATED STEM INSTRUCTION THROUGH AN OBSERVATION PROTOCOL</td>
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<td>Emily Dare(^1), Joshua Ellis(^1), Elizabeth Ring-Whalen(^2), Gillian Roehrig(^3)</td>
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<td>(^1)Florida International University; (^2)St. Catherine University; (^3)University of Minnesota</td>
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| 13:45 - 15:00 | Workshop 09 - DEVELOPING KNOWLEDGE-IN-USE ASSESSMENT TASKS                      | D2     |
| Chairperson(s): Marcus Kubsch | DEVELOPING KNOWLEDGE-IN-USE ASSESSMENT TASKS |        |
|              | Marcus Kubsch\(^1\), Phyllis Haugabook Pennock\(^2\), Brian Gane\(^3\) |        |
|              | \(^1\)IPN; \(^2\)CREATE for STEM Institute, Michigan State University; \(^3\)Learning Sciences Research Institute (LSRI), University of Illinois at Chicago |        |

| 13:45 - 15:00 | Workshop 10 - ASSESSING WITHOUT MARK SCHEMES OR RUBRICS: A COMPARATIVE JUDGEMENT APPROACH TO MEASURING CONCEPTUAL UNDERSTANDING IN SCIENCE | D3     |
| Chairperson(s): Jasper Green | ASSESSING WITHOUT MARK SCHEMES OR RUBRICS: A COMPARATIVE JUDGEMENT APPROACH TO MEASURING CONCEPTUAL UNDERSTANDING IN SCIENCE |        |
|              | Jasper Green | University College London Institute of Education |        |

| 13:45 - 15:00 | SP02 - SUMMER SCHOOL 2018                                                      | F1     |
| Chairperson(s): Pasi Nieminen | BECOMING A TEACHER: REFLECTIVE PRACTICE AS A WAY OF EXPLORING SECONDARY SCIENCE TEACHER BELIEFS AND PRACTICES |        |
|              | Preeti Titu\(^1\), Gillian Roehrig\(^2\), Joshua Ellis\(^3\) |        |
|              | \(^1\)University of MN; \(^2\)University of Minnesota; \(^3\)Florida International University |        |

| 13:45 - 15:00 | CUEING IN TUTORIAL VIDEOS IN ORGANIC CHEMISTRY: INVESTIGATION OF LEARNING EFFECTIVENESS USING EYE TRACKING |        |
|              | Marc Roedemer\(^1\), Julia Eckhard\(^2\), Nicole Graulich\(^3\), Sascha Bernholt\(^4\) |        |
|              | \(^1\)Leibniz Institute for Science and Mathematics Education (IPN) at Kiel University; \(^2\)Justus-Liebig-University Gießen |        |

| 13:45 - 15:00 | INQUIRING INTO INQUIRY: WHAT CAN WE LEARN ABOUT INQUIRY AS MEANS AND ENDS FROM PISA AND TIMSS STUDY? |        |
|              | Nani Teig | University of Oslo |        |

| 13:45 - 15:00 | MODELING AND DEVELOPMENT OF CONTENT KNOWLEDGE AND ITS IMPORTANCE FOR EXPLAINING PHYSICS |        |
|              | Patrick Enkrott\(^1\), David Buschhüter; Andreas Borowski |        |
|              | University of Potsdam |        |

| 13:45 - 15:00 | COMPARING THE Correctness And Consistency Of STUDENTS’ MENTAL MODELS On COMBUSTION IN MODELLING-BASED AND REGULAR CURRICULUM |        |
|              | Chihang Chang | Kang Chiao International School |        |

| 13:45 - 15:00 | SCIENCE TEACHERS’ PERCEPTIONS AND NEEDS ON INTEGRATING ENGINEERING DESIGN |        |
|              | Jesse Hietala, Risto Leinonen; Pelka E. Hirvonen; Mervi A. Asikainen |        |
|              | University of Eastern Finland |        |
ON THE EXCHANGEABILITY OF DIFFERENT MEASUREMENT METHODS AND THEIR USE TO ELICIT EVIDENCE ON INSTRUMENT’S COGNITIVE VALIDITY
Livia Murer¹; Susanne Metzger²; Angela Bonetti³; Christoph Gut⁴
¹Zurich University of Teacher Education and University of Basel; ²University of Applied Sciences and Arts Northwestern Switzerland and University of Basel; ³Zurich University of Teacher Education

ASSESSING EXPERIMENTAL COMPETENCES IN SCIENCE
Angela Bonetti¹; Christoph Gut¹; Maik Walpuski²
¹Zurich University of Teacher Education; ²University of Duisburg-Essen

EVALUATING STUDENT SELF-PERCEPTIONS AND IMPORTANCE OF WORK AND LIFE SKILLS SKILLS AND CORE IDEAS ENABLING PROMOTION OF GREATER INTEREST
Helen Semilarski; Regina Soobard; Milla Rannikmäe
University of Tartu

STUDENT DIFFICULTIES WITH BOUNDARY CONDITIONS FOR THE DIFFUSION EQUATION
Sofie Van den Eynde¹; Mieke De Cock²; Johan Deprez²; Martin Goedhart²
¹KU Leuven; ²University of Groningen

READING EVOLUTIONARY TREES: TESTING AND EVALUATION OF THE SYNTHETIC TREE-READING MODEL (STREAM)
Thilo Schramm; Yvonne Schachtschneider; Philipp Schmiemann
University Duisburg-Essen

PEER ASSESSMENT IN LOWER SECONDARY SCHOOL SCIENCE
Laura Ketonen; Jouni Viiri; Pasi Nieminen
University of Jyväskylä

ANALYSING AND SUPPORTING STUDENTS’ UNDERSTANDING OF SYMBOLIC-MATHEMATICAL MODELS IN CHEMISTRY
Ines Komor; Helena van Vorst; Elke Sumfieth
University of Duisburg-Essen

DEVELOPING PROFESSIONAL IDENTITY AMONG LEADING CHEMISTRY TEACHERS
Ruth Waldman¹; Ron Blonder²
¹Weizmann Institute of Science; ²Weizmann institute of science

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13:45 - 15:00 SP03 - SUMMER SCHOOL 2018 Room F2
Chairperson(s): Gjalt Prins

STUDENTS’ FREEDOM AND EXPERIENCES DURING OUTDOOR SCIENCE LEARNING
Anttoni Kervinen¹; Wolff-Michael Roth¹; Kalle Juuti¹; Anna Uitto¹
¹University of Helsinki, Finland; ²University of Victoria, BC; ³University of Helsinki

ORAL EXPLANATORY COMPETENCE IN SCIENCE EDUCATION AT PRIMARY SCHOOL
Jennifer Krupinski; Sarah Rau-Patschke; Stefan Rumann
Universität Duisburg-Essen

ENGAGING YOUNG CHILDREN IN OUTDOOR EDUCATION EXPLORATORY SCIENTIFIC DIALOGUES AND THE IMPORTANCE OF CHILDREN’ S FINDINGS OF NATURE ELEMENTS
Ingunn Skalstad
University of Southeast Norway

STUDENTS’ PERCEPTION TOWARDS EXTERNAL REPRESENTATIONS OF THE ATOMIC LEVEL
Perihan Akman; Sabine Fechner
Paderborn University

STUDENTS’ REASONING IN THE DOMAIN OF SUSTAINABILITY EDUCATION: THE CASE OF PLASTICS.
Esther de Waard; Wouter van Joolingen; Gjalt Prins
Freudenthal Institute, Utrecht University

DIPPING INTO THE ART OF WRITING SCIENCE: IS TASK-BASED LANGUAGE TEACHING A KEY TO SUCCESS?
Johanna Taglieber; Corinna Pieber; Suzanne Kapelari; Wolfgang Dür; Barbara Hinger
University of Innsbruck, Department of subject-specific Education

EMBODIED SIMULATIONS IN BIOLOGY EDUCATION
C.L. Geraedts
Vrije Universiteit Amsterdam

21ST CENTURY BIOLOGY EDUCATION AND MEASURING BIOLOGICAL LITERACY
Helen Semilarski; Anne Laius
University of Tartu
DESIGN-BASED RESEARCH ACTIVITY ON WAVES AND MODERN PHYSICS IN SECONDARY SCHOOL
Federica Minozzi; Irene Marzoli
University of Camerino

THE ROLE OF STUDENTS’ CONCEPTION ON RANDOMNESS AND PROBABILITY THEORY IN THE
CONTEXT OF SCIENCE
Alexandra Jansky; Sascha Schmeling; Martin Hopf
1University of Vienna; 2CERN

AN INTRINSICALLY INTEGRATED EDUCATIONAL GAME ON NEWTONIAN MECHANICS TO PROMOTE
CONCEPTUAL DEVELOPMENT
Anne van der Linden; Wouter van Joolingen; Ralph Meulenbroeks
Freudenthal Institute, Utrecht University

INTEGRATING BIOINFORMATICS AT THE INTERDISCIPLINARY INTERSECTION OF ELEMENTARY AND
SECONDARY SCHOOL CURRICULA USING A BOTTOM-UP APPROACH
Ana Martins; Leonor Lencastre; Fernando Tavares
1Faculty of Sciences of University of Porto; Research Center in Biodiversity and Genetic Resources
2Faculty of Psychology and Educational Sciences of University of Porto

SYSTEMS THINKING IN BIOLOGY EDUCATION
Melde G.R. Gilissen; Marie-Christine P.J Knippels; Wouter R. van Joolingen
Utrecht University

THE INFLUENCE OF CLOSE INDIVIDUALS IN ADOLESCENTS’ EDUCATIONAL AND CAREER CHOICES
— GENDERED CHOICES IN STEM AS A SPECIAL INTEREST
Kirs Ikonen; Risto Leinonen; Pekka E. Hirvonen; Mervi A. Asikainen
University of Eastern Finland

GENDER AND SMALL GROUP STEM ACTIVITIES: A COMPARISON OF STUDENTS’ SCIENCE AND
ENGINEERING PARTICIPATION
Jeanna Wieselmann; Emily Dare; Elizabeth Ring-Whalen; Gillian Roehrig
1University of Minnesota; 2Florida International University; 3St. Catherine University

CREATING PEDAGOGIES FOR SUSTAINABILITY IN CHILE THROUGH CHEMISTRY EDUCATION:
BENEFITS AND CHALLENGES FROM TEACHERS’ PERSPECTIVES
Denise Quiroz Martinez
University College London

STUDENTS’ INITIAL UNDERSTANDING OF MODELS OF COMPLEX BIOLOGICAL PROCESSES
Susanne Jansen; Wouter van Joolingen; Marie-Christine Knippels
Utrecht University

STUDENTS’ USE OF SCIENCE CAPITAL IN CHEMISTRY
Lilith Rüschenpöhler; Silvija Markic
Ludwigsburg University of Education

INVESTIGATING THE INTERACTION BETWEEN LEARNING ABOUT THE NATURE OF SCIENCE AND
QUANTUM PHYSICS IN SECONDARY SCHOOLS
Kirsten Stadermann; Martin Goedhart
1University of Groningen, NL; 2Institute of Science Education and Communication, University of
Groningen, NL

NAVIGATING CLIMATE CHANGE: THE ROLE OF POLITICS IN YOUTH DISCOURSE AND SCIENTIFIC
REASONING
Lynne Zummo
Stanford University

TEACHING NATURE OF SCIENCE (NOS) IN GREECE; EVALUATION OF THE CONDITION & STUDY OF
EFFECTIVE WAYS TO INCLUDE IT INTO TEACHING IN THE SECONDARY EDUCATION
Anna Koumara
University of Ioannina

TOWARDS A FRAMEWORK OF EQUITABLE DISCIPLINARY RESPONSIVENESS IN SCIENCE
EDUCATION
Christa Haverly
Michigan State University
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<td>Workshop 11 - MODERNISING SCIENCE TEACHING: BRINGING THE VIRTUAL UNIVERSE INTO THE CLASSROOM</td>
<td>Magdalena Kersting</td>
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<td>MODERNISING SCIENCE TEACHING: BRINGING THE VIRTUAL UNIVERSE INTO THE CLASSROOM</td>
<td>Magdalena Kersting¹; Jackie Bondell²</td>
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<td>¹University of Oslo, Dept. of Physics; ²ARC Centre of Excellence for Gravitational Wave Discovery (OzGrav), Faculty of Science Engineering and Technology, Swinburne Uni</td>
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<td>13:45 - 15:00</td>
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<td>Tom Bielik¹; Lynn Stephens²</td>
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<td>SUPPORTING STUDENTS’ MODELING PRACTICE USING AN ONLINE COMPUTATIONAL MODELING TOOL</td>
<td>¹CREATE for STEM at Michigan State University; ²The Concord Consortium</td>
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<td>13:45 - 15:00</td>
<td>Workshop 13 - HOW TO MAKE DIY INSTRUCTIONAL VIDEOS FOR CLASSROOM FLIPPING — IT IS EASIER THAN YOU THINK!</td>
<td>Rachel Ka Wai Lui</td>
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<td>HOW TO MAKE DIY INSTRUCTIONAL VIDEOS FOR CLASSROOM FLIPPING — IT IS EASIER THAN YOU THINK!</td>
<td>The University of Hong Kong</td>
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<td>13:45 - 15:00</td>
<td>Workshop 14 - INTERDISCIPLINARY ESCAPE ROOM: CONSTRUCTING COMPUTATIONAL MODELS FOR DIFFUSION WITH THE POWERFUL SIMPLIFICATION TOOLS OF PHYSICS</td>
<td>Haim Edri</td>
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<td>INTERDISCIPLINARY ESCAPE ROOM: CONSTRUCTING COMPUTATIONAL MODELS FOR DIFFUSION WITH THE POWERFUL SIMPLIFICATION TOOLS OF PHYSICS</td>
<td>Haim Edri; Elon Langbeheim⁰; Samuel Safran; Edit Yerushalmi</td>
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<td>Weizmann Institute of Science</td>
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**TUESDAY 15:00 - 16:30**

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<td>Cecilia Dudas; Carl-Johan Rundgren; Iann Lundegård</td>
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<td>MND, Stockholm University</td>
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<td>Cristian Abrahamsson⁰; Claes Malmberg⁰; Ann-Marie Pendrill⁰</td>
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<td>¹Lund University; ²Halmstad University</td>
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<td>THE EFFECT OF TEACHING PRACTICES ON SITUATIONAL INTEREST TOWARDS SCIENCE AND</td>
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<td>TECHNOLOGY AMONG MIDDLE SCHOOL STUDENTS</td>
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<td>Ousmane Sy³; Patrice Potvin³; Isabelle Vinatier⁰</td>
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<td>¹Université du Québec à Trois-Rivières; ²Université du Québec à Montréal; ³Université de Nantes</td>
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<td>EPISTEMIC EMOTIONS IN SCIENCE CLASSROOM ACTIVITIES</td>
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<td>Elisa Vilhunen; Kalle Juuti; Visajaani Salonen; Jari Lavonen; Katarina Salmela-Aro</td>
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<td>University of Helsinki</td>
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<td>C. Alexander Scherb; Sandra Nitz</td>
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“IF SCIENCE WAS A ROAD”… SEARCHING FOR TEACHERS’ SOCIAL REPRESENTATIONS OF SCIENCE AND SCIENTIFIC CONTROVERSIES
Lynda Dunlop1; Fernanda Veneu2
1University of York; 2Oswaldo Cruz Foundation

ACTIVITIES AND LABORATORY WORK OF OUT-OF-FIELD TEACHERS: AN INDICATOR OF PCK
Harleen Singh; Julie Luft; Jessica Napier
University of Georgia

IMPACT OF A SCIENCE TEACHER’S EMOTION MANAGEMENT ON SOCIAL BONDS
Alberto Bellocchi
Queensland University of Technology

15:00 - 16:30 OP27 - STRAND 2 - SCIENCE LEARNING, BILINGUAL CONTEXTS AND LEARNING THROUGH A FOREIGN LANGUAGE
Room B1
Chairperson(s): Alain Jameau

HANDS-ON SCIENCE TO PROMOTE LANGUAGE LEARNING IN BILINGUAL CONTEXTS
Marta Marialva
Instituto Camões

’SAY WHAT?’ - 21ST CENTURY SKILLS, ENGLISH LANGUAGE LEARNERS AND STEM OUTREACH
Stephanie Florence-Czuba; Isha DeCoito
Western University

BILINGUAL MODULES IN BIOLOGY: COMPARISON OF MOTIVATIONAL EFFECTS IN DIFFERENT SCHOOL YEARS
Stephanie Ohlberger; Claas Wegner
Bielefeld University

LEARNING PHYSICS AND CHEMISTRY IN A FOREIGN LANGUAGE: THE EXAMPLE OF THE RUTHERFORD MODEL AT HIGH SCHOOL
alain jameau1; carole Le Henaff2
1University of Western Brittany; 2University of Western Brittany - School of Education (ESPE)

15:00 - 16:30 OP28 - STRAND 2 - REPRESENTATION AND MATERIALITY IN SCIENCE LEARNING
Room B2

THE BODILY PRODUCTION OF PHENOMENA IN THE SCIENCE LABORATORY: RECOGNIZING AN OVERLOOKED CONTENT
Liv Kondrup Hardahl1; Per-Olof Wickman2; Cecilia Caiman3
1University College Absalon; 2Stockholm University, Department of Mathematics and Science Education

CHILDREN’S PERCEPTIONS OF REPRESENTATIONAL PRACTICES IN SCIENCE LEARNING
Shingo Uchinokura
Kagoshima University

STUDENTS’ VIEWS OF FORCE DIAGRAMS WHILE SOLVING PHYSICS PROBLEMS
Judyanto Sirait; Janet Ainley
University of Leicester

GAZE TRANSITIONS IN MULTIPLE CHOICE TASKS WITH GRAPH AND TEXT REPRESENTATIONS
Martina Kekule1; Jarkko Hautala1; Jasmin Kilpelainen1; Jouni Viiri2
1Charles University; 2University of Jyväskylä

15:00 - 16:30 OP29 - STRAND 6 - FRAMEWORKS FOR IMPROVING SCIENCE EDUCATION
Room B3
Chairperson(s): Jonathan Osborne

REALISM VERSUS RELATIVISM — REALLY? A CRITICAL REALIST FRAMEWORK FOR SCIENCE EDUCATION
Robyn Yucel
Deakin University

THE USE OF EPISTEMIC LENSES TO ANALYSE SCIENCE AND ENGINEERING IN STEM EDUCATION PROPOSALS
Cristina Simarro; Digna Couso
CRECIM, Universitat Autònoma de Barcelona (UAB)
15:00 - 16:30  OP30 - STRAND 8 - SKILLS FOR IMAGINING FUTURES AND TAKING ACTION  Room B4
Chairperson(s): Jenny Hellgren

TOWARD THE RECOGNITION OF FUTURE-SCAFFOLDING SKILLS IN SCIENCE EDUCATION
Eleonora Barelli1; Giulia Tasquier1; Laura Branchetti1; Antti Laherto1; Elina Palmgren1; Caitlin Wilson4; Olivia Levirni1
1Alma Mater Studiorum - University of Bologna, Department of Physics and Astronomy; 2University of Parma, Department of Mathematics, Physics and Computer Science; 3University of Helsinki, Department of Physics; 4Lundvernd - The Icelandic Environment Association

BROADENING STUDENTS’ FUTURES THINKING: RESULTS FROM A MODULE ON QUANTUM COMPUTERS
Antti Laherto; Elina Palmgren; Tapio Rasa; Pia Erkko
University of Helsinki

TEACHING FOR AND LEARNING OF ACTION COMPETENCE IN EDUCATION ON SOCIO-SCIENTIFIC ISSUES
Cecilia Eriksson; Eva Lundqvist; Malena Lidar
Department of Education, Uppsala University

I DON’T WANT TO MAKE THEM ACTIVISTS - BUT HELP THEM BECOME RESPONSIBLE CITIZENS
Jenny Hellgren; Katarina Ottander; Christina Ottander
Umeå University

15:00 - 16:30  OP31 - STRAND 9 - ENGAGING WITH SUSTAINABILITY II  Room B5
Chairperson(s): George Malandrakis

DOES CULTURAL BACKGROUND HAVE AN INFLUENCE ON THE CONNECTEDNESS TO NATURE?
Silvia Fränkel; Daniela Sellmann-Risse; Melanie Basten
Bielefeld University

FAMILIARIZING YOUNG CHILDREN WITH THE IDEA OF SUSTAINABILITY
Maria-Christina Kasimati; Marida Ergazaki
University of Patras

INTERDISCIPLINARITY IN EDUCATION FOR SUSTAINABLE DEVELOPMENT
Eldri Scheie; Shelley Stromholt
Norwegian Centre for Science Education, University of Oslo

GREEK STUDENT-TEACHERS’ LATENT KNOWLEDGE ABOUT URBAN SUSTAINABILITY: PRELIMINARY FINDINGS
George Malandrakis1; Constantinos Papadopoulos2; Zisis Kyriakou2; Dimitrios Pnevmatikos2; Penelope Papadopoulou2
1Aristotle University of Thessaloniki; 2University of Western Macedonia

15:00 - 16:30  OP32 - STRAND 9 - THE PEDA戈ogy OF ENVIRONMENTAL EDUCATION II  Room B6
Chairperson(s): Alexandros Amprazis

THE ENJOYABLE USE OF NATURE: APPRECIATION OF NATURE AND THE TWO MAJOR ENVIRONMENTAL VALUE MODEL (2-MEV)
Constantinos Manoli1; Bruce Johnson1; Franz Bogner2
1University of Arizona; 2University of Bayreuth, Z-MNU (Centre of Math & Science Education)

TEACHING ELEMENTARY PUPILS ABOUT ALIEN SPECIES
Toru DOI1; Toshio Kishimoto2
1University of Toyama; 2Museum of Natural and Environmental History, Shizuoka
PERCEPTION OF ECOLOGICAL PROBLEMS AND RISKS: DOES ACADEMIC ENVIRONMENTAL EDUCATION MATTER?
Nurit Carmi¹; Iris Alkaher²
¹Tel-Hai Academic College; ²Kibbutzim College of Education, Technology and the Arts Tel-Aviv, Israel

PLANT BLINDNESS INTENSITY THROUGHOUT THE SCHOOL YEARS: A CROSS-AGE STUDY
Alexandros Amprazis; Penelope Papadopoulou
University of Western Macedonia, Greece

15:00 - 16:30  OP33 - STRAND 12 - TEACHERS’ IDENTITIES, PRACTICES AND TEACHER EDUCATION  Room B7

CRITICAL DISCOURSE ANALYSIS OF SCIENCE TEACHER IDENTITY WORK IN URBAN SCHOOLS
Katherine Wade-Jaimes
University of Memphis

“IT STARTS WITH THINKING ABOUT WHAT YOU CAN DO:” CRITICAL PRACTICE AMONG JUSTICE-ORIENTED SCIENCE TEACHERS
Sara Tolbert¹; Alexa Schindel¹
¹University of Canterbury; ²University at Buffalo, New York

IDENTIFYING ELEMENTS OF EFFECTIVE PROGRAMS FOR PREPARING AMERICAN INDIAN SECONDARY STEM TEACHERS
Regina Sievert¹; Joan LaFrance²
¹Salish Kootenai College; ²Mekinak Consulting

A GENDER COMPARISON OF TECHNOLOGY TEACHERS’ DISPOSITION TOWARD CRITICAL THINKING
Willem Rauscher; Sonja van Putten
University of Pretoria

15:00 - 16:30  Poster Symposium PS02 - UNDERSTANDING OUT-OFF-SCHOOL LEARNING PROCESSES  Room C1
IN STEM DISCIPLINES WITHIN THE GRADUATE PROGRAM GINT

EDUCATIONAL RECONSTRUCTION OF CURRENTS AND STRUCTURE FORMATIONS
Kai Bliesmer; Michael Komorek
Carl von Ossietzky Universität Oldenburg

THE SYSTEM BEHIND CLIMATE. COGNITIVE AND MOTIVATIONAL PROCESSES IN THE DEVELOPMENT OF CLIMATE SYSTEM UNDERSTANDING THROUGHOUT A SEQUENCE LINKING IN-SCHOOL & OUT-OF-SCHOOL-LEARNING
Claudia Gorr¹; Michael Komorek¹; Claus Michelsen²
¹Carl-von-Ossietzky-Universität Oldenburg; ²University of Southern Denmark

ADOLESCENTS’ REASONING AND JUDGEMENT ABOUT COMPLEX PROBLEMS IN SUSTAINABLE DEVELOPMENT: AN INTERVENTION STUDY
Annegret Jansen; Ulrike-Marie Krause
University of Oldenburg

IMPROVING A SCIENCE OUT-OF-SCHOOL LAB IN A DESIGN BASED RESEARCH APPROACH
Sonke Janssen; Gunnar Friege
Leibniz Universität Hannover

COMPLEMENTARY NETWORKING OF OUT-OF-SCHOOL LEARNING ENVIRONMENTS
Michael Komorek; Christin Sajons
University of Oldenburg

DIVERGENT THINKING OF STUDENTS TAKING PART IN SCIENCE COMPETITIONS
Swantje Müller; Verena Pietzner
University of Oldenburg

CLIMATE CHANGE AND THE PHYSICAL DYNAMICS OF COAST, WADDEN SEA AND OCEAN AS TOPICS FOR EXTRACURRICULAR LEARNING
Annika Roskam; Michael Komorek; Kai Bliesmer
Carl von Ossietzky Universität Oldenburg

UNDERSTANDING PUPILS’ LEARNING PROCESSES IN OUT-OF-SCHOOL SCIENCE LABS
Christin Marie Sajons; Michael Komorek
Carl von Ossietzky Universität Oldenburg
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Anastasia Striligka; Michael Komorek; Dimitris Stavrou
1Carl von Ossietzky Universität Oldenburg; 2University of Crete

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Micha Winkelmann; Susanne Wessnigk; Henrike Haverkamp
Leibniz Universität Hannover - AG Physikdidaktik

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Chairperson(s): Sevil Akaygun

ASSESSMENT OF PRE-SERVICE ELEMENTARY SCIENCE TEACHERS ABOUT A PROGRAMME OF INITIATION TO ACTIVISM THROUGH THE PRODUCTION OF VIDEOS ON LOCAL PROBLEMS
Daniel Cebrián-Robles1; Enrique España-Ramos2; Pedro Reis3
1Málaga University; 2Malaga University; 3Universidade de Lisboa, Instituto de Educação

STARTING SMALL: THE ADOPTION OF MOBILE-FILMMAKING IN THE SCIENCE CLASSROOM
Kaitlyn Martin1; Lloyd Davis1; Susan Sandretto2
1Centre for Science Communication, University of Otago; 2College of Education, University of Otago

ESSENTIALS IN THE DESIGN OF WEBQUESTS TO LEVERAGE STUDENTS’ LEARNING
Maria Napal; Isabel Zudaire; Irantzu Uriz
Universidad Pública de Navarra

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Sevil Akaygun; Emine Adadan
Bogazici University

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Chairperson(s): Grady Venville

STEM EDUCATION FROM AN AUSTRALIAN PERSPECTIVE
Ann Osman; Jan Van Driel; David Clarke
University of Melbourne

TRENDS, IMPLICATIONS AND POSSIBILITIES FOR THE INTERDISCIPLINARY SCHOOL STEM CURRICULUM
Victoria Millar
The University of Melbourne

INVESTIGATING THE NATURE OF STEM: ANALYSIS OF CURRICULUM DOCUMENTS FROM THE U.S., KOREA AND TAIWAN USING THE FAMILY RESEMBLANCE APPROACH
Wonyong Park; Jen-Yi Wu; Sibel Erduran
University of Oxford

A WORLDLY PERSPECTIVE: USING THEORY TO ANALYSE STEM CURRICULA
Grady Venville1; Leonie Rennie2; John Wallace3
1Australian National University; 2Curtin University; 3Toronto University

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Chairperson(s): Iris Schifff

HOW CAN CONTEXT HELP TO SOLVE A PROBLEM? A PROCEDURAL ANALYSIS OF CONTEXTUALIZED PROBLEM-SOLVING
Patrick Löffler; Alexander Kauertz
University of Koblenz-Landau

A TAXONOMY FOR EXAMINING EPISTEMIC PROBLEM-SOLVING APPROACHES IN STEM INQUIRY ACTIVITIES
Timothy Tan; Yew-Jin Lee; Peter Lee
National Institute of Education, Nanyang Technological University, Singapore
### WORKING WITH FIRST- OR SECOND-HAND DATA IN SCHOOL LABS: DOES IT MAKE A DIFFERENCE?

Burkhard Priemer; Stephan Pfeiler
Humboldt-Universität zu Berlin

### INQUIRY COMPETENCES OF JUNIOR AND SENIOR CLASS BIOLOGY STUDENTS

Iris Schiff; Lisa Virtbauer; Elisabeth Scheicher
University of Salzburg, School of Education

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<td>Jesper Sjöström</td>
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<td>Anita Schuchardt</td>
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<td>Laurent Moutet</td>
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<td>Annie K. L. Chan; Maurice M. W. Cheng</td>
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1: Department of Science and Mathematics Education, Umeå University; 2: Department of Applied Educational Science; 3: School of Humanities, Education and Social Sciences; 4: Laboratory for Psycholinguistic Research, Department of Speech and Language Pathology, University of Zagreb; 5: Uppsala University; 6: Purdue University; 7: Michigan State University
A SPECTRUM-LIKE MODEL FOR STUDENTS’ UNDERSTANDING OF SCIENCE: A CASE IN CHEMICAL REACTION
Maurice M.W. Cheng1; Y.C. Wong2
1The University of Waikato; 2Shung Tak Catholic English College, Hong Kong

EXAMINING PRESERVICE CHEMISTRY TEACHERS’ UNDERSTANDING OF GAS BEHAVIOR: THE CONTRIBUTION OF METACOGNITIVE AWARENESS
Emine Adadan
Bogazici University

15:00 - 16:30 OP40 - STRAND 7 - ARGUMENTATION AND EPISTEMIC COGNITION Room F3
Chairperson(s): Irene Hadjicosti

EPISTEMIC KNOWLEDGE MOBILIZED BY HIGH SCHOOL STUDENTS DURING A ROLE-PLAY ABOUT FOOD SAFETY
Lucia Casas Quiroga; Beatriz Crujeiras Pérez
Universidade de Santiago de Compostela

CONTEMPLATING THE OPPOSITION: DOES A PERSONAL TOUCH MATTER?
Kalypso Iordanou1; Deanna Kuhn2
1University of Central Lancashire Cyprus; 2Columbia University

A QUALITATIVE COMPARATIVE STUDY TO ELICIT FEATURES OF EPISTEMIC KNOWLEDGE WHEN MIDDLE SCHOOL STUDENTS ENGAGED IN DIALOGICAL ARGUMENTATION
Getachew Tarekegn1; Jonathan Osborne2; Mesfin Tadesse2
1Addis Ababa University; 2Graduate School of Education

STUDENTS’ FORMS OF DIALOGUE WHEN ENGAGED WITH CONTEMPORARY BIOLOGICAL RESEARCH
Irene Hadjicosti1; Kostas Korfiatis2; Stephen Price3; Ralph Levinson3
1University of Cyprus; 2University of Cyprus; 3University College London

15:00 - 16:30 OP41 - STRAND 13 - LEARNING ENVIRONMENTS IN PRE-SERVICE TEACHER EDUCATION Room G1
Chairperson(s): Kirsti Marie Jegstad

DEVELOPMENT OF A LEARNING ENVIRONMENT TO ENHANCE TEACHER STUDENTS’ DIAGNOSTIC COMPETENCE
Ingrid Krumphals; Claudia Haagen-Schützenhöfer
University of Graz

NOVEL EDUCATIONAL COMPUTATIONAL CHEMISTRY LEARNING ENVIRONMENTS EFFECT ON PRE-SERVICE CHEMISTRY TEACHERS’ PERCEPTIONS OF TECHNOLOGICAL PEDAGOGICAL CONTENT KNOWLEDGE
Jorge Rodríguez-Becerra1; Lízeth Cáceres-Jensen2; Tatiana Díaz3; Víctor Bahamonde Padilla4; Johannes Pernaa1; Maija Aksela1
1Universidad Metropolitana de Ciencias de la Educación; 2University of Helsinki

A FRAMEWORK FOR CREATING TOOLS FOR USE IN EDUCATIONAL ENVIRONMENTS: ANALYZING LEARNING AS PROOF OF CONCEPT
Susan Kirch1; Pooneh Sabouri1; Moyu Zhang2; Wanjing Ma2
1New York University; 2University of Pennsylvania

THE OUTDOORS AS A SETTING FOR LEARNING CHEMISTRY IN TEACHER EDUCATION
Kirsti Marie Jegstad1; Jan Höper2; Kari Beate Remmen3
1OsloMet - Oslo Metropolitan University; 2UiT The Arctic University of Norway; 3University of Oslo

15:00 - 16:30 OP42 - STRAND 13 - PEDAGOGICAL CONTENT KNOWLEDGE III Room G2
Chairperson(s): Jaana Herranen

TEACHER EDUCATION IN QUANTUM PHYSICS — A PROPOSAL FOR IMPROVING PEDAGOGICAL CONTENT KNOWLEDGE
Gesche Pospiech; Matthias Schöne
TU Dresden

EARTH SCIENCE IN PRESERVICE TEACHER: VALIDATING AN INSTRUMENT FOR MEASURING PCK IN ELEMENTARY PST
Claudia Vergara1; David Santibañez2; Beatriz Becerra3; Sofia Letelier4; Hernan Cofre4
1Alberto Hurtado University; 2Universidad Católica Silva Henríquez; 3Universidad Católica de Valparaíso; 4Universidad Católica de Valparaíso
THE DEVELOPMENT OF PRE-SERVICE TEACHERS’ PCK ABOUT Teaching ELECTROMAGNETISM
Coréne Coetzee1; Estelle Gaigher1; Marissa Rollnick2
1University of Pretoria; 2WITS University

TOWARDS LEARNER-DRIVEN SCIENCE TEACHER EDUCATION FOR SUSTAINABILITY
Jaana Herranen; Maija Aksela
University of Helsinki

15:00 - 16:30  OP43 - STRAND 13 - PRE-SERVICE TEACHERS IN PRIMARY SCHOOL AND PRESCHOOL  Room G3
Chairperson(s): Martina Lavagnini

SCIENCE AND DIGITALIZATION IN PRESCHOOL TEACHER EDUCATION - STUDENT TEACHERS’ EXPERIENCES
Per Höglström
Högskolan i Halmstad

THE RELEVANCE OF SCIENCE AND TEACHING SCIENCE ACCORDING TO FINNISH PRIMARY TEACHER STUDENTS
Pia Sjöblom1; Ann-Sofi Härmälä-Braskén
Abo Akademi University

PRIMARY PRESERVICE TEACHERS’ ATTITUDES AND INTENTION TOWARDS TEACHING SCIENCE
Reece Mills1; Chrystal Whiteford2; Daniel Brown2
1Queensland University of Technology; 2Griffith University

PROSPECTIVE PRIMARY TEACHERS LEARN ABOUT THE INTERPLAY OF MATHEMATICS AND PHYSICS
Martina Lavagnini1; Marisa Michelini1; Gesche Pospiech2
1University of Udine; 2TU Dresden

15:00 - 16:30  OP44 - STRAND 14 - SUSTAINABLE DEVELOPMENT GOALS (SDGS)  Room G4
Chairperson(s): Tapashi Chowdhury

IN-SERVICE TEACHERS’ PERCEPTIONS REGARDING THE IMPLEMENTATION OF THE GREEN CHEMISTRY IN THE CLASSROOM
Pia José González; Mariona Espinet; Anna Marbà
Universitat Autònoma de Barcelona

SELF-EFFICACY OF IN-SERVICE SECONDARY SCHOOL TEACHERS TOWARD EDUCATION FOR SUSTAINABLE DEVELOPMENT: PRELIMINARY FINDINGS
Athanasios Moigias1; George Malandrakis2; Penelope Papadopoulou1; Costas Gavrilakis4
1Democritus University of Thrace; 2Aristotle University of Thessaloniki; 3University of Western Macedonia; 4University of Ioannina

VALUE INHERENT PEDAGOGY IN TEACHING SCIENCE
Uri Livne; Uri Livne; Avraham Merzel; Yifat Kolikant
The Hebrew University of Jerusalem

TEACHER OWNERSHIP OF USING SOCIO-SCIENTIFIC ISSUES TO PROMOTE FUTURE CITIZENRY
Tapashi Chowdhury; Jack Holbrook; Miia Rannikmae
University of Tartu

15:00 - 16:30  OP45 - STRAND 14 - IMPLEMENTING INQUIRY-BASED SCIENCE EDUCATION I  Room G5
Chairperson(s): Ella Yonai

PROFESSIONALISING TEACHERS FOR INQUIRY-BASED SCIENCE EDUCATION - CHALLENGES AND LIMITS
Elisabeth Hofer; Anja Lembens
University of Vienna, AECC Chemistry

SCIENTIFIC INQUIRY FOR SCIENCE TEACHING IN THE EXTREME NORTH OF CHILE: PERCEPTIONS AND CHALLENGES FROM THE SCHOOL COMMUNITY OF A RURAL SCHOOL
KATHERINE ACOSTA1; Marlene Morales2; Carlos Rodríguez2; Juan Jimenez3
1UNIVERSIDAD DE TARAPACÁ; 2University of Tarapacá; 3Illinois Institute of Technology

CHANGES IN ACADEMIC LANGUAGE AND SCIENCE INQUIRY INTERACTIONS IN A 4TH GRADE CHILEAN CLASSROOM AFTER A PRACTICE-BASED PROFESSIONAL DEVELOPMENT
Dominga Miranda; Alejandra Menezes; Maximiliano Montenegro; Andrea Valenzuela
Pontificia Universidad Católica de Chile
TUESDAY AUGUST 27

PRINCIPLE-BASED DESIGN: A COURSE FOR TEACHERS ON WORKING WITH A SCANNING ELECTRON MICROSCOPE
Ella Yonai; Blonder Ron
The Weizmann Institute of Science

15:00 - 16:30 OP46 - STRAND 16 - SCIENCE, INQUIRY AND MATH SKILLS AT PRIMARY LEVEL
Room G6
Chairperson(s): Mario Quintanilla

ONLINE CITIZEN SCIENCE IN PRIMARY CLASSROOMS: DEVELOPING SCIENCE CAPABILITIES FOR CITIZENSHIP
Dayle Anderson; Markus Luczak- Roesch; Cathal Doyle; Yevgeniya Li; Cameron Pierson; Brigitte Glasson
Victoria University Of Wellington

THE EFFECTIVENESS OF A DIGITAL TOOL IN IMPROVING PRIMARY SCIENCE TEACHING AND SCIENCE THINKING SKILLS
Louise Stubberfield; Lily Ickowitz-Seidler; Sarah Leonardi
1Wellcome Trust; 2CFE Research

THE PEDAGOGICAL CHARACTERISTICS OF LEARNING TASKS IN MATHEMATICS AND SCIENCES IN PRIMARY SCHOOLS
Irit Sasson
Tel-Hai Academic College

PERCEPTION OF ELEMENTARY STUDENTS OF CHILE ABOUT THEIR EMOTIONS WHEN THEY CONSULT IN LINE SCIENTIFIC KNOWLEDGE TO RESOLVE THEIR SCHOOL TASKS.
Mario Quintanilla; Miguel Manzanilla; Eloy Peña; Alberto Labarrere
1Pontificia Universidad Católica de Chile; 2Universidad Santo Tomas de Chile

15:00 - 16:30 OP47 - STRAND 17 - UNIVERSITY STUDENTS’ UNDERSTANDING IN DISCIPLINE-BASED SCIENCE EDUCATION
Room G7
Chairperson(s): RAFAELLE DA SILVA SOUZA

HIGH SCHOOL AND UNIVERSITY STUDENTS’ UNDERSTANDING OF SOLUBILITY AND SOLUBILITY PRODUCT CONCEPTS. A PHENOMENOGRAPHIC APPROACH.
Daniel Zuazagoitia; Oscar Gonzalez; Consuelo Dominguez-Sales
1University Basque Country; 2UNIVERSITY BASQUE COUNTRY; 3University of Valencia

MISCONCEPTIONS OF ENGINEERING AND PHYSICS UNIVERSITY STUDENTS ABOUT SELF-REGULATION IN A SIMPLE DC CIRCUIT
Sergio Rosa-Cintas; Asuncion Menargues; Carolina Nicolás-Castellano; Ruben Limiñana; Alexandra Rey-Cubero; Juan Francisco Alvarez-Herrero; Joaquín Martínez-Torregrosa; Isabel Lujan
University of Alicante

RECONSTRUCTING QUANTUM PHYSICS FOR INSTRUCTION
Elina Palmgren; Terhi Mäntylä
1University of Helsinki, Department of Physics; 2University of Tampere, Faculty of Education and Culture

A LOOK AT THE CURRICULAR COMPONENT OF QUANTUM MECHANICS IN THE PUBLIC UNIVERSITIES OF BRAZIL
Rafaelle Da Silva Souza; Ileana Maria Greca; Indianara Silva; Elder Sales Teixeira
1Universidade Federal da Bahia; 2Universidade de Burgos; 3Universidade Estadual de Feira de Santana

15:00 - 16:30 OP48 - STRAND 17 - STEM, RRI AND INTERDISCIPLINARITY AT UNIVERSITY LEVEL
Room G8
Chairperson(s): Chia-Hui Hung

THE STRATEGIC UNDERGRADUATE STEM TALENT ACCELERATION INITIATIVE (SUSTAIN): IMPACTS ON THE SOCIALIZATION OF LOW-INCOME COLLEGE STUDENTS
Gaye Ceyhan; Alia Thompson; John Tillotson; Jason Wiles
Syracuse University

STARBIOS2 - ENGAGING WITH RESPONSIBLE RESEARCH THROUGH SCIENCE EDUCATION
Doris Elster
University of Bremen

A NOVEL INTERDISCIPLINARY APPROACH TO DIVERSIFY BIOECONOMY PARTICIPATION: A PILOT STUDY
Shana McAlexander; Katherine McCance; Margaret Blanchard; Richard Venditti
North Carolina State University
ART IN MEDICAL EDUCATION: SOCIETY, TECHNOLOGY, ENGINEERING, ART, AND MEDICINE (STEAM) LEARNING TO STRENGTHEN THE PROFESSIONALISM
Chia-Hui Hung1; Chi-Sheng Chen2
1Chung-Shan medical university and Chung-Shan medical university hospital; 2Jenteh junior college of medicine, nursing and management

TUESDAY 17:00 - 18:30

17:00 - 18:30  OP92 - STRAND 3 - PROJECT BASED EDUCATION AND SPECIAL PROGRAMMES  Room A1
Chairperson(s): Niklas Kramer

GIFTED UPPER SECONDARY STUDENTS’ ENGAGEMENT IN LEARNING PHYSICS THROUGH PROJECT BASED LEARNING
Taina Makkonen; Jari Lavonen
University of Helsinki

ENGAGING UPPER SECONDARY STUDENTS LEARNING NEWTONIAN MECHANICS THROUGH PROJECT BASED LEARNING
Jari Lavonen1; Taina Makkonen2; Kalle Juutili3; Visajaani Salonen1; Janna Inkinen1; Katarina Salmela-Aro1;
Klinge Condor1; Joseph Krajcik1; Barbara Schneider1
1University of Helsinki; 2Universidad Nacional de San Agustín; 3Michigan State University

IN-SCHOOL SCIENCE ENRICHMENT PROGRAM FOR GIFTED CHILDREN: EFFECTS ON PSYCHOLOGICAL OUTCOMES AMONG PARTICIPANTS AT THE NORWEIGIAN TALENT SCIENCE CENTERS
Ella Idsøe1; Merethe Freyland2; Thormod Idsøe3
1Norwegian Centre for Science Education, University of Oslo; 2Norwegian Center for Science Education; 3Norwegian Center for Child Behavioral Development

THE EFFECTS OF AN INTERDISCIPLINARY WEEK-LONG WORKSHOP ABOUT “THE CARDIOVASCULAR SYSTEM”
Niklas Kramer; Claas Wegner
Bielefeld University

17:00 - 18:30  OP93 - STRAND 3 - PRACTICAL WORK AND EXPERIMENTS  Room A2
Chairperson(s): Seamus Delaney, Australia

THE IMPACT OF CURRICULUM CHANGE ON PRACTICAL WORK IN SCIENCE FOR 11 — 18S: FINDINGS FROM A THREE-YEAR NATIONAL SURVEY IN ENGLAND AND SCOTLAND
Vanessa Kind1; Helen Cramman2
1University of Durham; 2Durham University

PRACTICAL WORK OR SIMULATIONS? VOICES FROM GENERATION Z
Promail K.Y. Leung1; Maurice M.W. Cheng2
1The University of Hong Kong; 2The University of Waikato

ANALYSIS OF LEARNING WITH DYNAMIC MODELS AND EXPERIMENTS IN OPTICS
Albert Teichrew; Roger Erb
Department of Physics Education, Goethe University Frankfurt

TEACHER PRACTICES TO LINK MACRO-LEVEL OBSERVATIONS WITH SUB-MICRO REPRESENTATIONS OF CHEMISTRY UNDERSTANDING - AN INTERNATIONAL COMPARATIVE STUDY
Seamus Delaney1; Karin Soika2; Luka Vinko3; Connie Cirkony4; Liiivi Kivimäe5; Iztook Devetak6
1Deakin University, Australia; 2Tallinn University, Estonia; 3University of Ljubljana, Slovenia; 4University of Ljubljana, Slovenia; 5University of Ljubljana, Slovenia; 6Monash University, Australia

17:00 - 18:30  OP94 - STRAND 2 - GENDER AND DIVERSITY IN SCIENCE LEARNING  Room B1
Chairperson(s): Susanne Walan

DIVERSE STUDENTS, DIVERSE INQUIRY? HANDS-ON INQUIRY LEARNING IN HETEROGENEOUS CHEMISTRY CLASSROOMS
Dennis Kirstein; Sebastian Habig; Maik Walpuski
University of Duisburg-Essen

INFLUENCE OF THE SOCIO-CULTURAL CONTEXT ON STUDENTS’ NAÏVE KNOWLEDGE: EXAMPLE OF TANZANIAN STUDENTS’ UNDERSTANDING OF VOLCANIC AND SEISMIC PROCESSES AND RISKS
Florence Le Hebel1; Valérie Fontanieu2
1Laboratoire ICAR, ENS de Lyon, France; 2IFE, ENS de Lyon, France
TUESDAY AUGUST 27

HOW CAN WE HELP DISADVANTAGED STUDENTS TO CONTINUE WITH SCIENCE ONCE IT IS NO LONGER COMPELLARY?
Michael Reiss1; Tamjid Mujtaba1; Richard Sheldrake2
1UCL Institute of Education; 2UCL Institute of Education

COMBINING DRAMA AND PROP MAKING IN A MAKERSPACE TO STIMULATE GIRLS’ INTEREST IN STEM AND THEIR DEVELOPMENT OF 21ST CENTURY SKILLS.
Susanne Walan
Karlstad University

17:00 - 18:30 OP95 - STRAND 6 - TEACHERS’ AND SCIENTISTS’ PERCEPTIONS Room B2
Chairperson(s): Jen-Yi Wu

SCIENCE TEACHERS’ PERCEPTIONS OF THE NATURE OF SCIENCE CONSIDERING THEIR PRE AND IN-SERVICE EDUCATION
Busra Aksoz; Zeynep Kızıltepe; Ebru Kaya
Bogazici University

EXPLORING PHYSICS TEACHERS’ CONCEPTIONS OF THE NATURE OF THE SCIENCES
Dimitrios Schiza1; Dimitris Psillos2
1International Hellenic University; 2School of Primary Education, Aristotle University of Thessaloniki,

TEACHERS’ VIEWS ON PHYSICS, TECHNOLOGY AND RESPONSIBILITY
Frederik Bub; Thorid Rabe
Martin Luther University Halle-Wittenberg

SCIENTISTS’ PERCEPTIONS OF THE NATURE OF SCIENCE: AN INVESTIGATION BASED ON THE FAMILY RESEMBLANCE APPROACH
Jen-Yi Wu1; Sibel Erduran2
1Ministry of Science and Technology; 2University of Oxford

17:00 - 18:30 OP96 - STRAND 6 - NATURE OF STEM Room B3
Chairperson(s): Katrin Vaino

THE PORTRAYAL OF ENGINEERING OPTIMIZATION IN SECONDARY SCIENCE VERSUS TECHNOLOGY EDUCATION
Allison Antink-Meyer; Ryan Brown
Illinois State University

A LITERATURE REVIEW ON THE USE OF THE TERMS ‘TECHNOLOGY’ AND ‘ENGINEERING’: THE NATURE OF TECHNOLOGY IN SCIENCE EDUCATION
Sejung Kim; Jinwoong Song
Seoul National University

EXPLORING THE NATURE OF STEM BEYOND THE ACRONYM
Terry Lyons
Queensland University of Technology

DEVELOPING A QUESTIONNAIRE TO MEASURE STUDENTS’ CONCEPTIONS OF THE NATURE OF TECHNOLOGY
Katrin Vaino1; Toomas Vaino; Mila Rannikmäe
University of Tartu

17:00 - 18:30 OP97 - STRAND 8 - EVERYDAY SITUATIONS AND DECISIONS Room B4
Chairperson(s): Durdane Bayram Jacobs

IDENTIFYING EVERYDAY DECISION SITUATIONS OF LEARNERS IN SCIENCE EDUCATION
Laurence Schmitz; Christiane S. Reiners
University of Cologne

ADULT SCIENCE LITERACY IN ACTION: ENGAGING WITH A REAL LIFE SOCIO-SCIENTIFIC ISSUE
Keren Dalyot; Ayelet Baram-Tsabari
Technion Israel Institute of Technology

FINDING CONSENSUS IN CONFLICTS: IMPLEMENTATION OF PLACE-BASED SOCIO-SCIENTIFIC TEACHING & LEARNING
Hui-Chuan Chang; Hui Lee
Curriculum Design and Human Potentials Development, National Dong Hwa University
A CITIZENSHIP CHEMISTRY LESSON: STUDENTS’ INFORMED DECISION-MAKING BY USING DIFFERENT PERSPECTIVES ABOUT USE AND SALE OF LAUGHING GAS AMONG YOUTHS
Durdane Bayram Jacobs¹; Ineke Henze²; Godfried Wieske³
¹Radboud University; ²Delft University of Technology; ³Stanislas College Pijnacker

17:00 - 18:30 OP98 - STRAND 9 - LEARNING OUTSIDE THE CLASSROOM I Room B5
Chairperson(s): Youngjin Choi

A COMPARATIVE CASE STUDY OF TEACHER-COACHES WHO LEAD AFTER-SCHOOL STEM CLUBS AT TWO RURAL, LOW WEALTH MIDDLE SCHOOLS
Kylie Swanson Hoyle¹; Margaret Blanchard²
¹University of Colorado Colorado Springs; ²North Carolina State University

FACTORS INFLUENCING STUDENT LEARNING IN RURAL U.S. AFTER-SCHOOL STEM CLUBS
Margaret Blanchard¹; Kristie Gutierrez²; Kylie Swanson Hoyle¹; Christopher Allred³; Jason Painter¹; N. Scott Ragan¹
¹North Carolina State University; ²Old Dominion University; ³University of Colorado Colorado Springs

LIFELONG LEARNING WITH GIRAFFES: BIOINSPIRATION AT THE ZOO
Michal Topaz; Tali Tal
Technion – Israel Institute of Technology

CHARACTERISTICS OF SPATIAL ABILITY IN EARTH SCIENCE ACTIVITY USING ORIENTEERING
Youngjin Choi; Donghee Shin
Ewha Womans University

17:00 - 18:30 OP99 - STRAND 9 - STUDENTS’ KNOWLEDGE AND UNDERSTANDING OF ENVIRONMENTAL TOPICS AND ISSUES Room B6
Chairperson(s): Jonathan Hense

BIODIVERSITY AND CULTURAL DIVERSITY: STUDENTS’ CONCEPTIONS AND VALUES RELATED TO BIODIVERSITY AND INTERCULTURALLY — CASE OF LEBANON
Fadi El Hage¹; Taghrid Diab²; Arnaud Martin²; Carla Khater³
¹Université Saint-Joseph; ²Université de Montpellier; ³CNRS Libanais

EVALUATION OF STUDENTS’ SELF-REPORTED KNOWLEDGE AND FACTUAL IDENTIFICATION SKILLS OF NATIVE BIRD SPECIES IN [CITY]
Ulrike Sturm; Kim G. Mortega; Silke L. Voigt-Heucke; Alexandra Moormann
Museum für Naturkunde Berlin - Leibniz Institute for Evolution and Biodiversity Science

USING MOBILE GAZE TRACKING TO STUDY STUDENTS’ OBSERVATIONS DURING AN OUTDOOR ECOLOGY LESSON
Anna Uttö; Anttoni Kervinen
University of Helsinki

THE 5-MIN-BIOLOGY - A SHORT AND POWERFUL METHOD TO DEVELOP SPECIES KNOWLEDGE IN BIOLOGY LESSONS
Jonathan Hense; Annette Scheersooi
Biology Education, University Bonn

17:00 - 18:30 OP100 - STRAND 12 - TEACHING AND STEM EXPERIENCES Room B7
Chairperson(s): Ainur Almukhambetova

GENDERED SCIENCE TEACHING: TO BOYS OR NOT TO BOYS? THAT IS THE QUESTION
Ruth Amos; Avital Shirazi
UCL Institute of Education

RELATIONSHIP OF STUDENTS’ ATTITUDE TOWARDS SCIENCE WITH THEIR LEARNING APPROACH: A GENDER BASE STUDY
Muhammad Anwer; Michael Reiss
UCL Institute of Education

AFFIRMING TEACHING AND LEARNING SCIENCE EXPERIENCES FOR RACIAL, CULTURAL, AND LINGUISTICALLY DIVERSE STUDENTS IN A STEM-INCLUSIVE HIGH SCHOOL
Noemi Waight; Jennifer Tripp; Lorenda Chisolm
University at Buffalo
WHY THE PIPELINE LEAKS? UNDERSTANDING FEMALE HIGHER EDUCATION STUDENTS’ EXPERIENCES IN STEM IN KAZAKHSTAN

Ainur Almukambetova; Aliya Kuzhabekova; Daniel Hernandez Torrano
Nazarbayev University Graduate school of education

17:00 - 18:30  OP101 - STRAND 7 - ASSESSING ARGUMENTATION          Room C1

Chairperson(s): Yann Shiou Ong

ADDRESSING THE PRACTICE OF ARGUING FROM EVIDENCE IN SCIENCE USING FORCED-CHOICE ITEM FORMATS

Sara Dozier1; Linda Morell2; Weeraphat Suksirir; Jonathan Osborne1; Mark Wilson2
1Stanford University; 2University of California, Berkeley

TOWARD DEVELOPING AUTHENTIC MEASURES OF TEACHER EPistemOLOGIES AND STUDENT ATTITUDES TO ARGUMENT

Nicole Zillmer; April Holton; J. Bryan Henderson
Arizona State University

ARTICULATED REASONING IN SPOKEN STUDENT ARGUMENTS

Kaisa Jokiranta; Markus Hännkönen; Jenna Hiltunen; Sami Lehesvuori; Pasi Nieminen; Jouko Viiri
University of Jyväskylä

CLUSTER SIZE MEASUREMENT: A STUDY OF SECONDARY STUDENTS PROBLEMATISING DATA

Yann Shiou Ong1; Richard Duschl2
1National Institute of Education, Nanyang Technological University; 2Pennsylvania State University

17:00 - 18:30  OP102 - STRAND 4 - USING DIGITAL GAMES FOR LEARNING BIOLOGY          Room D1

Chairperson(s): Georgia Hodges

PLAYING MOLECULAR BIOLOGY — COMBINING A GAME-BASED VIRTUAL LABORATORY AND HANDS-ON EXPERIMENTS IN A BLENDED-LEARNING COURSE FOR PRE-SERVICE TEACHERS

Steffen Schaal1; Christian König2; Max Mannsperger1
1University of Education Ludwigsburg; 2University of Hohenheim

CHARACTERISING THE EDUCATIONAL POTENTIALS OF MOBILE APPLICATIONS RELATED TO ECOLOGY

Maria Zoe Maldonado Véliz1; Romina Cecilia Torres2; Leticia García Romano3
1Science and Technology Teaching Department, National University of Córdoba, Córdoba, Argentina; 2National Scientific and Technical Research Council, Córdoba, Argentina; 3Science and Technology Teaching Department, CONICET, National University of Córdoba, Córdoba, Argentina

ASSESSING CONCEPTUAL UNDERSTANDING OF HIGH SCHOOL STUDENTS WITH A DIGITAL EDUCATIONAL GENETICS GAME

Cody Smith1; Arif Rachmatullah1; Eric Wiebe2; Trudi Lord3; Frieda Reichsman4; Chad Dorsey5; Bradford Mott1; James Lester1; Danielle Boulender1
1North Carolina State University; 2Concord Consortium

A MIXED METHODS STUDY COMPARING LEARNING GAINS ASSOCIATED WITH SERIOUS GAMEPLAY AND HANDS-ON SCIENCE IN ELEMENTARY CLASSROOMS

Georgia Hodges; Kayla Flanagan
University of Georgia

17:00 - 18:30  OP103 - STRAND 10 - STEM CURRICULUM STUDIES 2          Room D2

Chairperson(s): Nina Waaddegaard

ELEMENTARY STUDENT CONCEPTIONS OF STEM: DOES ATTENDING A STEM SCHOOL MAKE A DIFFERENCE?

Elizabeth Ring-Whalen1; Jeanna Wieselmann2; Gillian Roehrig2
1St. Catherine University; 2University of Minnesota

EVALUATING THE QUALITY OF A K-12 INTEGRATED STEM CURRICULUM

Gillian Roehrig1; Emily Dare2; Elisabeth Ring-Whalen2; Jeanna Wieselmann1
1University of Minnesota; 2Florida International University; 3St Catherine University

TEACHERS’ NEGOTIATION OF USABILITY OF INDUSTRIAL SCIENCE AND TECHNOLOGY TEACHING RESOURCES

Maria Andrée1; Lena Hansson2
1Department of Mathematics and Science Education; 2University of Kristianstad
TEACHER DILEMMAS OF STEM EDUCATION IN DENMARK
Nina Waaddegaard
Department of Science Education, University of Copenhagen

17:00 - 18:30  OP104 - STRAND 11 - STUDENTS’ ASSESSMENT IN COMPUTER-BASED AND DIGITAL ENVIRONMENTS  Room D3
Chairperson(s): Mats Kieserling

COMPUTER-AUTOMATED SCORING OF RESPONSES TO ITEMS IN OPEN FORMAT ABOUT ASPECTS OF META-MODELLING KNOWLEDGE
Dirk Krüger; Moritz Krell
Freie Universität Berlin

ASSESSMENT OF ARGUMENTATION — CONSIDERATIONS FOR AUTOMATED ANALYSIS AND ENGLISH LANGUAGE LEARNERS
Christopher Wilson¹; Jonathan Osborne²; Kevin Haudek³; Molly Stuhlsatz¹; Tina Cheuk²; Brian Donovan³; Zoe Buck Bracey¹; Marisol Mercado Santiago³
¹BSCS Science Learning; ²Stanford University; ³Michigan State University

TO QUIT OR NOT TO QUIT: USING LOG FILE DATA TO UNDERSTAND PROFILES OF STUDENTS’ PERFORMANCE ON SIMULATED INQUIRY TASKS
Nani Teig
University of Oslo

DIGITISATION IN CHEMISTRY LESSONS - DEVELOPMENT AND EVALUATION OF AN EXPERIMENTAL DIGITAL LEARNING ENVIRONMENT WITH UNIVERSAL ACCESSIBILITY
Mats Kieserling; Insa Melle
TU Dortmund University

17:00 - 18:30  OP105 - STRAND 5 - TEACHING AND LEARNING ABOUT ENERGY AND HEAT  Room E2 - Italia
Chairperson(s): Massimiliano Malgieri

RESEARCH-BASED DESIGN OF A TEACHING AND LEARNING SEQUENCE FOR THE FIRST LAW OF THERMODYNAMICS
Kalliopi Meli; Dimitrios Kolopoulos
University of Patras

USING INFRARED CAMERAS TO SUPPORT TEACHERS’ AND PUPILS SCIENTIFIC COMMUNICATION IN LEARNING ABOUT CHALLENGING THERMAL PHENOMENA
Niclas Åhman¹; Fredrik Jeppsson¹
¹Linnaeus University, Department of Physics and Electrical Engineering; ²Linköping University, Norrköping, Sweden

ADAPTATIONS TO PROJECT-BASED LEARNING OF AN ENERGY MODEL-BASED TEACHING SEQUENCE
Caterina Solé¹; Maria Isabel Hernández²; Conxita Márquez²
¹CRECIM (Autonomous University of Barcelona); ²Autonomous University of Barcelona

REDESIGNING A TEACHING-LEARNING SEQUENCE ABOUT THE PHYSICAL BASIS OF GREENHOUSE EFFECT AND GLOBAL WARMING
Pasquale Onorato¹; Massimiliano Malgieri¹; Alessandro Salmoiraghi¹; Stefano Oss¹; Anna De Ambrosis²
¹University of Trento; ²University of Pavia

17:00 - 18:30  OP106 - STRAND 1 - DEVELOPING STUDENTS’ UNDERSTANDING OF THE CONCEPT OF ENERGY  Room F1
Chairperson(s): Daniel Gysin

SYSTEMS, TRANSFER, AND FIELDS: EVALUATING A NEW APPROACH TO ENERGY INSTRUCTION
David Fortus¹; Marcus Kubsch²; Tom Bielik³; Joseph Krajcik²; Yaron Lehavi²; Knut Neumann²; Jeffrey Nordine¹; Sebastian Optiz³; Israel Touitou³
¹Weizmann Institute of Science; ²Israel Institute for Science and Mathematics Education (IPN); ³Michigan State University; ⁴David Yellin College

INVESTIGATING A SYSTEMS TRANSFER APPROACH TO TEACHING ENERGY IN MIDDLE SCHOOL
Marcus Kubsch¹; Sebastian Optiz³; Jeffrey Nordine¹; Knut Neumann²; David Fortus¹; Joseph Krajcik²
¹IPN; ²Weizmann Institute of Science; ³CREATE for STEM Institute
WHAT CONCEPTUAL FRONTIERS MUST SECONDARY SCHOOL STUDENTS OVERCOME IN ORDER TO UNDERSTAND THE CONCEPT OF ENERGY TRANSFER THROUGH HEAT?
Camilo Vergara; Víctor López; Digna Couso
CRECIM

KNOWLEDGE COORDINATION AND THE USE OF CONTEXT DURING THE TRANSFER PROCESS IN PHYSICS
Daniel Gysin; Markus Rehm; Dorothee Browelli
1University of Teacher Education Lucerne; 2University of Education, Heidelberg

17:00 - 18:30  OP107 - STRAND 1 - UNDERSTANDING PHYSICS CONCEPTS: QUANTUM MECHANICS AND COSMOLOGY
Room F2
Chairperson(s): Kristina Zuza

"BUT THE ELECTRON IS NOT ALIVE?" - STUDENTS’ CHALLENGES WITH THE CONCEPT OF OBSERVATION IN QUANTUM PHYSICS
Anders Huseby; Berit Bunqum
The Norwegian University of Science and Technology

UNDERSTANDING THE MEANING OF THE QUANTUM OF ACTION: ABSOLUTE ENTROPY OF THE IDEAL MONOA TOMIC GAS
Francesca Monti
Department of Computer Science, University of Verona

AN INVESTIGATION OF STUDENTS’ CONCEPTUAL UNDERSTANDING ABOUT COSMOLOGY THROUGH CLUSTER ANALYSIS
Arturo Colantonio; Italo Testa; Irene Marzoli; Silvio Leccia; Emanuela puddu; Silvia Galano
1University of Camerino; 2University “Federico II”; 3INAF - Astronomical Observatory of Campodimonte

ANALYZING THE UPPER SECONDARY SCHOOL STUDENTS’ UNDERSTANDING OF THE UNIVERSE
Kristina Zuza; Joanes Lizarraga
UPV/EHU

17:00 - 18:30  OP108 - STRAND 18 - EXPLORING SCIENTIFIC PRACTICES AND AFFECT
Room F3
Chairperson(s): Joni Lämsä

EXPLORING THE QUALITY OF INQUIRY-BASED SCIENCE - DEVELOPING A FRAMEWORK FOR VIDEO ANALYSIS
Marianne Odegaard; Solveig Karlsten; Marit Kjærnsli; Mai Lill Suhr Lunde; Eva Kristin Narvhus; Magne Olufsen; Johannes Sauleset
1University of Oslo; 2University of Tromsø

A VIDEO-BASED GROUNDED THEORY STUDY OF CLASSROOM PEDAGOGY: COMBINING PUPIL, TEACHER AND RESEARCHER PERSPECTIVES
John-Paul Riordan; Mark Hardman
1Canterbury Christ Church University; 2UCL Institute of Education

CONNECTIONS BETWEEN SCIENTIFIC PRACTICES IN ONE TASK ABOUT ENZYMES
Paloma Blanco-Anaya; Peregrina Varela-Caamiña; Joaquin Diaz de Bustamante
Universidade de Santiago de Compostela

AUTOMATIC CONTENT ANALYSIS IN COLLABORATIVE INQUIRY-BASED LEARNING
Joni Lämsä; Catalina Espinoza; Roberto Araya; Jouni Viiri; Abelino Jiménez G.; Raul Gormaz; Raija Hämäläinen
1University of Jyväskylä; 2University of Chile

17:00 - 18:30  OP109 - STRAND 13 - REFLECTIVE PRACTICES IN PRE-SERVICE TEACHER EDUCATION
Room G1
Chairperson(s): Alexander Koch

SELF-REFLECTION OF A CHEMISTRY TEACHER
Jarmila Kmetová; Marek Skorsepa
Matej Bel University

DEVELOPMENT OF REFLECTION SKILLS OF PRE-SERVICE PHYSICS TEACHERS
Maren Kempin; Christoph Kuglermeyer
University of Bremen
FOSTERING REFLEXIVE SKILLS IN PRACTICAL TRAINING USING TASKS AND PROMPTS - COMPETENCIES AND ATTITUDES OF BIOLOGY TEACHER STUDENTS
Stephanie Grünbauer; Dörte Ostersehlt
University of Bremen

AN EMPIRICAL PILOT IN ASSESSING STUDENT TEACHERS' BIOGRAPHY AND INSTRUCTIONAL BELIEFS
Alexander Koch
University of Missouri

17:00 - 18:30  OP110 - STRAND 13 - NATURE OF SCIENCE AND SCIENTIFIC INQUIRY  Room G2
Chairperson(s): Sila Kaya

CHANGE IN BELIEFS ABOUT SCIENCE WORKSHOPS: AN INTERNATIONAL PROJECT DURING INITIAL TEACHER TRAINING
Iñigo Rodríguez-Arteche¹; María del Carmen Barreto-Pérez²; Maite Sardiña-Bañà³; Maria Mercedes Martínez-Aznar³
¹Universidad Rey Juan Carlos; ²Universidad de Piura; ³Universidad Complutense de Madrid

PRESERVICE PHYSICS AND CHEMISTRY TEACHERS' LEARNING ABOUT INQUIRY DURING A LESSON STUDY
Mónica Baptista; Teresa Conceição; João Pedro Ponte
Instituto de Educação da Universidade de Lisboa

PRESCHOOL TEACHER STUDENTS VIEW'S INFLUENCE ON THEIR INTENTION TO USE TAUGHT INQUIRY METHODS
Anastasios Zoupidis¹; Vasileios Tselves²; Petros Kariotoglou¹
¹University of Western Macedonia, Greece; ²National and Kapodistrian University of Athens

ENGAGING PRE-SERVICE SCIENCE TEACHERS IN CONTEMPORARY SOCIAL ASPECTS OF NOS: IMPROVING ENTREPRENEURIAL UNDERSTANDING
Sila Kaya¹; Naomi Birdthistle²; Orla McCormack¹; Sibel Erduran¹
¹University of Limerick, ²Swinburne University of Technology; ³University of Oxford

17:00 - 18:30  OP111 - STRAND 13 - CONNECTING PRE-SERVICE TEACHER EDUCATION TO PRACTICE  Room G3
Chairperson(s): Merryn Dawborn-Gundlach

FUTURE CHEMISTRY TEACHER'S PERCEPTIONS OF VOCATIONALLY RELEVANT LEARNING ACTIVITIES
Johannes Pernaa; Maija Aksela
University of Helsinki, Department of Chemistry

THE DEVELOPMENT AND IMPLEMENTATION OF AN INSTRUCTIONAL FRAMEWORK FOR SCIENCE TEACHER PREPARATION BASED ON CORE PRACTICES
Ron Gray
Northern Arizona University

PRE-SERVICE SCIENCE TEACHERS' PERCEPTIONS OF HOW THEY LEARN TO FACILITATE INQUIRY-BASED PRACTICAL WORK
Maria Tsakeni
University of the Free State

TEACHER RETENTION: SUPPORTING EARLY-CAREER SCIENCE TEACHERS TO STAY IN THE TEACHING PROFESSION
Merryn Dawborn-Gundlach; Merryn Dawborn-Gundlach
University of Melbourne

17:00 - 18:30  OP112 - STRAND 14 - TEACHERS AND STEM REFORM  Room G4
Chairperson(s): Heba EL-Deghaidy

TEACHER PRAXIS IN PROMOTING INQUIRY FOCUSED QUESTIONING IN STEM: REFOCUSBING THE ‘LEARNING PIT’
YVONNE ZEEGERS¹; Katrina Elliott²; Marianne Nicholas²
¹University of South Australia; ²South Australian Department for Education

A CROSS CULTURAL ANALYSIS OF PRIMARY TEACHERS' CURRENT UNDERSTANDINGS AND PERCEPTIONS OF STEM EDUCATION
Jennifer Mansfield; Kathy Smith; Sindu George
Monash University
ZERO TO STEM: THE JOURNEY OF A U.S. ELEMENTARY SCHOOL BECOMING A STEM SCHOOL AND IMPLICATIONS FOR PROFESSIONAL DEVELOPMENT
Julianne Wenner; Sara Hagenah
Boise State University

SCIENCE TEACHERS PERCEPTIONS OF STEM INTEGRATION
Heba EL-Deghaidy¹; Nasser Mansour²
¹The American University In Cairo; ²Exeter University

17:00 - 18:30  OP113 - STRAND 14 - IMPLEMENTING INQUIRY-BASED SCIENCE EDUCATION II
Room G5
Chairperson(s): Smadar Levy

THE IMPACT OF A PHYSICS-BASED INQUIRY WORKSHOP ON HIGH SCHOOL AND MIDDLE SCHOOL SCIENCE TEACHERS
Elon Langbeheim; Edit Yerushalmi
The Weizmann Institute of Science

DEVELOPING SCIENCE TEACHERS’ TPACK AND ITS IMPACT ON DESIGNING TECHNOLOGY-BASED INQUIRY ACTIVITIES
Mohamed Mustafa
University of Ottawa

THE MULTIPLIER ROLE IN TEACHER PROFESSIONAL DEVELOPMENT - A QUALITATIVE STUDY OF IMPLEMENTATION OF INQUIRY-BASED LEARNING
Ragnhild Lyngved Staberg¹; Rune Ratdal²
¹The Norwegian University of Science and Technology; ²Trondheim Municipality, Sunnland school

TEACHER-LEADERS’ LEARNING WHILE LEADING A PLC OF PHYSICS TEACHERS — THE CASE OF THE INQUIRY-BASED LABORATORY
Smadar Levy; Esther Bagno; Hana Berger; Bat-Sheva Eylon
Weizmann Institute of Science

17:00 - 18:30  OP114 - STRAND 16 - SCIENCES IN PRIMARY SCHOOL/HEALTH-BIOLOGY EDUCATION
Room G6
Chairperson(s): Xana Sá-Pinto

USING PHILOSOPHY-INSPIRED CATEGORIZATION STRATEGIES TO DESIGN A LEARNING ENVIRONMENT ABOUT BIOLOGICAL CLASSIFICATION: A CASE STUDY WITH 4TH GRADERS
Eftychia Valanidou; Marida Ergazaki; Renia Gasparatou
University of Patras

COLLABORATION BETWEEN TEACHERS AND SCHOOL NURSES CONCERNING SEX EDUCATION IN UPPER PRIMARY SCHOOL
Mats Lundström; Ann-Cathrine Bramhagen
Malmö University

THE PROJECT-BASED LEARNING: IMPACT ON LEARNING OF GEOLOGY BY SYRIAN REFUGEE GRADE 6 STUDENTS
ASSAAD YAMMINE¹; Pauline Abdouche²
¹LEBANESE UNIVERSITY; ²UL

THE IMPACT OF EXPLORING SEXUAL SELECTION IN ELEMENTARY SCHOOL STUDENTS UNDERSTANDING OF EVOLUTION
Xana Sá-Pinto¹; Alexandre Pinto²; Patricia Pessoa³; Pedro Cardia³; Joaquim Bernardino Lopes³
¹CIDTFF.UA; ²P.Porto: ESE; ³UTAD

17:00 - 18:30  OP115 - STRAND 17 - CROSSING STAGES IN THE HIGHER EDUCATIONAL SYSTEM AND PROFESSIONAL EXPERTISE
Room G7
Chairperson(s): Trevor Anderson

IMAGINING THE FUTURE - POSSIBLE SELVES IN HIGHER EDUCATION
Katia Kromann Nielsen; Lars Ulriksen
Department of Science Education, University of Copenhagen

DISCIPLINARY CULTURE CARRIERS AND THE INTER-RELATED-NESS BETWEEN VARIOUS STAGES IN THE EDUCATIONAL SYSTEM
Maja Elmgren; Anita Hussénius
Uppsala University
ANALYSIS OF LEARNING ASSISTANTS’ PHYSICS IDENTITY DEVELOPMENT AND RECONCILIATION OF MULTIMEMBERSHIP THROUGH THE LENS OF COMMUNITIES OF PRACTICE
Eleanor Close; Jessica Conn; Shahrzad Hesaaraki; Austin McCauley; Xandria Quichocho
Texas State University

USING EXPERT RESEARCH KNOWLEDGE TO INFORM UNDERGRADUATE BIOCHEMISTRY INSTRUCTION
Trevor Anderson¹; Nancy Pelaez²; Kathleen Jeffery²; Stefan Irby²; Caleb Trujillo²
¹Purdue University; ²Michigan State University

17:00 - 18:30  OP116 - STRAND 17 - PRE-SERVICE TEACHER EDUCATION AND TEACHER TRAINING  Room G8
Chairperson(s): Arpana Dhar

AN EDUCATIONAL FRAMEWORK TO SUPPORT TEACHERS IN DEVELOPING AND IMPLEMENTING INQUIRY-BASED AND PROJECT-BASED ASSIGNMENTS IN ACADEMIC SCIENCE & ENGINEERING COURSES
Ria Dolfing; Peter Wolfs
University of Groningen

MIGHT TEXTBOOKS MINIMISE THE MISSING LINK BETWEEN THEORY AND PRACTICE IN TEACHER TRAINING?
Katrin Bölsterli Bardy¹; Maja Brückmann²
¹University of Teacher Education Lucerne PHLU; ²University of Oldenburg

BEYOND BIOLOGY — WHAT IS FOREFRONTED WHEN BIOLOGISTS ARE SHADOWED?
Kristina Andersson¹; Annica Gullberg²
¹Uppsala University; ²Uppsala University, Centre for Gender Research

PEARLS AND PERILS OF COLLABORATION: A REFLECTIVE JOURNEY
Arpana Dhar
Curtin University
WEDNESDAY 9:00 - 11:00

Symposium 21 - DIALOGICAL PERSPECTIVES IN SCIENCE EDUCATION: APPROACHING DIALOGUE IN CONTEMPORARY SCIENCE CLASSROOMS
Room A1

Chairperson(s): Miranda Rocksén, Anne Solli; Discussant: Eduardo Mortimer

A BAKHTINIAN APPROACH TO ISSUES OF PUBLIC DEBATE
Anne Solli; Thomas Hillman; Åsa Mäkitalo
University of Gothenburg

TEACHER ORCHESTRATION OF WHOLE-CLASS DISCUSSIONS IN SCIENCE: EXPLORING DIALOGIC AND AUTHORITATIVE PASSAGES
Sami Lehesvuori; Markus Hähkööniemi; Jouni Viiri; Pasi Nieminen; Kaisa Jokiranta; Jenna Hiltunen
University of Jyväskylä

SENSEMAKING AT THE INTERSECTION OF AUTHORITATIVE AND STUDENT-GENERATED REPRESENTATIONS
Line Ingulfsen; Anniken Furberg; Erik Knain
University of Oslo

APPROACHING DIALOGUE IN A SEQUENCE OF LESSONS ABOUT EVOLUTION: SCIENCE CLASSROOM COMMUNICATION ON MULTIPLE-SCALES
Miranda Rocksén
University of Gothenburg

Symposium 29 - STUDENTS AWARENESS AND OPPORTUNITIES FOR STEM CAREER
Room A2

Chairperson(s): Silvija Markic, Sarah Hayes; Discussant: Rachel Mamlok-Naaman

STUDENTS LOOKING SCIENCE-RELATED CAREERS FROM DIFFERENT PERSPECTIVES
Anssi Salonen; Ilpo Jääppinen; Tuula Keinonen
University of Eastern Finland

CULTURE AND GENDER DIFFERENCES IN VOCATIONAL ORIENTATION IN SCIENCE
Marina Höning; Lilith Rüschenpöhler; Julian Küsel; Silvija Markic
Ludwigsburg University of Education

DEVELOPMENT AND EVALUATION OF TOOLS FOR GENDER- AND DIVERSITY-SENSITIVE CAREER ORIENTATION IN CHEMISTRY
Ute Brinkmann; Tatjana Jersich; Markus Prechtl
Technische Universität Darmstadt

CHANGING THE PERCEPTIONS THAT POST-PRIMARY SCHOOL STUDENTS’ HOLD ABOUT SCIENTISTS AND THEIR WORK THROUGH A CAREER ORIENTATION PROGRAMME
Sarah Hayes; Aimee Stapleton; Martin McHugh
University of Limerick

Symposium 22 - COLLABORATIVE CONSTRUCTION OF KNOWLEDGE IN SCIENCE CLASSROOMS ENACTS RELATIONSHIPS OF DEMOCRACY
Room B1

Chairperson(s): Elizabeth Cavicchi, Maria Cristina Trevissoi; Discussant: Edvin Ostergaard

PRODUCTIVE DISCUSSIONS: NURTURING SCIENCE LITERATE STUDENTS AND ACTIVE CITIZENS
Carlo Bertoni
Liceo scientifico Copernico

TECHNOLOGY PROJECTS: A SCHOOL SUBJECT TO INTRODUCE DEMOCRATIC VALUES
Alicia Lopez Jornet
CIC Batxillerats

COLLABORATIVE EXPLORING IN SKY AND SPACE: LEARNERS AND TEACHER CONSTRUCT KNOWLEDGE AND DEMOCRATIC RELATIONSHIPS
Elizabeth Cavicchi
Edgerton Center, MIT

BRING THE DREAM TO LIGHT: HOW COLLABORATIVE CONSTRUCTION OF KNOWLEDGE IN HIGH SCHOOL PHYSICS/SCIENCE DEVELOPS DEMOCRATIC VALUES AND EXPERIENCES
Maria Cristina Trevissoi
“A. Roiti” high school
### Symposium 23 - FACTORS INFLUENCING TEACHING, LEARNING, AND ACCEPTING EVOLUTION

**Chairperson(s):** Daniela Fiedler; **Discussant:** Marcus Hammann

**Reading the Tree of Life: Factors Influencing the Ability to Read Evolutionary Trees**
- Thilo Schramm
- Yvonne Schachtlschneider
- Philipp Schmiemann
  - University Duisburg-Essen

**Quantitative Study of Lower-Secondary School Students' Acceptance of Evolution in France**
- Magali Coupard
- Jérémy Castéra
- Corinne Jégou
- Julie Gobert
- Pascale Brandt-Pomares
- Alice DELSERIEYS-PEDREGOSA
  - Aix Marseille Université

**"Evolution? I Don't Believe in It": Theological Tensions Around the Teaching and Learning of Evolution in the Israeli Society**
- Merav Siani¹
- Anat Yarden²
  ¹Herzog Academic College Israel; ²Weizmann Institute of Science

**The Effectiveness of Secondary Education in Promoting Understanding of Natural Selection: A Comparison Between Flanders and the Netherlands.**
- Rianne Pinxten
- Ellen Vandervieren
- Marcel Eens
  - University of Antwerp

### Symposium 24 - CRITICAL PERSPECTIVES IN COMPUTER SCIENCE EDUCATION

**Chairperson(s):** Anne-Kathrin Peters, Billy Wong; **Discussant:** Michael Reiss

**Computer Science Education as Bildung and Identity Development**
- Lea Budde
- Carsten Schulte
  - Paderborn University

**Computer Science vs ICT: The Gender Impact of Curriculum Change in England**
- Peter Kemp¹
- Billy Wong²
  ¹University of Roehampton; ²University of Reading

**Becoming a Computer Science Student: First Year Higher Education Students' Identity Work and Academic Integration Process**
- Katia Kromann Nielsen
- Andrea F. M. Gregersen
- Henriette Tolstrup Holmegaard
  - Department of Science Education, University of Copenhagen

**Understanding and Developing Desirable Computing Identities in a Dialogue with Students and Teachers**

**Understanding and Developing Desirable Computing Identities in a Dialogue with Students and Teachers**
- Anne-Kathrin Peters
  - Uppsala University

### Symposium 25 - NEW FRAMEWORKS FOR STUDYING EQUITY IN INFORMAL SCIENCE EDUCATION: CROSS-CULTURAL PERSPECTIVES

**Chairperson(s):** Angela Calabrese Barton; **Discussant:** Edna Tan

**Characterising Youth Participation in Natural History Museum-Led Citizen Science: Designing for the Development of Agency for More Equitable Participation in Environmental Science**
- Heidi L. Ballard¹
- Julia Lorke²
- Rebecca D. Swanson³
- Maryam Ghadiri Khamapostanl¹
- Lucy D. Robinson²
  ¹University of California, Davis, CA, USA; ²Tufts University, Boston, MA, USA

**High Leverage Practices in Support of Equitable and Transformative Pathways Towards STEM-Agentic Lives**
- Won Jung Kim
- Angela Calabrese Barton
- Sinead Brien
- ReAnna Roby
  - Michigan State University

**The "Practice Turn" in Informal Learning STEAM Pedagogies**
- Bronwyn Bevan¹
- Joseph Roche²
- Sam Mejias³
  ¹University of Washington; ²Trinity College; ³London School of Economics
WHO IS BEING SERVED? EQUITY AND THE PATTERNS OF PARTICIPATION IN INFORMAL STEM LEARNING SETTINGS
Spela Godec1; Louise Archer1; Emily Dawson2
1UCL Institute of Education; 2University College London

09:00 - 11:00 Symposium 26 - CITIZEN SCIENCE AND SCIENCE EDUCATION: OPPORTUNITIES TO LEARN, LEARNING OUTCOMES TO ACHIEVE
Chairperson(s): Till Bruckermann; Discussant: Miriam Brandt

AGREEMENT IS NEEDED! — IDENTIFICATION OF COMMON GOALS FOR AN URBAN ECOLOGY CITIZEN SCIENCE PROJECT THROUGH A DELPHI STUDY
Till Bruckermann; Ute Harms
Leibniz Institute for Science and Mathematics Education (IPN)

RESEARCH ON LEARNING OUTCOMES IN A BIODIVERSITY CITIZEN SCIENCE PROJECT WITH SCHOOLS
Martin Scheuch1; Manfred Bardy-Durchhalter2; Julia Kelemen-Finan3; Silvia Winter4
1University College for Agricultural and Educational Education; 2Austrian Educational Competence Centre for Biology, University of Vienna; 3naturschutzakademie.at [Austrian Academy for Nature Conservation], Stockerau, Austria; 4Institute for Nature Conservation & Division of Plant Protection, University of Natural Resources an

DESIGN FOR PARTICIPATION IN SCIENTIFIC RESEARCH ENHANCES PUPILS’ ENGAGEMENT WITH LEARNING OPPORTUNITIES
Susanne Rafolt; Suzannen Kapelari; Elisabeth Carli
University of Innsbruck

"DON’T STEP ON THE VOLCANOES!” - DEVELOPING ENVIRONMENTAL SCIENCE AGENCY THROUGH PARTICIPATION IN MUSEUM-LED CITIZEN SCIENCE PROJECTS
Julia Lorke1; Heidi L. Ballard2; Maria Aristiedou3; Christothea Herodotou4; Rebecca D. Swanson5; Lucy D. Robinson6
1Natural History Museum, London, UK; 2University of California, Davis, CA, USA; 3Open University, Milton Keynes, UK; 4Tufts University, Boston, MA, USA

MATERIALITY IN STEM IDENTITY RESEARCH: ENTANGLEMENTS WITH DIGITAL AND PHYSICAL MATTER
Emily Dawson
UCL

SCIENCE IDENTITIES - STABLE, CHANGING AND IN PLURAL
Lars Ulriksen; Henriette T. Holmegaard
Department of Science Education, University of Copenhagen

PERFORMING, CLAIMING, AND ENVISIONING POSSIBLE SELVES IN STEM IN THE FLOW OF LIFE: THE ROLE OF INSIDE-NESS AND PLACEMAKING
Jrène Rahm1; Jrène Rahm1; Allison Gonsalves2; Audrey Lachaine2
1Université de Montréal; 2McGill University

EXPLORING PEDAGOGIES THAT SUPPORT YOUTH STEM IDENTITIES DEVELOPMENT IN MIDDLE SCHOOL SCIENCE CLASSROOMS
Hosun Kang1; Angela Calabrese-Barton2; Edna Tan3
1University of California Irvine; 2Michigan State University; 3The University of North Carolina at Greensboro

THE ROLE OF AESTHETICS IN LEARNING SCIENCE: EXAMINING AN INTEGRATED ART-SCIENCE LESSON
Per-Olof Wickman1; Shelley Hannigan2; Joseph Ferguson2; Vaughan Prain2; Russell Tytler2
1Stockholm University; 2Deakin University

THE ROLE OF AESTHETICS IN THE TEACHING AND LEARNING OF DATA MODELLING
Joseph Ferguson; Russell Tytler; Peta White
Deakin University
THE ROLE OF ART PRACTICE IN ELEMENTARY SCHOOL SCIENCE
Cecilia Caiman; Britt Jakobson
Stockholm University

THE ROLE OF AESTHETICS IN KOREAN STEAM CURRICULUM
Kongju Mun1; Yohan Hwang2
1Seoul National University; 2Chungnam National University

09:00 - 11:00 Symposium 35 - DEVELOPING TEACHING PRACTICES IN EARLY YEARS STEM EDUCATION: OPPORTUNITIES AND CHALLENGES
Chairperson(s): Esme Glauer; Fani Stylianidou; Discussant: Costas Constantinou

TEACHER'S PERSPECTIVES IN RELATION TO TEACHING STEM IN SWEDISH PRESCHOOLS
Kerstin Bäckman
University of Gavle

TEACHING NATURE OF SCIENCE IN PRESCHOOL WITH A STARTING POINT IN CHILDREN’S PICTURE BOOKS
Lena Hansson; Lotta Leden; Susanne Thulin
Kristianstad University

TEACHER PEDAGOGY WHEN USING TANGIBLE ROBOTS SUCH AS BEE-BOTS.
Coral Campbell; Christopher Speldewinde
Deakin University

FOSTERING CREATIVITY AND INQUIRY IN EARLY YEARS SCIENCE: DEVELOPING A RESEARCH BASED APPROACH TO PROFESSIONAL DEVELOPMENT
Esme Glauer1; Fani Stylianidou2
1University College London Institute of Education; 2IKY / Erasmus+ Hellenic National Agency Higher Education Sector

09:00 - 11:00 Invited Symposium 13 - BRIDGING THE GAP BETWEEN SCIENCE EDUCATION RESEARCH, EDUCATIONAL PRACTICES, SOCIETY AND CITIZENS: INQUIRY BASED LEARNING AND RESPONSIBLE RESEARCH AND INNOVATION
Chairperson(s): Claudio Fazio; Discussant: Marisa Michelini

RETENTION OF LEARNING THROUGH INQUIRY
Dagmara Sokotowska
Smoluchowski Institute of Physics, Jagiellonian University, Kraków, Poland

INTRODUCTION OF NEW FINDINGS IN SCIENCE TO PRE-UNIVERSITY EDUCATION USING INQUIRY BASED LEARNING
Mojca Čepič; Jerneja Pavlin
Faculty of Education, University of Ljubljana, Slovenia

CHALLENGES AND OPPORTUNITIES FOR RETHINKING INQUIRY BASED SCIENCE EDUCATION
Eilish McCloughlin1; Odilia Finlayson2
1CASTeL, School of Physical Sciences, Dublin City University, Ireland; 2CASTeL, School of Chemical Sciences, Dublin City University, Ireland

INQUIRY IN HIGHER EDUCATION: AN EXAMPLE OF CROSSING DISCIPLINARY KNOWLEDGE BOUNDARIES
Cecília Galvão1; Cláudia Faria1; Wanda Viegas2; Luís F. Goulão3; Amélia Branco4
1Instituto de Educação, Universidade de Lisboa, Portugal; 2Leaf/Instituto Superior de Agronomia, Universidade de Lisboa, Portugal; 3Instituto Superior de Economia e Gestão, Universidade de Lisboa, Portugal

09:00 - 11:00 Symposium 36 - SCIENCE EDUCATION CHALLENGES TO HEGEMONIC POWER STRUCTURES
Chairperson(s): John Bencze; Discussant: Steve Alsop

TURBULENT TIMES: NEOLIBERALISM AND SCIENCE EDUCATION
Lyn Carter
Australian Catholic University, Melbourne

COMMUNICATING CURRICULUM REFORM TO THE GENERAL PUBLIC: CHALLENGES AND LIMITATIONS
Isabel Martins
Federal University of Rio de Janeiro
SCIENCE AND SOCIAL JUSTICE: THE CASE FOR CRITICAL REALISM
Ralph Levinson1; Matthew Weinstein2
1University College, London, Institute of Education; 2University of Washington, Tacoma

MOBILIZING CRITICAL & ALTRUISTIC SCIENCE EDUCATION
John Bencze1; Dave Del Gobbo2; Sarah El Halwany2; Mirjan Krstovic3; Minja Milanovic2; Zoya Padamsi2; Chantal Pouliot1; Nadia Qureshi2; Majd Zouda2
1OISE, University of Toronto; 2Peel District School Board; 3Laval University

09:00 - 11:00 Invited Symposium 07 - POLICY AND PEDAGOGY: INTERNATIONAL REFORM AND DESIGN CHALLENGES OF SCIENCE AND STEM EDUCATION.
Room E2 - Italia
Sponsored by NARST-International Committee

Chairperson(s): Richard Duschl; Discussant: Lucy Avraamidou

Richard Duschl
Caruth Institute for Engineering Education Southern Methodist University, Germany

Costas Constantinou
University of Cyprus

Doris Jorde
BioCEEDUniversity Of Oslo, Norway

Jonathan Osborne,
Stanford University, United States

Eilish McLoughlin
Dublin City University, Ireland

Audrey Msimanga
Sol Plaatje University, South Africa

Fang-Ying Yang
National Taiwan Normal University, Taiwan

09:00 - 11:00 Symposium 18 - MECHANISTIC REASONING: A MULTI-DISCIPLINARY PERSPECTIVE
Room F1

Chairperson(s): Michal Haskel-Ittah, Anat Yarden; Discussant: Kapon Shulamit

STUDENTS’ MECHANISTIC REASONING RELATED TO TRACING MATTER AND ENERGY IN THE CONTEXT OF THE CARBON CYCLE
Marcus Hammann; Marcus Hammann; Roman Asshoff; Katharina Düsing; Daniel Hüskens
University of Münster

REASONING ABOUT GENETIC MECHANISMS: THE CRITICAL ROLE OF FUNCTIONS
Michal Haskel-Ittah1; Ravit Golan Duncan1; Anat Yarden1
1Weizmann Institute of Science; 2Rutgers

A MECHANISTIC PERSPECTIVE ON ORGANIC CHEMISTRY
Ira Caspari1; Nicole Graulich2
1University of Massachusetts Boston; 2Justus-Liebig-University Giessen

STUDENTS-GENERATED DRAWINGS FOR PROMOTING MECHANISTIC REASONING IN EXPLAINING CHEMICAL REACTIONS.
Vanessa de Andrade3; Yael Shwartz2; Mônica Baptista1; Sofia Freire1
1University of Lisbon, Institute of Education; 2Department of Science Teaching, Weizmann Institute of Science

09:00 - 11:00 Symposium 19 - PHILOSOPHICAL AND CONCEPTUAL CHALLENGES IN QUANTUM PHYSICS EDUCATION
Room F2

Chairperson(s): Ellen Karoline Henriksen; Discussant: Alexander Kauertz

UNDERSTANDING ENERGY DIAGRAMS AS A PREREQUISITE FOR UNDERSTANDING QUANTUM MECHANICS
Kim Krijtenburg-Lewerissa1; Henk Pol2; Wouter van Joolingen1
1ELAN Institute for Teacher Training; 2Freudenthal Institute for Science and Mathematics Education

“YOU HAVE TO SORT OUT WHAT YOU THINK!” - STUDENTS’ VIEWS OF NATURE OF SCIENCE IN QUANTUM PHYSICS
Kirsten Stadermann; Martin Goedhart
Institute for Science Education and Communication, University of Groningen

MODES OF DISCOURSE IN QUANTUM PHYSICS: A THEORETICAL PROPOSAL FOR AN ANALYTICAL FRAMEWORK
Alexandro Pereira
Instituto de Física da UFRGS
NORWEGIAN UPPER SECONDARY STUDENTS’ IDEAS ABOUT THE WAVE NATURE OF MATTER
Maria Vetleseter Boe1; Susanne Viefers1; Berit Bungum2; Ellen Karoline Henriksen1
1University of Oslo, Dept. of Physics; 2Norwegian University of Science and Technology

09:00 - 11:00 Symposium 20 - NEW MATERIALISM AND ITS IMPLICATIONS FOR SCIENCE EDUCATION
Research Methodology - II
Room F3

Chairperson(s): Mark Hardman; Discussant: Lindsay Hetherington

TAKE-N-FOR-GRANTED LABORATORY MATERIAL PRACTICES AND ITS CONSEQUENCES FOR STUDENTS
Anita Hussénius
Uppsala University

DANCING WITH ROBOTS: AN ETHNOGRAPHIC LOOK AT EMBODIED PERFORMANCE OF HUMAN-ROBOT ASSEMBLAGES
Marcella Fioroni1; Steve Alsop2
1Crescent School; 2York University

MATERIAL, MODELS AND MULTIPLICITIES IN THE SCIENCE CLASSROOM
Mark Hardman1; John-Paul Riordan2
1UCL Institute of Education; 2Canterbury Christ Church University

NEW MATERIALISM AND NEW METHODOLOGIES IN SCIENCE EDUCATION RESEARCH
Mark Hardman1; Jill Noakes2; Lindsay Hetherington2
1UCL Institute of Education; 2University of Exeter

09:00 - 11:00 Symposium 04 - WHAT’S THE PROBLEM? IDENTIFICATION OF STUDENTS’ CHARACTERISTICS HINDERING LEARNING ABOUT EVOLUTION
Room G1

Chairperson(s): Ute Harms; Discussant: Kostas Kampourakis

UPPER SECONDARY SCHOOL STUDENTS’ IMPLICIT ASSOCIATIONS OF GENETICS AND TELEOLOGICAL CONCEPTIONS
Florian Stern1; Kostas Kampourakis; Marine Delaval; Andreas Müller
University of Geneva

CONTEXT DEPENDENCE OF THRESHOLD CONCEPTS IN STUDENTS’ NATURAL SELECTION EXPLANATIONS
Andreas Göransson1; Daniela Fedler2; Daniel Orraryd2; Lena Tibell1
1Department of science and technology, Linköping University; 2Department of Biology Education, Leibniz Institute for Science and Mathematics Education (IPN) at Ki; 3Department of Social and Welfare studies, Linköping University, Norrköping, Sweden

TO ZOOM INTO EVOLUTIONARY TIME: INTERACTING WITH A DYNAMIC TREE OF LIFE
Jörgen Stenlund1; Lena Tibell1; Konrad Konrad Schönborn1
1School of Science and Technology, Örebro University; 2Linköping university Department of Science and Technology; 3Linköping University Department of Science and Technology

FOCUSING PRE-SERVICE TEACHERS: MEASURING DIAGNOSTIC KNOWLEDGE ABOUT EVOLUTION WITH THE SIMULATED CLASSROOM BIOLOGY (SCRBIO).
Julian Fischer1; Nils Machts2; Jens Möller3; Ute Harms4
1IPN Leibniz-Institute for Science and Mathematics Education at the University of Kiel; 2Institute for Educational Psychological Teaching and Learning Research (IPL) at the University of Kiel

09:00 - 11:00 Symposium 31 - ACTION RESEARCH FOR INNOVATION AND PROFESSIONAL DEVELOPMENT IN SCIENCE EDUCATION
Room G2

Chairperson(s): Ingo Eilks; Discussant: Sylvija Markic

TEACHER-DRIVEN PARTICIPATORY ACTION RESEARCH FOR INNOVATING THE HIGH SCHOOL CHEMISTRY CURRICULUM THROUGH GREEN CHEMISTRY
Ingo Eilks1; Michael Linkwitz2
1University of Bremen; 2Otto-Hahn-Gymnasium, Bergisch-Gladbach, Germany

FROM THE SCHOOL LABORATORY TO CHEESE FACTORY
Marika Kapanadze1; Natela Bagatrishvili2
1Ilija State University, Georgia; 2State School N7, Telavi, Georgia

WHAT KIND OF A TEACHER AM I? MY SELF-STUDY ON MY SCIENCE, TECHNOLOGY, ENGINEERING, MATHEMATICS (STEM) LESSON
Ismail Dönmez1; Mehmet Fatih TASAR2
1Mus Alparslan University; 2Gazi University
### Symposium 32 - RECONSIDERING, REFINING AND REIMAGINING PCK FOR SCIENCE EDUCATION

09:00 - 11:00

Chairperson(s): Rebecca Cooper, Andreas Borowski; Discussant: Oliver Tepner

**Building Consensus to Advance PCK Research**
Janet Carlson¹; Kirsten Daehler²; Andreas Borowski³; Kennedy Chan⁴; Rebecca Cooper⁵; Jan van Driel⁶
¹Graduate School of Science Education, Stanford University; ²WestEd; ³Universität Potsdam; ⁴Hong Kong University; ⁵Monash University; ⁶University of Melbourne

**Reimagining the Existing: Interpreting Multiple Studies in the Light of the New PCK Model**
Sophie Kirschner¹; Elizabeth Mavhunga²; Stefan Sorge³; Anita Stender⁴; Chris Wilson⁵
¹JLU Giessen; ²Wits School of Education; ³IPN Kiel; ⁴University of Duisburg-Essen; ⁵BSCS Science Learning

**EPCK: Diving into the Inner Circle**
Alicia Alonso¹; Amanda Berry²; Pernilla Nilsson³
¹Michigan State University; ²Monash University; ³Halmstad University

**Asessing PCK Using a Grand Rubric**
Marissa Rollnick¹; Kennedy Kam Ho CHAN²
¹University of the Witwatersrand; ²The University of Hong Kong

### Symposium 33 - Digitally Supported Teaching and Learning Formats - Development and Evaluation

09:00 - 11:00

Chairperson(s): Insa Melle, Germany; Discussant: Felix Ho

**Development of an Inclusive, Digital Media Supported Learning Environment for Inquiry-Based Learning**
Sandra Puddu¹; Brigitte Koliander²; Philipp Spitzer³
¹PH Vienna; ²PH Niederösterreich; ³University of Vienna, AECC Chemistry

**Science Pre-Service Teachers TPACK and Beliefs about Learning with Digital Media**
Julian Kuesel; Silvija Markic
Ludwigsburg University of Education

**A Blended Learning Approach for In-Service Teachers Training Based on Online Moodle Platform**
Chiara Schettini; Rossana Galassi; Daniela Amendola
University of Camerino

**Professionalisation of Prospective Teachers for Digitisation in Chemistry Education — Development and Evaluation of a University Seminar**
Franziska Zimmermann; Insa Melle
TU Dortmund University

### Symposium 34 - Affordances of Augmented Reality for Learning Science

09:00 - 11:00

Chairperson(s): Seamus Delaney; Discussant: Eleni Kyza

**Teachers’ Perspectives on Location-Based Learning via Augmented-World**
Miri Barak; Shadi Asakle
Technion, Israel Institute of Technology

**Augmented Reality in Lower Secondary Science Teaching: Teachers and Students as Producers**
Brigitte Lund Nielsen; Harald Brandt
VIA University College

**Combining Established Teaching Media with Augmented Reality (AR) — Investigation of the Effects on Learning Results and of Teachers’ and Students’ Views on AR**
Christoph Thyssen; Carsten Hoffmann
TU Kaiserslautern

**Teacher Perceptions of Their Role and Duty to Implement Augmented Reality Into Science Teaching**
Seamus Delaney; Caitlyn Pryse; George Aranda
Deakin University, Australia
**Symposium 30 - SCIENCE EDUCATION FOR SUSTAINABLE DEVELOPMENT: COMPARING THE CHALLENGES OF THE ANTHROPOCENE**

Chairperson(s): Elaosi Vhurumuku; Discussant: Washington Takawira Dudu

**TEACHER EDUCATION AND ANTHROPOCENE**
Nina Christenson¹; Kassahun Weldemariam²
¹Karlstad University; ²University of Gothenburg

**INITIAL SCIENCE TEACHER EDUCATION FOR SUSTAINABLE DEVELOPMENT: ANALYSIS OF CURRICULUM FOR A SOUTH AFRICAN UNIVERSITY**
Elaosi Vhurumuku¹; Washington Dudu²
¹University of Witwatersrand; ²University of Northwest

**INITIAL SCIENCE TEACHER EDUCATION FOR SUSTAINABLE DEVELOPMENT: A CASE STUDY OF BINDURA UNIVERSITY, ZIMBABWE**
Nicholas Zezekwa¹; Elaosi Vhurumuku²
¹Bindura University; ²University of Witwatersrand

**THE INTEGRATION OF SUSTAINABLE DEVELOPMENT IN LIFE SCIENCES CLASSROOM PRACTICES: A CASE STUDY OF THE UNIVERSITY OF THE WITWATERSRAND, SOUTH AFRICA**
Portia Kavai
University of Witwatersrand

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**Interactive Poster P01 - STRAND 1 - UNDERSTANDING WITHIN CHEMISTRY, BIOLOGY AND ENVIRONMENTAL CONTEXT**

**STUDENTS' CONCEPTUAL PROGRESSION OF CHEMICAL REACTIONS**
Merve Nur Yavuzkaya; Emine Adadan
Boğaziçi University

**STUDENTS' INTERPRETATION OF GRAPH SLOPE IN KINEMATICS INVESTIGATED BY THE EYE-TRACKING METHOD**
Martina Kekule
Charles University

**THE INTERPLAY BETWEEN INDIVIDUAL REFLECTION AND COLLABORATIVE LEARNING - USING THE PEER-INTERACTION-METHOD TO DIAGNOSE AND FOSTER STUDENTS' CONCEPTIONS ABOUT COMBUSTION**
Julian Heeg; Sarah Hundertmark; Sascha Schanze
Leibniz Universität Hannover - Institute for Science Education

**STUDENTS' MODEL-BASED REASONING ABOUT THE RELATIONSHIPS BETWEEN THE GAS LAW AND A REAL-WORLD EVENT**
Claus Auning
University of Southern Denmark

**STUDENTS' MENTAL MODELS OF THE MARINE ENVIRONMENT: IMPLICATIONS FOR ENVIRONMENTAL SCIENCE EDUCATION**
Shu-Chiu Liu¹; Miao-Hsuan Yen²
¹Center for General Education, National Sun Yat-sen University, Kaohsiung, Taiwan; ²Graduate Institute of Science Education, National Taiwan Normal University, Taipei, Taiwan

**INFLUENCE OF EXPERIENCE ON TREE READING PERFORMANCE**
Inga Ubben¹; Sandra Nitz²; Annette Upmeier zu Belzen³
¹Humboldt-Universitaet zu Berlin; ²Universitaet Koblenz-Landau

**PUPILS’ SCIENTIFIC CONCEPT FORMATION OF METALS IN PRIMARY SCIENCE IN JAPAN**
Yukinori Utsumi
Gifu University

**SEED DIVERSITY: HOW DO PRIMARY SCHOOL CHILDREN EXPLAIN IT?**
Bernat Esquius; Isabel Jiménez
UVIC

**THE FITS MODEL: LEARNING SCIENCE BY DESIGN CHALLENGES**
Dave van breukelen; Maurice Smeets
Fontys University of Applied Sciences
**QUESTIONING STRATEGIES TO PROMOTE AND ASSESS, COGNITION METACOGNITION AND CONCEPTUAL UNDERSTANDING IN CHEMISTRY: AN ANALYSIS**
James Trimble¹; James Lovatt²; Odilla E. Finlayson¹
¹CASTeL, School of Chemical Sciences, Dublin City University; ²CASTeL, DCU Institute of Education, Dublin City University

**SMALL-GROUP DISCUSSIONS — A TOOL TO SUPPORT PROSPECTIVE PRIMARY TEACHERS CONCEPTUAL UNDERSTANDING?**
Ann-Sofi Härmälä-Braskén
Åbo Akademi University

**INSTRUCTING SECONDARY SCHOOL STUDENTS IN ‘TRIPLET’ CONCEPT MAPPING FOR CHEMISTRY — A PILOT STUDY**
Ylva Pamment
Department of Educational Sciences, Lund University

**SCIENTIFIC PERSPECTIVISM FOR A-LEVEL CHEMISTRY EDUCATION**
Ilse Landä¹; Hanna Westbroek¹; Jacqueline van Muijlwijk-Koezen¹; Fred Janssen²; Martijn Meeter¹
¹Vrije Universiteit Amsterdam; ²ICLON Universiteit Leiden

**EXPERIMENTATION PERSPECTIVES AS POTENTIAL SCAFFOLDS FOR LEARNING TO DESIGN CHEMICAL EXPERIMENTS**
Ria Kraakman-van der Zwaë¹; Fred Janssen²; Hanna Westbroek¹; Jacqueline van Muijlwijk-Koezen³
¹VU University Amsterdam; Faculty of Behavioural and Movement Sciences; ²ICLON, Leiden University Graduate School of Teaching; ³VU University, Amsterdam Institute for Molecules, Medicines and Systems, Amsterdam Institute of Mole

**LINKING THE DEVELOPMENT OF INQUIRY COMPETENCES TO THE UNDERSTANDING OF THE STRUCTURE AND COMPOSITION OF MATTER IN CHEMISTRY — A MODEL-BASED APPROACH**
Julia Sprung; Benjamin Boltmann; Theresa Goetz; Andreas Nehring
Leibniz Universität Hannover - Institute for Science Education

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### 13:45 - 15:00 Interactive Poster P02 - STRand 1 - UNDERSTANDING WITHIN PHYSICS AND MATHEMATICS CONTEXT

Room A2

Chairperson(s): Jenny Magnes

**EXPLANATIONS AND AWARENESS ABOUT COMPUTER SIMULATIONS OF COMPLEX SYSTEMS: A STUDY TO UNDERSTAND THE GAP BETWEEN EXPERTS AND NOVICES**
Eleonora Barelli
DIFA - University of Bologna

**THOUGHTS ABOUT QUANTUM PHYSICS EDUCATION**
Marco Giliberti¹; Giovanni Organtini²
¹Physics Department University of Milan; ²Physics Department La Sapienza università di Roma

**UNDERSTANDING DENSITY THROUGH ITS MICROSCOPIC CAUSES IN SECONDARY EDUCATION**
Irantzu Uriz; María Napal; María Isabel Zudaire
Universidad Pública de Navarra

**FRAMEWORK FOR TEACHING AND LEARNING MATHEMATIZATION IN PHYSICS**
Gesche Pospiech
TU Dresden

**THE LEVEL OF UNDERSTANDING OF SELECTED CONCEPTS IN PHYSICS OF STUDENTS FROM DIFFERENT COUNTRIES**
Tünde Kiss; Klára Velmovská
Comenius University, Faculty of Mathematics, Physics and Informatics

**STUDENTS LEARNING ABOUT KINEMATICS THROUGH MULTIPLE REPRESENTATIONS**
André Martins Silva; Mónica Baptista
Instituto de Educação da Universidade de Lisboa

**TEACHING QUANTUM PHYSICS IN HIGH-SCHOOL**
Efraim Y Weissman; Avi Merzel; Nadav Katz; Igal Galili
The Hebrew University of Jerusalem

**NAVIGATING FOUR DIMENSIONS — UPPER SECONDARY STUDENTS’ UNDERSTANDING OF MOVEMENT IN SPACETIME**
Magdalena Kersting
University of Oslo, Dept. of Physics

**DELPHI-STUDY TO DEFINE THE TERM “STUDENTS’ CONCEPTIONS”**
Ingrid Krumphals¹; Thomas Plotz²; Claudia Haagen-Schützenhöfer³
¹University of Graz; ²University of Vienna
GESTALT AND FUNCTIONALITY AS INDEPENDENT DIMENSIONS OF MENTAL MODELS
Malte Ubben; Stefan Heusler
Westfälische Wilhelms-Universität Münster

UNDERSTANDING FOURIER TRANSFORMS THROUGH INTUITION BUILDING
Jenny Magnes; Kathleen Raley-Susman
Vassar College

13:45 - 15:00 Interactive Poster P19 - STRAND 12 - CULTURAL SOCIAL AND GENDER ISSUES IN SCIENCE AND TECHNOLOGY EDUCATION Room B1

Chairperson(s): Guillaume Cyr

EXPLORING PRE-SERVICE PHYSICS TEACHERS’ DEVELOPMENT OF PHYSICS IDENTITY THROUGH THE USE OF MULTIPLE REPRESENTATIONS (MR)
Nuril Munfaridah; Lucy Avraamidou; Martin Goedhart
Institute for Science Education and Communication, University of Groningen

STEREOTYPES SEEM TO BE UNSTOPPABLE. STEREOTYPES, SUPPORT IN SCHOOL AND THE FAMILY AND THEIR CONTRIBUTION TO ACADEMIC SELF-CONCEPT IN STEM
Silke Luttenberger1; Manuela Paechter2; Bernhard Ertl3
1University of Teacher Education Styria; 2University of Graz; 3Universität der Bundeswehr München

STUDENTS COPING WITH AUTHORITATIVE DIMENSIONS OF SCIENCE LESSONS
Anttoni Kervinen1; Wolf-Michael Roth2; Kalle Juuti1; Anna Utto1
1University of Helsinki, Finland; 2University of Victoria, BC, Canada

AN INVESTIGATION OF THE IMPACT OF AN INDUSTRY-FOCUSED GENDER INTERVENTION ON THE SELF-PERCEPTIONS AND CAREER ASPIRATIONS OF FEMALE UNDERGRADUATE STUDENTS IN THE STEM DISCIPLINES
Tracey O’Connell
University of Limerick

GENDER AND SCIENCE: MEN AND WOMEN IN GREEK GYMNASIUM SCIENCE TEXTBOOKS
Georgios Ampatzidis; Anastasia Armeni
University of Patras

“YOU’RE RUINING IT”: POSITIONING AND IDENTITY IN A 6TH GRADE PLACE-BASED LEARNING CONTEXT
Lynne Zummo
Stanford University

BRIDGING QUESTIONS OF ‘WHO’ AND ‘WHAT’ IN SCIENCE EDUCATION RESEARCH
Anne-Sofie Nyström; Anna Danielsson
Uppsala University, Dept. of Education

A FRAMEWORK FOR STUDYING THE INTEGRATION OF SEXUAL DIVERSITY IN SECONDARY SCHOOL SCIENCE TEACHING
Guillaume Cyr; Martin Riopel; Janik Bastien-Charlebois
Université du Québec à Montréal (UQAM)

13:45 - 15:00 Interactive Poster P15 - STRAND 8 - SCIENTIFIC LITERACY AND SOCIO-SCIENTIFIC ISSUES Room B2

Chairperson(s): Torill Heiby

CARTOGRAPHY AS A TOOL TO ADDRESS ACTIVISM WITH PRE-SERVICE SCIENCE TEACHERS ON A SOCIALLY ACUTE QUESTION: MEAT PRODUCTION AND CONSUMPTION
Aurelio Cabello-Garrido; Daniel Cebrián-Robles; Enrique España-Ramos; Francisco José González-Garcia; Antonio Joaquin Franco-Mariscal; Ángel Blanco-López
Málaga University

HOW DO STUDENTS USE FACTS AND VALUES IN A WRITTEN TASK ABOUT RISK ASSESSMENT OF IRRADIATED STRAWBERRIES?
Linda Schenk1; Margareta Enghag2; Karin Haglund2
1KTH - Royal Institute of Technology; 2Stockholm University; 3Tumba gymnasium

COMPARING SYNTHETIC AND GREEN PESTICIDES IN CHEMISTRY TEACHING FROM A SUSTAINABILITY PERSPECTIVE
Christian Zowada1; Nadja Belova1; Vania Zuin2; Ingo Eilks1
1University of Bremen; 2Universidade Federal de Sao Carlos
MAPPING THE DIMENSIONS OF BIODIVERSITY AND CITIZENSHIP IN A DISCUSSION ON SOCIOSCIENTIFIC ISSUES
Anne Freitas¹; Rafael Castro¹; Marcelo Motokane²
¹Postgraduate Program in Science Teaching, University of São Paulo; ²University of São Paulo

ANIMAL TESTING IN BIOMEDICAL RESEARCH - A SOCIOSCIENTIFIC ISSUE AT SCHOOL
Elena Kinz; Julia Auer; Simone Schumann; Brigitte Gschmeidler
Open Science - Lebenswissenschaften im Dialog

RELATIONSHIPS AMONG FAMILIARITY OF SCIENCE TERMS, TEXT COMPREHENSION AND READING TIME IN SCIENCE TEXT READING
Donghyuk Yang; Eun Jung Yun; Yunebae Park
Kyungpook National University

CITIZENSHIP EDUCATION, RRI AND THE POWER OF COLS
Paola Ambrogi¹; Giulia Tasquier²; Margherita Venturi²
¹IIS Nobili; ²University of Bologna

USING SCIENCE-BASED NEWS REPORTS TO BRIDGE A LANGUAGE GAP: A LANGUAGE AND LITERACY PERSPECTIVE ON LEARNING SECONDARY SCIENCE
Billy McClune
Queen’s University Belfast

INVESTIGATING PERSPECTIVE-TAKING ON SOCIOSCIENTIFIC ISSUES AMONG JAPANESE PRIMARY SCHOOL STUDENTS
Sayuri Tokura¹; Etsuji Yamaguchi¹; Miki Sakamoto¹; Tomokazu Yamamoto²; Shigenori Inagaki³; Kazuya Wakabayashi¹; Motoaki Matano³
¹Kobe University; ²Hyogo University of Teacher Education; ³Elementary School Attached to Kobe University

THE EFFECTS OF SCIENCE CLASSES EXPERIENCE IN CONCEPTIONS ABOUT S&T AND ENVIRONMENTAL CHALLENGES
Raquel Bertoldo¹; Marcelo Giordan¹; Helena Carvalho²
¹University of São Paulo; ²University Institute of Lisbon - ISCTE-IUL

STEM CLUBS: DEVELOPING AN EVIDENCE-BASED EVALUATIVE FRAMEWORK
Angela Fitzgerald¹; Tania Leach¹; Kate Davis¹; Margie Power¹; Neil Martin¹; Stephanie Piper¹; Rena Singh²
¹University of Southern Queensland; ²Inspiring Australia Queensland

CITIZENSHIP EDUCATION AND SUSTAINABILITY ISSUES IN LOWER SECONDARY SCIENCE EDUCATION
Michiel Van Harskamp; Marie-Christine Knippels; Wouter Van Joolingen
Freudenthal Institute, Utrecht University

GENE-ETICS. AN INTERDISCIPLINARY LEARNING RESOURCE INTRODUCING CRISPR TECHNOLOGY IN AN ETHICAL DEBATE
Torill Høiby¹; Caroline Aakerøy Moe²; Tine Weise Håland³; Linda Smedbakken¹; Øyvind Rundtom¹
¹Skedsmo STEM center, Municipality of Skedsmo; ²Kjeller school; ³Skedsmo STEM centre

13:45 - 15:00 Interactive Poster P14 - STRAND 6 - NATURE OF SCIENCE: HISTORY PHILOSOPHY AND SOCIOLGY OF SCIENCE Room B3
Chairperson(s): Mehmet Fatih Tasar

EXPLORING PRESERVICE TEACHERS’ COLLABORATIVE DEVELOPMENT OF HISTORY OF SCIENCE BASED LESSONS
Wonyong Park¹; Sibel Erduran²; Jinwoong Song²
¹University of Oxford; ²Seoul National University

THE ROLE OF AN EXPLICIT AND REFLECTIVE APPROACH TO IMPROVE TEACHING AND NOS CONCEPTIONS OF PRESERVICE BIOLOGY TEACHERS IN BRAZIL
Nathália Helena Azevedo; Daniela Scarpa; Maria Elisa Prestes; Filipe Berçot
University of São Paulo

INTEGRATING INQUIRY, HISTORY AND REFLECTIVE LEARNING TO IMPROVE VIEWS OF SCIENCE: DESIGN AND EVALUATION OF AN INTERVENTION
Cristina Cobo Huesa; Ana Maria Abril Gallego; Marta Romero Ariza
University of Jaén

TEACHING THE NATURE OF SCIENCE IN INDIGENOUS MEXICAN COMMUNITIES USING SITUATED LEARNING
Paulina Guerrero-Gutiérrez
King’s College London (Waterloo Campus)
DO SCIENTIFIC INQUIRY ACTIVITIES AT SUPER SCIENCE SCHOOLS IN JAPAN CONTRIBUTE TO STUDENTS’ UNDERSTANDING OF THE NATURE OF SCIENCE?
Kenji Matsubara, Yasuhiro Hagiwara; Yuji Saruta
National Institute for Educational Policy Research

EPISTEMOLOGICAL REPRESENTATIONS ABOUT THE COMPETENCES OF SCIENTIFIC THOUGHT IN EDUCATORS OF INFANT IN FORMATION. A STUDY IN CHILE.
Mario Quintanilla; Miguel Manzanilla; Eloy Peña
Pontificia Universidad Católica de Chile

ADVANCED SPANISH SCIENCE STUDENTS’ UNDERSTANDING ABOUT SOME ASPECTS ON NATURE OF SCIENCE
Isabel María Cruz-Lorite; Antonio Joaquín Franco-Mariscal; Ángel Blanco-López
1University of Malaga; 2University of Málaga

THE SUBSTANTIALLY IN THE ORGANIZATION THEORETICAL OF HEAT
Marina Garzón Barrios; Marina Castells
1UNIVERSIDAD PEDAGÓGICA NACIONAL; 2UNIVERSIDAD DE BARCELONA

“NATURE OF SCIENCE (NOS) KNOWLEDGE IS NOT TESTED IN HIGH STAKES EXAMINATIONS” — GRADE 10 TEACHERS’ PERSPECTIVES ABOUT THE TEACHING OF NOS IN SOUTH AFRICA
Remerdezayi Gudyanga; Loyiso Jita
University of the Free State

SCIENTIFIC AND RELIGIOUS PERSPECTIVES ON EVOLUTION: AN APPROACH BASED ON PEDAGOGY OF DIFFERENCE
David Owens; Rachel Pear; Hanan Alexander; Michael Reiss
1Georgia Southern University; 2University of Haifa; 3University College London

CREATIVITY IN DATA ANALYSIS THROUGH CONFRONTATION WITH ANOMALOUS DATA
Pascal Pollmeier; Sabine Fechner
Paderborn University

STEREOCHEMISTRY IN HIGH SCHOOL: HISTORICITY IN BRAZILIAN TEXTBOOKS OF ORGANIC CHEMISTRY
José Cláudio Del Pino; Daniele Raupp; Tania Renata Prochnow
1UFRGS; 2ULBRA

THE NATURE OF STEM? OR "IS STEM A THING?" DISCUSSING THE IMPLICATIONS OF STEM FOR SCIENCE EDUCATION
Valérie Akerson; Valérie Akerson; Angela Burgess; Alex Gerber; Meize Guo; Taikir Khan; Steven Newman
Indiana University

TEACHING SERENDIPITY IN SCIENCE THROUGH VIGNETTE
Yasemin Doyğun; Hasan Özcan; Mehmet Fatih Taşar
1Aksaray University; 2Gazi University

13:45 - 15:00 Interactive Poster P13 - STRAND 2 - LEARNING SCIENCE: COGNITIVE AFFECTIVE AND SOCIAL ASPECTS
Room B4

Chairperson(s): CARLOS Garcia

SMART SPACES - A TRIAL OF SPACED LEARNING IN CHEMISTRY REVISION
Mark Hardman
UCL Institute of Education

A STUDENT-ACTIVE APPROACH TO SCIENCE MODELS AND REPRESENTATION - A WAY TO IMPROVE SCIENTIFIC LANGUAGE OF SECOND LANGUAGE LEARNERS?
Lizette Widing; Pernilla Nilsson; Pernilla Granlkint Enochson
1School of Education, Halmstad University; 2Humanities and Social Science, Halmstad University

MEASURING OVERCONFIDENCE IN SCIENCE CLASSROOM: A SET OF CONCEPT TEST AND CONFIDENCE SCALE
Ai Nurlaelasari Rusmana; Yustika Syabandari; Rahmi Qurota Ainul; Minsu Ha; Arif Rachmatullah; Eni Nuraeni
1Kangwon National University; 2North Carolina State University; 3Universitas Pendidikan Indonesia

THE EARTHQUAKE AMONG SCIENCE, POETRY, TECHNOLOGY AND MUSIC: AN INTEGRATED LEARNING ACTIVITY
Lucia Stacchiotti; Alessandra Beccaceci; Alessandro Acqua; Eleonora Paris
University of Camerino

VISUAL LITERACY IN BIOLOGY EDUCATION
Elisabeth Scheicher; Iris Schiffl
Paris Lodron University
ASSESSING NINTH GRADE STUDENTS' UNDERSTANDING OF FORCE AND MOTION MODELS AND INVESTIGATING ITS RELATIONSHIP TO THE CONCEPTION OF LEARNING SCIENCE
Silvia Wen-Yu Lee; Silvia Wen-Yu Lee
National Changhua University of Education

CHEMISTRY TEACHERS' DEVELOPMENT OF RELEVANT AND INTERESTING CONTEXT-BASED OPEN-ENDED PROBLEMS
Karolina Broman
Umeå University

STUDENTS' APPROACHES TO LEARNING ENVIRONMENTAL SCIENCE IN A DISTANCE-LEARNING COURSE
David Gonzalez Gomez1; Jin Su Jeong1; Alejandrina Gallego2; Florentina Cañada1
1University of Extremadura; 2National University of Distance Education

CURIOUSER AND CURIOUSER: EVALUATING THE IMPACT OF A PROFESSIONAL DEVELOPMENT INITIATIVE IN SUPPORTING PRIMARY TEACHERS TO DEVELOP PUPILS' EPISTEMIC REASONING AND SELF-CONCEPT AS SCIENTIST.
Deborah Myers
Northumbria University

EVOLUTION, AFFECT AND ACCEPTANCE: A PSYCHOANALYTICAL EXAMINATION OF THE CONTROVERSY
Emma Newall
UCL Institute of Education

CHILDREN’S MOTIVATION AND INTEREST DEVELOPMENT IN SCIENCE FROM DAYCARE TO UPPER SECONDARY SCHOOL
Morten Rask Petersen
UCL University College

WORKING ON WHAT THE STUDENTS THINK ABOUT CHEMICAL REACTIONS. A DIDACTIC INTERVENTION ON MISCONCEPTIONS AT PRIMARY SCHOOL LEVEL
Florentina Canada; Miriam Hernandez; Maria Antonia Davila; Jesus Sanchez-Martin
University of Extremadura

HOW TO SPEAK ABOUT SCIENCE EMOTIONS. THE USE OF BOARD GAMES AS A COLLECTING METHOD FOR EMOTIONAL EVALUATION OF UNIVERSITY SCIENCE STUDENTS.
JESÚS SÁNCHEZ-MARTÍN1; Florentina Cañada-Cañada2; MARÍA ANTONIA DÁVILA-ACEDO2; MIRIAM HERNÁNDEZ DEL BARCO2
1University of Extremadura; 2UNIVERSITY OF EXTREMADURA

THE SKEPTICS - EXPERIENCES OF BILDUNG IN UNIVERSITY LEVEL PHYSIC
Ronny Kjelsberg
NTNU - Norwegian University og Sience and Technology

KEY VARIABLES FOR THE MOTIVATION OF WOMEN IN DIFFERENT STEM FIELDS
Manuela Paechter1; Silke Luttenberger2; Bernhard Ertl3
1University of Graz; 2University of Teacher Education Styria; 3Universität der Bundeswehr München

CLIMATE CHANGE IMAGES AS EMOTIONAL EXPERIENCE. A WORK IN PROGRESS
CARLOS Garcia; CARLOS Garcia; Carlos Garcia
Universidad de Guadalajara

13:45 - 15:00 Interactive Poster P16 - STRAND 9 - HEALTH AND THE OUTDOORS
Room B5

Chairperson(s): Graça S. Carvalho

LEARNING AND TEACHING SCIENCE OUTSIDE THE CLASSROOM: EXPERIENCES WITH PRE SERVICE TEACHERS IN CHILE AND BRAZIL
Natália Candido Vendrasco1; Adriana Pugliese2
1Pontificia Universidad Católica de Chile; 2Universidade Federal do ABC - UFABC

THE SCIENCE TEACHER’S PREPARATIONS FOR THE OUT-OF-SCHOOL LEARNING
Mona Kvivesen
UiT The Artic University of Norway

THE IMPACT OF A SCIENCE CAMP ON PUPILS MOTIVATING TO LEARN NATURAL SCIENCES
Petra Ivánková1; Martin Lindner2
1Comenius University in Bratislava; 2Martin Luther Universität Halle Wittenberg

LONG-TERM EFFECTS OF SCIENCE SUMMER CAMPS
Martin Lindner
Martin-Luther-University
AN ETHIC OF CARE IN SCIENCE EDUCATION THROUGH OUTDOOR LEARNING
Joan Whelan; Orla Kelly
DCU

EDUCATIONAL KITCHEN-GARDEN PROJECTS: STRENGTHS, WEAKNESSES, OPPORTUNITIES AND THREATS
Stella Petrou; Konstantinos Korfiatis
University of Cyprus

EATING DISORDER AND RISK OF SUICIDAL BEHAVIOR IN SECONDARY SCHOOL STUDENTS
Olga Mayoral1; Marta Talavera1; David Martin1; Raissa Arbona1
1Universitat de València; 2Conselleria de Sanitat. Generalitat Valenciana

DEVELOPMENT OF STANDARDS OF PRACTICE FOR HEALTH PROMOTION IN COLLEGES OF EDUCATION
Irit Hof-Nahor1; Nurit Bar-Yossef2; Irit Livne3
1Oranim College of Education; 2Kibbuzim College of Education, Technology and Arts, Tel-Aviv, Israel; 3Ministry of Education

THE ROLE-PLAYING GAME AS AN INNOVATIVE ACTIVITY IN THE TEACHING OF SCIENCE TO PROMOTE ATTITUDES AND HEALTHY NUTRITIONAL HABITS IN STUDENTS OF SECONDARY SCHOOL
Erika Gonzalez-Sanchez; Vito Brero; Maria del Carmen Acebal
University of Malaga

EXPLORING HOW A CARD-TYPE GAME FOR TERMINAL CARE CAN PROMOTE THE HEALTH AND WELL-BEING AWARENESS OF NON-SCIENCE STUDENTS
Shiho Miyake1; Asami Ohnuki2
1Kobe College; 2Shirayuri University

SUBJECT-SPECIFIC HUMOUR AS A CREATIVE METHOD FOR TEACHING HEALTH LITERACY
Marisa Alena Holzapfel; Karin Starchelscheid; Maik Walpuski
University of Duisburg-Essen

CO-CREATION (CoC) PROCESS IN A SITUATION OF STUDY (SOS) ON HEALTH EDUCATION
Graça S. Carvalho1; Eva T.O. Boff2; Maria Cristina P. Araújo3
1CIEC, University of Minho, Braga, Portugal; 2UNIJUI, Ijuí, RS, Brazil

13:45 - 15:00 Interactive Poster P17 - STRAND 9 - NATURE, ECOLOGY & ENVIRONMENT Room B6
Chairperson(s): Mariana Tambellini Faustino

ANIMALPOCKY: AN OBSERVATION LEARNING SUPPORT APPLICATION USING AUGMENTED REALITY FOR ZOOS
Arisa Emoto1; Arata Hisano2; Itsuki Kabawata2; Fusako Kusunoki2; Kumiko Hanaki2; Noriko Atake2; Shigenori Inagaki1; Tomoyuki Nogami2
1Kobe University; 2Tama Art University; 3Kobe Municipal Oji Zoo

THE TASTE OF BIODIVERSITY: EXPLORING DOMESTIC PLANT BREEDS INTRASPECIFIC DIVERSITY TO FOSTER SCIENTIFIC LITERACY
Sara Abom1; Lisa Afonso2; Xana Sá-Pinto3
1Politécnico do Porto; 2Faculdade de Psicologia e Ciências da Educação da Universidade do Porto; 3CIDTFF.UA

RE-COUPING NATURE AND CULTURE: HOW CAN PRIMARY TEACHER EDUCATORS ENABLE PRE-SERVICE TEACHERS AND THEIR PUPILS TO BREATHE LIFE BACK INTO HUMANITY’S TIN FORESTS?
Deborah Myers
Northumbria University

TEACHING NATURE — A CASE STUDY OF 5-7-YEAR-OLD CHILDREN ENGAGED IN OUTDOOR LEARNING ACTIVITIES, FROM AN ESD PERSPECTIVE
Christiana Glettler
KPH Graz

THE NEW ECOLOGICAL PARADIGM SCALE FOR USE WITH CHILDREN IN SLOVENIA
Gregor Torkar1; Vanja Debevec2; Constantinos Manoli3; Bruce Johnson4
1University of Ljubljana Faculty of Education; 2Skocjan Caves Public Service Agency; 3University of Arizona, College of Education

STORYTELLING-DRIVEN PERSPECTIVE-TAKING IN SUPPORT OF ENVIRONMENTAL IDENTITY
Florian Rietz; Nicolas Robin; Arvid Nagel
University of Teacher Education St.Gallen
EVALUATION OF LEARNING SUPPORT FUNCTION OF SIMULATION GAME FOR FOREST MANAGEMENT
Shota Asahina⁴; Shuya Kawaguchi⁵; Yoshiaki Takeda⁶; Hideo Funaoi⁷; Etsuji Yamaguchi⁷; Fusako Kusunoki⁷; Masanori Sugimoto⁸; Hiroshi Mizoguchi⁹; Shigenori Inagaki⁹
¹Kobe University; ²Tokyo University of Science; ³Soka University; ⁴Tama Art University; ⁵Hokkaido University

DEVELOPMENT OF A SCALE TO TEST ENVIRONMENTAL LITERACY AND TO PREDICT ENVIRONMENTAL RESPONSIBLE BEHAVIOUR OF PRE-SERVICE TEACHERS
Lidia Caño; Oihana Barrutia
University of the Basque Country

USING MEDIA IN ENVIRONMENTAL EDUCATION PRACTICES: THE CHALLENGE OF PROMOTING MEDIA LITERACY
Mariana Tambellini Faustino; Rosana Louro Ferreira Silva
Universidade de São Paulo

EXPLORING THE ENVIRONMENTAL CAPITAL OF THAI VISITORS REGARDING FLOODING AND CLIMATE CHANGE ISSUES: A CASE STUDY AT A LARGE SCIENCE MUSEUM IN THAILAND
Supa Tanprasertkun
University College London Institute of Education

UPPER-SECONDARY SCHOOL PHYSICS STUDENTS’ UNDERSTANDING OF THE GREENHOUSE EFFECT
Terhi Mäntylä; Leena Partanen; Viivi Nousiainen
Tampere University

MAKING THE CHANGE POSSIBLE. INCLUSION OF ESD IN THE TRAINING OF SECONDARY SCHOOL TEACHERS
Olga Mayoral; Maria Calero; M. Pilar Martínez-Agut; M. Àngels Ull; Victoria Vázquez; Amparo Vilches
Universitat de València

A HOLISTIC MODEL FOR CLIMATE CHANGE EDUCATION
Sakari Tolppanen¹; Hannele Cantell¹; Essi Aarnio-Innanvuori¹; Anna Lehtonen²
¹University of Eastern Finland; ²University of Helsinki; ³WWF

EXAMINING CHANGES OF UNIVERSITY STUDENTS’ PERCEPTIONS ON CLIMATE CHANGE AFTER ATTENDING INTERNATIONAL CLIMATE CHANGE EDUCATION PROGRAM
Jun Yang; Chan-Jong Kim; Seung-Urn Choe
Seoul National University

INTERGENERATIONAL STEM EDUCATION FOR ADOLESCENTS TOWARDS LIVEABLE FUTURES: CAN YOU LOOK AN EARTHWORM IN THE EYE AND SAY, “I DID MY BEST FOR YOU”? Kathy Paige; David Lloyd; Richard Smith
University of South Australia

MOVING BEYOND A KNOWLEDGE DEFICIT PERSPECTIVE & TOWARDS A MODEL FOR YOUTH CLIMATE CHANGE BEHAVIOR
K.C. Busch¹; Daniel Gruehn¹; Nicole Ardoin²; Kathryn Stevenson¹
¹North Carolina State University; ²Stanford University

DEVELOPMENT OF AN UNIVERSAL INDICATOR FOR EDUCATION FOR SUSTAINABLE DEVELOPMENT BY A SYSTEMATIC LITERATURE REVIEW
Benjamin J. Tempel; Sonja Schaal; Steffen Schaal
University of Education Ludwigsburg

THE USE OF A MIXED METHODOLOGICAL APPROACH TO ANALYSE THE SPECIFIC CODING ORIENTATION
Larissa Nascimento; Rafael Castro; Marcelo Motokane
Universidade de São Paulo

DEVELOPMENT OF A TEST INSTRUMENT TO MEASURE TEACHER STUDENTS’ CONTENT KNOWLEDGE AND PEDAGOGICAL CONTENT KNOWLEDGE
Lisa Moseler; Oliver Kraft; Inga Gryl; Stefan Rumann
University of Duisburg Essen
ASSESSMENT OF TEAM COMMUNICATION SKILLS IN STEM OUT-OF-SCHOOL TIME SETTINGS
Frances Lawrenz1; Amy Grack Nelson2
1U of Minnesota; 2Science Museum of Minnesota

HAVE STUDENTS ATTENDING ALSO INFORMAL LECTURES A BETTER ASTRONOMICAL KNOWLEDGE?
EXPLORING THE 10-13 AGE COMPARING SCHOOL AND INFORMAL LECTURES
Sandro Bardelli1; Elena Zucca1; Angelo Adamo2
1INAF-Astrophysical and Space Science Observatory; 2INAF-Astrophysical and Space Science Observatory

SELF-EFFICACY AND SCIENTIFIC LITERACY TO MEASURE LEARNING
Daniel Solis1; Nancy Longnecker2; David A. W. Hutchinson3
1Centre for Science Communication, University of Otago; The Dodd-Walls Centre for Photonic and Quantum Technologies, Department of Physics, University of Otago; 2Centre for Science Communication, University of Otago; 3The Dodd-Walls Centre for Photonic and Quantum Technologies, Department of Physics, University of Otago

MAXIMIZING INTRINSIC INTEREST & POTENTIAL OF SCIENCE GIFTED STUDENTS THROUGH
‘STRUCTURED SCHOOL-BASED SCIENCE GIFTED EDUCATION FRAMEWORK’ IN A THOROUGH-
TRAIN SCHOOL IN HONG KONG
Man Ho Li; Ka Chun Suen; Mei Yu Lin; Wing Kwong Chan
Po Leung Kuk Laws Foundation College

PROPOSAL OF THE USE OF SCIENTIFIC LITERACY INDICATORS TO ANALYSE A WRITTEN EVALUATION
Larissa Nascimento; Heloísa Flores; Marcelo Motokane; Gabriela Zanarotti
Universidade de São Paulo

DEVELOPMENT OF THE WEB-BASED AUTOMATED COMPUTER SCORING SYSTEM USING ARTIFICIAL INTELLIGENCE IN KOREA
Jisun Park1; Minsu Ha2; Jun-ki Lee3; Sein Shin4; Gyeong-geon Lee5
1Ewha Womans University; 2Kangwon National University; 3Chonbuk National University; 4Chungbuk National University; 5Seoul National University

EXPLORING HOW COLLEGE STUDENTS SOLVE PHYSICS PROBLEMS: AN EYE-MOVEMENT ANALYSIS
Guo-Li Chiou; Fang-Ying Yang
National Taiwan Normal University

DEVELOPMENT OF A TEST INSTRUMENT FOR A CONCEPTUAL UNDERSTANDING OF ELECTROMAGNETIC RADIATION
Thomas Plotz
University of Vienna

RELATIONSHIP OF EMOTIONS WITH ASSOCIATED VARIABLES TO THE SCIENCE LEARNING IN SECONDARY STUDENTS
Pedro Membiela; Miguel Angel Yebra; Manuel Vidal; Antonio González
University of Vigo

INFLUENCE OF CONTEXTUAL VARIABLES IN THE PERCEPTION OF SCIENCE LEARNING IN SECONDARY STUDENTS
Pedro Membiela; Miguel Angel Yebra; Manuel Vidal; Antonio González
University of Vigo

ASSESSMENT OF K-12 STUDENTS’ SCIENCE AND LITERACY KNOWLEDGE
Claire Cesljarev1; Valarie Akerson2
1Indiana University; 2Indiana University

DEVELOPMENT AND VALIDATION OF A LEARNING PROGRESSION MODEL FOR CHEMICAL KINETICS
JOAQUIM FERNANDO MENDES DA SILVA; ANTONIO CARLOS OLIVEIRA GUERRA; LUCIANA GONDIM MONTEIRO
Federal University of Rio de Janeiro

A MODEL FOR TRANSFER OF INTELLECTUAL RESOURCES BETWEEN SCIENCE AND MATHEMATICS: AN EMPIRICAL STUDY
Kyungwoon Seo1; Brian Hand2; Kyong Mi Choi3
1Seoul National University; 2University of Iowa; 3University of Virginia

WHAT WE CAN (AND CANNOT) LEARN FROM INTERNATIONAL TESTING: AN EXAMPLE FROM AUSTRALIA
Helen Georgiou
University of Wollongong

DEVELOPMENT OF STUDENTS’ CHEMISTRY COMPETENCES AT THE TRANSITION BETWEEN PRIMARY AND SECONDARY SCHOOL
Alina Behrendt; Vanessa Fischer; Maik Walpuski
University of Duisburg-Essen
PUTTING SCIENCE CAPITAL TO THE TEST: VALIDATION OF AN ASSESSMENT OF CAREER ASPIRATION FACTORS
M. Gail Jones1; Megan Ennes1; Katherine Chesnutt1; Emily Cayton2; Drew Weedfall1; Emma Refvem1;
Kathryn Rende1; Pamela Huff1
1NC State University; 2Campbell University

DISCIPLINARY EXPERTS IN PRIMARY SCIENCE AND MATHEMATICS EDUCATION: INFLUENCES ON TEACHING AND LEARNING
Reece Mills; Theresa Bourke; Erin Siostrom
Queensland University of Technology

ANALYSIS OF IMPLEMENTED SCIENCE CURRICULA: AN APPROACH FROM TEACHERS’ PEDAGOGICAL PERSPECTIVES
Susumu Nozoe1; Tetsuo Isozaki2
1University of Miyazaki; 2Hiroshima University

US AND JAPANESE SCIENCE TEACHERS DEFINITION AND ENACTMENT OF INQUIRY-BASED TEACHING AND LEARNING PRACTICES
Noemi Waight1; Koichi Furuya2; Melinda Whitford1
1University at Buffalo; 2Joetsu University of Education

FUNDING FOR INSTRUCTIONAL MATERIALS IN SECONDARY SCIENCE CLASSROOMS
Emily Cayton1; M. Gail Jones2; Megan Ennes2; Katherine Chesnutt2
1Campbell University; 2North Carolina State University

OUTCOMES OF AN INTEGRATED STEM HIGH SCHOOL - ENABLING ACCESS AND ACHIEVEMENT FOR ALL STUDENTS
Carla Johnson1; Toni Sondergeld2; Virginia Bolshakova1
1Purdue University; 2Drexel University

DETERMINING THE EFFECTIVENESS OF AN E-TESTING MODEL IN ENABLING TEACHERS TO PROVIDE FEEDBACK TO STUDENTS FOR PROMOTING COMPONENTS OF SCIENTIFIC LITERACY IN THE CLASSROOM
Triin Rosin; Katrin Vaino; Regina Soobard; Mia Rannikmäe
University of Tartu

13:45 - 15:00 Interactive Poster P20 - STRAND 4 - USE OF MOBILE DEVICES IN SCIENCE EDUCATION (AND ONLINE LEARNING ENVIRONMENT) Room D1
Chairperson(s): Athanasios Velentzas

A FEEDBACK LOOP TO IMPROVE STUDENTS’ PERSISTENCE IN A STEM ONLINE LEARNING ENVIRONMENT SETTING
Yannick Skelling-Desmeules1; Patrick Charland1
1Université du Québec à Montréal; 2Université du Québec à Montréal (UQAM)

BLENDED LEARNING: USE OF DIGITAL APPS BEFORE AND DURING A MULTIDISCIPLINARY FIELD TRIP WITH INTERNATIONAL STUDENTS
Jardar K. Cyvin; John Magne Grindeland
NTNU - Norwegian University of Science and Technology

SCHOOL-WORK EXPERIENCE WITH SMARTPHONE APPS ON WAVES
Daniele Buongiorno1; Marisa Michelini1; Sergej Faletic2
1University of Udine; 2University of Ljubljana

IMPACT OF EDUCATIONAL ROBOTICS ON STUDENTS’ INTEREST AND PERFORMANCE IN CHEMISTRY
Hugo Lapierre; Patrick Charland; Yannick Skelling-Desmeules
Université du Québec à Montréal

MOBILE RECORDING DATA, AN AID FOR FORMULATING AND TESTING HYPOTHESIS, THE CASE OF PHOTOSYNTHEIS.
Charalambia Lazaridou; Zacharias Zacharia; Konstantinos Korfias
University of Cyprus

IMPLEMENTING MOBILE LEARNING IN PLANT BIOLOGY, THE CASE OF FOURTH GRADERS.
Charalambia Lazaridou; Zacharias Zacharia
University of Cyprus

EFFECTS OF DIGITAL MEDIA IN HETEROGENEOUS CHEMISTRY LESSONS
Lars Greitemann; Insa Melle
TU Dortmund University
EXPLORING INSTRUCTIONAL CONTEXTS THAT FACILITATE THE SOPHISTICATION OF CONCEPTIONS REPRESENTED IN MODELLING ACTIVITIES WITH SMART TECHNOLOGY
Heesoo Ha; Heui-Baik Kim
Seoul National University

THE POTENTIAL OF GENETICS MOBILE APPS TO BE USED IN SECONDARY SCHOOLS IN ARGENTINA
Alejandra Malbrán Barros1; Carolina Rodriguez2; Leticia García Romano2
1Science and Technology Teaching Department, National University of Córdoba, Córdoba, Argentina; 2Science and Technology Teaching Department, National University of Córdoba - National Scientific and

EXPLORING DIFFICULTIES IN THE USE OF MOBILE DEVICE SENSORS IN THE SCIENCE CLASSROOM: THE CASE OF ACCELEROMETERS
Alexandros Kateris1; Panagiotis Lazos2; Serafeim Tsoukos3; Pavlos Tzamalis4; Athanasios Velentzas5
12nd Experimental Lyceum of Athens; 2National and Kapodistrian University of Athens; 32nd Experimental Junior High School of Athens; 4Agricultural University of Athens; 5National Technical University of Athens

13:45 - 15:00 Interactive Poster P21 - STRAND 4 - ICT AND OTHER RESOURCES FOR TEACHING/LEARNING SCIENCE
Room D2

Chairperson(s): Jin Su Jeong

USING FLIPPED CLASSROOM WITH DIGITAL MEDIA FOR PRE-SERVICE PRIMARY SCIENCE TEACHER EDUCATION
Julian Kuesel; Marina Hoenig
Ludwigsburg University of Education

DIAGNOSTIC OF THE VIRTUAL LEARNING ENVIRONMENT IN THE GRADUATION COURSE IN PHYSICS IN DISTANCE EDUCATION IN BRAZIL
Maria Sônia Veloso1; Agostinho Serrano2; Ney David Veloso3
1Universidade Federal de Roraima; 2ULBRA; 3Universidade Estácio de Sá

IMPROVING LEARNER KNOWLEDGE AND EXPERIENCE BY EMPLOYING NEWTON PROJECT SERIOUS GAMES IN PROGRAMMING COURSES
Radoslav Vargic1; Gregor Rozina1; Dan Zhao2; Gabriel Muntean2
1FEI STUBA; 2DCU

EYE MOVEMENTS DURING DETERMINATION OF BUTTERFLIES WITH IDENTIFICATION KEY
Tanja Gnidovec; Anna Vamberova; Mojca Zemlja; Gregor Torkar
University of Ljubljana, Faculty of Education

A SIMULATION TO SUPPORT AUTHENTIC OBSERVATION
Chang Youn Lee; Hun-Gi Hong
Seoul National University

THE EFFECTS OF GAME SCAFFOLDING ON PLAYERS’ VISUAL BEHAVIORS
Guo-Li Chiou1; Chung-Yuan Hsu2; Meng-Jung Tsai1; Po-Fen Hsu1
1National Taiwan Normal University; 2National Pingtung University of Science and Technology

DO EYE-MOVEMENTS RELATE TO STRATEGY USE? A NEW APPROACH TO CAPTURE DYNAMIC SELF-REGULATION DURING A COMPLEX SCIENCE TASK
Chia-Yu Wang1; Ke-Wei Lee2
1National Taiwan University of Science and Technology, Taiwan; 2National Chiao Tung University, Taiwan

CONCEPTUAL AND PEDAGOGICAL FRAMEWORK FOR AN INTERACTIVE ECOSYSTEM SERIOUS GAME
Martin Riopel1; Jean-Philippe Ayotte-Beauder1; Alexandre Ayotte1
1Université du Québec à Montréal; 2Université de Sherbrooke; 3Cyberlude

HOW STUDENTS COMBINE REPRESENTATIONS FROM DIFFERENT MEDIATIONS TO UNDERSTAND THE ELECTRIC FIELD CONCEPT IN ELECTROSTATICS.
Agostinho Serrano; Graciela Paz Meggiolaro
Universidade Luterana do Brasil

ASSESSING E-LEARNING FACTORS IN SCIENCE EDUCATION WITH MULTI-CRITERIA DECISION-MAKING AND F-DEMATEL METHOD
Jin Su Jeong; David González-Gómez
University of Extremadura
### Poster Symposium PS01 - THINKING TO WRITE AND WRITING TO THINK: SUPPORTING STUDENT WRITING IN SCIENCE AND ENGINEERING IN U.S. PUBLIC SCHOOLS

**Chairperson(s):** Gabriel Della Vecchia

1. **ALIGNING WRITTEN EXPLANATIONS WITH DESIGN REASONING IN ELEMENTARY ENGINEERING CLASSROOMS**
   - Patricia Paugh\(^1\); Kristen Wendell\(^2\)
   - \(^1\)University of Massachusetts Boston; \(^2\)Tufts University

2. **SUPPORTING MULTIPLE GENRES OF SCIENTIFIC WRITING IN GRADE 5 PROJECT-BASED LEARNING**
   - Gabriel Della Vecchia; Annemarie Palincsar
   - University of Michigan

3. **SOCIALIZING WRITTEN SCIENCE EXPLANATIONS WITH ACADEMIC CONVERSATIONS THAT SUPPORT ELS’ REASONING ABOUT EVIDENCE**
   - Zenaida Aquirre-Munoz
   - University of Houston

4. **USING CADE TO DECONSTRUCT STUDENTS’ EVIDENTIARY REASONING IN SECONDARY BIOLOGY LABORATORY TASKS**
   - Ala Samarapungavan; Kari Clase; Chandrani Mishra; Nancy Pelaez; Stephanie Gardner; Nesibe Karakis; Shuangting Li; Jamison Wills; Kari Clase; Nancy Pelaez
   - Purdue University

5. **ASSESSING STUDENTS’ SCIENCE INQUIRY PRACTICES AND DUSTING OFF THE MESSY MIDDLE**
   - Haiying Li, Janice Gobert, Rachel Dickier
   - Rutgers University

### Interactive Poster P22 - STRAND 5 - TEACHING-LEARNING SEQUENCES AS INNOVATIONS FOR SCIENCE TEACHING AND LEARNING

**Chairperson(s):** David Di Fuccia

1. **EFFECTS OF DIFFERENTLY IMPLEMENTED FLIPPED-LEARNING ON ACADEMIC ACHIEVEMENT AND LEARNING MOTIVATION IN HIGH SCHOOL SCIENCE LESSONS**
   - Gyeong-Geon Lee; Young-Eun Jeon; Hun-Gi Hong
   - Seoul National University

2. **DESIGN OF TLS WITH AUGMENTED REALITY TO PROMOTE VISUALIZATION IN UNIVERSITY TEACHING WITH A STEM APPROACH**
   - Cristian Merino\(^1\); Waldo Quiroz\(^2\); Ainoa Marzàbal\(^2\); Sonia Pino\(^1\); Alexis González\(^1\); Patricio Leyton\(^1\); Ximena Carrasco\(^1\); Agustín Aduriz Bravo\(^3\)
   - \(^1\)Pontificia Universidad Católica de Valparaíso; \(^2\)Pontificia Universidad Católica de Chile; \(^3\)Universidad de Buenos Aires

3. **WHY AND HOW LOW-COST PRACTICAL ACTIVITIES CAN BE USED**
   - Marian Mulcahy
   - UCL Institute of Education

4. **DESCRIBING, JUSTIFYING AND EXPLAINING: HOW TO SUPPORT WRITING LAB REPORTS IN PHYSICS CLASSES**
   - Philip Timmerman; Heiko Krabbe
   - Ruhr-University Bochum, Physics Education Department

5. **SEQUENCE EVALUATION OF HIGH SCHOOL STEM PROJECTS: A RUBRIC CONSTRUCTION AND VALIDATION**
   - Miquel Pérez-Torres; Digna Couso; Conxita Márquez
   - Autonomous University of Barcelona

6. **A CASE OF STUDY FOR THE UNDERSTANDING OF GENETICS USING THE CRISPR SCIENTIFIC ADVANCE IN A TEACHING LEARNING SEQUENCE**
   - Maria Paz Beltrán Salvo; Cristian Merino Rubilar
   - Pontificia Universidad Católica de Valparaíso

7. **EFFECTS OF TEACHING THE CONCEPT OF NEUROPLASTICITY TO INDUCE A GROWTH MINDSET ON MOTIVATION AND ACHIEVEMENT: A META-ANALYSIS**
   - Jérémie Blanchette Sarrasin; Lucian Nenciovici; Lorie-Marlène Brault Foisy; Geneviève Allaire-Duquette; Martin Riopel; Steve Masson
   - Université du Québec à Montréal

8. **DEVELOPMENT OF ART-SCIENCE CONVERGENCE EDUCATION CONTENTS ON BIODIVERSITY: FOCUSING ON DESIGN ELEMENTS AND SCENARIOS**
   - Chanmi Jung
   - Ewha Womans University
**Impact of a Role-Playing Game about Nuclear Energy on the Scientific Knowledge of Pre-Service Elementary Teachers**

Isabel María Cruz-Lorite; Daniel Cebrían-Robles; Antonio Joaquín Franco-Marsical; Enrique España-Ramos

1University of Malaga; 2University of Málaga

**An Intervention Study on Student’s Decision-Making Using Trade-Offs to Resolve Socio-Scientific Issues**

Miki Sakamoto; Etsuji Yamaguchi; Tomokazu Yamamoto; Shigenori Inagaki; Kazuya Wakabayashi; Sayuri Tokura

1Graduate School of Human Development and Environment Kobe University; 2Hyogo University of Teacher Education, Japan

**“Escape This!” - Evaluating New Chemical Escape Room Activity for High-School Students**

Shelley Rap; Malka Yayon; Dvora Katchevich; Ran Peleg; Ron Blonder

1Weizmann Institute of Science; 2EDQuest

**Memorizing Ecological Concepts: Alternative for Teaching Ecological Concepts to High School Students**

Juliana Nascimento Silva; Cirlande Cabral Silva; Hileia Monteiro Maciel-Cabral; Luiz Caldeira Brant Tolentino Neto; Patricia Macêdo de Castro; Daniel Morin Ocampo; Elizane da Silva Davila

1Universidade do Estado do Amazonas; 2INSTITUTO FEDERAL DO AMAZONAS; 3Universidade Federal de Santa Maria; 4Universidade Estadual de Roraima; 5Instituto Federal Farroupilha

**The Beauty to Learn About Brazilian Mega-Biodiversity: Production, Validation and Uses of Inquiry Didactic Sequences**

Marcelo Tadeu Motokane; Caio de Castro Freire; Rafael Gil Castro; Mariana Guelero Valle; Anne Caroline Freitas; Ana Elisa Montebelli Motta; Suzana Ural

1University of São Paulo; 2Univ. of São Paulo; 3Univ. Federal do Maranhão

**An Investigative Learning from an Inclined Plane Experiment**

Michele Ueno Guimaraes; João Felipe Viana de Araújo

Universidade Federal de Ouro Preto

**Aiming for an Integrated Perspective on Models of Light in the Secondary School**

Massimiliano Malgieri; Claudio Sutrini; Anna De Ambrosis

1University of Pavia, Department of Physics; 2ISS Taramelli-Foscolo, Pavia

**A Teaching-Learning Sequence to Bridge the Gap from Micro to Macro in Thermodynamics**

Massimiliano Malgieri; Pasquale Onorato; Monica Di Savino; Anna De Ambrosis

1University of Pavia, Department of Physics; 2University of Trento, Department of Physics

**Promoting the Understanding of Quantum Mechanics and the Exploration of Theoretical Inquiry Practices in Secondary School**

Giacomo Zuccarini; Marisa Michelini

University of Udine

**Electronic Waste as a Context for Teaching Chemistry**

David Di Fuccia

University of Kassel

13:45 - 15:00 Interactive Poster P03 - Strand 7 - Discourse and Argumentation in Science Education

**Teaching Planning and Multimodality in the Initial Education of Chemistry Teachers**

Evelin Sgarbosa; Marcelo Giordan

University of São Paulo

**The Role of Gestures in the Transition Between Representations**

Marcelo Giordan; Andriée Tiberghien; Eduardo Fleury Mortimer; Ana Luiza Quadros

1Faculty of Education - University of Sao Paulo; 2Université Lyon 2; 3Faculty of Education - Federal University of Minas Gerais; 4Chemistry Institute - Federal University of Minas Gerais

**Implications of Non-Verbal Modes of Representation for Language Learners**

Melanie Williams; Kok-Sing Tang

1Edith Cowan University; 2Curtin University
ARGUMENTATION IN THE CHEMISTRY TEACHING: ANALYSIS OF DISCURSIVE INTERACTIONS AND VERBAL ACTIONS
Welington Francisco; Lôany G. Silva; Wilmo E. Francisco Junior
1Universidade Federal da Integração Latino-Americana; 2Universidade Federal do Tocantins; 3Universidade Federal de Alagoas

PRE-SERVICE TEACHER’S DISCURSIVE MOVES GUIDING WORK WITH EVIDENCE
Ana Elisa Montebelli Motta; Marcelo Tadeu Motokane
1Postgraduate Program in Science Teaching, University of São Paulo; 2Faculty of Philosophy, Sciences and Letters of Ribeirão Preto, University of São Paulo

ROLES OF OUR VIEWS IN ARGUMENTATIVE REASONING EXPRESSED IN A SOCIO-SCIENTIFIC DEBATE
Rosária Justi; Marina Martins
Universidade Federal de Minas Gerais

SCAFFOLDING EVIDENCE-BASED REASONING IN A TECHNOLOGY SUPPORTED ENGINEERING DESIGN ACTIVITY
Carina Rebello; Yuri Piedrahita Uruena; Alejandra Magana Deleon; Chandan Dasgupta
1Purdue University; 2Indian Institute of Technology Bombay

EVALUATING STUDENTS’ ARGUMENTATION ON ANTIMICROBIAL RESISTANCE: A PILOT STUDY IN AN AUSTRIAN UPPER SECONDARY SCHOOL
Konstantin J. Sagmeister; Pamela Vrabl; Christoph W. Schinagl; Suzanne Kapelari
1University of Innsbruck, Department of Subject-Specific Education; 2University of Innsbruck, Department of Microbiology

EXAMINING SCIENCE AND NON-SCIENCE TEACHERS’ SKILLS FOR CONSTRUCTING ARGUMENTS, EVALUATING ARGUMENTS AND THEIR PERCEIVED SELF-EFFICACY OF TEACHING ARGUMENTATION
Kalypso Jordanou; Evangelia Lytzerinou
1University of Central Lancashire Cyprus; 2Open University Cyprus

IDENTIFICATION OF EVIDENCE BY ENGINEERING UNDERGRADUATES AND PRE-SERVICE SCIENCE TEACHERS IN AN ARGUMENTATION ACTIVITY
María-José Caño-Iglesias; Antonio-Joaquín Franco-Mariscal; Ángel Blanco-López
1University of Málaga; 2University of Malaga

THE DEVELOPMENT AND CHARACTERIZATION OF A SEQUENCE OF TEACHING ON SCIENTIFIC ARGUMENTATION IN THE IMMUNOLOGY CLASSES FOR HIGH SCHOOL STUDENTS IN HEALTH
Daniel Manzoni-de-Almeida; Terezinha Gennari, D.; Sérgio Lopes, M
Escola de Ciências Biológicas e da Saúde, Centro Universitário das Faculdades Metropolitanas Unidas

THINKING, DOING, TALKING STEM
Jan Sermeus; Christel Balck; Annelies Pil; Wim Temmerman; Jelle De Schrijver
Odisee

CASE STUDY OF COLLECTIVE THINKING EMERGED IN GROUP BASED SCIENTIFIC PROBLEM SOLVING PROCESSES
Chuylim Choi; Sun-Kyung Lee
Seoul National University

ANALYSIS OF EPISTEMIC THINKING IN MIDDLE SCHOOL STUDENTS IN AN ARGUMENT-BASED INQUIRY (ABI) SCIENCE CLASS
Jeonghee Nam; Jiyoun Park; Heehwa Kim; Jongseok Park; Jeongwoo Son; Eugene Kang
1Pusan National University; 2Kyungpook National University; 3Gyeongsang National University

EPISTEMIC GOALS FOR PROMOTING ARGUMENTATION IN INQUIRY BASED CLASSES
Lucia Sasseron; Arthur Ferraz
University of São Paulo

THE CONTROVERSIAL ASPECT OF THE SOCIO-SCIENTIFIC ISSUE AS A DISCURSIVE CONSTRUCTION OF THE TEACHER
Gabriel Saraiva Gomes; Marcelo Giordan
School of Education, University of São Paulo

SOCIOCIENTIFIC ARGUMENTATION IN THE CONTEXT OF BIODIVERSITY-RELATED ISSUES: APPLICATION OF TOULMIN’S ARGUMENT PATTERN FOR TEACHING TO JUSTIFY CLAIMS
Gonzalo Miguel Ángel Bermudez; María Emilia Ottogalli; Lia Patricia García; Ana Lia De Longhi
1Universidad Nacional de Córdoba - National Scientific and Technical Research Council (CONICET); 2Universidad Nacional de Córdoba (FCEyN). IPEM, Ministerio de Educación de la Provincia de Córdoba; 3Universidad Nacional de Córdoba, Facultad de Ciencias Exactas, Físicas y Naturales
QUALITATIVE PERFORMANCE EVALUATION OF WORD EMBEDDING MODEL BY LEARNING SCIENCE TEXTBOOK CORPUS
Eunjeong Yun; Yunebae Park; Donghyuk Yang
Kyungpook National University

WHAT ARE WE WRITING ABOUT? USING BOTTOM-UP TEXT MINING TECHNIQUES TO UNCOVER RESEARCH TRENDS IN ABSTRACTS OF SCIENCE EDUCATION ARTICLES
Alexander Buessing
Didactics of Biology, Osnabrück University

DEMONSTRATION EXPERIMENTS IN COGNITIVE PSYCHOLOGY RESEARCH FOCUS
Claus Bolte
Freie Universität Berlin

LEARNING TO BE A SCIENCE TEACHER EDUCATOR: THINKING ABOUT POSITIONALITY IN MY PHD STUDY
matselma mphahlele
University of the Witwatersrand

CURIOUS CHILDREN AND KNOWLEDGABLE ADULTS - EARLY CHILDHOOD STUDENT TEACHERS’ SPECIES IDENTIFICATION SKILLS AND THEIR VIEWS ON THE IMPORTANCE OF SPECIES KNOWLEDGE
Tuula H. Skarstein; Frode Skarstein
University of Stavanger

GREEK PARENTS PERCEPTIONS REGARDING MOBILE DEVICES USAGE BY PRESCHOOL-AGED LEARNERS
Michail Kalogiannakis; Stamatios Papadakis
University of Crete - Faculty of Education - Department of Preschool Education

ENHANCEMENT AND IMPLEMENTATION OF SCIENCE AND MATHEMATICS IN PRE-SCHOOL TEACHERS PRACTICES IN NORTHERN-NORWAY
Saeed Manshad; Jo Espen Tau Strand; Mona Kvivesen
UiT, The Arctic University of Norway

LITTLE SCIENTISTS: THE IMPACT OF STEM PROFESSIONAL LEARNING ON EARLY CHILDHOOD EDUCATORS
Lena Danaia; Amy MacDonald; Shukla Sikder; Carmen Huser
Charles Sturt University

EARLY-YEARS STEM EDUCATION AND ROBOTICS — THE BOTSTEM FRAMEWORK, TOOLKIT, AND IMPLEMENTED ACTIVITIES IN SPAIN
Ileana Greca; Eva García Terceño; Jairo Ortiz-Revilla
Universidad de Burgos

ROBOTICS AND EARLY-YEARS STEM EDUCATION — BOTSTEM FRAMEWORK, TOOLKIT, AND IMPLEMENTED ACTIVITIES IN SWEDEN
Björn Cronquist; Marie Fridberg; Andreas Redfors
Kristianstad University

PRE-SCHOOL STUDENTS DRAW AN ENGINEER
Emine Sahin- Topalçengiz; Bekir Yildirim; Funda Savasci-Acikalin
1Mus Alparslan University/Istanbul University-Cerrahpasa; 2Mus Alparslan University; 3Istanbul University-Cerrahpasa

KINDERGARTEN STUDENTS’ CONCEPTIONS ABOUT EARTHQUAKES
S.Lizette Ramos; Claudia Huerta
1Universidad de Guadalajara; 2Instituto Superior de Investigación y Docencia para el Magisterio

DINOSAUR FOOTPRINTS IN THE PLAYGROUND: THE USE OF EVIDENCE TO CONSTRUCT EXPLANATIONS IN EARLY CHILDHOOD EDUCATION
Esther Cascarosa; Esté Mateo González; Beatriz Mazas Gil
University of Zaragoza

A PROPOSAL FOR LEARNING HEALTHY NUTRITION WITH FOUR-YEARS-OLD SCHOOLCHILDREN
Belén Guardiola Haro; Luisa López Banet; Isabel Banos-González
University of Murcia
**13:45 - 15:00 Workshop 15 - AGORA: A GAMIFIED INTERACTIVE EDUCATIONAL MOBILE APPLICATION**  
Room G1  
Chairperson(s): Mohammed Rizkallah  
AGORA: A GAMIFIED INTERACTIVE EDUCATIONAL MOBILE APPLICATION  
Mohammed Rizkallah1; Engin Karahan1; Alaa Hassan1; Dima Sorri1; Hoor Away2; Hossam Serag1  
1American University in Cairo; 2Eskisehir Osmangazi University

**13:45 - 15:00 Interactive Poster P12 - STRAND 17 - SCIENCE TEACHING AT THE UNIVERSITY LEVEL**  
Area H1  
Chairperson(s): Susanne Engström  
ANALYSIS OF LEARNING OF THE TOPIC OF NUCLEAR MAGNETIC RESONANCE IN A PHYSICS COURSE FOR STUDENTS OF LIFE SCIENCES  
Sergej Faletic  
University of Ljubljana Faculty of Mathematics and Physics  
CRITERIA-BASED ASSESSMENT OF KNOWLEDGE IN BIOLOGY IN HIGHER EDUCATION  
Veronica Flodin1; Jessica Slove Davidsson2  
1MND, Stockholm University; 2Stockholm University, Biology Education Dpt  
TECHNOLOGY-ENHANCED LEARNING SUPPORTING ENGAGEMENT, ASSESSMENT, AND REFLECTION IN HIGHER EDUCATION SCIENCE  
Joseph Roche  
Trinity College Dublin  
DEVELOPMENT AND EVALUATION OF A CHEMISTRY TEST FOR HIGHER EDUCATION  
Bianca Paczulla; Vanessa Fischer; Elke Sumfleth; Maik Walpuski  
University of Duisburg-Essen  
SPECIES DIVERSITY AS A FACTOR IN THE DESIGN OF FOOD CHAINS  
Luka Praprotnik; Gregor Torkar  
University of Ljubljana, Faculty of Education  
ASSESSMENT OF AN EDUCATIONAL RECONSTRUCTION PROPOSAL OF PHYSICS AT THE UNIVERSITY  
Liliana Ortigoza1; Juan José Llovera-González2; Héctor Santiago Odetti3  
1Departamento de Física. Facultad de Bioquímica y Ciencias Biológicas. Universidad Nacional del Litoral; 2Instituto de Ciencias Básicas. Universidad Tecnológica de La Habana “José Antonio Echeverría”, Cuba; 3Facultad de Bioquímica y Ciencias Biológicas, Universidad Nacional del Litoral, Santa Fe, Argentina  
HOW CAN A PROGRESSION IN TEACHING FOR SUSTAINABLE DEVELOPMENT BE ACHIEVED IN ENGINEERING EDUCATION?  
Helena Lennholm  
Learning in engineering sciences  
TEACHING THE TREE OF LIFE TO UNDERGRADUATE STUDENTS.  
Kristy Daniel1; E. Austin Leone2  
1Texas State University; 2Oklahoma State University  
SERIAL DILUTIONS: STILL A NIGHTMARE FOR SCIENCE UNDERGRADUATE STUDENTS.  
Ángel-Luis García-Ponce1; Ana R Quesada2; Miguel Ángel Medina2; Ángel Blanco-López4  
BUILDING ACADEMIC TENACITY IN SCIENCE STUDENTS TO FOSTER WELLBEING AND ACADEMIC SUCCESS
Gulnur Bird; Karen Smith; Daisy Li; Jocelyn Micaleff; Patty Hambler
UBC

STUDENTS’ EPISTEMOLOGICAL THINKING ABOUT SOURCES OF KNOWLEDGE FOR CONTROVERSIAL ISSUES
Kathryn Green; Lisa Borgerding
1North Carolina State University; 2Kent State University

STUDENT HORMONAL STRESS RESPONSES IN TWO LEARNING ENVIRONMENTS
Kristy Daniel; Antonia Mac Crossan; Mar Huertas Pau
Texas State University

INTEGRATING STUDENTS INTO THE TEACHING TEAM: HOW PEER TUTORING CAN ENHANCE SCIENCE EDUCATION
William Man Yin Cheung
The University of Hong Kong

PRACTICAL PERFORMANCE ASSESSMENT OF EXPERIMENTAL COMPETENCE IN SCIENCE TEACHER EDUCATION LABORATORY CLASSES
Fabian Poensgen; Christiane Reiners
University of Cologne

EXPLORING THE RELATIONSHIPS BETWEEN UNDERGRADUATES’ SCIENTIFIC EPISTEMIC VIEWS AND PERCEIVED SELF-EFFICACY FOR SCIENCE, TECHNOLOGY, ENGINEERING AND MATHEMATICS (STEM) KNOWLEDGE
Elaosi Vhurumuku
University of Witwatersrand, School of Education, South Africa

PRE-SERVICE CHEMISTRY TEACHERS’ ATTITUDES TOWARDS INFORMATION AND COMMUNICATION TECHNOLOGIES: A CASE STUDY OF A SOUTHERN AFRICAN UNIVERSITY
Sayuri Tokura1; Etsuji Yamaguchi1; Miki Sakamoto1; Tomokazu Yamamoto2; Shigenori Inagaki1; Kazuya Wakabayashi1; Motoaki Matano1
1Kobe University; 2Hyogo University of Teacher Education; 3Elementary School Attached to Kobe University

PHYSICS HIGHER EDUCATION AND BOURDIEU’S SYMBOLIC CAPITAL IN TEACHER EDUCATION
Susanne Engström; Per Norström
KTH/ITM

13:45 - 15:00 Interactive Poster P11 - STRand 16 - SCIENCE TEACHING-LEARNING AT PRIMARY SCHOOL LEVEL AND EARLY CHILDHOOD

Chairperson(s): Granada Muñoz Franco

SIGNIFICANCE OF FISH DISSECTION FOR UNDERSTANDING VIEW OF LIFE AND BIODIVERSITY
Junko Iwama1; Shizuo Matsubara2
1Aoyama Gakuin University; 2Toin University of Yokohama

IMPROVEMENT OF THE DRAWING EXPRESSION OF SCIENTIFIC MODELS IN STUDENTS OF PRIMARY EDUCATION
Teresa Zamalloa1; Araitz Uskola1; Miren Begoñe Burgotx Etxaburu1; Gurutze Maguregui1
1University of the Basque Country; 2Instituto de Evaluación e Investigación Educativa ISEI-IVEI (Gobierno Vasco)

THE INTEGRATION OF EXPERIMENT DURING IMPLEMENTATION OF INQUIRY-BASED TEACHING
Ioanna Stavrou; Constantina Stefanidou; Kirakos Kiriakou; Violetta Galanopoulou; Constantine Skordoulis
National & Kapodistrian University of Athens

WHAT LEARNING RESULTS REGARDING TEACHING OF SCIENCES ARE ACHIEVED FOR FUTURE TEACHERS OF EARLY CHILDHOOD EDUCATION?
José Cantó1; Jordi Solbes2; Antonio de Pro1
1Universitat de València; 2University of Valencia (Spain); 3University of Murcia (Spain)

IMPROVING PRE-SERVICE TEACHERS’ SCIENCE PROCESS SKILLS AND VIEWS ON SCIENCE INQUIRY
Zeynep Koyunlu Ünlü
Yozgat Bozok University

PRE-SERVICE ELEMENTARY SCIENCE TEACHERS’ VIEWS ABOUT SCIENTIFIC INQUIRY. A PILOT STUDY
Mª Marta Alarcón-Orozco; Isabel Mª Cruz-Lorite; Antonio-Joaquín Franco-Mariscal; Ángel Blanco-López
Universidad de Málaga
REINFORCEMENT OF KNOWLEDGE ABOUT GERMINATION AND PLANT GROWTH: A CASE STUDY OF A LEARNING SUPPORT SYSTEM BASED ON FULL-BODY INTERACTION AND COLLABORATION

Naoki Komiya; Minami Yano; Kazuki Yamamoto; Ryohei Egusa; Shigenori Inagaki; Hiroshi Mizoguchi; Miki Namatame; Fusako Kusunoki

Tokyo University of Science; Tama Art University; Meiji Gakuin University; Kobe University; Tsukuba University of Technology

SCIENCE COMPETENCES IN THE FIFTH GRADE OF ELEMENTARY SCHOOL

Matija Purkat; Iztok Devetak

University of Ljubljana, Faculty of Education, Slovenia

PRIMARY STUDENTS INFORMATION PROBLEM SOLVING (IPS) IN SCIENCE LEARNING

Qingna Jin; Mijung Kim; Suzanna Wong

University of Alberta

HOW CHILDREN EXPRESS SCIENTIFIC SKILLS IN WRITTEN TEXTS

Marcelo Tadeu Motokane; Luciana Sedano Souza; Adriana S. Tavares Ferreira; Marcelo Pereira

University of São Paulo; Univ. Estadual de Santa Cruz; Univ. of São Paulo

SCIENTIFIC COMPETENCY AND HUMAN NUTRITION IN PRIMARY SCHOOL TEXTBOOK IN SPAIN AND PORTUGAL

Juan-Carlos Rivadulla-López; Susana García-Barros; Maria-Jesús Fuentes-Silveira; Cristina Martínez-Losada

Universidade da Coruña

SCIENTIFIC COMPETENCIES IN PRIMARY AND SECONDARY SCHOOL TEXTBOOKS

Susana García-Barros; Juan Carlos Rivadulla-López; Cristina Martínez-Losada; Maria Jesús Fuentes-Silveira

Universidade da Coruña

VIRGINIA APGAR: FROM UNIVERSITY TO PRIMARY SCHOOL

Granada Muñoz Franco; Mireia Illescas-Navarro; Hortensia Morón-Monge

Universidad de Sevilla

13:45 - 15:00 Interactive Poster P07 - STRAND 13 - PRE-SERVICE SCIENCE TEACHER EDUCATION (II) Area H3

Chairperson(s): Federico Piazzi

DEVELOPING CLIL SCIENCE TEACHING COMPETENCIES: INTEGRATING SCIENCE TEACHING EXPERTISE IN HONG KONG

Michael Tsang; Angel Lam; Maurice Cheng; Yuen Long Merchants' Association Secondary School; Simon Fraser University, Waikato University

CONTEXTS AND PROCESSES IN SELECTING MIDDLE AND HIGH SCHOOL SCIENCE TEACHERS IN JAPAN

Yoshisake Kumanga; Shizuoka University

INCLUSIVE EDUCATION IN SCIENCE — THE NEED FOR MULTIPROFESSIONAL COOPERATION

Robin Schilknecht; Sarah Hundertmark; Vanessa Schad; Xiaokang Sun; Alexander Kauertz; Bettina Lindmeier; Christian Lindmeier; Sandra Nitz; Andreas Nehring

University of Koblenz-Landau; Leibniz Universität Hannover

CONSTRUCTIVISM IN STEM TEACHER PREPARATION

Christina Lunsmann; Jori Beck; Kristie Gutierrez

Young Harris College; Old Dominion University

MOMENTARY EXPERIENCES OF STUDENT TEACHERS CONDUCTING SCIENCE EXPERIMENTS IN SECONDARY TEACHER EDUCATION

Robbert Smit; Nicolas Robin; Florian Rietz

University of Teacher Education St. Gallen

VISUAL EXPRESSION OF THE GEOLOGICAL CHANGE MODEL DURING A HYDROGEOLOGY TEACHING SEQUENCE WHICH INCLUDES FIELDWORK

Araitz Ustakoa; Nahia Seijas

University of the Basque Country UPV/EHU

PRE-SERVICE TEACHERS’ SOCIAL REPRESENTATION ON SCIENTIST AND SCIENCE TEACHER: BETWEEN TWO DISTANT WORLDS

Guilherme Brockington; Ernani Vassoler Rodrigues; Carlos Alberto Magalhaes Junior; Camila Contrucci; Lucas Mesquita; Guilherme Bruneri; Pamella Aline de Almeida; Leonardo André Testoni; Camilo Lelis-Santos

Federal University of ABC; University of Sao Paulo; State University of Maringa; Federal University of Sao Paulo
BECOMING A CHEMISTRY TEACHER: EXPECTATIONS AND REALITY IN CHEMISTRY EDUCATION COURSES
Sabine Streller; Claus Bolte
Freie Universitaet Berlin

THE CASE OF MOTIVATED REASONING IN PRE-SERVICE SCIENCE TEACHER AND YOUNG SCIENCE RESEARCHER
Rahmi Qurota Anii1; Ai Nurlaelasari Rusmana1; Yustika Syabandari1; Minsu Ha1; Sein Shin2; Jun-ki Lee3
1Kangwon National University; 2Chungbuk National University, South Korea; 3Chonbuk National University, South Korea

EMOTIONS AND INTERACTION RITUALS IN CLASSES OF PRE-SERVICE PHYSICS TEACHERS
Mauricio Pietrocola; Edison Amaro
University of São Paulo

IMPROVING PHYSICS TEACHING THROUGH ACTION RESEARCH
Marika Kapanadze
Ilia State University, Georgia

THE ROLE OF REPRESENTATIONS: AN EXPERIENCE WITH TEACHERS IN TRAINING
Ana Luiza Quadros1; Daniela Martins B. Pena2; Maria Luiza S. T. Botelho3
1Federal University of Minas Gerais, Brazil; 2Federal University of Minas Gerais; 3Federal University of Minas Gerais

UNDERGRADUATE STUDENTS PARTICIPATING IN THE INSTITUTIONAL PROGRAM OF SCHOLARSHIPS OF INITIATION TO TEACHING (PIBID) DEVELOP MORE PROCEDURAL AND ATTITUdINAL CONTENTS IN THEIR INITIAL TEACHER EDUCATION
Luiz Fonseca dos Santos Jr; Magda Medhat Pechliye
Universidade Presbiteriana Mackenzie

THE DESIGN OF AN INNOVATIVE SCIENTIFIC INTERDISCIPLINARY LAB FOR PRE-SERVICE PRIMARY TEACHERS
Federico Plazzi; Cecilia Bulgarelli; Barbara Mantovani; Marianna Marchini; Barbara Pecori; Fiorella Prada; Giulia Tasquier; Ira Vannini; Margherita Venturi
Alma Mater Studiorum - University of Bologna

ANALYSIS OF AN ARGUMENTATION ACTIVITY ON INVASIVE PLANTS IN PRE-SERVICE SCIENCE TEACHERS
Jose Manuel Hierrezuelo-Orsorio; Pedro Juárez-González; Daniel Cebrián-Robles; Antonio Joaquin Franco-Mariscal
Department of Science Education, University of Málaga, Campus de Teatinos s/n, 29071 Málaga, Spain

ARE WE PREPARING TEACHERS FOR INTERDISCIPLINARY PRACTICE? A LOOK TO THE PRESERVICE CHEMISTRY TEACHER EDUCATION IN BRAZIL
FABIANA OCAMPOS; Gildo Girotto Jr.
Universidade Estadual de Campinas

TEACHER COMPETENCIES FOR THE SUCCESS OF INCLUSIVE SCIENCE EDUCATION
Daniela Egger
Institute of Sustainable and Environmental Chemistry (ISEC)

FROM EDUCATING SCIENCE TEACHERS TOWARDS EDUCATING STEM TEACHERS
Morten Rask Petersen; Linda Ahrenkile; Tom Nauerby
UCL University College

PRE-SERVICE TEACHERS WORKING WITH RESEARCHERS AND ENGINEERS TO INTEGRATE RESEARCH-ORIENTED INSTRUCTION IN SCIENCE AND MATH CLASSROOM
Aviva Klieger; Moriya Mor; Tami Yaron; Aehsan Haj-Yahya
Beit Berl College

PRESERVICE TEACHERS ENGAGING IN STEM EDUCATION RESEARCH
Jennifer Wilhelm; Molly Fisher
University of Kentucky

HELPING STUDENTS TO UNDERSTAND BIOLOGY TERMINOLOGY: INSIGHTS FROM EXPERIENCED TEACHER EDUCATORS
Hlologelo Climant Khoza; Audrey Msimanga; Eunice Nyamupangedengu
University of the Witwatersrand
WEDNESDAY AUGUST 28

INITIAL SKILLS IN DRAWING OF THE PRE-SERVICE BIOLOGY TEACHERS
Jan Petr¹; Lukas Rokos²
¹University of South Bohemia in Ceske Budejovice, Faculty of Education; ²University of South Bohemia in Ceske Budejovice; Faculty of Education

CELL BIOLOGY ANALOGIES IN BRAZILIAN BIOLOGY TEXTBOOKS: A TEACHER GUIDE BASED ON FAR MODEL
Carla Araujo; Iago Taveira Oliveira; Zara Guimarães
Universidade de Brasília

BIOLOGY STUDENTS’ COMPETENCIES IN THE COURSE OF PRACTICAL TRAINING EXPERIENCES
Iris Schiffli; Cornelia Schadler; Natalie Baumgartner-Hirscher
University of Salzburg, School of Education

THE TWO-SIDED COIN OF EFFECTIVE EVOLUTION EDUCATION: TEACHERS’ COMPETENCIES AND STUDENTS’ RECEPTIVITY
Elizabeth Watts; Clemens Hoffmann
Friedrich-Schiller-Universität Jena

VALUATIONS OF INNOVATIVE ICT ACTIVITIES IN ENVIRONMENTAL EDUCATION BY TRAINING TEACHERS
Vito Brero; Maria del Carmen Acebal; Jose Antonio Rueda; Erika González
Málaga University

AN ASSESSMENT OF VISUO-SEMIOTIC REASONING SKILLS AMONG PRE-SERVICE BIOLOGY TEACHERS
Lindelani Mnguni
University of South Africa

PRE-SERVICE SCIENCE TEACHERS’ PROFESSIONAL LEARNING WITHIN INFORMAL SCIENCE LEARNING CONTEXTS: A UNIVERSITY AND COMMUNITY PARTNERSHIP
Saiqa Azam¹; Karen Goodnough¹; Patrick Wells¹; Ross Elliot²
¹Memorial University of Newfoundland; ²Ocean Learning Partnerships (OLP)

DELPHI STUDY ON GOALS, OBJECTIVES, AND DESIGN FEATURES OF CERN TEACHER PROGRAMMES
Anja Kranjc Horvat¹; Gerfried Wiener²; Sascha Schmeling²; Andreas Borowski²
¹University of Potsdam; ²CERN

DESIGN AND ASSESSMENT OF A SCORING RUBRIC FOR EVALUATING SCIENCE TEACHERS’ CLASSROOM PRACTICES
Angelos Sofianidis; Maria Kallery
Aristotle University of Thessaloniki

THE TRANSITION FROM PRIMARY TO SECONDARY SCHOOL IN SCIENCE EDUCATION
Julia Brüggerhoff; Sarah Rau-Patschke; Stefan Rumann
University of Duisburg-Essen

THE BRAZILIAN CHEMISTRY TEACHERS: CULTURAL CAPITAL AND SOCIAL CLASS IN THE CHOICE FOR THE NECESSARY
Luciana Massi¹; Gabriela Agostini²
¹Universidade Estadual Paulista; ²Universidade Estadual Paulista (UNESP)

THE STRUCTURAL CHALLENGE IN BRAZILIAN TEACHER EDUCATION: THE PHYSICS TEACHER SHORTAGE
André Rodrigues; Cristiano Mattos
University of São Paulo

SCIENCE TEACHERS CONTINUOUS EDUCATION THROUGH THE THREE PEDAGOGICAL MOMENTS
Eliziane da Silva Dávila¹; Daniel Morin Ocampo²; Cirlande Cabral da Silva²; Luiz Caldeira Brant Tolentino-Neto²
¹Instituto Federal Farroupilha - Campus São Vicente do Sul; ²Universidade Federal de Santa Maria (UFSM); ³Instituto Federal do Amazonas (IFAM)

TRANSFORMING THE PEDAGOGICAL PRACTICES OF ETHIOPIAN PHYSICS TEACHERS FROM DIDACTIC TO DIALOGIC TEACHING
TAHA Rajab¹; Vanessa Kind¹; Mekbib Alemu²; Mesfin Tadesse²
¹Durham University; ²Addis Ababa University
EXPLORING THE POTENTIAL OF SUSTAINED ROUND —TABLE DISCUSSIONS AS A PROFESSIONAL DEVELOPMENT ACTIVITY FOR DEVELOPING IN-SERVICE TEACHERS’ CONTENT KNOWLEDGE
Eunice Nyamupangedengu; Anastasia Buma
University of the Witwatersrand

SECONDARY TEACHERS LEARNING TO TEACH STEM: OUTCOMES OF A PROFESSIONAL LEARNING PROGRAM
Linda Hobbs; John Cripps Clark
Deakin University

EFFECTS OF A PHYSICS EDUCATION PROFESSIONAL DEVELOPMENT COURSE ON IN-SERVICE PRIMARY TEACHERS: CHALLENGES AND OPPORTUNITIES
Carolina Nicolas-Castellano1; Asuncion Menargues1; Joaquin Martinez-Torregrosa1; Ruben Limiñana1; Carla Zembal-Saul2; Sergio Rosa-Cintas1; Isabel Lujan1
1University of Alicante; 2Penn State University

EVALUATION CONCEPTIONS AND SCIENCE TEACHING CHALLENGES IN THE CONTEXT OF TEACHING PLANNING
Nicole Glock Maceno1; Marcello Giordan2
1University of São Paulo; 2University of Sao Paulo

RESULTS OF IMPROVED PROGRAM TO DEVELOP TEACHERS’ ABILITIES TO CONSTRUCT AND EVALUATE ARGUMENTS
Tomokazu Yamamotol; Shinichi Kамиyama2
1Hyogo University of Teacher Education; 2Obayashi Sacred Heart Primary School

DEVELOPMENT AND EVALUATION OF A TEACHER TRAINING ADDRESSING THE USE OF EXPERIMENTS IN CHEMISTRY EDUCATION
Henning Krake; Malli Walpuski
University of Duisburg-Essen

FOSTERING SCIENTIFIC SKILLS IN HIGH SCHOOL VIA TEACHER EDUCATION: AN EXPERIENCE OF COLLABORATION BETWEEN TEACHERS AND PHYSICS RESEARCHERS TO DESIGN EXPERIMENT-BASED LEARNING ACTIVITIES AND SUPPORT CURRICULUM DEVELOPMENT
Filippo Pallottol; Alberto Parolal; Maria Bondani1
1University of Insubria, Department of Science and High Technology; 2University of Insubria, Department of Science and High Technology; 3CNR - Institute for Photonics and Nanotechnologies University of Insubria - Department of Science an

13:45 - 15:00 Interactive Poster P09 - STRAND 14 - FOCI OF AND APPROACHES TO TEACHER TRAININGS Area H6
Chairperson(s): Cirlande Cabral Silva

SCIENCE TEACHERS’ PEDAGOGICAL DEVELOPMENT: FOCUSING ON LESSON STUDY
Tetsuo Isozakil; Susumu Nozoe2; Takako Isozakil
1Hiroshima University; 2University of Miyazaki; 3University of Toyama

DEVELOPING RESEARCH-BASED TEACHER PROFESSIONAL DEVELOPMENT ACTIVITIES — MAKING STATE-OF-THE-ART RESEARCH ACCESSIBLE FOR TEACHERS AND SCHOOLS
Siike Rönnebeck1; Tobias Röger2; Ilka Parchmann3
1Kiel University; 2IPN Leibniz-Institute for Science and Mathematics Education

URBAN ADVANTAGE: A PROFESSIONAL DEVELOPMENT PARTNERSHIP BETWEEN PRIMARY SCHOOLS AND INFORMAL SCIENCE INSTITUTIONS IN NEW YORK CITY
Angela Kelly; Lauren Slagus
Stony Brook University

THE RELATIONSHIP BETWEEN MENTOR TEACHER MENTORING CHARACTERISTICS AND MENTEE TEACHERS REFLECTIVE PRACTICE IN COLLABORATIVE MENTORING FOR BEGINNING SCIENCE TEACHER
Eugene Kang1; Jihoon Park1; Heehwa Kim2; Jongseok Park1; Jeongwoo Son2; Jeonghee Nam2
1Pusan National University; 2Kyungpook National University; 3Gyeongsang National University

COLLABORATING WITH BIOLOGY TEACHERS TO ENGAGE STUDENTS IN EVIDENTIARY REASONING THROUGH INSTRUCTIONAL SCAFFOLDING
Chandrani Mishra; Kari Clase; Alia Samarapungavan; Nancy Pelaez; Stephanie Gardner; Nesibe Karakis; Shuangting Li
Purdue University
LEARNING HYPERSPACE FOR FORMATIVE ASSESSMENT AND INQUIRY-BASED TEACHING
Radka Zavodska; Iva Stuchlikova; Jan Petr; Lukas Rokos
University of South Bohemia in Ceske Budejovice, Faculty of Education

CO-DESIGNING OF PROJECT-BASED LEARNING UNITS: DESIGNING A DIGITAL INSTRUMENT FOR ASSESSING LEARNING OUTCOMES OF A PROJECT-BASED LEARNING UNIT
Miikka Turkkila; Kalte Juuti; Jari Lavonen; Katarina Salmela-Aro
University of Helsinki

TEACHERS AS RESEARCHERS: A PROFESSIONAL DEVELOPMENT BASED PEDAGOGICAL INQUIRY INTO CONTEXTUALIZING TEACHING SCIENCE PROCESS SKILLS
Aminath Shiyama
University of Bristol

IMPROVING TEACHER PEDAGOGICAL DESIGN CAPACITY AND STUDENT COMPETENCY WITH ARGUMENTATION THROUGH A LESSON STUDY BASED PROFESSIONAL DEVELOPMENT
Jonathan Bowers; Lisa Kenyon; Leonard Kenyon; Brian Boyd; Ann Farrell; William Boone; Brittany Juhas
1Wright State University; 2Miami University

REFLECTIONS ABOUT THE SUPERVISED TEACHING PRACTICE IN BIOLOGY
Hileia Monteiro Maciel-Cabral; Cirlande Cabral Silva; Luiz Caldeira Brant Tolentino Neto; Patricia Macêdo de Castro; Daniel Morin Ocampo; Eliziane da Silva Davila
1Universidade do Estado do Amazonas; 2INSTITUTO FEDERAL DO AMAZONAS; 3Universidade Federal de Santa Maria; 4Universidade Estadual de Roraima; 5Instituto Federal Farroupilha

13:45 - 15:00 Interactive Poster P05 - STRAND 3 - SCIENCE TEACHING PROCESSES Area H7

Chairperson(s): Montserrat Tortosa

PEDAGOGY OF DIFFERENTIATED LEARNING AND TEACHING IN THE CHEMISTRY CLASSROOM: THE INFLUENCE OF AN INTERVENTION PROGRAM OF DIFFERENTIATED INSTRUCTION ON STUDENT’S MISCONCEPTIONS, AND SELF-EFFICACY BELIEFS AND ATTITUDES OF HIGH SCHOOL CHEMISTRY STUDENTS AND TEACHERS
Enas Easa, Ron BlonderWeizmann Institute of Science, Israel

ENHANCING SECONDARY SCHOOL STUDENTS’ LEARNING AND INTEREST FOR ENERGY: RESULTS FROM THE IMPLEMENTATION OF AN INTERVENTION
Georgia Toli; Maria Kallery
Department of Physics, Aristotle University of Thessaloniki

EVALUATION OF A RESEARCH-BASED LEARNING NEUROSCIENCE CURRICULUM FOR SCIENTIFICALLY GIFTED STUDENTS: IMPLICATIONS FOR NURTURING FUTURE SCIENTISTS
KA CHUN SUEN; MAN HO LI; MEI YU LIN; RAYMOND CHUEN CHUNG CHANG; WING KWONG CHAN
1Po Leung Kuk Laws Foundation College; 2School of Biomedical Sciences, LKS Faculty of Medicine, The University of Hong Kong

EDUCATIONAL ILLUSIONS
Laura Weiss; Andreas Müller
1Université de Genève; 2Université de Genève

DIAGNOSIS OF DIFFICULTY-GENERATING CHARACTERISTICS BASED ON PROBLEM-SOLVING IN PHYSICS
Mareike Freese; Jan Winkelmann
Department of Physics Education, Goethe University Frankfurt

DRAWING OF CARTOON STRIPS AS A VISUALIZATION TOOL IN LEARNING THE THEORY OF TITRATION
Jouni Välisaari; Piia Nuora
University of Jyväskylä

PROMOTING STUDENTS’ INTEREST IN SCIENCE THROUGH SCHOOL-BASED BIOTECHNOLOGY CURRICULUM IN A HONG KONG SECONDARY SCHOOL
Mei Yu Lin; Man Ho Li; Ka Chun Suen; WING KWONG CHAN
Po Leung Kuk Laws Foundation College

SCIENCE CLASSES - A MODEL FOR INTERDISCIPLINARY SCIENCE EDUCATION
Alena Schulte; Claas Wegner
Bielefeld University

PRACTICAL SCIENCE EDUCATION AND TEACHER CHALLENGES
Tine Weise Håland; Torill Høiby; Linda Merete Smedbakken; Øyvind Rundtorn
Skedsmo STEM center, Municipality of Skedsmo
QUALITY OF INSTRUCTION IN SCIENCE EDUCATION VIDEO STUDIES A SYSTEMATIC REVIEW BETWEEN GENERIC AND SUBJECT SPECIFIC CRITERIA
Benjamin Heinitz; Andreas Nehring
Leibniz Universität Hannover

RESEARCH-BASED PHYSICS USING SENSORS AT SECONDARY: STUDENTS’ CHALLENGES AND DIFFICULTIES PERCEIVED
Montserrat Tortosa¹; Fina Guitart Mas²; Marek Skorsep³
¹Associació per a la Innovació i la Recerca Educativa en Ciències; ²Universitat de Barcelona; ³Bel Matej University

13:45 - 15:00 Interactive Poster P10 - STRAND 14 - TEACHERS’ PERCEPTIONS, EXPERIENCES, PCK AND CK Area H8
Chairperson(s): Peer Daugbjerg

LINKING PEDAGOGICAL CONTENT KNOWLEDGE AND PRACTICAL EXPERIENCE IN STEM TEACHER EDUCATION: A SYSTEMATIC REVIEW OF THE LITERATURE
Antoinette Meiners; Peter Wulff; Andreas Borowski
University of Potsdam

PEDAGOGICAL CONTENT KNOWLEDGE IN BIOLOGIE TEACHERS:A CASE STady FOR TEACHING EVOLUTION
Arlette Bessaber¹; Claudia Vergara²; Hernan Cofre³
¹Universidad Católica de Valparaíso; ²Alberto Hurtado University; ³Universidad Católica de Valparaiso

RELATIONSHIP OF EMOTIONS WITH ASSOCIATED VARIABLES TO THE SCIENCE TEACHING ON IN-SERVICE TEACHERS
Pedro Membiela¹; Katherine Acosta²; Antonio González¹
¹University of Vigo; ²University of Arica

ORIENTATION TO TEACHING INTRODUCTORY ELECTRICITY - AIMS AND MOTIVES OF TEACHERS
Thomas Schubatzky¹; Claudia Haagen-Schützenhöfer¹; Jan-Philipp Burde¹; Thomas Wilhelm¹; Lana Ivanjek¹; Martin Hopf¹; Liza Doptaka³; Verena Spatz³
¹University of Graz; ²Goethe-University Frankfurt; ³University of Vienna; ⁴University of Technology Darmstadt

CLOSING THE GAP BETWEEN TEACHING PRACTICE AND EDUCATIONAL RESEARCH: SCIENCE TEACHERS WITH A PHD DEGREE CONDUCTING PRACTICE-ORIENTED RESEARCH IN SCHOOL CONTEXT
Gjalt Prins¹; Harrie Eijkelhof²
¹Freudenthal Institute, Utrecht University; ²Freudenthal Institute

DEMISTIFYING IN-SERVICE TEACHERS’ STRUGGLE: THEIR NEEDS AND CHALLENGES IN ENCOMPASSING STEM/STEAM EDUCATION
Turner Lam; Tzu Hua Wang; Fu Yuan Chiu
National Tsing Hua University

AN INVESTIGATION OF LIFE SCIENCE TEACHERS’ CONTENT KNOWLEDGE AND PERSISTENT MISCONCEPTIONS
Amy Tankersley¹; Elizabeth Lewis¹; Ana Rivera²; Lyrica Lucas¹; Brandon Heldon³
¹University of Nebraska-Lincoln; ²Seattle University; ³Boulder Learning Inc.

THE QUALITY OF EXPERIENCED CHEMISTRY TEACHERS’ TOPIC SPECIFIC PCK AND CONTENT KNOWLEDGE IN ELECTROCHEMISTRY
Fumai Mudindo; Marissa Rollnick; Eunice Nyamupangedengu
University of Witwatersrand

PRIMARY SCHOOL TEACHERS EXPERIENCE OF THE DIGITALISATION OF TEACHING
Pernilla Josefsson; Clara Eishow
School of Natural Science, Technology and Environmental

FIRST STEPS TOWARDS BUILDING ENGINEERING PCK - NOVICE TEACHERS IN THE CONTEXT OF PROFESSIONAL DEVELOPMENT
Peer Daugbjerg; Lars Brian Krogh; Martin Sillasen
VIA University College
## WEDNESDAY 15:00 - 17:00

**OP51 - STRAND 1 - FORMS OF REASONING IN SCIENCE LEARNING**

**Chairperson(s): Takuya Matsuura**

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<td>Takuya Matsuura</td>
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**OP50 - STRAND 1 - REPRESENTATION AND METAREPRESENTATIONAL COMPETENCE IN SCIENCE LEARNING**

**Chairperson(s): Sina Lenski**

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<td>YOUNG CHILDREN AND PERSONIFYING REASONING</td>
<td>Marida Ergazaki, Aggeliki Dimitrakopoulou, Alexandra Spai, Dimitra Nousi</td>
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<td>Yun-Ping Ge, Hak Ping Tam</td>
<td>†National Dong-Hua University; ‡National Taiwan Normal University</td>
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<td>Sina Lenski, Jörg Großschedl</td>
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**OP51 - STRAND 2 - INTEREST AND MOTIVATION IN STEM**

**Chairperson(s): Ayla Cetin-Dindar**

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Robbert Smit; Nicolas Robin; Christina De Toffol; Sanja Atanasova
University of Teacher Education St. Gallen

STUDENTS’ CONCEPTIONS OF STEM PROFESSIONALS AND THEIR RELATION TO THEIR STEM CAREER INTEREST
Winnie Wina Mui So; Yu Chen
The Education University of Hong Kong

AN INNOVATIVE DESIGN IN RESEARCH, EDUCATION, AND MENTORSHIP PRE-COLLEGE PROGRAM
Hiba Hamdan1; Enja Osman2
1University of Cambridge; 2American University of Beirut

THE EFFECT OF EDUCATIONAL GAMES ON STUDENT MOTIVATION IN SCIENCE
Ayla Cetin-Dindar
Bartin University

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Chairperson(s): Sophie Canac

SCIENTIFIC CONCEPTS AND THE ROLE OF IMAGINATION IN THE LANGUAGE GAMES OF THE SCIENCE CLASSROOM
Magdalena Kersting
University of Oslo, Dept. of Physics

THE INFLUENCE OF LANGUAGE ON STUDENTS’ CONCEPTIONS OF THE NATURE OF MODELS
Ohad Levkovitch; Anat Yarden
Weizmann Institute of Science

PRE-SERVICE BIOLOGY TEACHERS’ CLASSROOM PRACTICES BASED ON HISTORY OF SCIENCE
Cirek Dilek Bakanay1; Burcu Gülay Güney2
1Istanbul Aydın University; 2Istanbul Aydın University

THE BON-IDEA HISTORY INFORM THE DESIGN OF NARRATIVES FOR HIGHLIGHTING GENERAL ASPECTS OF NOS?
Georgios Ampatzidis; Marida Ergazaki
University of Patras

DEVELOPMENT OF A RESOURCE FOR THE TEACHING OF CHEMICAL FORMULAS AND ITS APPROPRIATION BY TEACHERS
Sophie Canac1; Isabelle Kermen2
1Université Paris-Est Créteil; 2Université d’Artois

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Chairperson(s): Chuckie Calsado

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Judith Lederman1; Norman Lederman1; Selina Bartels2; Juan Jimenez1
1Illinois Institute of Technology; 2Valparaiso University

VIEWS ABOUT SCIENTIFIC INQUIRY: A STUDY OF GR 12 LEARNERS IN A SOUTH AFRICAN SCHOOL
Estelle Gaigher1; Annemarie Hattingh2; Gillian Kay2
1University of Pretoria; 2University of Cape Town

DO LUNAR PHASES INFLUENCE THE GROWTH OF PLANTS? SCIENTIFIC INQUIRY TO ENCOURAGE CRITICAL THINKING IN THE CLASSROOM
Tatiana Pina; Olga Mayoral; Jordi Solbes
University of Valencia

INQUIRY-BASED TEACHING AND LEARNING THROUGH SCIENCE FAIRS
Jürgen Paul; Yelva Larsen; Jorge Groß
University of Bamberg

BASELINE INQUIRY ON THE NATIONALIST, SCIENTIFIC, AND MASS-ORIENTED EDUCATION (NSMOE) STEM FRAMEWORK AND PEDAGOGY OF LUMAD COMMUNITY SCHOOLS IN MINDANAO, PHILIPPINES — ISSUES, CHALLENGES, SUCCESSES AND POSSIBILITIES
Chuckie Calsado; Arlene Clarisse Yu Julve; Jonallin Yang
AGHAM—Advocates of Science and Technology for the People
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Veerle Verschoren; Jan Sermeus; Eef Cornelissen; Jelle De Schrijver
Odisee University College

“I DO NOT LIKE A LENTIL BURGER FOR DINNER” HIGH SCHOOL STUDENTS’ MORAL REASONING IN SOCIO-SCIENTIFIC ISSUES
Tore Van der Leij
Groningen University

HOW DO PRE-SERVICE PRIMARY TEACHERS ASSESS THE CIRCUS WITH PERFORMING ANIMALS AND ITS EDUCATIONAL VALUE? A STUDY WITH PORTUGUESE, SPANISH AND GREEK STUDENTS
António Almeida; Beatriz García Fernández; Penelope Papadopoulou
1Instituto Politécnico de Lisboa; 2Facultad de Educación de Ciudad Real, Universidad de Castilla-La Mancha; 3University of Western Macedonia, Greece

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Universidad de Murcia

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Marianne Bissonnette; Pierre Chastenay; Chantal Francoeur
Université du Québec à Montréal

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Leonie Rennie; Susan Stocklmayer; John Gilbert
1Curtin University; 2Australian National University; 3The University of Reading

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Russell Tyler; Peta White
Deakin University

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Xavier Fazio
Brock University

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Rosária Justi; Beatriz Almeida; Monique Santos
Universidade Federal de Minas Gerais

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Hyunju Lee; Suhi Kwon
Ewha Womans University

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Room B6
Chairperson(s): Benedikt Heuckmann

WAKE UP- PREDICTORS OF STEM CELL DONATION FOR LEUKEMIA PATIENTS
Julia Holzer; Doris Elster
Universität Bremen

HEALTH LITERACY FOR CHILDREN WITH CHRONIC KIDNEY DISEASE
S.Lizette Ramos; Beatriz Panduro-Espinoza
1Universidad de Guadalajara; 2Hospital Civil de Guadalajara Dr. Juan I. Menchaca y Universidad de Guadalajara

LEARNING ABOUT HEALTHY NUTRITION WITH AN ESCAPE GAME
Tal Yachin; Miri Barak
Technion - Israel Institute of Technology
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Franziska Ginschel; Kirsten Schlüter
Institute of Biology Education

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Zélia Anastácio
Universidade do Minho

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Benedikt Heuckmann; Marcus Hammann; Roman Asshoff
University of Münster

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Chairperson(s): Anna Günther-Hanssen

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Ilse Bartosch¹; Malte Hüsing¹; Anja Lembens⁵; Bernhard Müllner¹; Agnes Turner²
¹University of Vienna; ²University of Klagenfurt

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Freja Kressdorf; Thorid Rabe
Martin-Luther-University

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Stephanie Rafanelli
Stanford University

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Aizuddin Mohamed Anuar; Sibel Erduran; Maia Chankseliani
University of Oxford

CHARACTERISING THE STANCE ON STEM OF STUDENTS FROM SECONDARY SCHOOL
Carme Grimalt-Álvaro; Digna Couso
CRECIM (Autonomous University of Barcelona)

CHILDREN’S ENTANGLEMENTS WITH SCIENTIFIC CONCEPTS: EMBODIED SCIENTIFIC
SUBJECTIVITY IN PRESCHOOL EMERGENT SCIENCE
Anna Günther-Hanssen
Department of Education, Uppsala University

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Chairperson(s): Jonna Wiblom

NORM CRITICAL SEXUALITY EDUCATION IN SWEDISH UPPER SECONDARY SCHOOL
Auli Arvola Orlander
Department of Mathematics and Science Education

SCRIPTURAL COMPETENCE AND CONSTRUCTION OF CONCEPTUAL KNOWLEDGE IN BIOLOGY. AN
EXAMPLE IN SECONDARY SCHOOL (ECRICOL PROJECT)
Yann LHOSTE¹; Séverine PERRON²; Patricia SCHNEEBERGER²; Denise ORANGE-RAVACHOL³
¹Université des Antilles; ²Université de Bordeaux; ³Université de Lille

HOW DO SCHOOL STUDENTS USE THEIR EXTANT KNOWLEDGE IN CONTEMPORARY BIOMEDICAL
RESEARCH?
Ralph Levinson¹; Stephen Price²; Haira Gandolfi¹; Paul Davies¹; Constantinos Korfias¹
¹University College London Institute of Education; ²University College London; ³University of Cyprus

A TRAINING PROGRAMME TO IMPROVE THE ARGUMENTATION COMPETENCE OF BIOLOGY
STUDENTS AGED 16-18. PRELIMINARY STUDY
José Antonio García Pérez; Daniel Cebrián-Robles; Ángel Blanco-López
Facultad de Ciencias de la Educación. Universidad de Málaga

DESIGNING FOR DIALOGUE IN TEACHING WITH SOCIO-SCIENTIFIC CONTROVERSIES
Jonna Wiblom; Maria Andrée; Carl-Johan Rundgren
Department of Mathematics and Science Education
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WHAT HAPPENS IN DIGITAL SCIENCE CLASSROOMS?
Susanne Walan
Karlstad University

EXAMINING THE PHYSICS TEACHERS’ SELF-EFFICACY BELIEFS TOWARDS THE USE OF
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Osman Sinan Demir; Uygar Kanlı
Gazi University Department of Physics Education

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Haydee De Loof; Susanne Walan; Jelle Boeve-dePauw; Niklas Gericke
1University of Antwerp; 2Karlstad University

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PROTOCOL EDITOR
Claire Wajeman; Isabelle Girault; Cédric d’Ham
Grenoble Alpes University

PROMOTING TEACHERS’ TPACK AND TPACK-CONFIDENCE THROUGH A VIDEO EDITING
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Bat-Shahar Dorfman; Bronwyn Terrill; Kate Patterson; Anat Yarden; Ron Blonder
1Weizmann Institute of Science; 2Garvan Institute of Medical Research

DESIGNING CAREER-RELATED INSTRUCTION IN SCIENCE EDUCATION
Anssi Salonen; Sirpa Kärkkäinen; Tuula Keinonen
University of Eastern Finland

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Giovanni Ravaioli; Eleonora Barelli; Laura Branchetti; Michael Lodí; Sara Satanassi; Olivia Levrini
1University of Bologna; 2University of Parma

DIDACTIC PROFILES IN PBL STEM TEACHING-LEARNING SEQUENCES
Jordi Domènech-Casal
Universitat Autònoma de Barcelona

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Engin Karahan; Ayçin Ünal
1Eskisehir Osmangazi University; 2Mugla Science and Arts Center

INVESTIGATING THE EFFECTS OF ROBOTIC ACTIVITIES IN SCIENCE CENTERS ON THE
DEVELOPMENT OF STUDENTS’ SCIENCE PROCESS SKILLS
Ömer Faruk Akca; Uygar Kanlı; Fitnat Köseoğlu
Gazi University, Gazi Faculty of Education, Department of Math and Science Education Program

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Melde G.R. Gilissen; Marie-Christine P.J. Knippels; Wouter R. van Joolingen
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THE IDEAS-COSMOS-EVIDENCE MODEL AND THE TEACHING OF THE EVOLUTION THEORY:
A FIRST APPROACH
Pinelopi Papadopoulou; Christina Dinolazou
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ANALYSIS OF THE PRODUCTION OF SCIENTIFIC PROJECTS BY UNDERGRADUATE BIOLOGY
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Daniel Manzoni-de-Almeida; Silvia Trivelato, F.L.; Pedro Marinho, E. L.; Marsilvio Gonçalves Pereira
1Escola de Ciências Biológicas e da Saúde, Centro Universitário das Faculdades Metropolitana
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Federal da Paraíba
INVESTIGATIONS OF MODELLERS AND MODEL VIEWERS IN AN OUT-OF-SCHOOL GENETIC-TECHNOLOGY LABORATORY
Julia Mierdel, Franz Bogner
University of Bayreuth

CHOOSING COURSE CONTENTS: TEACHERS’ APPROACHES TO GENETICS TEACHING MIRROR INCLUSION OR AVOIDANCE OF SENSITIVE ISSUES
Tuomas Aivelo, Anna Uitto
University of Helsinki

15:00 - 17:00  OP191 - STRAND 10 - CHALLENGES IN SCIENCE EDUCATION  Room E2 - Italia
Chairperson(s): Joshua Ellis

IMPLEMENTATION OF INQUIRY-BASED SCIENCE CURRICULUM REFORM IN CHALLENGING TEACHING ENVIRONMENT: PHILIPPINE CONTEXT
Dennis Danipog1; Suzanne Rice2; Susan-Marie Harding2
1University of the Philippines; 2University of Melbourne

EMERGENT NETWORKS AND RELATIONS BETWEEN DIFFERENT LEVELS OF A PHYSICS CLASSROOM’S COMPLEXITY
Ernani Rodrigues; Mauricio Pietrocola
Universidade de São Paulo

HOW DO TEACHERS TEACH UNCERTAINTY IN FRENCH HIGH SCHOOLS?
Julien Browaeys1; Nicolas Decamp2; Deborah Martin1
1MSC, Université Paris Diderot; 2LDAR Université Paris Diderot, UA, UCP, UPEC, U Rouen; 3Education Nationale

INTEGRATIVE STEM M.ED. DEGREE ALIGNING WITH CONTEMPORARY PERSPECTIVES IN ACADEMIA AND INDUSTRY
Noa Ragonis; Tili Wagner; Daphne Goldman; Osnat Dagan
Beit Berl College

TOWARD A PRODUCTIVE DEFINITION OF TECHNOLOGY IN STEM EDUCATION
Joshua Ellis1; Jeanna Wieselmann2; Gillian Roehrig2; Emily Dare2; Elizabeth Ring-Whalen3
1Florida International University; 2University of Minnesota; 3St. Catherine University

15:00 - 17:00  INVITED ROUND TABLE SYMPOSIUM DISCIPLINE-BASED EDUCATION RESEARCH JOURNALS  Room F1
Chairperson(s): Paola R.L. Heron

CBE—LIFE SCIENCES EDUCATION
Stephanie M. Gardner,
Department of Biological Sciences, Purdue University, USA

CHEMISTRY EDUCATION RESEARCH AND PRACTICE
David Treagust,
School of Education, Curtin University, Australia

THE JOURNAL OF GEOSCIENCES EDUCATION
Anne E. Egger,
Geological Sciences and Science Education Central Washington University Ellensburg, USA

PHYSICS EDUCATION
Gary Williams, Institute of Physics, London, UK

PHYSICAL REVIEW — PHYSICS EDUCATION RESEARCH
Paula Heron,
Department of Physics, University of Washington, Seattle, USA

15:00 - 17:00  INVITED ROUND TABLE SYMPOSIUM SCIENCE EDUCATION JOURNALS  Room F2
Chairperson(s): Sibel Erduran, Giulia Tasquier

CULTURAL STUDIES OF SCIENCE EDUCATION
Christina Siry1; Catherine Milne2; Michael P. Mueller3
1University of Luxembourg, 2New York University, USA, 3University of Alaska Anchorage, USA

INTERNATIONAL JOURNAL OF SCIENCE EDUCATION
Jan Van Driel, University of Melbourne, Australia
ENHANCING GLOBAL SCHOLARSHIP IN THE JOURNAL OF RESEARCH IN SCIENCE TEACHING
Dana L. Zeidler¹, Fouad Abd-El-Khalick²
¹University of South Florida, USA, ²University of North Carolina at Chapel Hill, USA

JOURNAL OF SCIENCE TEACHER EDUCATION: DEVELOPING KNOWLEDGE ABOUT SCIENCE TEACHER EDUCATION
Wayne Melville¹, Geeta Verma², Todd Campbell¹, Byung-Yeol Park¹
¹Lakehead University, Canada, ²University of Colorado Denver, USA, ³University of Connecticut, USA

RESEARCH IN SCIENCE AND TECHNOLOGICAL EDUCATION
Ann Childs; Judith Hillier; Jane McNicholl
Oxford University, UK

RESEARCH IN SCIENCE EDUCATION JOURNAL
Donna King
Queensland University of Technology, Australia

SCIENCE & EDUCATION: CONTRIBUTIONS FROM HISTORY, PHILOSOPHY, AND SOCIOLOGY OF SCIENCE AND MATHEMATICS
Kostas Kampourakis
University of Genève, Switzerland

EDITOR VOICES FROM SCIENCE EDUCATION: UPDATES ON A JOURNAL’S FIRST 100 YEARS
John Settlage¹, Sherry Southerland²
¹University of Connecticut, USA, ²Florida State University, USA

STUDIES IN SCIENCE EDUCATION
Justin Dillon
University of Exeter, UK

15:00 - 17:00  OP62 - STRAND 15 - ENGINEERING AND COMPUTATIONAL THINKING IN PRESCHOOL  Room F3
Chairperson(s): Elin Eriksson

ENHANCING COMPUTATIONAL THINKING SKILLS IN EARLY CHILDHOOD EDUCATION
Kalliopi Kanaki; Michail Kalogiannakis
University of Crete - Department of Preschool Education

A FRAMEWORK OF EARLY CHILDHOOD SCIENCE AND DIGITAL LEARNING: A COMPARATIVE ANALYSIS OF AUSTRALIAN AND FINNISH CURricula
Sari Havu-Nuutinen¹; Sanika Kewalramani²; Sini Kontkanen¹; Susanna Pöntinen¹; Nikolai Veresov²
¹University of Eastern Finland; ²Monash University

PRESCHOOL CHILDREN’S ENGINEERING PLANS
Nicole Glen
Bridgewater State University

DEVELOPING A ROBOT-SUPPORTED INCLUSIVE EDUCATION (ROSiE): A PLAY-BASED APPROACH TO STEM-TEACHING AND INCLUSION IN EARLY CHILDHOOD EDUCATION
Lykke Bertel¹; Eva Brooks¹; Susanne Dau²
¹Aalborg University; ²University College North

SCIENCE TEACHING IN PRESCHOOL WITH THE USE OF STRUCTURED TEACHING MATERIAL
Elin Eriksson; Monika Vinterek
Dalarna university

15:00 - 17:00  OP63 - STRAND 10 - CURRICULUM DEVELOPMENT 2  Room G1
Chairperson(s): Teresa Lupión-Cobos

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Petros Kariotoglou; Anastasios Zoupidis
University of Western Macedonia, Greece

SCIENTISTS’ VIEWS OF SCIENTIFIC ORIGINAlITY : OPPORTUNITIES AND CONSTRAINTS IN SCHOOL SCIENCE
Sarah Frodsham; Debra McGregor
Oxford Brookes University

DISCIPLINARY LITERACY AND INQUIRY-BASED INSTRUCTION: MAXIMIZING OR MISSING OPPORTUNITIES FOR GROWTH
Emily Hayden¹; Michelle Baird²
¹Iowa State University; ²Empire State College

EMPLOYING MODELING-BASED LEARNING TO MEET SCIENCE EDUCATION POLICY REFORMS FOCUSED ON INCLUDING DISCIPLINARY LITERACY
Michelle Eades-Baird¹; Emily Hayden²
¹SUNY Empire State College; ²Iowa State University
FACTORS INFLUENCING TEACHER RESPONSE TO EXTERNALLY DRIVEN CURRICULUM REFORM. A CASE STUDY.
Teresa Lupión-Cobos; Jose Hierrezuelo-Osorio; Isabel Cruz-Lorite; Ángel Blanco-López
University Of Malaga

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Chairperson(s): Erika Offerdahl

INTERPRETATION AND UTILIZATION OF WRITTEN FEEDBACK COMMENTS BY ELEMENTARY SCHOOL STUDENTS WORKING ON SCIENCE INVESTIGATION TASKS
Evangelia Irakleous; Nikos Papadouris; Costas Constantinou
University of Cyprus

WHAT COMPETENCES DO TEACHERS FOCUS AT WHEN FORMATIVELY ASSESSING THEIR STUDENTS’ IN INQUIRY-BASED SCIENCE EDUCATION?
Regula Grob1; Monika Holmeier2; Peter Labudde2
1University of Teacher Education Lucerne PHLU; 2Center for Science and Technology Education, University of Teacher Education Northwestern Switzerlan

A TEACHER SCAFFOLDING STUDENTS FORMATIVE ASSESSMENT DURING FINNISH LESSONS IN MAGNETISM
Sari Harmoinen
University of Oulu

SCIENCE EDUCATION STUDENTS’ OUTCOME AND ATTITUDE EFFECT WITH DIGITAL FORMATIVE ASSESSMENT INTERFACE
Jin Su Jeong; David González-Gómez; Florentina Cañada-Cañada; J. Samuel Sánchez-Cepeda; M. Carmen Conde-Núñez
University of Extremadura

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Erika Offerdahl1; Melody McConnell2; Jeffrey Boyer3; Aramati Casper3
1Washington State University; 2North Dakota State University; 3Colorado State University

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Room G3
Chairperson(s): Asli Saylan Kirmizigül

EXPLORING PRACTICING AND PRE-SERVICE TEACHERS’ PROCEDURAL METACOGNITIVE KNOWLEDGE: INITIAL FINDINGS AND POTENTIAL IMPLICATIONS
Gregory Thomas
University of Alberta

PERCEPTION OF EXPLANATIONS IN CHEMISTRY EDUCATION
Michael Elmer; Oliver Tepner
University of Regensburg

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Sathyam Sheoratan1; Ineke Henze1; Erik Barendsen2; Marc de Vries1
1Delft University of Technology; 2University of Nijmegen

WHAT IS THE QUESTION? CHARACTERIZING TEACHER QUESTIONING PRACTICE IN SECONDARY BIOLOGY LESSONS IN MEXICO
Maria Guadalupe Perez-Martinez1; Maria Teresa Guerra Ramos2; Jose Alberto Rojas Calzada1; Sara Sofia Calvário Ruiz1
1CONACYT - Universidad Autonoma de Aguascalientes; 2CINVESTAV-Unidad Monterrey; 1Universidad Autonoma de Aguascalientes

COMPARISON OF COMPUTER-AIDED AND HANDS-ON TEACHING APPROACHES ON STUDENTS’ ANXIETY TOWARDS SCIENCE
Asli Saylan Kirmizigül; Hasan Kaya
Erciyes University

THE ROLE OF MATHEMATICS FOR PHYSICS TEACHING AND LEARNING IN UPPER-SECONDARY SCHOOL
Lena Hansson; Òrjan Hansson; Kristina Juter; Andreas Redfors
Kristianstad University
WEDNESDAY AUGUST 28

INDIVIDUAL MODELLING ROUTES IN THE PROCESS OF SCIENTIFIC-MATHEMATICAL MODELLING
Johannes Meister; Annette Upmeier zu Belzen
Humboldt-Universität zu Berlin

COLLABORATIVE THOUGHT EXPERIMENTS: WHAT IS IT AND HOW DOES IT OCCURRED?
Hartono Bancong; Jinwoong Song
Seoul National University

MODELLING WITH EMBODIMENT IN SCIENCE EDUCATION: AN EVALUATION UNDER TWO APPROACHES
Paula Tuzón1; Jordi Solbes2; Samuel Hernandez2; Maria Angeles Gomez-Climent3
1Universitat de València; 2Universitat de Valencia; 3Universidad Internacional de La Rioja, Universidad de Valencia

DEVELOPING STUDENTS’ CRITICAL THINKING: LIKELIHOOD AND UNCERTAINTY ANALYSIS IN PARTICLE PHYSICS
Farahnaz Sadidi; Gesche Pospiech
Technische Universität Dresden

15:00 - 17:00  OP67 - STRAND 13 - PRESERVICE TEACHERS’ CONCEPTUAL KNOWLEDGE
Room G5
Chairperson(s): Frackson Mumba

EVALUATION OF THE EFFECTIVENESS OF A PRE-SERVICE CHEMISTRY TEACHERS’ PROFESSIONAL VISION DEVELOPMENT COURSE
Linda Honskusová; Martin Rusek
Charles University, Faculty of Education

PRE-SERVICE TEACHERS’ EXPLANATIONS OF PHYSICAL PHENOMENA USING A SELF-CONSTRUCTED PARTICLE MODEL OF MATTER
Arnau Amat; Isabel Jiménez-Bargalló
Universitat de Vic

CONCEPTIONS ABOUT “MESAUREMENT” AND “ATTRIBUTE” OF PRE-SERVICE PRIMARY SCHOOL TEACHERS IN FRANCE
Clement MAISCH
Université de Cergy-Pontoise

ENHANCING PRE-SERVICE ELEMENTARY TEACHERS’ PHYSICAL SCIENCE CONCEPTUAL KNOWLEDGE AND OWNERSHIP
Dermot Donnelly; Jennifer Click; Sara Meadows; Frederick Nelson; David Andrews
California State University Fresno

ARGUMENT-DRIVEN INQUIRY: INVESTIGATION OF PRE-SERVICE TEACHERS’ CONCEPTUAL UNDERSTANDINGS OF CHEMISTRY CONCEPTS
Guluzar Eymur1; Pınar Seda Çetin2
1Giresun Üniversitesi; 2Abant İzzet Baysal Üniversitesi

DEVELOPING PRE-SERVICE SCIENCE TEACHERS’ UNDERSTANDING OF ENGINEERING DESIGN AND SCIENTIFIC METHOD
Frackson Mumba
University of Virginia

15:00 - 17:00  OP68 - STRAND 14 - PEDAGOGICAL CONTENT KNOWLEDGE IV
Room G6
Chairperson(s): Samanta Angeliki

RESOLVING SHULMAN’S “AMALGAM”: A NEW MODEL FOR PEDAGOGICAL CONTENT KNOWLEDGE (PCK)
Vanessa Kind1; Kennedy Chan2
1University of Durham; 2Hong Kong University

STUDYING EXPERIENCES OF SCIENCE TEACHERS: EXPLORING PERSONAL PEDAGOGICAL CONTENT KNOWLEDGE OF GRADE SIX AND NINE TEACHERS
Saiqa Azam
Memorial University of Newfoundland

IN-SERVICE CHEMISTRY TEACHERS’ PCK OF ELECTROCHEMISTRY: A CASE IN SÃO PAULO, BRAZIL
Pablo Castro; Carmen Fernandez
University of São Paulo

THE IMPACT OF A LEARNING STUDY ON THE DEVELOPMENT OF PCK IN STOICHIOMETRY: THE STORY OF THREE TEACHERS
Stephen Andrew Malcolm; Elizabeth Mavhunga; Marissa Rollnick
University of the Witwatersrand
RELATIONSHIP BETWEEN TEACHERS’ TSPK, BELIEFS AND STUDENT OUTCOMES IN INTRODUCTORY ELECTRICITY
Thomas Schubatzky¹; Claudia Haagen-Schützenhöfer¹; Jan-Philipp Burde²; Thomas Wilhelm²; Lana Ivanjek²; Martin Hopf²; Liza Dopotka³; Verena Spatz³
¹University of Graz; ²Goethe-University Frankfurt; ³University of Vienna; ⁴University of Technology Darmstadt

GREEK SCIENCE TEACHERS’ TPACK EXPRESSION FOLLOWING PROFESSIONAL DEVELOPMENT
Angeliki Samanta¹; Dimitrios Psillos²
¹27th Primary School of Acharnes; ²Aristotle University of Thessaloniki

15:00 - 17:00 OP69 - STRAND 14 - CLASSROOM ASSESSMENT PRACTICES
Chairperson(s): Sandhya Krishnan

TEACHERS’ VIEW ON FORMATIVE ASSESSMENT — THE IMPACT OF EXPERIMENTAL TEACHING WITH PEER-ASSESSMENT
Iva Stuchlikova¹; Alena Hospesova; Iva Zlabkova; Jan Petr; Radka Zavodska; Lukas Rokos
Jihočeská univerzita v Českých Budějovicích

BOUNDARY OBJECTS AND CHANGES IN ASSESSMENT PRACTICES IN INQUIRY SCIENCE LESSONS
Catarina Correia¹; Natasha Serret²; Chris Harrison³
¹King’s College London; ²Nottingham Trent University

ENHANCING PHYSICS TEACHERS’ PROFESSIONAL DEVELOPMENT USING A DESIGN-BASED RESEARCH PROJECT
Thomas Frågåt; Maria Vetleseter Bøe; Carl Angell
Department of Physics, University of Oslo

EVALUATING SCIENCE TEACHERS’ TEACHING PRACTICES: STRENGTHS AND WEAKNESSES
Angelos Sofianidis; Maria Kallery
Aristotle University of Thessaloniki

PRODUCTIVE NEGATIVITY UNDERLYING FORMATIVE ASSESSMENT IN GAME-BASED LEARNING OF SCIENCE
Sandhya Krishnan; Georgia Hodges
The University of Georgia

15:00 - 17:00 OP70 - STRAND 14 - PROFESSIONAL DEVELOPMENT PROGRAMS OR COURSES
Chairperson(s): Claude-Émilie Marec

INVESTIGATING THE CONSISTENCY BETWEEN SCIENCE TEACHERS’ VIEWS AND PRACTICES DURING A PROFESSIONAL DEVELOPMENT PROGRAM
Christina Tsalikis¹; Pinelopi Papadopoulou¹; George Malandrakis²; Petros Kariotoglou³
¹University of Western Macedonia, Greece; ²Aristotle University of Thessaloniki, Greece; ³University of Western Macedonia, Florina, Greece

COMPONENTS OF PROFESSIONAL GROWTH IN SCIENCE TEACHERS: ANATOMY, PHYSIOLOGY AND TRAJECTORY OF TEACHER TRANSFORMATION
Corina Gonzalez Weil; Christopher Chacana-González; Joaquín Donoso-Pérez; Rafael Fernández-Verdugo; Bárbara González-Urzúa
Pontificia Universidad Católica de Valparaíso

A CASE OF DEVELOPING STEM CONCEPTIONS IN AN ONLINE TEACHER PROFESSIONAL DEVELOPMENT
Tasneem Anwar
The Aga Khan University

USING ACTIVITY THEORY TO ANALYZE CONTRADICTIONS IN A SCIENCE TEACHER TRAINING COURSE
Eftychia Nanni; Eleni Kolokouri
University of Ioannina

DEVELOPMENT OF ELEMENTARY SCHOOL TEACHERS’ SELF-EFFICACY FOLLOWING A SCIENCE AND TECHNOLOGY TRAINING AND SUPPORT PROGRAM
Claude-Émilie Marec¹; Christian Tessier²; Simon Langlois³
¹UQAM; ²Collège Bois-de-Boulogne; ³Cégep Marie-Victorin
### Thursday 9:00 - 11:00

#### Symposium 40 - Children's Learning in Multiple Scientific Contexts: From Motivation to STEM Education

**Room A1**

**Chairperson(s):** Eleni Kolokouri, Katerina Plakitsi; **Discussant:** Estelle Blanquet

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<td>Eleni Kolokouri; Katerina Plakitsi, University of Ioannina</td>
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<td>Motive as an Analytical Tool to Assess Focus in Preschool Science Activities</td>
<td>Clara Vidal Carulla; Karina Abdou, Linnaeus University, Kalmar, Sweden</td>
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<td>Empathizing and Systemizing in Early Years — A Video-Based Study on the Motivation to Do Science</td>
<td>Nina Skorsetz; Manuela Welzel-Breuer, Goethe University, Frankfurt; Heidelberg University of Education</td>
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<td>How to Stimulate Low-SES Multi-Language Learning Four-Year-Olds?</td>
<td>Thijs Eeckhout; Helena Taelman; Marlies Algoet; Odisee, University of Applied Sciences, Education (Teacher Training), Brussels, Belgium</td>
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#### Symposium 48 - Multi-Theoretical Frameworks and Methodologies for Advancing Equity: Figured-Worlds, Identities, Agencies, and Subjectivities

**Room A2**

**Chairperson(s):** Lucy Avraamidou; **Discussant:** Gillian Bayne

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<td>Shakhnoza Kayumova; Akira Harper, University of Massachusetts-Dartmouth</td>
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<td>Christina Siry; Sara Wilmes, University of Luxembourg</td>
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<td>Anna Danielsson; Susanne Engström; Per Norström; Kristina Andersson, Uppsala University, KTH Royal Institute of Technology, Sweden; Uppsala University, Sweden</td>
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<td>Identity, Agency and Subjectivities of Afro-Diasporic Teachers in STEM Classrooms</td>
<td>Jennifer Adams; Atasi Das; La Toya Strong; Susan McCullough, University of Calgary; The Graduate Center, CUNY, USA; Queens College, CUNY, USA</td>
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#### Symposium 41 - Catching and Holding Students' Interest in Science Learning

**Room B1**

**Chairperson(s):** Kimberley Pressick-Kilborn, Niels Dohn; **Discussant:** Martina Nieswandt

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<td>Niels Dohn, Aarhus University</td>
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<td>Catching and Holding Students' Interest in Biology Classes by Supporting Their Autonomy</td>
<td>Nadine Großmann; Cornelia Stiller; Inga Desch; Matthias Wilde, Bielefeld University; <em>n/a</em></td>
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<td>Curiosity Towards Science Inquiry in Preschool and Primary School</td>
<td>Stine Mariegaard; Morten Petersen; Claus Michelsen, University of Southern Denmark; UCL University College</td>
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<td>Pedagogical Practices That Catch and Hold Primary Students' Interest in Science: (Re-)Examining the Importance of ‘Connectedness’</td>
<td>Kimberley Pressick-Kilborn, University of Technology Sydney</td>
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09:00 - 11:00  Symposium 42 - PISA 2015: WHAT CAN SCIENCE EDUCATION LEARN FROM THE DATA?  Room B2

Chairperson(s): Jonathan Osborne; Discussant: Jonathan Osborne

SCIENCE TEACHING AND LEARNING: ANALYSIS OF PISA 2015 DATA FROM THE UNITED STATES AND GERMANY
Cory Forbes¹; Knut Neuman²; Anna Schiepe-Tiska³
¹Univ; ²IPN, Kiel; ³TUM, Munich

POSSIBLE CHARACTERISTICS OF PISA SCIENCE ITEMS DISCRIMINATING STUDENTS PERFORMANCE ACCORDING TO THEIR SOCIO-ECONOMICO-CULTURAL LEVEL AND THEIR ACADEMIC LEVEL
Mylène Duclos¹; Florence Le Hebel¹; Andréée Tiberghien¹; Pascale Montpied¹; Valérie Fontanier¹
¹UMS LLE Ecole Normale Supérieure de Lyon; ²CNRS, Lyon; ³IFE, Ecole Normale Supérieure de Lyon

ESTABLISHING MULTIDIMENSIONALITY: IDENTIFYING PATTERNS OF INQUIRY-DRIVEN SCIENCE INSTRUCTION
Sara Dozier
Stanford University

EXPLOITING COMPUTER-GENERATED DATA TO STUDY STUDENTS’ TEST-TAKING BEHAVIOR
Davide Azzoloni; Loris Vergolini; Nicola Bazoli
IRVAPP (Research Institute for the Evaluation of Public Policies) Bruno Kessler Foundation

09:00 - 11:00  Symposium 43 - SCIENCE IN EXHIBITIONS: DIFFERENT PERSPECTIVES FROM DIFFERENT ACTORS  Room B3

Chairperson(s): Marianne Achiam, Alexandra Moormann; Discussant: Kerstin Kremer

MUSEUM SCIENCE EXHIBITIONS AS ‘WRITERLY’ OR ‘READERLY’
Justin Dillon
University of Exeter

COMMUNICATION OBJECTIVES AND GOALS WITHIN A NATURAL HISTORY MUSEUM EXHIBITION
Alexandra Moormann¹; Kerstin Kremer²
¹Museum für Naturkunde; ²IPN Kiel Leibniz Institute for Science and Mathematics Education at Kiel University

SCIENTIST TALK: CONJECTURES OF THE IMPLIED VISITOR
Line Bruun Nicolaisen
University of Copenhagen

SCIENTISTS’ PERSPECTIVES ON SCIENCE EXHIBITIONS
Marianne Achiam; Jens Dolin
Department of Science Education, University of Copenhagen

09:00 - 11:00  Symposium 44 - WHAT DOES IT MEAN TO BE CRITICAL IN SCIENCE EDUCATION? IBERO-AMERICAN PERSPECTIVES  Room B4

Chairperson(s): Isabel Martins; Discussant: Christina Siry

WHAT COUNTS AS CRITICAL IN SCIENCE EDUCATION?
Livia Mantuano¹; Isabel Martins¹; Mariona Espinet²
¹Universidade Federal do Rio de Janeiro; ²Universitat Autònoma de Barcelona

CRITICAL APPROACHES IN SCIENCE EDUCATION: SOUTH AMERICAN PERSPECTIVES
Vilanova Rita¹; Isabel Martins¹; Ana Barrios²; Silvina Cordero¹; Ana Dumrauf²; Livia Mantuano²; Ruth Pantoya³
¹Universidad de la República; ²Universidad de Nariño; ³Universidad Nacional de La Plata

A SEARCH FOR PERSPECTIVES ON THE CONCEPT OF CRITIC IN SCIENCE EDUCATION JOURNALS: THE CASE OF MEXICO
Lizette Ramos¹; Adrianna Gomez²
¹Universidad de Guadalajara; ²Cinvestav, Mexico
EXPLORING CRITICITY IN THE SPANISH SCIENCE EDUCATION RESEARCH LITERATURE: THE CASE OF ENSEÑANZA DE LAS CIENCIAS
Laura Valdes Sanchez¹; Samuel Molina Schnorr²; Mariona Espinet³
¹Universitat Autònoma de Barcelona; ²Universidade de São Paulo

09:00 - 11:00 Symposium 45 - SCIENCE TEACHER PROFESSIONAL DEVELOPMENT: ADDRESSING CHALLENGES OF COMPLEXITY, RESPONSIVITY, AND SCALE
Room B5
Chairperson(s): Hannah Sevian; Discussant: David Treagust

SUPPORTING NOVICE SCIENCE TEACHERS IN HIGH-POVERTY SCHOOLS: CHALLENGES TO A SYSTEM-LEVEL APPROACH
Gail Richmond; Kraig Wray
Michigan State University

INTEGRATION INTO THE SCHOOL SYSTEM: CHALLENGES OF SECOND CAREER STEM TEACHERS
Effrat Akiri; Gabriella Shwartz; Yehudit Judy Dori
Technion - Israel Institute of Technology

A TEACHER-RESEARCHER JOINT VENTURE INITIATES CONCEPTUAL CHANGE IN STEM EDUCATION
Christel Bailyn¹; Jan Semmeus¹; Wirn Temmerman¹; Bram Robberecht¹; Jelle De Schrijver¹; Beatriz Garcia Fernandez²; Tsepô Mokuku³
¹Odisee University College teacher training secondary education Belgium; ²Universidad de Castilla-La Mancha, Ciudad Real, Spain; ³National University of Lesotho, Roma, Lesotho

TEACHER-DRIVEN PARTNERSHIP TO SUPPORT MID-CAREER CHEMISTRY TEACHERS
Hannah Sevian¹; Scott Bailyn¹; Gregory Banks³; Michael Clinchot²; Vesal Dini³; Marianne Dunne²; Robert Huiie²; Rebecca Lewis⁴; Stephanie Murray³; Raúl Orduña Picón¹; Pamela Pelletier³; Vicente Talanquer²
¹University of Massachusetts Boston; ²Boston Public Schools; ³Tufts University; ⁴Hingham Public Schools; ⁵University of Arizona

09:00 - 11:00 Symposium 46 - STRATEGIES OF NOS RESEARCH: STRENGTHS, LIMITATIONS, AND LOOKING FORWARD
Room B6
Chairperson(s): Andreas Nehring; Discussant: Norman Lederman, Judith Lederman

LET’S BE PRACTICAL: A CRITICAL REVIEW OF STUDIES ON LEARNING THE NATURE OF SCIENCE AMONG STUDENTS AND SCIENCE TEACHERS
Hernán Cofré¹; Paola Nuñez¹; David Santibañez²; Jose Manuel Pavez³; Martina Valencia¹; Claudia Vergara⁴
¹P. Universidad Católica de Valparaíso; ²Universidad Católica Silva Henríquez; ³University of Georgia; ⁴Universidad Alberto Hurtado

DEVELOPING SECONDARY SCIENCE TEACHERS’ EPISTEMOLOGICAL VIEWS OF SCIENCE AND PCK FOR ARGUMENTATION
Patrick Enderle; Renee’ Schwartz
Georgia State University

SCIENCE TEACHERS’ PCK OF ARGUMENTATION AND EPISTEMOLOGICAL BELIEFS: INFLUENCE OF A PD PROGRAM
Ozden Sengul¹; Patrick Enderle²; Renee’ Schwartz²
¹Bogazici University; ²Georgia State University

SYSTEMATICALLY REANALYSING QUANTITATIVE STUDIES ON EPISTEMIC BELIEFS IN SCIENCE: SAME SAME BUT DIFFERENT?
Andreas Nehring¹; Andrea Bernholt¹; Peter Edelsbrunner¹; Nele Kampa¹; Julia Schiefer⁴
¹Leibniz Universität Hannover - Institute for Science Education; ²Leibniz-Institut für die Pädagogik der Naturwissenschaften und Mathematik (IPN); ³ETH Zürich; ⁴Universität Tübingen

09:00 - 11:00 Symposium 12 - METAPHOR AND NARRATIVE IN SCIENCE AND SCIENCE EDUCATION
Room B7
Chairperson(s): Jörg Zabel, Annamaria Contini; Discussant: Tamer Amin

STORIES ABOUT NATURE AS AESTHETIC EXPERIENCE IN SCIENCE EDUCATION
Annamaria Contini; Lorenzo Manera; Alice Giuliani
University of Modena and Reggio Emilia, Italy, Department of Education and Human Sciences
METAPHORS AND STORIES IN A SCIENCE CLASSROOM — AN EXAMPLE
Federico Corni; Tiziana Altiero; Enrico Giliberti; Alessandra Landini
Department of Education and Humanities, University of Modena and Reggio Emilia, Italy

EXPERIENCING FORCES OF NATURE THROUGH THEIR STORIES
Hans Fuchs; Elisabeth Dumont
1Institute of Applied Mathematics and Physics, Winterthur, Switzerland; 2Institute of Applied Mathematics and Physics, ZHAW, Winterthur, Switzerland

NATURE AS A BREEDER: ABOUT BIOLOGY AS A METAPHORICAL SCIENCE, AND THE IMPLICATIONS FOR TEACHING
Jörg Zabel
University of Leipzig

Invited Symposium 09 - THE ROLE OF NATIONAL AND REGIONAL JOURNALS IN PROMOTING SCIENCE EDUCATION RESEARCH IN EUROPE
Room C1
Chairperson(s): Mariona Espinet; Discussant: Justin Dillon

THE CASE OF THE SPANISH JOURNAL ENSEÑANZA DE LAS CIENCIAS
Mariona Espinet; Anna Martí; Consina Márquez
Departament de Didàctica de la Matemàtica i de les Ciències Experimentalis, Universitat Autònoma de B

PUBLISHING AND DISSEMINATING RESEARCH OUTCOMES: CHALLENGES OF A FRENCH INTERNATIONAL JOURNAL OF RESEARCH IN SCIENCE AND TECHNOLOGY EDUCATION
Isabelle Kermen; Yann Lhoste
1Université d’Artois, LDAR, France; 2Université des Antilles, Pôle Martinique

NORDIC STUDIES IN SCIENCE EDUCATION (NORDINA)
Carl-Johan Rundgren; Are Turmo
1Department of Mathematics and Science Education at Stockholm University, Stockholm, Sweden; 2Norwegian Centre for Science Education, University of Oslo, Oslo, Norway

ZEITSCHRIFT FÜR DIDAKTIK DER NATURWISSENSCHAFTEN (ZFDN) — GERMAN JOURNAL OF SCIENCE EDUCATION
Knut Neumann; Annette Upmeier zu Belzen; Claudia von Aufschnaiter
1IPN - Leibniz Institute for Science and Mathematics Education, Kiel University, Germany; 2Humboldt-Universität zu Berlin, Germany; 3Institut für Didaktik der Physik, Justus-Liebig-Universität Gießen, Germany

Invited Symposium 10 - SIG 1 - COMPUTATIONAL THINKING, CODING AND DIGITAL TECHNOLOGIES IN EARLY CHILDHOOD
Room D1
Chairperson(s): Coral Campbell; Discussant: Coral Campbell

PREPARING PRE-SERVICE TEACHERS TO PROMOTE STEM ACTIVITIES IN PRESCHOOL CLASSROOMS WITH SCRATCHJR
Michail Kaloqiarmakis; Stamatios Papadakis
University of Crete

INTERSUBJECTIVE COMMUNICATION AND DIGITALIZATION IN EARLY YEARS CHEMISTRY AND PHYSICS
Andreas Redfors; Marie Fridberg; Agneta Jonsson; Susanne Thulin
1Kristianstad University; 2Kristianstad University

CREATIVITY AND CODING IN EARLY CHILDHOOD EDUCATION
Karen Murcia; Coral Pepper; Mathilda Joubert
1Curtin University; 2SHERIDAN COLLEGE

UNPLUGGED PROGRAMMING IN EARLY CHILDHOOD: THE POSSIBILITIES?
George Aranda; Joseph Ferguson
Deakin University
A DUAL-PROCESS APPROACH TO SCIENTIFIC LITERACY: PREDICTIVE AND ADAPTIVE RATIONALITY
Albert Zeyer
Bern University of Applied Sciences

PUPILS’ PERCEPTIONS ABOUT THE CONSEQUENCES OF THEIR SUSTAINABILITY-RELEVANT BEHAVIOUR
Deidre Bauer¹; Julia Arnold²; Kerstin Kremer²
¹IPN - Leibniz Institute for Science and Mathematics Education, Kiel, Germany; ²FHNW University of Applied Sciences and Arts Northwestern Switzerland

CAN PRE-SERVICE TEACHERS’ PERCEPTION OF ALLERGIC STUDENTS’ QUALITY OF LIFE BE A PREDICTOR OF THEIR ADAPTATION IN FUTURE PROFESSION?
Iztok Devetak¹; Sonja Posega Devetak¹; Tina Vesel Tajsek¹
¹University of Ljubljana, Faculty of Education, Ljubljana, Slovenia; ²General and teaching hospital Izola, Department of pediatrics, Izola, Slovenia; ³University Children’s Hospital, Department of Allergology, Rheumatology and Clinical Immunology, Ljubljana

DEVELOPMENT OF ADAPTIVE DIDACTIC RESOURCES FOR DECISION-MAKING ON ENVIRONMENTAL HEALTH PROBLEMS. FIRST STEP: CURRICULAR ANALYSIS
Gavidia Valentín; Álvaro Nuria; Olga Mayorala
Universitat de València

ISSUES OF CULTURE, POWER, AND IDENTITIES FOR U.S. SCIENCE EDUCATORS
Mary Atwater
University of Georgia, USA

“I AM A YOUNG IMMIGRANT WOMAN DOING PHYSICS AND ON TOP OF THAT I AM MUSLIM”: IDENTITIES AS COALITIONS
Lucy Avraamidou
University of Groningen

CULTURED IDENTITIES: A SOCIOLOGICAL ANALYSIS OF HOW THE CULTURE OF SCHOOL PHYSICS SHAPES STUDENTS’ VIEWS OF ADVANCED PHYSICS AS ‘NOT FOR ME’
Louise Archer
UCL Institute of Education

NAVIGATING SCIENCE IDENTITIES ACROSS CULTURAL CONTEXTS - TRANSITIONS, CULTURE AND NEGOTIATIONS
Lena Moller Madsen; Henriette Tolstrup Holmegaard
University of Copenhagen

LEARNING PHYSICS THROUGH MAKER PROJECTS — BETWEEN DISCIPLINARY AUTHENTICITY AND PERSONAL RELEVANCE
Maayan Schwartzer¹; Tal Peer²; Shulamit Kapon²
¹Technion - Israel Institute of Technology; ²Acheret Center

INTERDISCIPLINARITY IN STEM AS BOUNDARY PLAY
Pratim Sengupta; Marie-Claire Shanahan
University of Calgary

SLIPPING BETWEEN DISCIPLINES: HOW FORMING CAUSAL EXPLANATIONS MAY COMPEL CROSSING DISCIPLINARY BOUNDARIES
Sharona T. Levy¹; Asnat R. Zohar²; Ilana Dubovi³
¹University of Haifa; ²Ben-Gurion University
DISCIPLINES AND INTERDISCIPLINARITY IN STEM EDUCATION TO FOSTER SCIENTIFIC AUTHENTICITY AND DEVELOP EPISODESKILLS
Laura Branchetti¹; Olivia Levrini²
¹University of Parma; ²University of Bologna

09:00 - 11:00  Symposium 37 - USE OF VISUAL REPRESENTATIONS IN ASTRONOMY EDUCATION: ISSUES, AFFORDANCES AND RESEARCH PERSPECTIVES
Room F1

Chairperson(s): Italo Testa; Discussant: Kristina Zuza

VISUALISATION AND SPATIAL THINKING IN PRIMARY (ELEMENTARY) STUDENTS’ UNDERSTANDINGS OF ASTRONOMY
Russell Tytler¹; Peta White¹; Joanne Mulligan²
¹Deakin University; ²Macquarie University

STUDENTS’ CONCEPTUAL UNDERSTANDINGS ENHANCED THROUGH TECHNOLOGY INSTRUCTION AND VISUALIZATIONS
Kathy Cabe Trundle¹; Mesut Saçkes²
¹Utah State University, US; ²Balikesir University, Turkey

EXTRAPOLATION OF 3D AND ITS IMPORTANCE FOR TEACHING AND LEARNING PHYSICS AND ASTRONOMY - AN EXAMPLE FROM ASTROPHYSICS
Urban Eriksson
National Resource Center for Physics Education, Department of Physics, Lund university, Lund, Sweden

COMPARING THE EFFECTS OF TEXTBOOK AND INNOVATIVE VISUAL REPRESENTATIONS ON STUDENTS’ CONCEPTUALIZATION OF FAMILIAR ASTRONOMY PHENOMENA
Italo Testa¹; Silvia Galano¹; Arturo Colantoni²; Emanuella Puddu¹; Silvio Leccia¹
¹Federico II University; ²School of Science and Technology, Physics Division, University of Camerino, Italy; ¹INAF - Astronomical Observatory of Capodimonte, Naples, Italy

09:00 - 11:00  Symposium 02 - KNOWLEDGE FORMS AND TRANSFER IN SCIENCE EDUCATION
Room F2

Chairperson(s): Nina Bonderup Dohn; Discussant: Andrée Tiberghien

THE CONTEXT-DEPENDENCE OF KNOWLEDGE FORMS IN SCIENCE EDUCATION - A PHILOSOPHICAL ANALYSIS
Søren Harnow Klausen; Nina Bonderup Dohn
University of Southern Denmark

REAL EXPERIMENTS, COMPUTER SIMULATIONS AND MODELING: ACHIEVING SYNERGIES BETWEEN FORMS OF KNOWLEDGE IN AN ELECTRIC CIRCUIT THEORY LAB
Jonte Bernhard¹; Anna-Karin Carstensen²
¹Linköping Universitet; ²Jönköping University

CONCEPTUAL PROBLEMS IN TRANSFORMATION OF KNOWLEDGE BETWEEN DISCIPLINES: REACTION KINETICS
Michael May
University of Southern Denmark

POSITIONING STUDENTS TO DEVELOP AND TRANSFORM KNOWLEDGE IN INQUIRY-BASED VERSUS COOK-BOOK LABORATORY WORK
Nina Bonderup Dohn¹; Niels Bonderup Dohn²
¹University of Southern Denmark; ²Aarhus University

09:00 - 11:00  Symposium 39 - ARGUMENTATION AS AN EPISODESKITRACTICE
Room F3

Chairperson(s): Manuel Bächtold; Discussant: Kalypso Iordanou

DIFFERENTIATING POINTS OF VIEW AND KNOWLEDGE IN PERSONAL EPISODESKILOLOGY: TOWARDS A BETTER UNDERSTANDING OF ARGUMENTATION
Kévin De Checchi¹; Manuel Bächtold¹; Valérie Tartas²
¹University of Montpellier; ²University Jean Jaurès Toulouse

EPISODESKIC AIM AND RELIABLE PROCESSES IN ARGUMENTATION: DISCUSSING THE ACCEPTABILITY OF DIETS
Pablo Brocos Mosquera¹; Maria Pilar Jiménez-Aleixandre¹; Michael Baker²
¹University of Santiago de Compostela; ²CNRS - Télécom ParisTech
ARGUING TO EXPLAIN THE EVOLUTIONARY LINKS BETWEEN TWO HUMAN DISEASES: A CASE STUDY RESEARCH
Noa Ageitos1; Blanca Puig Mauriz1; Laura Colucci-Gray1
1University of Santiago de Compostela; 2The University of Edinburgh

DEVELOPING ARGUMENTATIVE SKILLS WITH COMPUTER-MEDIATED DEBATES ON SOCIO-SCIENTIFIC ISSUES
Gabriel Pallerés; Manuel Bächtold; Valérie Munier
University of Montpellier

09:00 - 11:00 Symposium 49 - UNDERSTANDING THE ROLE OF COHERENT SCIENCE TEACHER EDUCATION IN PROMOTING COHERENT SCIENCE INSTRUCTION: INSIGHTS FROM AN INTERNATIONAL COLLABORATION
Room G1
Chairperson(s): Jeffrey Nordine; Discussant: Amanda Berry

PROMOTING COHERENT SCIENCE INSTRUCTION THROUGH SCIENCE TEACHER EDUCATION
Jeffrey Nordine1; Ibrahim Delen2; Robert Evans3; Kalle Juuti4; Jari Lavonen5; Pernilla Nilsson5; Mathias Ropohl6; Matthias Stadler7
1Leibniz Institute for Science and Mathematics Education (IPN) at Kiel University; 2Usak University; 3University of Copenhagen; 4University of Helsinki; 5Halmstad University; 6University of Duisburg-Essen; 7University of Bergen

COHERENCE IN SCIENCE TEACHER EDUCATION: SUPPORTING PRESERVICE TEACHERS’ USE OF DIGITAL TECHNOLOGIES IN SCIENCE
Pernilla Nilsson; Pernilla Grankładt Enochson; Mattias Rundberg
Halmstad University

COHERENCE IN SCIENCE TEACHER EDUCATION: A CASE STUDY IN FINNISH TEACHER EDUCATION
Kalle Juuti; Jari Lavonen; Johanna Jauhiainen; Timo Kärkkäinen
University of Helsinki

TRANSITION FROM UNIVERSITY TO SCHOOL-BASED TEACHER EDUCATION
Mathias Ropohl1; Robert Evans3; Jakob Rasmus Holm3; Jenny Lorentzen3
1University of Duisburg-Essen; 2University of Copenhagen; 3IPN - Leibniz Institute for Science and Mathematics Education

09:00 - 11:00 Symposium 50 - ADDRESSING DIVERSITY IN SCIENCE - REQUIREMENTS, CHALLENGES, METHODS
Room G2
Chairperson(s): Stefan Sorge; Discussant: Gillian Roehrig

SAME SAME BUT DIFFERENT? UNDERSTANDING DIFFERENCES IN TEACHERS’ DIVERSITY-RELATED BELIEFS AND SELF-EFFICACY
Alice Langhans; Stefan Sorge; Katrin Engeln; Knut Neumann
Leibniz Institute for Science and Mathematics Education at Kiel University

TEACHING SCIENCE IN MULTICULTURAL CLASSROOMS: CHALLENGES AND OPPORTUNITIES FOR INTERCULTURAL LEARNING
Josette Farrugia
University of Malta

MAKING USE OF CONTEXTS AND INQUIRY TO ENGAGE ALL STUDENTS IN STEM LEARNING
Marta Romero Ariza; Ana Maria Abril Gallego; Antonio Quesada Armenteros
University of Jaén

CLASSROOM INTERACTIONAL MANAGEMENT IN ACHIEVEMENT-RELATED DIVERSITY SCIENCE AND MATH CLASSROOMS
Gökhan Kaya1; Metin Şardağ2; Gultekin Cakmakci3
1Kastamonu University; 2Van Yüzüncü Yıl University; 3Hacettepe University

09:00 - 11:00 Symposium 52 - CAREER-BASED SCENARIOS PROMOTING STUDENTS CAREER AWARENESS AND INTEREST TOWARDS SCIENCE — THE MULTICO PROJECT
Room G4
Chairperson(s): Tuula Keinonen, Costas Constantinou; Discussant: Jari Lavonen

USING A PHYSICS BASED CAREER SCENARIO TO PROMOTE FEMALE STUDENTS’ INTEREST IN PHYSICS AND PHYSICS CAREERS
John Connolly; Shirley Simon
University College London
ESTABLISHING RELEVANCE OF SCIENCE LEARNING THROUGH CAREER-BASED SCENARIOS
Miia Rannikmäe; Regina Soobard; Klaara Kask
University of Tartu

STRENGTHENING STUDENTS’ INTEREST IN SCIENCE: THE CASE OF ‘SAVING THE POLAR BEARS’
Irene Drymiotou; Costas Constantinou
University of Cyprus

FOSTERING STUDENTS’ INTEREST IN SCIENCE: THE ROLE OF VISITS TO AUTHENTIC WORKPLACES AND CONTACT TO SCIENCE EXPERTS
Lara Weiser; Annette Scheersoi
University of Bonn

09:00 - 11:00  Symposium 01- EVOLUTION EDUCATION RE-CONSIDERED  Room G5
Chairperson(s): Michael Reiss; Discussant: Ute Harms

LEARNING EVOLUTION ALONG A LEARNING PROGRESSION - LONGTERM CASE-STUDIES FROM AUSTRIA
Heidemarie Amon1; Jaqueline Scheibstock2; Martin Scheuch3
1Universität Wien AECC; 2Universität Wien AECC-Bio; 3University College for Agricultural and Environmental Education

BRIDGING THE GAP TOWARDS FLYING: ARCHAEOPTERYX AS A UNIQUE INQUIRY-BASED LEARNING MODULE
Franz Bogner
University of Bayreuth

UNDERSTANDING EVOLUTION 5-14: PRACTICAL GUIDANCE AND THEORETICAL REFLECTIONS
Terry Russell
University of Liverpool

MODELS AND MODELING IN EVOLUTION
Anita Schuchardt1; Kathy Malone2
1University of Minnesota; 2Nazarbayev University

THURSDAY 15:00 - 16:30

15:00 - 16:30  OP71 - STRAND 13 - PRE-SERVICE TEACHER EDUCATION STRATEGIES  Room A1
Chairperson(s): Teresa Conceição

PLANNING SCIENCE LESSONS WITH CONCEPTUAL INSTRUCTION MAPS
Christoph Gut1; Maja Brückmann2
1Zurich University of Teacher Education; 2University of Oldenburg

PRESERVICE SCIENCE TEACHERS’ USE OF VISUAL REPRESENTATIONS WHEN COMMUNICATING SCIENCE INFORMATION
Christine Tippett1; William McClune2
1University of Ottawa; 2Queens University, Belfast

SCIENCE TEACHERS’ VIEWS ON COTeachING WITH SCIENCE TEACHER EDUCATORS IN PRESERVICE TEACHER EDUCATION
Karen Marangio; Rebecca Cooper; Amanda Berry
Monash University

LESSON STUDY AS A PROFESSIONAL DEVELOPMENT MODEL TO PROMOTE PRE-SERVICE PHYSICS AND CHEMISTRY TEACHERS’ LEARNING ABOUT MULTIPLE REPRESENTATIONS
Teresa Conceição; Mónica Baptista; João Pedro da Ponte
University of Lisbon, Institute of Education

15:00 - 16:30  OP72 - STRAND 13 - PRE-SERVICE TEACHERS ENGAGING IN MODELING IN SCIENCE  Room A2
Chairperson(s): Siv G. Aalbergsjø

MODELING AND DEVELOPMENT OF CONTENT KNOWLEDGE AND ITS IMPORTANCE FOR EXPLAINING PHYSICS
Patrick Enkrott1; David Buschhüter1; Andreas Borowski2
1University of Potsdam; 2Universität Potsdam
A CASE STUDY EXAMINING HOW DIFFERENT PATHWAYS TO PRIMARY TEACHING EXPERIENCE SCIENTIFIC MODELING
Tina Vo1; Thomas (TJ) McKenna 2
1University of Nevada-Las Vegas; 2Boston University, Boston, Massachusetts, USA

DEVELOPING A TYPOLOGY OF PRE-SERVICE SCIENCE TEACHERS’ MODELLING STRATEGIES
Maximilian Göhner; Moritz Krell
Freie Universität Berlin

STUDENT TEACHERS’ VIEWPOINTS ON WORKING WITH MODELS AND MODELLING IN CHEMISTRY
Siv G. Aalberg1; Per Øyvind Dokken Solid
OsloMet - Oslo Metropolitan University

15:00 - 16:30 OP73 - STRAND 2 - SELF-PERCEPTION AND SOCIAL ISSUES IN SCIENCE LEARNING Room B1
Chairperson(s): Kristie Gutierrez

PSYCHOLOGICAL PATTERNS IN CHEMISTRY SELF-CONCEPT: RELATIONS WITH GENDER AND CULTURE
Lilith Ruschenpöhler; Silvija Markic
Ludwigsburg University of Education

A METACOGNITIVE ACTIVITY TO TEACH ABOUT THE AMOUNT OF SUBSTANCE CONCEPT USING SELF-QUESTIONING STRATEGY
JADIS H. PICIRILLI SILVA; SOLANGE LOCATELLI
Federal University of ABC

OUTREACH ACTIVITIES FOR YOUTH IN A RESEARCH UNIVERSITY — THE PARTICIPANTS VIEWS
Efrat Nativ Ronen; Tali Tal
Technion Israel Institute of Technology

LEADING FAMILIES TO STEM WITH EXTRA SCHOOL LEARNING
Kristie Gutierrez1; Margaret Blanchard2
1Old Dominion University; 2North Carolina State University

15:00 - 16:30 OP141 - STRAND 2 - LABORATORY, HANDS-ON ACTIVITIES AND SKILLS DEVELOPMENT Room B2
Chairperson(s): Martina Nieswandt

HOW CAN SCIENCE INQUIRY ENCOURAGE SOCIAL COHESION?
Alberto Bellocchi
Queensland University of Technology

PROBING CONCEPTUAL LEARNING DURING PRACTICAL WORK IN CHEMISTRY — A CASE STUDY
Ylva Pamment
Department of Educational Sciences, Lund Universitet

EXPERIMENTING WITH PROMPTS VS. RECIPE-STYLE EXPERIMENTING: IMPACT ON MOTIVATION AND ACHIEVEMENT
Cornelia Stiller; Matthias Wilde
Bielefeld University

AFFECT — A VITAL COMPONENT FOR MEANINGFUL ENGAGEMENT IN HIGH SCHOOL BIOLOGY INQUIRY AND ENGINEERING DESIGN GROUP ACTIVITIES
Martina Nieswandt1; Elizabeth McEneaney2
1University of Massachusetts Amherst; 2University of Massachusetts, Amherst

15:00 - 16:30 OP75 - STRAND 8 - OUT-OF-SCHOOL EXPERIENCES Room B3
Chairperson(s): Yelva Larsen

CONTROVERSIES RELATED TO BIODIVERSITY IN MUSEUM’S AUDIENCE PERSPECTIVE
Iohana Barbosa Pereira; Martha Marandino
Universidade de São Paulo

EFFECTS OF AUTHENTICITY AT OUT OF SCHOOL LEARNING OFFERS ON SCIENTIFIC UNDERSTANDING AND SYSTEMS THINKING SKILLS OF SECONDARY LEVEL ONE STUDENTS
Daniela Schrieb1; Andreas Müller2; Nicolas Robin1
1PHSG; 2University of Geneva
THURSDAY AUGUST 29

15:00 - 16:30  **OP76 - STRAND 9 - LEARNING OUTSIDE THE CLASSROOM II**  Room B4

Chairperson(s): Ingrid Eikeland

**WHAT DO THE FUTURE TEACHERS TEACH WHEN MAKING A BIOLOGY FIELD TRIP? A STUDY IN SOUTHERN COLOMBIA**
Elias Francisco Amortegui1; Valentín Gavidia Catalan2; Olga Mayoral García-Berlanga2
1Universidad Surcolombiana; 2Universidad de Valencia

**INTERACTIONS OF KNOWLEDGE ACROSS FIELD AND CLASSROOM SETTINGS**
Michael Giarnelliaro
Oregon State University

**ECOLOGICAL LITERACY IN FIELDWORK — TEACHING LEARNING AND MATERIALITY**
Kristin Persson; Maria Andrée; Cecilia Caiman
MND, Stockholm University

**STUDENTS ENGAGING IN A CONTROVERSY-BASED EDUCATIONAL PROGRAMME ABOUT BACTERIAL RESISTANCE IN A SCIENCE CENTRE**
Ingrid Eikeland1; Merethe Frøyland2
1Norwegian University of Life Sciences; 2Norwegian Centre for Science Education

15:00 - 16:30  **OP77 - STRAND 9 - LEARNING AT SCIENCE MUSEUMS**  Room B5

Chairperson(s): Patricia Patrick

**THE IMPACT OF SCHOOL VISITS TO A SCIENCE MUSEUM ON STUDENT SCIENCE IDENTITY: A LONGITUDINAL STUDY**
Neta Shaby1; Dana Vedder Weiss2
1Ben Gurion University of the Negev; 2Ben Gurion university of the Negev

**DEVELOPMENT AND EVALUATION OF A NON-FORMAL ENVIRONMENTAL EDUCATION PROGRAM AT THE LOCAL PALEONTOLOGICAL MUSEUM**
Marianna Kalaitzidaki; Nektaria Karagianni
University Of Crete, Primary Education

**A RESEARCH ON SCIENCE LEARNING EXPERIENCE OF ADULTS IN THE CONTEXT OF SCIENCE MUSEUM**
Songyi Heo1; Sung-Won Kim2
1Ewha Womans University,Seoul Science Center; 2Ewha Womans University

**FAMILIES TALKING ABOUT STINGRAYS: DETERMINING THE LEVEL OF CONVERSATION COMPONENTS AT A STINGRAY TOUCH TANK**
Patricia Patrick
Columbus State University

15:00 - 16:30  **OP78 - STRAND 12 - VIEWS ABOUT SCIENTISTS**  Room B6

Chairperson(s): Katrin Hochberg

**MIDDLE SCHOOL GIRLS IN A SCIENTIFIC CONTEXT AND THEIR CONCEPTION ABOUT SCIENTISTS: WHAT CAN BE LEARNED?**
Maria Inês Ribas Rodrigues1; Diana Ribas Rodrigues1; Camila Sgnori1
1Federal University of ABC; 2Federal University of ABC - UFABC; 3University of São Paulo - USP

**THE ANALYSIS OF THE IMAGE OF SCIENTISTS PORTRAIT IN THE TURKISH BIOLOGY TEXTBOOKS IN TERMS OF GENDER BIAS**
cicek dilek Bakanay
İstanbul Aydin University
INTERACTION BETWEEN INTEREST AND SELF-CONCEPT IN PREDICTING SCIENCE CAREER ASPIRATIONS
Jingoo Kang; Ilpo Jäppinen; Anssi Salonen; Tuula Keinonen
University of Eastern Finland

WHAT DO SCIENTISTS DO? — INCREASING AWARENESS OF SOCIAL AND NETWORKING ASPECTS IN EVERYDAY ACTIVITIES OF SCIENTISTS TEACHING SPIN AND MAGNETISM PHENOMENA IN SCHOOL LABS
Katrin Hochberg; Jochen Kuhn
TU Kaiserslautern

15:00 - 16:30  OP79 - STRAND 12 - EXPLORATIONS OF PRIVILEGE AND CULTURE  Room B7
Chairperson(s): Silvija Markic

MULTICULTURAL ENVIRONMENTAL EDUCATION - INSIGHTS FROM A PIONEERING ULTRAORTHODOX CITY IN ISRAEL
Daphne Goldman1; Iris Alkaher2
1Beit Berl College; 2Kibbutzim College of Education, Technology and The Arts

SCIENCE EDUCATION FOR REFUGEE STUDENTS — IMPLEMENTATION, PERCEPTION AND IMPLICATIONS
Mario Schmiedebach; Claas Wegner
Bielefeld University

MAKING PRIVILEGE THROUGH STEM EDUCATION
Majd Zouda
OISE, University of Toronto

TEACHERS’ BELIEFS ABOUT THE ROLE OF CULTURE IN CHEMISTRY LEARNING
Silvija Markic1; Lilith Rüschenpöhler1; Marlon Schneider2
1Ludwigsburg University of Education; 2University of Bremen

15:00 - 16:30  OP80 - STRAND 7 - EXPERIMENTATION, DATA EVALUATION, AND ARGUMENTATION  Room C1
Chairperson(s): Jorunn Grip

STUDENTS’ RESPONSES TO ANOMALOUS DATA AND CONCEPTUAL UNDERSTANDING
Ana Elisa Montebedeli Motta1; Caio Castro Freire1; Marcelo Tadeu Motokane2
1Postgraduate Program in Science Teaching, University of São Paulo; 2Faculty of Philosophy, Sciences and Letters of Ribeirão Preto, University of São Paulo

STUDENTS’ EXPLANATIONS AND ARGUMENTS WHEN USING FIRST OR SECOND-HAND DATA
Maira Batistoni e Silva; Silvia Frateschi Trivelato
Universidade de São Paulo

GROUP DIALOGUES IN NORWEUGIAN PHYSICS CLASSROOMS
Jorunn Grip; Arne Stormo
NTNU - Norwegian University of Science and Technology

15:00 - 16:30  OP81 - STRAND 4 - INTERACTIVE MATERIALS AND GAMES IN PHYSICS AND CHEMISTRY  Room D1
Chairperson(s): Sandhya Krishnan

LEARNING CHEMISTRY THROUGH CONCEPT MAP WITH CLICKABLE DIGITAL RESOURCES (HYPERMEDIA MAP)
Joana Aguiar; Paulo Correia
Universidade de São Paulo

THE DESIGN AND EVALUATION OF DIGITAL MATERIALS TO INTRODUCE QUANTUM PHYSICS AT UPPER SECONDARY SCHOOL
Tim Bouchée; Lesley de Putter-Smits; Marieke Thurlings; Birgit Pepin
Eindhoven University of Technology

APPROACHING MODERN PHYSICS THROUGH A VIDEOGAME
Maria Guida1; Alessia Giampaoli2; Lisa Lazzarato3
1INDIRE; 2LNLS-INFN; 3Formicablu srl

PRODUCTIVE NEGATIVITY UNDERLYING FORMATIVE ASSESSMENT IN GAME-BASED LEARNING OF SCIENCE
Sandhya Krishnan; Georgia Hodges
The University of Georgia
15:00 - 16:30  OP192 - STRAND 11 - ASSESSING STUDENTS' INTEREST  Room D3
Chairperson(s): Daniel Morin Ocampo

STUDENTS’ CONTEXTUAL INTERESTS IN DIFFERENT SCIENCE SUBJECT-BASED CONTENT
Moonika Teppo; Regina Soobard; Miia Rannikmae
University of Tartu

IDENTIFICATION OF CHEMISTRY CONTEXTS THAT INTEREST GREEK STUDENTS
Katerina Salta1; Dionysios Koulougliotis2
1National and Kapodistrian University of Athens; 2Ionian University

BOOSTING ENJOYMENT AND INTEREST BUT NOT NECESSARILY ACHIEVEMENT: THE EFFECTS OF INQUIRY-BASED SCIENCE EDUCATION ON STUDENT OUTCOMES
Christian Bertsch1; Silvia Salchegger2; Christina Wallner-Paschon2
1University of Teacher Education Vienna; 2BIFIE - Bundesinstitut für Bildungsforschung, Innovation & Entwicklung des österreichischen Schulwes

THE DIFFERENT TYPOLOGIES DESCRIBING THE INTEREST OF BRAZILIAN YOUTH IN SCIENCE
Daniel Morin Ocampo1; Eliziane da Silva Dávila2; Luiz Caldeira Brant Tolentiño-Neto1; Cirlande Cabral da Silva1
1UFSM; 2IFFAR; 3IFAM

15:00 - 16:30  OP38 - STRAND 1 - SCIENTIFIC UNDERSTANDING AND LEARNING WITH CHILDREN  Room E2 - Italia
Chairperson(s): Ala a Samarapungavan

FOSTERING DIVERSITY AND CULTURAL AWARENESS EMANATED FROM LEARNING ONE’S CONTEXT
Lamprini Chartofylaka; Thomas Forissier
Université des Antilles

USING A COGNITIVE SCIENCE FRAMEWORK TO EXPLAIN ACHIEVEMENT EFFECTS RESULTING FROM INTEGRATING LITERACY WITHIN SCIENCE IN GRADES 1-2
Nancy Romance; Michael Vitale
Florida Atlantic University

NEW PERSPECTIVES ON STUDENTS’ MODELS OF AN ABSTRACT CONCEPT: THE CASE OF THE ‘ABSENT’ LIGHT
Kalliopi Paridi
University of Cyprus

KINDERTAGENER’S EMERGING PARTICLE MODELS OF MATTER TO EXPLAIN MATERIAL PHENOMENA
Ala Samarapungavan; Lynn Bryan
Purdue University

15:00 - 16:30  IW01 - Invited Workshop - GETTING YOUR IDEAS INTO PRINT: PLANNING, DEVELOPING AND PUBLISHING A BOOK IN THE ESERA SERIES  Room F1
Chairperson(s): Claudia Acuna, Robin Millar

15:00 - 16:30  OP83 - STRAND 1 - ECOLOGICAL AND ENVIRONMENTAL EDUCATION  Room F2
Chairperson(s): Barnd Unger

STUDENTS’ MEANING MAKING IN ECOLOGY EDUCATION
Hanna Wanselin; Brita Johansson Cederblad; Lena Wennersten; Mats Lindahl; Susanne Wikman Linnaeus

THE WATER CYCLE: AQUIFERS AND UNDERGROUND WATERS POLLUTION MODELLING.
Maria Roser Nebot; Conxita Márquez
Universidad Autónoma de Barcelona

STUDENT’ CONCEPTIONS ABOUT THE DRIVERS AND CONSEQUENCES OF GLOBAL CHANGE
Irene Lampert; Kai Niebert
University of Zurich

GRANDMA JOHNSON REVISITED — PRE-SERVICE TEACHERS METAPHORICAL UNDERSTANDING OF DECOMPOSITION
Barnd Unger
Leibniz Universität Hannover
15:00 - 16:30  OP84 - STRAND 15 - EMOTIONAL ENGAGEMENT, INTEREST AND MOTIVATION IN EARLY CHILDHOOD SCIENCE  Room F3

Chairperson(s): Maria Kallery

**DRAMATIC INQUIRY, ENGINEERING DESIGN CHALLENGES AND INTEGRATED STEAM: EFFECTS ON EARLY CHILDHOOD COGNITION AND INTEREST IN ENGINEERING AND TECHNOLOGY**
Kathy Malone¹; Karen Irving¹; Vinta Tiarani¹; Rachel Kajfez¹; Hochlei Lin¹; Trudy Giassi¹; Brian Edmiston²
¹Nazarbayev University; ²The Ohio State University

**EMOTIONAL ENGAGEMENT IN THE APPLICATION OF EXPERIMENTAL ACTIVITIES WITH EARLY CHILDRENS**
Kellys Saucedo; Mauricio Pietrocola
Faculty of Education - University of Sao Paulo

**FOSTERING ENJOYMENT IN SCIENCE EDUCATION THROUGH DRAMA ACTIVITIES IN SCIENCE BIRTHDAYS**
Jaakko Turkka; Maija Aksela
University of Helsinki, Department of Chemistry

**COGNITIVE STYLE AND MOTIVATION AND LEARNING IN INQUIRY BASED EARLY-YEARS SCIENCE ACTIVITIES**
Maria Kallery¹; Agelos Sofianidis¹; Popi Pationioti²; Kaliopi Tsialma³; Xristina Katsiana²
¹Aristotle University of Thessaloniki; ²Pre-primary Education; ³Primary Education

15:00 - 16:30  OP85 - STRAND 13 - METHODS OF SCIENCE TEACHING - COURSES AND SKILLS  Room G1

Chairperson(s): Jan Schröder

**PRACTICE TEACHERS’ VIEWS AND EXPERIENCES OF RESEARCH-BASED SCIENCE TEACHER EDUCATION – A CASE WITHIN INITIAL TEACHER EDUCATION IN NORWAY**
Katarina Pajchel; Kirsti Jegstad; Gunilla Eklund; Siv G. Aalbergsjø; Per Øyvind Dokken Solid
OsloMet - Oslo Metropolitan University

**DEVELOPMENT OF AN ASSESSMENT OF ATTENTIVENESS FOR SCIENCE TEACHER PROGRAM EVALUATION**
Leslie Atking; Michele Carney; Sara Hagenah; Tatia Totorica
Boise State University

**EFFECT OF INTERACTIVE PRACTICUM COURSE ON SCIENCE TEACHING PRACTICES OF PRE-SERVICE SCIENCE TEACHERS**
Iyad Dkeidek¹; Iyad Dkeidek²
¹Al-Qasimi Academic College for teachers; ²Al-Quds University

**ASSESSING STUDENT TEACHERS’ SKILLS TO PLAN PHYSICS LESSONS**
Jan Schröder¹; Christoph Vogelsang²; Josef Riese¹
¹RWTH Aachen University; ²Universität Paderborn

15:00 - 16:30  OP86 - STRAND 13 - PEDAGOGICAL CONTENT KNOWLEDGE V  Room G2

Chairperson(s): Vesna Ferk Savec

**TEACHING KNOWLEDGE RELATED TO SCIENTIFIC PRACTICES: A REFLECTION FROM THE HISTORY OF PCK**
Stefannie Ibraim¹; Rosária Justi²
¹Universidade de Brasilia; ²Universidade Federal de Minas Gerais

**DEVELOPMENT OF PROSPECTIVE PHYSICS TEACHERS’ PCK WHILE PREPARING TO A TEACHING PRACTICE**
Ann-Kathrin Joswig; Josef Riese
RWTH Aachen University

**TRACKING EFFECT OF PEDAGOGICAL TRANSFORMATION OF CONTENT KNOWLEDGE ON LEARNER PERFORMANCE: A JOURNEY FROM TSPCK INTERVENTION TO LEARNER PERFORMANCE**
Olutosin Solomon Akinyemi; Elizabeth Mavhunga
University of the Witwatersrand

**THE IMPLEMENTATION OF TPACK AND SAMR MODELS IN SCIENCE TEACHER TRAINING PROGRAMS AT THE UNIVERSITY OF LJUBLJANA**
Vesna Ferk Savec; Spela Hrast
University of ljubljana, Faculty of Education
THURSDAY AUGUST 29

15:00 - 16:30  OP87 - STRAND 13 - PERCEPTIONS OF STEM  Room G3

Chairperson(s): Mónica Baptista

SINGAPOREAN PRE-SERVICE TEACHERS’ PERCEPTIONS ON STEM EDUCATION
Dominic Koh; Aik Ling Tan
National Institute of Education

PERCEIVED RELEVANCE OF PHYSICS CONTENT KNOWLEDGE - PERSONAL CONSTRUCTS
Joost Massolt; Andreas Borowski
University of Potsdam

REVEALING PRE-SERVICE TEACHERS’ MIND MAPS ON STEM EDUCATION THROUGH STEM IMAGES
Aslı Koçulu; Şefika Girgin; Ünsal Umut Topsakal
Yıldız Technical University

PROSPECTIVE PHYSICS AND MATHEMATICS TEACHERS’ PERSPECTIVES ABOUT STEM INTEGRATION
Mónica Baptista; Ana Henriques; Hélia Oliveira
Instituto de Educação da Universidade de Lisboa

15:00 - 16:30  OP88 - STRAND 14 - DESCRIBING AND ASSESSING TEACHING PERFORMANCE  Room G4

Chairperson(s): Simon Taylor

WHAT MAKES A GOOD PHYSICS TEACHER? THE SHARED VISION OF FINNISH TEACHER EDUCATORS.
John Airey, Lotta Jons; Mats Braskén
1Department of Mathematics and Science Education, Stockholm University; 2Åbo Akademi University

Evolving nature of teaching practices of an experienced primary school science teacher
Deya Chakraborty; Saroj Kumar Sanyal; Gillian Kidman; Niranjan Casinader
1Monash University; 2Ichamati Government Primary School

Science and math teachers performance assessment to develop personalized professional learning
Dace Namsone; Pavel Pestov; Ilze Saleniece; Liga Cakane
1University of Latvia; 2National Center for Education

Adopting knowledge building pedagogy to support epistemic agency and collaborative contribution in science classes: A case study in New Zealand schools
Simon Taylor
University of Waikato

15:00 - 16:30  OP89 - STRAND 14 - INSTITUTIONAL CONTEXT AND SUPPORT FOR TEACHING  Room G5

Chairperson(s): Paulo Sérgio Garcia

Teachers’ working context and inquiry-based learning design work during professional development
Shani Zur; Rachel Levin Peled; Tai Tai
Technion - Israel Institute of Technology

Towards a cognitive behavioural intervention to support science teacher wellbeing
Richard Brock; Alex Manning; Emma Towers
King’s College London

Teach to lead ... to stay?: Examining the impact of the structure and nature of Noyce Master Teacher Fellows’ program on STEM teacher retention
Brett A. Criswell; Gregory T. Rushton; Katherne Sharp
1Department of STEM Education, University of Kentucky; 2Tennessee STEM Education Center, Middle Tennessee State University

The impact of large scale assessments on professional development opportunities for elementary science teachers in Brazil and Canada
Paulo Sérgio Garcia, Xavier Fazio
1Universidade Municipal de São Caetano do Sul; 2University of Brock
15:00 - 16:30  OP90 - STRAND 16 - CHILDREN IDEAS ABOUT SCIENCE AND SCIENTISTS/EPISTEMIC-EVERYDAY KNOWLEDGE  Room G6

Chairperson(s): Stephane Cyr

A SERIOUS GAME TO TEACH EPISTEMIC KNOWLEDGE: THE PLEASURE OF LEARNING TO THINK AND ACT LIKE A SCIENTIST
Angel Vazquez-Alonso; Maria-Antonia Manassero-Mas; Antoni J. Bennassar Roig
1University of Balearic Islands; 2University of the Balearic Islands

ELEMENTARY SCHOOL STUDENTS PLANNING AND CARRYING OUT INVESTIGATIONS: EPISTEMIC THINGS AND EXPERIMENTAL CONDITIONS
Lucia Sasseron
University of Sao Paulo

‘A SCIENTIST KNOWS WHAT S/HE’S DOING’: EXPLORING THE EFFECT OF SCIENTIST-LED OUTREACH ON PRIMARY CHILDREN’S SCIENCE SELF-EFFICACY BELIEFS
Sarah Carroll; Veronica McCauley; Muriel Grenon
1School of Natural Sciences, National University of Ireland Galway; 2School of Education, National University of Ireland Galway

INTERDISCIPLINARITY MODEL FOR MATHEMATICS AND SCIENCE IN PRIMARY SCHOOL
Stephane Cyr; Simon Langlois; Guillaume Poliquin; Patrick Charland; Nathan Béchard; Andréane St-Hilaire
1Universite du quebec à Montréal; 2Collège Marie-Victorin; 3Collège Ahuntsic; 4Collège Maisonneuve

15:00 - 16:30  OP91 - STRAND 17 - INTERACTIVE LEARNING ENVIRONMENTS AT UNIVERSITY LEVEL  Room G7

Chairperson(s): Nadja Belova

SUPPORTING THE UNDERSTANDING OF THE KEY CORE CONCEPTS OF ENGINEERING MECHANICS BY THE HELP OF INTERACTIVE ONLINE MODULES
Marcel Pelz; Martin Lang; Yasemin Özmên; Jörg Schröder; Felix Walker; Ralf Müller; Christopher Klupak
1University of Duisburg-Essen; 2Technical University of Kaiserslautern

EMERGENT LEARNING OF STEREOCHEMISTRY DURING ACTIVE ENGAGEMENT WITH MULTIMODAL SEMIOTIC RESOURCES
Susanne Wikman; Anne Linder; Cedric Linder
1Linnaeus university; 2Uppsala University

DO GAMIFIED VIRTUAL LABORATORY SIMULATIONS LEAD TO AN INCREASE IN STUDENT KNOWLEDGE AND INTRINSIC MOTIVATION TO LEARN IN AN INTRODUCTORY BIOLOGY COURSE FOR NON-MAJORS?
Bina Rai; Chen Huei Leo
Singapore University of Technology and Design

INNOVATING HIGHER EDUCATION VIA GAME BASED LEARNING ON MISCONCEPTIONS
Nadja Belova; Christian Zowada
University of Bremen

15:00 - 16:30  OP196 - STRAND 2 - CULTURAL DIFFERENCES, LANGUAGE AND ADULT EDUCATION  Room G8

Chairperson(s): Angela Stott

INTERNATIONAL STUDENTS’ SOCIAL AND INTELLECTUAL INTEGRATION IN A STEM INITIAL TEACHER EDUCATION COURSE IN ENGLAND
Catarina Correia; Arthur Galamba
King’s College London

A TASK-SPECIFIC WARNING INTERVENTION IMPROVES ADULTS PERFORMANCE IN OVERCOMING INTUITIVE INTERFERENCE
Genevieve Allaire-Duquette; Reuven Babai; Ruth Stavy
Tel Aviv University

A WORD-LEVEL ANALYSIS OF BARKING AT PRINT FOR ENGLISH SECOND LANGUAGE SCIENCE TEXTS
Angela Stott; Tanya Beelders
1University of the Free State South Campus; 2University of the Free State
ARE WE AFRAID OF INTERNATIONAL INSTRUCTORS? : EXAMINING EXPERIENCES OF INTERNATIONAL INSTRUCTORS AND THEIR STUDENTS’ PERCEPTIONS ABOUT THEM
Banu Aysar Erumit1, Valarie L. Akerson2, Gayle A. Buck2
1Recep Tayyip Erdogan University; 2Indiana University

THURSDAY 17:00 - 18:30

17:00 - 18:30  OP117 - STRAND 13 - RESEARCH METHODS  Room A1
Chairperson(s): Tanwarat Pinthong

USING EYE TRACKING TECHNIQUES TO INVESTIGATE RESPONSE PROCESSES TO MULTIPLE-CHOICE ITEMS OF A SCIENTIFIC REASONING TEST
Sabrina Mathesius1; Annette Ulmeier zu Belzen2; Dirk Krüger1
1Freie Universität Berlin; 2Humboldt-Universität zu Berlin

THE USE OF A PERSPECTIVE-BASED GENERIC QUESTIONING TOOL TO SCAFFOLD BIOLOGY TEACHER QUESTIONING
Eveline de Boer1; Fred Janssen1; Michiel Dam1; Jan van Driel2
1ICLON; 2UoM

A SEMANTICS PERSPECTIVE FOR THE ANALYSIS OF KNOWLEDGE BUILDING IN TLSS DESIGNED BY PRE-SERVICE SECONDARY SCIENCE TEACHERS
Sylvia Moraga1, Mariona Espinet1
1Universidad de Playa Ancha; 2Universitat Autònoma de Barcelona

A MIX-METHODS STUDY FOR IDENTIFYING COMPONENTS AND INDICATORS CONTRIBUTING TO SCIENCE TEACHER IDENTITY
Tanwarat Pinthong1; Chatree Faikhamta1; Weeyawat Jaitrong1; Jeerawan Ketsing1
1Kasetsart University; 2Natural History Museum, National Science Museum

17:00 - 18:30  OP180 - STRAND 13 - TEACHER NOTICING AND PROFESSIONAL VISION IN PRE-SERVICE TEACHER EDUCATION  Room A2
Chairperson(s): Adriana Zaragoza

DEVELOPMENT AND VALIDATION OF AN INSTRUMENT FOR IDENTIFYING PRE-SERVICE PHYSICS TEACHERS’ PROFESSIONAL VISION
Carina Wöhleke; Dietmar Höttecke
University of Hamburg

EXPLORING PRE-SERVICE TEACHERS’ VIEWS AND EXPERIENCES ABOUT INTERCULTURAL LEARNING IN SCIENCE DURING AN INTERNATIONAL SUMMER SCHOOL
Anne Bonnevie Lund1; Maria Evagorou2; Ragnhild Lyngved Staberg2; Maria I.M. Febri1; Jardar Cyvin1; Marta Ariza1; Antonio Quesada Armentoros3
1NTNU - Norwegian University of Science and Technology; 2University of Nicosia; 3University of Jaén

PRE-SERVICE SCIENCE TEACHERS’ CONCEPTIONS ON SCIENTIFIC INQUIRY: A PRACTICAL EXPERIENCE
Juan Jimenez1; Soraya Hamed2
1Illinois Institute of Technology; 2Universidad de Sevilla

KNOWLEDGE TRANSFER TO THE TEACHING PRACTICE IN SCIENCE EDUCATION: EXPLORING PRE-SERVICE TEACHERS’ PROFESSIONAL VISION IN THE CONTEXT OF TEACHER PLANNING
Adriana Zaragoza; Martina Alles; Tina Seidel
Technische Universität München

17:00 - 18:30  OP119 - STRAND 6 - CULTURAL-HISTORICAL APPROACHES TO PHYSICS TEACHING  Room B1
Chairperson(s): Seth Chaiklin

CLASSICAL MECHANICS IN THE NEW AGE TEACHING — BREAKING WITH THE OLD CURRICULAR PERSPECTIVE
Ehud Goren; Igal Galili
The Hebrew University of Jerusalem

FOR THE PLURALITY OF THE HISTORY AND NATURE OF SCIENCE IN CLASSROOM: EXPLORING THE 1919 SOLAR ECLIPSE EXPEDITION AND THE GENERAL RELATIVITY
Sofia Basilio1; Flávia Polati2; Danilo Cardoso1
1Universidade de São Paulo; 2Universidade Federal do Rio Grande do Norte
17:00 - 18:30  OP120 - STRAND 8 - COMPETENCIES AND CAREERS  Room B2
Chairperson(s): Kathryn Garthwaite

SECONDARY SCHOOL STUDENTS’ SCIENCE-RELATED CAREER AWARENESS: AN EXPLORATORY STUDY
Tormi Kotkas; Miia Rannikmäe; Jack Holbrook
University of Tartu

A STUDY ON STEM HUMAN RESOURCES COMMUNITY ABILITY; FOCUS ON HIGHER EDUCATION STUDENTS IN JAPAN AND AFRICA
Tomotaka KURODA
Graduate School of Science & Technology, Shizuoka University

EFFECTS OF THE USE OF REAL-TIME DATA WITH SSI INSTRUCTION ON PROMOTING MIDDLE SCHOOL STUDENTS’ SCIENTIFIC CORE COMPETENCIES
Suhi Kwon1; Yohan Hwang2; Hyunju Lee1
1Ewha Womans University; 2Chungnam National University

A QUALITATIVE RISK ANALYSIS FRAMEWORK IN ACTION
Sally Birdsall; Kathryn Garthwaite; Bev France
University of Auckland

17:00 - 18:30  OP121 - STRAND 8 - DECISION-MAKING AND SOCIOScientIFIC ISSUES  Room B3
Chairperson(s): Kohei Maruyama

USING SOCIOScientIFIC ISSUES TO PRACTICE DECISION-MAKING IN AUSTRALIAN DISADVANCED SCHOOLS
Vaille Dawson
The University of Western Australia

DECISION-MAKING ABOUT SOCIOScientIFIC ISSUES IN A LARGE POSTSECONDARY STEM COURSE: DESCRIBING STUDENTS’ USE OF EVIDENCE
P. Citlally Jimenez; Jenny Dauer
University of Nebraska-Lincoln

QUALITY OF THE SSI DECISION-MAKING STAGES DESIGNED BY SCIENCE STUDENT TEACHERS
Kari Sormunen; Anu Hartikainen-Ahia
University of Eastern Finland

JUNIOR HIGH SCHOOL SCIENCE LESSONS FOR FOSTERING DECISION MAKING: A FOCUS ON ORGAN TRANSPLANTATION
Kohei Maruyama; Hiroki Fujii
Graduate School of Education, Okayama University

17:00 - 18:30  OP122 - STRAND 9 - SCIENCE AND ENVIRONMENTAL EDUCATION: POLICY, PROGRAMME AND PRACTICE  Room B4
Chairperson(s): Kristine Bakkemo Kostøl

A CRITICAL ANALYSIS OF ENVIRONMENTAL EDUCATION RELATED POLICY IN ENGLAND
Melissa Glackin; Heather King
King’s College London

IS THERE A DISCONNECT BETWEEN THEORY AND PRACTICE IN ENVIRONMENTAL EDUCATION?
Peta White1; Sally Birdsall1; Fabian Sack2
1Deakin University; 2Auckland University; ‘Sustainably Pty Ltd

THURSDAY AUGUST 29
USING SOCIAL NETWORK ANALYSIS TO IMPROVE A COMMUNITY OF PRACTICE: A CASE STUDY OF ENVIRONMENTAL EDUCATION CENTERS
K.C. Busch; Kathryn Stevenson; Kathryn Green; Danielle Lawson
North Carolina State University

“FELT IN A WAY THAT I WAS PART OF SOMETHING BIG” — THE INFLUENCE OF A STEM PARTNERSHIP PROGRAM ON STUDENTS
Kristine Bakkemo Kostøl; Kari Beate Remmen; Shelley Stromholt; Anette Braathen
1Norwegian Centre for Science Education, University of Oslo, Norway; 2Department of teacher education and school research, University of Oslo, Norway

17:00 - 18:30 OP123 - STRAND 9 - ENVIRONMENTAL EDUCATION AND CHALLENGING TOPICS
Chairperson(s): Gonzalo Guerrero

OBSERVING EXTREME ENVIRONMENTAL EVENTS IN THE HIMALAYAS AND STATUS OF ENVIRONMENTAL EDUCATION AND ATTITUDE OF THE DOWNSTREAM COMMUNITY
Shakil Regmi1; Bodo Bookhagen2; Bruce Johnson3; Bed Mani Dahal4
1Martin Luther University Halle-Wittenberg; 2University of Potsdam; 3University of Arizona; 4Kathmandu University

SCIENCE LESSON IN JUNIOR HIGH SCHOOL FOCUSED ON THE RELATIONSHIP BETWEEN GLOBAL WARMING AND HEAVY RAINFALL
Kenta Namba; Hiroki Fujii
Graduate School of Education, Okayama University

COLLABORATIVE SCIENCE TEACHER EDUCATION THROUGH INQUIRY ON CLIMATE ISSUES: A CASE STUDY
Franz Rauch1; Diana Radmann1; Bernhard Schmölzer2
1Alpen-Adria-University Klagenfurt; 2University of Teacher Education Klagenfurt

INTERDISCIPLINARY SCIENCE OUTDOORS: EXPLORING OPPORTUNITIES FROM RESEARCH-PRACTICE PARTNERSHIPS
Gonzalo Guerrero
Universidad de Santiago de Chile

17:00 - 18:30 OP124 - STRAND 12 - GENDER ISSUES AND FEMINISM
Chairperson(s): Kathryn Scantlebury

GRADUATE WOMEN’S LEADERSHIP DEVELOPMENT IN SCIENCE AND ENGINEERING: A WORKSHOP MODEL
Angela Kelly; Christine O’Connell; Jennifer Gatz; Monica Bugallo
Stony Brook University

A CRITICAL ANALYSIS OF CONTENT IN SEX- AND RELATIONSHIP CHAPTERS IN BIOLOGY TEXTBOOKS
Hannele Junkala
Umeå University

REPOSITIONING GENDER INEQUALITY IN UK BIOCENCE: WHAT SUCCESSFUL PATHWAYS REVEAL
Jaimie Miller-Friedmann
University of Oxford

DO THEY KNOW WHAT THEY ARE MISSING? CHEMISTRY EDUCATION’S FAILURE TO ENGAGE WITH MATERIALISM FEMINISM
Kathryn Scantlebury1; Anita Hussenius2; Catherine Milne3
1University of Delaware; 2Uppsala University; 3New York University

17:00 - 18:30 OP125 - STRAND 12 - LINGUISTIC DIVERSITY IN SCIENCE
Chairperson(s): Greses Perez

INCREASING THE ATTITUDES TOWARD SCIENCE WITH TEACHING STRATEGY IN A BILINGUAL COURSE
David Gonzalez Gomez; Jin Su Jeong; J. Samuel Sánchez Cepeda
University of Extremadura

CAPACITY BUILDING IN MULTILINGUAL SCIENCE CLASSROOMS: A FRAMEWORK FOR COLLECTIVE EXPANSIVE LEARNING
Saouma BouJaoude1; Saouma BouJaoude1; Sara Salloum2
1American University of Beirut; 2Balamand University
THURSDAY AUGUST 29

INTERTEXTUALITY IN SCIENCE TEXTBOOKS AS VEHICLE FOR CONCEPTUAL LEARNING IN MULTILINGUAL SETTINGS
Sara Salloum
University of Balamand

TRANSLANGLUAGING IN THE SCIENCE CLASSROOM: LEARNING ENGINEERING IN MULTILINGUAL CONTEXTS
Greses Perez
Stanford University

17:00 - 18:30  OP126 - STRAND 1 - CONCEPT MAPS AND NETWORKS  Room C1
Chairperson(s): Richard Taylor

NETWORK CARTOGRAPHY OF STUDENTS’ DECLARATIVE KNOWLEDGE: FINDING ABSTRACT KEY CONCEPTS
Ismo Koponen; Maija Nousiainen
University of Helsinki, Department of Physics

VISUALISING THE STRUCTURE OF WRITTEN EXPLANATIONS
Steffen Wagner; Burkhard Priemer
Humboldt-Universität zu Berlin

EXPLORATION OF MIDDLE SCHOOL STUDENT’ UNDERSTANDING ON FIND DUST ISSUE USING ISSUE CONCEPT MAP(IC-MAP) IN COMMUNITY BASED SOCIOSCIENTIFIC ISSUES
Gahyoung Kim1; Kangju Mun2; Hyunjoo Lee3
1Rangwon National University; 2Seoul National University; 3Ewha Womans University

HUB-WORDS IN SCIENTIFIC SEMANTIC NETWORKS
Richard Taylor; Ann Childs; Judith Hillier
University of Oxford

17:00 - 18:30  OP127 - STRAND 11 - ASSESSMENT OF HIGH-ACHIEVING STUDENTS  Room D1
Chairperson(s): Magnus Oskarsson

A STUDY ON THE BIOGRAPHIES OF FORMER PARTICIPANTS OF A SCIENTIFIC ENRICHMENT-PROGRAMME FOR GIFTED PUPILS
Maria Sophie Schäfers; Claas Wegner
Bielefeld University

CAN WRITTEN EXAMINATION QUESTIONS EFFECTIVELY DISCRIMINATE BETWEEN STUDENTS’ WHO HAVE EXPERIENCED DIFFERENT TYPES OF PRACTICAL WORK?
Judith Bennett1; Chris Harrison2; Catarina Correia; Alistair Moore1; Peter Fairhurst1; Katherine Aston2
1University of York; 2King’s College London

DIVERGENT THINKING OF STUDENTS TAKING PART IN SCIENCE COMPETITIONS
Swantje Müller; Verena Pietzner
University of Oldenburg

EVERYDAY KNOWLEDGE IN TIMSS2015
Magnus Oskarsson; Nina Eliasson
Mid Sweden University

17:00 - 18:30  OP128 - STRAND 11 - INNOVATIVE APPROACHES TO STUDENT ASSESSMENT  Room D2
Chairperson(s): Radu Bogdan Toma

TOWARDS AN INTERDISCIPLINARY SYSTEMS THINKING FRAMEWORK
Justin Lefarth; Sophia Mambrey; Jana Landskron; Philipp Schmiemann
University of Duisburg-Essen; Biology Education II

DRAW-A-SCIENCE-COMIC: AN ALTERNATIVE TO DAST
Jaakko Lamminpää; Veli-Matti Vesterinen; Katja Puutio
University of Turku

DEVELOPMENT AND VALIDATION OF THE NEGATIVE APPRAISALS OF STUDYING SCHOOL SCIENCE (NASSS) SCALE
Radu Bogdan Toma1; Norman G. Lederman2; Jesús Ángel Meneses Villagrá1
1Universidad de Burgos; 2Illinois Institute of Technology
17:00 - 18:30  OP129 - STRAND 11 - ASSESSMENT OF CONCEPTUAL UNDERSTANDING  Room D3
Chairperson(s): Fernanda Regebe

EVALUATION OF LEARNING PROGRESSIONS ON CHEMICAL CONCEPTS IN SECONDARY SCHOOLS
Kübra Nur Celik
University of Duisburg-Essen

LEARNING PROGRESSIONS VS. LEARNING FLUCTUATIONS: DEVELOPMENTAL PATTERNS OF STUDENTS’ UNDERSTANDING OF CORE CHEMISTRY CONCEPTS
Sascha Bernholt; Lars Höft
Leibniz Institute for Science and Mathematics Education (IPN) at Kiel University

MEASURING CONCEPTUAL UNDERSTANDING: LINKING CONCEPT TESTS, EXPLICIT, AND IMPLICIT ASSOCIATIVE METHODS
Marine Delaval; Andreas Müller
University of Geneva

PERFORMANCE ANALYSIS OF STUDENTS REGARDING THE COMPLEXITY AND CONTENT DIMENSIONS OF ITEMS IN LEARNING OF PROGRAMMING LOGIC
Fernanda Regebe; Amanda Amantes
1IFBA / UFBA; 2UFBA

17:00 - 18:30  OP190 - STRAND 4 - DIGITAL AIDS FOR PLANNING AND DESIGNING TEACHING  Room E2 - Italia
Chairperson(s): Antonio-Joaquin Franco-Mariscal

GAME OF THRONES TO LEARN SCIENCE. AN EXPERIENCE WITH SPANISH PRE-SERVICE SCIENCE TEACHERS
Antonio-Joaquin Franco-Mariscal; Maria-José Cano-Iglesias; José Manuel Hierrezuelo-Osorio
1University of Malaga; 2University of Málaga

AN INTEGRATED DATABASE OF COMMON CHEMICALS AND CHEMISTRY LABORATORY EXPERIMENTS USED IN HUNGARY
Lajos Kovács; Gábor Betyár
1University of Szeged, Dept. Med. Chem. and MTA-SZTE Science Education Research Group; 2MTA-SZTE Science Education Research Group

DESIGN OF THE INFORMATION SCIENCE DICTIONARY BY SIGN LANGUAGE
Miki Namatame
Tsukuba University of Technology

PROMOTING SELF-REGULATED LEARNING BY DESIGNING A CHEMISTRY ONLINE BLENDED LEARNING ENVIRONMENT
Yael Shwartz; Rachel Rosanne Eidelman
1Weizmann Institute of Science; 2The Davidson Institute

17:00 - 18:30  OP130 - STRAND 15 - PLAY AND INQUIRY IN EARLY CHILDHOOD SCIENCE  Room F1
Chairperson(s): Inés Mosquera Bargiela

PLAYING WITH SCIENCE: CHILDREN’S PLAYFUL MEANING-MAKING IN THE CONTEXT OF SCIENTIFIC LITERACY PRACTICES
Jenni Vartiainen; Kristiina Kumpulainen
University of Helsinki

WHY WE SHOULD TAKE CHILDREN’S PLAYFUL INQUIRY SERIOUS
Lara Weiser; Annette Scheersoi
Biology Education, University of Bonn

ADVANCING THE DEVELOPMENT OF EARLY CHILDHOOD SCIENCE DATA COLLECTION INSTRUMENTS
Cristina Guarrella; Caroline Cohrssen; Jan van Driel
The University of Melbourne

SCIENTIFIC REASONING IN AN INQUIRY-BASED TASK. A CASE STUDY RESEARCH IN EARLY AGE
Inés Mosquera Bargiela
Universidade de Santiago de Compostela, Spain
1Blanca Puig; 2Paloma Blanco-Anaya; 3Lucy Avraamidou
1Universidade de Santiago de Compostela; 2University of Groningen
LONGITUDINAL IMPACT OF EARLY CHILDHOOD SCIENCE INSTRUCTION ON 5TH GRADE SCIENCE ACHIEVEMENT
Charlene Czerniak; Joan Kaderavek; Peter Paprzycki; Susanna Hapgood; Gale Mentzer; Scott Molitor
Robert Mendenhall
1The University of Toledo; 2University of Southern Mississippi; 3Acumen, LLC; 4Toledo Public Schools

SATISFYING CURIOUS YOUNG MINDS: VOLUNTEERING TO TEACH STEM IN EARLY CHILDHOOD CENTRES
Coral Campbell; Christopher Speldewinde
Deakin University

BUILDING SCIENCE CAPITAL AND HABITUS OF YOUTH THROUGH FAMILY STEM PROGRAMMING
Megan Ennes; M. Gail Jones; Emily Cayton; Katherine Chesnutt; Pamela Huff; Elizabeth Baird
1North Carolina State University; 2Campbell University; 4NC State University; 4NC Museum of Natural Sciences

INQUIRY BASED SCIENCE AND MATHEMATICS TEACHING OUTSIDE THE CLASSROOM, PUPILS CHOICES AND LEARNING OPTIONS
Karen Barfod; Peer Daugbjerg
VIA University College

HOW CAN LEARNERS EXPLAIN PHENOMENA IN ECOLOGY USING EVOLUTIONARY EVIDENCE FROM INFORMAL LEARNING ENVIRONMENTS AS RESOURCES?
Dina Agadi; Orit Ben Zvi Assaraf
Ben-Gurion University of the Negev

GENETIC CONCEPTS, REPRESENTATIONS AND MODELS IN STUDENTS’ AND EDUCATORS’ CONCEPTIONS
Despina Tsopoglou-Gkina; Penelope Papadopoulou
University of Western Macedonia, Greece

STEPPING ON THE THRESHOLD — VISUALIZATION DESIGN AND LEARNERS CAUSAL MODELS OF NATURAL SELECTION
Andreas Göransson
Department of science and technology, Linköping University

CONCEPTS USED BY STUDENTS IN EXPLAINING NATURAL SELECTION
Victoria Hollmann; Jörg Großschedl
University of Cologne

APPLYING ARGUMENTATION IN PRIMARY PRE-SERVICE TEACHER EDUCATION. A TEACHING-LEARNING SEQUENCE USING COLLABORATIVE VIDEO ANNOTATIONS
Jose Hierrezuelo; Teresa Lupión-Cobos; Cristina García-Ruiz
Department of Science Education, University of Málaga

NEW COLLABORATIVE AND PROJECT-BASED COURSE MODEL FOR RELEVANT PRE-SERVICE SCIENCE TEACHER EDUCATION
Ouli Haatainen; Topias Ilävalko; Maija Aksela
University of Helsinki

TEACHERS’ COLLABORATION AS A POTENTIAL TOOL TO DEVELOP PEDAGOGICAL CONTENT KNOWLEDGE OF PRE-SERVICE PHYSICS’ TEACHERS: AN EXPLORATORY STUDY OF AN INITIAL TEACHING PRACTICE EXPERIENCE IN THE CITY OF VALPARAÍSO.
Germán Ahumada Aballay; Betzabe Torres Olave
1Pontificia Universidad Católica de Valparaíso; 2University of Bristol

OPPORTUNITIES FOR PROGRESSION IN SUBJECT-MATTER DIDACTICS
Maria Åström; Marie Ståhl; Maria Svensson; Björn Fris Johannsen; Git Börjesson
Department of Pedagogical, Curricular and Professional Studies, University of Gothenburg, Sweden
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<td><strong>OP134 - STRAND 13 - LEARNING AND TEACHING PROBLEM SOLVING</strong></td>
<td>G2</td>
<td>Moritz Krell</td>
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<td>FINNISH TEACHER STUDENT´S CONCEPTS ABOUT CREATIVE PROBLEM SOLVING BEFORE AND AFTER A METHODOLOGY COURSE</td>
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<td>Merike Kesler; Kalle Juuti; Anna Uitto; University of Helsinki</td>
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<td>ADDRESSING THE CONCEPT OF DENSITY IN A PROBLEMATIZED WAY: APPLICATION TO PRE-SERVICE PRIMARY TEACHERS´ EDUCATION</td>
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<td>Ruben Liminiana; Sergio Rosa-Cintas; Carolina Nicolás-Castellano; Asuncion Menargues; Alexandra Rey-Cubero; Juan Francisco Álvarez-Herrero; Joaquín Martínez-Torregrosa; Isabel Lujan; University of Alicante</td>
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<td>EXAMINATION OF PRE-SERVICE PHYSICS TEACHERS´ PROBLEM SCOPING IN ENGINEERING DESIGN PROCESS OF A STEM PROJECT</td>
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<td>Fatma Caner; Feral Bekiroglu; Marmara University</td>
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<td>IMPACT OF CONTRIBUTING FACTORS ON THE DEVELOPMENT OF SCIENTIFIC REASONING COMPETENCIES</td>
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<td>Moritz Krell; Samia Khan; Sabrina Mathesius; Claudia Vergara; Dirk Krüger; Freie Universität Berlin; University of Dundee; Alberto Hurtado University Santiago, Chile</td>
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<td>17:00 - 18:30</td>
<td><strong>OP135 - STRAND 14 - CONTENT KNOWLEDGE IN TEACHER EDUCATION</strong></td>
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<td>Martie Sanders</td>
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<td>RETHINKING REVIEWS — HOW TO DESIGN REVIEWS ABOUT COMPLEX BIOLOGY FOR TEACHERS</td>
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<td>Birgitta Mc Ewen; Dept of Health, Karlstad University</td>
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<td>TEACHER KNOWLEDGE IN A PROFESSIONAL DEVELOPMENT COURSE IN A CURRICULAR REFORM IN BRAZIL</td>
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<td>Daniela Scarpa; Maira Batistoni Silva; Danusa Munford; Renata de Paula Orofino; University of São Paulo, Brazil; Federal University of ABC</td>
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<td>SUPPORTING PROFESSIONAL LEARNING COMMUNITIES TO DEVELOP CONTENT KNOWLEDGE FOR TEACHING AND LEARNING PHYSICS AT LOWER SECONDARY LEVEL</td>
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<td>Deirdre O’Neill; Eilish McLoughlin; Dublin City University</td>
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<td>IMPROVING TEACHER’S GUIDES TO SUPPORT EVOLUTION TEACHERS: MULTIPLE STAKEHOLDER PERCEPTIONS</td>
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<td>Martie Sanders; University of the Witwatersrand</td>
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<td><strong>OP136 - STRAND 14 - PROFESSIONAL LEARNING AND MENTORING</strong></td>
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<td>Sonja M. Mork</td>
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<td>NOVICE TEACHERS LEARNING TO TEACH OUT-OF-FIELD</td>
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<td>Linda Hobbs; Deakin University</td>
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<td>ASSESSING NOVICE AND EXPERIENCED STEM TEACHERS´ PROFESSIONAL GROWTH</td>
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<td>Effrat Akiri; Yehudit Judy Dori; Technion, Israel Institute of Technology</td>
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<td>IN-SERVICE TEACHER MENTORING FOR THE IMPLEMENTATION OF MODULES ON CUTTING-EDGE RESEARCH TOPICS</td>
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<td>Emily Michaelidi; Dimitris Stavrou; University of Crete</td>
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<td>EDUCATING THE EDUCATORS: CREATING A KNOWLEDGE DOMAIN FOR SCIENCE TEACHER EDUCATORS THROUGH PROFESSIONAL DEVELOPMENT</td>
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<td>Sonja M. Mork; Berit S. Haug; Ellen K. Henriksen; Doris Jorde; Merethe Frøyland; Norwegian Centre for Science Education, University of Oslo</td>
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<td>Jerneja Pavlin; Tina Čampa</td>
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<td><strong>COLLABORATIVE APPROACHES IN PRIMARY SCHOOL SCIENCE</strong></td>
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<td>Lena Danaia; Emma Bytsma; Rebecca Whiteley; Susan Cameron</td>
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<td><strong>INVESTIGATING SCIENTIFIC MODELING IN PRIMARY SCIENCE: A COMPARATIVE STUDY OF THE UNITED STATES AND GERMANY</strong></td>
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<td><strong>LEARNER MOTIVATION CASE STUDY IN STEM EDUCATION TECHNOLOGY ENHANCED LEARNING</strong></td>
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<td><strong>THE IMPACT OF INSTRUCTIONAL SCAFFOLDING ON STUDENTS' EVIDENTIARY REASONING IN THE CONTEXT OF AN EVOLUTIONARY TREE-THINKING UNDERGRADUATE BIOLOGY LABORATORY INVESTIGATION</strong></td>
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<td>Nancy Pelaez; Shiyou Liu; Stephanie Gardner; Chaonan Liu; Sharleen Flowers; Kari Classe; Ala Samarapungavan</td>
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<td>Joseph Dauer; Gretchen King; Tomas Helikar</td>
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<td>17:00 - 18:30</td>
<td>OP195 - STRAND 2 - SELF-CONCEPT, AGENCY AND MOTIVATION</td>
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<td><strong>DESIGNING A TEACHING-LEARNING SEQUENCE ABOUT SOUND FOR PRE-SERVICE PRIMARY TEACHERS</strong></td>
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<td>Arantza Rico; Aritz Ruiz-Gonzalez; Oier Azula; Jenaro Guisasola</td>
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<td>1University of the Basque Country (UPV/EHU); 2Tklnika: Centre for Innovation in Vocational Training</td>
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<td><strong>NOTHING MORE THAN THAT - STUDENTS’ MOTIVATIONS ENTERING HIGHER BIOLOGY EDUCATION</strong></td>
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<td>Uppsala University - Centre for Gender Research</td>
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<td><strong>THEORETICAL INVESTIGATION OF AGENCY IN STUDENT-CENTRED LEARNING COMMUNITIES IN STUDIES OF SCIENCE EDUCATION</strong></td>
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<td><strong>IS MECHANICS OR WAVE MORE CHALLENGING FOR STUDENTS? SELF-CONCEPTS AND STYLES OF SCIENTIFIC REASONING</strong></td>
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<td>1Yuen Long Merchants Association Secondary School; 2The University of Waikato</td>
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17:00 - 18:30  OP193 - STRAND 12 - STEM PROGRAMS

Room G8

Chairperson(s): Kathleen Schenkel

**PROJECT CLIC!: IMPROVING PRIMARY STUDENTS’ SCIENCE LEARNING BY EXPANDING THEIR ACADEMIC LANGUAGE AND SCIENCE INQUIRY SKILLS**
Alejandra Meneses\(^1\), Maximiliano Montenegro\(^2\), Nicolás Bedrossian\(^3\), Marcela Ruiz\(^1\), Andrea Valenzuela\(^1\)
\(^1\)Pontificia Universidad Católica de Chile; \(^2\)Lycée Antoine de Saint-Exupery; \(^3\)Universidad Alberto Hurtado

**LET THE CHURCH SAY “AMEN” TO STEM: NEGOTIATING THE ROLES OF THE FAITH-BASED COMMUNITY ON EDUCATIONAL PROGRAMS FOR YOUTH**
Natalie King; Natalie King
Georgia State University

**HIGH ACHIEVING STUDENTS’ SCIENCE IDENTITY PERFORMANCES WITHIN STEM DISCIPLINARY CULTURES IN NORWAY**
Maria Vetleseter Boe
University of Oslo, Dept. of Physics

**“WE HAVE TO CHANGE THINGS. OH, WE HAVE TO DO THIS.”: ENGINEERING SOLUTIONS WITH COMMUNITY**
Kathleen Schenkel\(^1\); Angela Calabrese Barton\(^1\); Edna Tan\(^2\)
\(^1\)Michigan State University; \(^2\)The University of North Carolina at Greensboro
**FRIDAY 9:00 - 11:00**

**OP139 - STRAND 1 - CONCEPTUAL CHANGE IN SCIENCE LEARNING**

**Room A1**

Chairperson(s): Sefika Girgin

**DO MISLEADING THERMAL SENSATIONS UNDERLIE SOME HEAT AND COLD MISCONCEPTIONS?**
Ivan Ezquerra-Romano¹; Angel Ezquerra¹; Federico Agen²
¹University College London, ²Universidad Complutense de Madrid

**ENHANCING CONCEPTUAL CHANGE IN SCIENCE EDUCATION THROUGH DRAMATIC INQUIRY**
Carolyn Swanson
Auckland University of Technology

**EXPLORING MISCONCEPTION AS A TRIGGER FOR ENHANCING STUDENTS’ CONCEPTUAL UNDERSTANDING**
Allen Espinosa¹; Heather Verkade²; Terrence Mulhern²; Jason Lodge³
¹The University of Melbourne (Current Address: Philippine Normal University); ²The University of Melbourne; ³The University of Melbourne (Current Address: The University of Queensland)

**CONCEPTUAL CHANGE REGARDING LIVING/NONLIVING THINGS RELIES ON INHIBITORY CONTROL: RESULTS FROM REACTION TIMES AND EEG**
Lorie-Marlène Brault Foisy¹; Yannick Skelling-Desmeules²; Emmanuel Ahr³; Jérémie Blanchette Sarrasin²; Grégoire Borst²; Patrice Potvin²; Steve Masson²; Patrick Charland³
¹Université du Québec à Montréal; ²Université du Québec à Montréal; ³LaPsyDÉ

**A META SYNTHESIS STUDY: EXPLORING STUDENTS’ CONCEPTIONS ON CONDENSATION, EVAPORATION AND BOILING CONCEPTS**
Sefika Girgin; Aslı Koçulu; Bayram Coğlu
Yıldız Technical University

**FRIDAY 9:00 - 11:00**

**OP140 - STRAND 1 - THE ROLE OF REPRESENTATIONS IN SCIENCE LEARNING**

**Room A2**

Chairperson(s): Andreas Larsson

**FROM WATCHING VIDEOS TO HAPTIC FEEDBACK: LEARNING ABOUT FORCES & ENERGY IN CHEMICAL BONDING**
Asnat Zohar; Sharona T. Levy
University of Haifa

**HOW CAN DRAWINGS HELP TO CONCEPTUALIZE BIOLOGICAL OBJECTS? — EXAMPLE OF BEETLES.**
Eliza Rybska¹; Jelle Boeve-dePauw³
¹Adam Mickiewicz University; ²Department of Training & Education Sciences, Edubron Research Unit, University of Antwerp, Belgium

**PHOTOGRAPHS IN BRAZILIAN CHEMISTRY TEXTBOOKS: A STUDY INVOLVING CHEMICAL KINETIC**
Wilmo Francisco Junior; Flávia Alves; Miyuki Yamashita
Federal University of Alagoas

**CHOOSING AN EXTERNAL REPRESENTATION TO EXPLAIN A CHEMICAL PHENOMENON - A MIXED-METHODS STUDY**
Perihan Akman; Sabine Fechner
Paderborn University

**TALKING CODE OR TYPING CODE - UNPACKING A METAPHORICAL STRUCTURE IN THE PROGRAMMING CLASSROOM**
Andreas Larsson; Karin Stolpe
Linköping University

**FRIDAY 9:00 - 11:00**

**OP74 - STRAND 6 - NATURE OF SCIENCE IN SCIENCE TEACHING**

**Room B1**

Chairperson(s): Aysegul Cilekrenkli

**ADDRESSING NATURE OF SCIENCE ASPECTS ON A PD PROGRAM FOR GREEK SCIENCE TEACHERS: DESIGN, IMPLEMENTATION AND VALIDATION**
Anna Kournara; Katerina Plakitsi
University of Ioannina
TENTATIVENESS AND SOCIOCULTURAL EMBEDDEDNESS - RESISTANT MYTHS ABOUT NATURE OF SCIENCE?
Stefan Mueller; Christiane S. Reiners
University of Cologne

PRE-SERVICE SCIENCE TEACHERS’ PERCEPTIONS OF NATURE OF SCIENCE: FOCUS GROUP DISCUSSION
Busra Aksoz1; Ebru Kaya1; Sibel Erduran1; Selin Akgun1; Aysegul Cilekrenkli1
1Bogazici University; 2University of Oxford

BRINGING THE DEBATES ON THE ROLE OF CULTURE IN SCIENCE INTO THE SCIENCE CLASSROOM
Hagop A. Yacoubian
Education Department, Lebanese American University

TEACHING WITH RECONCEPTUALISED FAMILY RESEMBLANCE APPROACH TO NATURE OF SCIENCE IN 5TH GRADE CLASSROOM: AN EXPERIMENTAL STUDY
Aysegul Cilekrenkli; Ebru Kaya
Bogazici University

SECONDARY MATHEMATICS AND SCIENCE TEACHERS’ REASONING ABOUT A SOCIOSCIENTIFIC ISSUE
David Owens1; Ben Herman1; Tanner Oertli2; Amy Lannin3; Troy Sadler4
1Georgia Southern University; 2University of Missouri; 3University of North Carolina Greensboro

ENABLING STUDENTS TO PRODUCE EVIDENCE-BASED ARGUMENTS RELATED TO SSI: TWO CASE STUDIES
Stein Dankert Kolsto
University of Bergen

BALANCING EMOTION AND REASON IN SOCIO-SCIENTIFIC ISSUES: NEW TEACHING APPROACH AND DESIGNING INSPIRED BY RECENT BRAIN RESEARCH
Francois Lombard; Marie Merminod; Daniel Schneider
University of Geneva

PROGRESS ON CLIMATE CHANGE PERCEPTIONS AFTER NGSS ADOPTION: A US, UK AND AUSTRALIA COMPARISON
Tina Cartwright1; Deb Hemler2; Paula Magee3
1Marshall University; 2Fairmont State University; 3Indiana University Indianapolis

ENERGY TRANSITION TO RENEWABLES: HOW STUDENTS’ AND SCIENTISTS’ METAPHORS (MIS) LEAD THE DEBATE
Sybille Hüfner1; Kai Niebert2; Simone Abels3
1University of Hildesheim; 2University of Zurich; 3Leuphana University Lüneburg

THE ROLE OF SCIENCE EDUCATION IN THE DYNAMICS OF PRODUCTION OF DEMOCRATIC POLITICAL CULTURE
Rita Vilanova1; Edgar Miranda2
1Federal University of Rio de Janeiro; 2Pedro II School

SCIENCE FOR DEMOCRACY AND SOCIAL JUSTICE
Brian Matthews; Arthur Galamba
King’s College London

DOES AND SHOULD SCIENCE EDUCATION STAND AGAINST THE RISE OF FASCIST-RELATED VIEWS IN THE 21ST CENTURY?
Arthur Galamba; Brian Matthews
King’s College London

ECOJUST ENGINEERING ASSEMBLAGES IN SCHOOL SCIENCE
John Bencze1; Dave Del Gobbo2; Sarah El Halwany1; Minja Milanovic1; Nadia Qureshi1; Zoya Padamsi1; Majd Zouda1
1OISE, University of Toronto; 2Peel District School Board

YOUTH VOICE IN POLARIZED AMERICA: THE POLITICS AND SCIENCE OF CLIMATE CHANGE
Lynne Zummo; Emma Gargroetzi
Stanford University
### OP144 - STRAND 8 - TEACHERS’ VIEWS AND ATTITUDES

**Chairperson(s):** Athanasia Kokolaki  
**Room B4**

- **PRE-SERVICE SCIENCE TEACHERS’ ATTITUDES TOWARDS CLIMATE CHANGE IN NORWAY - REGIONAL DIFFERENCES AND THE ROLE OF TEACHER EDUCATION**  
  Frode Skarstein  
  University of Stavanger

- **PRE-SERVICE ELEMENTARY TEACHERS’ MODEL-EVIDENCE LINK DESIGNS TO ENHANCE THEIR STUDENTS’ CRITICAL EVALUATION SKILLS**  
  Deniz Saribas¹; Deniz Saribas²; Zeynep Gonca Akdemir²  
  ¹Istanbul Aydin University; ²Purdue University

- **PROSPECTIVE TEACHERS’ PERCEPTION OF THE RELEVANCE OF SCHOOL - INDUSTRY COLLABORATION**  
  Spela Hrast; Vesna Ferk Savec  
  University of Ljubljana, Faculty of Education

- **DIDACTIC MODELS AND MODELLING FOR SUSTAINABILITY**  
  Jesper Sjöström¹; Ingo Elks²  
  ¹Malmö University - Faculty of Education and Society; ²University of Bremen - Institute for Science Education (IDN)

- **PRE-SERVICE PRIMARY TEACHER TRAINING ON RESPONSIBLE RESEARCH AND INNOVATION FRAMEWORK**  
  Athanasia Kokolaki; Dimitris Stavrou  
  University of Crete

### OP145 - STRAND 9 - HEALTH LITERACY, CONCEPTIONS, VALUES AND BELIEFS

**Chairperson(s):** Gizell Green  
**Room B5**

- **ELEMENTARY SCHOOL STUDENTS’ HEALTH CONCEPTIONS: SOCIAL SEMIOTIC ANALYSIS OF MULTIMODAL TEXTS**  
  Miriam Struchiner¹; Judith Bustamente Bautista²; Jhenifer Kely de Oliveira²  
  ¹Federal University of Rio de Janeiro - UFRJ; ²UFRJ

- **INFUSING PRO-ENVIRONMENTAL VALUES IN SCIENCE EDUCATION: A MULTIMODAL ANALYSIS OF ECOLOGY ANIMATIONS FOR CHILDREN**  
  William Feng¹; Len Unsworth²  
  ¹The Hong Kong Polytechnic University; ²Austrialian Catholic University

- **INFORMAL EDUCATORS’ ENVIRONMENTAL HEALTH KNOWLEDGE AND TEACHING BELIEFS: IMPLICATIONS FOR COMMUNICATING FISH CONSUMPTION ADVISORIES**  
  Kathleen Gray¹; Margaret Blanchard²; Catherine LePrevost¹  
  ¹University of North Carolina at Chapel Hill; ²North Carolina State University

- **RESUSCITATION AS A HEALTH ISSUE: BIOLOGY TEACHERS’ COMPETENCY AND ITS ASSOCIATION WITH THE SUBJECT**  
  Rico Dumcke¹; Claas Wegner¹; Niels Rahe-Meyer²  
  ¹Bielefeld University; ²Franziskus Hospital Bielefeld

- **EXAMINING PROFESSIONAL VALUES AMONG NURSING STUDENTS DURING TRAINING CHARACTERIZED BY DIFFERENT LEARNING METHODS**  
  Gizell Green  
  Ariel university

### OP146 - STRAND 12 - EQUITY, VALUES AND SCIENCES PARTICIPATION

**Chairperson(s):** Lucy Yeomans  
**Room B6**

- **MAPPING NETWORKS OF SUPPORT FOR UNDER-REPRESENTED STUDENTS IN PHYSICS**  
  Allison Gonsalves; Hannah Chestnutt; Abigail Spilkevitz  
  McGill University

- **USING INSTITUTIONAL HABITUS TO UNDERSTAND INEQUALITIES IN PHYSICS PARTICIPATION IN UK SECONDARY SCHOOLS**  
  Sandra Takei  
  King’s College London
FOR SCIENCE, FOR THE INSTITUTION OR FOR YOUTH: MAPPING PRACTITIONER DISCOURSE AROUND EQUITY & INFORMAL SCIENCE LEARNING
Emily Dawson; Uma Patel
UCL

SCIENCE PARTICIPATION: IS IT MORE IMPORTANT TO BE STUDIOUS THAN ‘SCIENCEY’?
Lucy Yeomans
University of Bath

09:00 - 11:00  OP147 - STRAND 12 - STEM PARTICIPATION AND ASPIRATIONS  Room B7
Chairperson(s): Jeanna Wieselmann

ROSES - THE RELEVANCE OF SCIENCE EDUCATION SECOND
Magnus Oskarsson1; Anna-Karin Westman1; Anders Jidesjö2
1Mid Sweden University; 2Linköping University

ANALYZING SCIENCE ASPIRATIONS AND BELIEFS OF BRAZILIAN HIGH SCHOOL STUDENTS USING SCIENCE CAPITAL AS A THEORETICAL BACKGROUND
JOAQUIM FERNANDO MENDES DA SILVA; PAULO ROGÉRIO ABRÃO MILEO Jr
Federal University of Rio de Janeiro

CHEMISTRY TEACHERS’ KNOWLEDGE ABOUT CHEMISTRY PROFESSIONS
Verena Pietzner; Anna Kotwica
University of Oldenburg

SMALL GROUP STEM ACTIVITIES AND GROUP GENDER COMPOSITION
Jeanna Wieselmann1; Emily Dare2; Elizabeth Ring-Whalen1; Gillian Roehrig1
1University of Minnesota; 2Florida International University; 3St. Catherine University

09:00 - 11:00  OP148 - STRAND 1 - COGNITIVE AND METACOGNITIVE FACTORS IN SCIENCE LEARNING  Room C1
Chairperson(s): Eunhee Kang

ATOMIC STRUCTURE - THE EFFECTS OF TWO COGNITIVE FACTORS ON SECONDARY STUDENTS’ UNDERSTANDING OF THE ‘ORBITAL’ AND ‘ELECTRON CLOUD’ CONCEPTS
Nikolaos Zarkadis; George Papageorgiou; Angelos Markos
Democritus University of Thrace

THE POSSIBILITY OF LUCKY BELIEFS IN THE SCIENCE CLASSROOM: GETTIER CASES AND THE VALUE OF RELIABLE BELIEF-FORMING PROCESSES
Richard Brock
King’s College London

FACTORS ASSOCIATED WITH STUDENTS’ ENGAGEMENT AND PARTICIPATION IN YEAR 11 AND YEAR 12 SCIENCE CLASSROOMS
Hye-Eun Chu1; Sonya Martin2; Dae Eon Kang3; Faisal Sudrajat3; Nathaniel Lewis1
1University of Minnesota; 2Florida International University; 3St. Catherine University

STUDENTS’ VIEWS ON THE “CATEGORICAL IMPERATIVE” OF AVOIDING CONTRADICTION
Cesar Delgado; Cesar Delgado
North Carolina State University

EMPOWERING STUDENTS THROUGH ENCOURAGING THEIR EPISTEMIC AUTHORITY FOR CONTENTS, PRACTICE AND CLASSROOM MANAGEMENT
Eunhee Kang; Kum-Bok Ryu
Seoul National University

09:00 - 11:00  OP149 - STRAND 4 - ANALYSIS OF LEARNING USING NOVEL DIGITAL TECHNOLOGY  Room D1
Chairperson(s): Janice Gobert

COLLABORATING PRIMARY STUDENT TEACHERS IN DESIGNING SCIENCE EXPERIMENTS WITH THE USE OF ICT
Argyris Nipyrakis; Dimitris Stavrou
University of Crete

INVESTIGATING ONLINE OPEN FORUMS AS EDUCATIONAL SPACES FOR HAZARDS LITERACY LEARNING
Kathryn Rende; M. Gail Jones
North Carolina State University
ONLINE NANOTECHNOLOGY COURSES FOR TEACHERS: LEARNING EVALUATION AND LEARNING PATTERNS
Yael Feldman-Maggor¹; Inbal Tuvi-Adard²; Ron Blonder³
¹The Weizmann Institute of Science; ²The Open University of Israel;

AUTOMATIC NETWORK ANALYSIS OF PHYSICS TEACHER TALK
Daniela Caballero¹; Toni Pikkarainen²; Jouu Viij¹; Roberto Araya³; Catalina Espinoza³
¹CIAE Universidad de Chile; ²University of Jyvaskyla

TEACHER SCAFFOLDS MEDIATED BY A SCIENCE INQUIRY DASHBOARD
Rachel Dicker¹; Janice Gobert¹; Michael Sao Pedro⁴; Haiying Li⁵
¹Rutgers University; ²Apprendis

09:00 - 11:00  OP194 - STRAND 18 - REPRESENTATIONS AND MODELS Room D2
Chairperson(s): Guilherme Marson

TO PAIR MENTOR, OR NOT TO PAIR MENTOR, THAT IS THE QUESTION?
Ian Abrahams; Rachael Sharpe; Nikolaos Fotou
University of Lincoln

DESIGN BASED RESEARCH AND THE MODEL OF EDUCATIONAL RECONSTRUCTION — A COMBINED APPROACH TO DESIGN SUCCESSFUL SCIENCE INSTRUCTION
Floor Kamphorst¹; Magdalena Kersting²
¹Utrecht University; ²University of Oslo, The University of Western Australia

MANIPULATING VIRTUAL 3D MODELS: THE ROLE OF INTERACTIVITY
Guilherme Marson¹; Rodrigo Consoli¹; Claudia Ayres¹; Eduardo Coll¹; Camila Cicuto²; Gustavo Cruz³
¹University of Sao Paulo; ²UNIPAMPA; ³Inst. Silvio Passareli

THEORISING THE REPRESENTATION OF SCIENTIFIC KNOWLEDGE IN STUDENTS’ MULTIMODAL ASSESSMENTS
Helen Georgiou; Wendy Nielsen; Annette Turney
University of Wollongong

09:00 - 11:00  OP150 - STRAND 5 - TEACHING AND LEARNING IN BIOLOGY AND PHYSICS Room D3
Chairperson(s): Debra McGregor

ENHANCING STUDENTS’ EPISTEMOLOGICAL BELIEFS ABOUT MODELS IN SCIENCE THROUGH A MODEL-BASED TLS ABOUT THE OPTICAL PROPERTIES OF MATERIALS
Stavros Koukioglou; Dimitrios Psillos
Aristotle University of Thessaloniki Faculty of Education School of Primary Education

CLIMBING A ‘LADDER OF LEARNING’ — EFFECTS OF STRUCTURING DIFFERENTIATED LEARNING ENVIRONMENTS IN SCIENCE EDUCATION
Helena van Vorst; Marie-Therese Hauerstein
Duisburg-Essen University

TEACHING EVOLUTION IN INDIGENOUS MEXICAN COMMUNITIES USING SITUATED LEARNING
Paulina Guerrero-Gutierrez
King’s College London (Waterloo Campus)

DESIGN AND EVALUATION OF A TEACHING UNIT TO IMPLEMENT STUDENTS’ QUESTIONS IN CHEMISTRY EDUCATION
Lisa Schmitz; Sabine Fechner
Paderborn University

STORYTELLING AND INQUIRY PRACTICAL WORK IN SCHOOL SCIENCE: WHY BOTHER?
Debra McGregor; Sarah Frodsham
Oxford Brookes University

09:00 - 11:00  OP49 - STRAND 1 - INQUIRY, LAB REPORTS AND COLLABORATIVE LEARNING IN SCIENCE Room E2 - Italia
Chairperson(s): Matthias Stadler

IMPACT OF PROCESS ORIENTED GUIDED INQUIRY LEARNING (POGIL) ON MIDDLE SCHOOL STUDENTS’ PERFORMANCE
Leman ALAKOYUN; Özgecan TAŞTAN KIRIK
Çukurova University
STUDENTS’ PROCEDURAL KNOWLEDGE OF SCIENTIFIC PRACTICES AND ITS DEVELOPMENT—A VIDEO-BASED ANALYSIS
Jörn J. Hägele; Andreas Vorholzer; Claudia von Aufschnaiter
Justus-Liebig-Universität Gießen

THE EFFECTS OF A COLLABORATIVE LEARNING ENVIRONMENT ON 7TH GRADERS’ INTEREST IN SCIENCE AND TECHNOLOGY AND ON CONCEPTUAL CHANGE.
Eric Durocher; Patrice Potvin
Université du Québec à Montréal (UQAM)

SIGNS FOR UNDERSTANDING CHEMISTRY IN LABORATORY REPORTS
Matthias Stadler1; Sigrun Eggereide2
1University of Bergen; 2Wang Toppidrettsgymnas

09:00 - 11:00 OP152 - STRAND 7 - WRITING, METACOGNITIVE SCAFFOLDS AND ARGUMENTATION Room F1
Chairperson(s): Mari Sjoeberg

DIPPING INTO THE ART OF WRITING SCIENCE: LINGUISTIC NEEDS OF AUSTRIAN HIGH SCHOOL LEARNERS IN SCIENCE EDUCATION
Corinna Pieber; Johanna Taglieber; Suzanne Kapelari; Wolfgang Dür; Barbara Hinger
University of Innsbruck, Department of subject-specific Education

FACILITATE STUDENT SCIENTIFIC ARGUMENTATION WITH METACOGNITIVE SCAFFOLDS
Qingna Jin
University of Alberta

WRITING SCIENTIFICALLY: SIMILARITIES BETWEEN READERS’ WRITING AND THE LANGUAGE OF THE TEXTS THEY HAVE READ
Rogerio Nigro
Gepec

MULTIMODAL SCIENTIFIC REASONING IN UNDERGRADUATE BIOLOGY; A SOCIAL SEMIOTIC APPROACH
Mari Sjoeberg; Erik Knain
Department of Teacher Education and School Research, University of Oslo

09:00 - 11:00 OP58 - STRAND 7 - ARGUMENTATION, LANGUAGE AND SCIENTIFIC INQUIRY Room F2
Chairperson(s): Melanie Williams

WHAT MAKES YOU ARGUE? THE INPUT OF EXERCISES’ STATEMENTS IN STUDENTS’ ARGUMENTATION SKILLS
Jennifer Virgino dos Santos Xavier1; Renata de Paula Orofino2; Melina de Souza Leite1; Daniela Lopes Scarpa3
1University of Sao Paulo; 2Federal University of ABC

THE PRODUCTION OF LITERARY INScriptions BY STUDENTS OF HIGHER EDUCATION IN THE HEALTH AREA WHEN CONDUCTING AN IMMUNOLOGY-INQUIRY-BASED LEARNING ACTIVITY
Bruno Sipavicius, K.A.1; João Rodrigo santos da silva2; Daniel Manzoni-de-Almeida3
1Escola de Ciências Biológicas e da Saúde, Centro Universitário das Faculdades Metropolitanas Unidas; 2Universidade Federal do ABC

AN ANALYTICAL TOOL TO EVALUATE ARGUMENTATION IN INQUIRY DIDACTIC SEQUENCE (IDS) ABOUT BIODIVERSITY
Marcelo Tadeu Motokane
University of São Paulo

THE ROLE OF METALANGUAGE IN UNDERSTANDING AND ADDRESSING THE LANGUAGE DEMANDS OF SCIENCE LEARNING
Lay Hoon Seah
National Institute of Education, Nanyang Technological University, Singapore

GESTICULATIONS AND Pantomime REDUCE THE LANGUAGE GAP FOR CHINESE EMERGENT BILINGUALS IN SCIENCE
Melanie Williams
Edith Cowan University
13TH CONFERENCE ESERA

FRIDAY AUGUST 30

09:00 - 11:00  OP154 - STRAND 7 - STUDENTS’ SCIENTIFIC EXPLANATIONS  Room F3
Chairperson(s): Mai Lill Suhr Lunde

HOW PRIMARY SCHOOL STUDENTS EXPLAIN SCIENTIFIC PHENOMENA
Jennifer Krupinski; Sarah Rau-Patschke; Stefan Rumann
Universität Duisburg-Essen

ON THE CONSTRUCTION OF “SCIENCE STORIES”: THE VALUE OF HISTORICAL NARRATIVES FOR SCIENCE EDUCATION
Agustín Adúriz-Bravo; Andrea Revel Chion
1Universidad de Buenos Aires/CONICET; 2Universidad de Buenos Aires

POSSIBILITIES AND CHALLENGES WITH VISUAL REPRESENTATIONS AS PROMPTS FOR STUDENT MEANING-MAKING ABOUT CONSEQUENCES OF CLIMATE CHANGE
Tobias Fredlund; Erik Knain; Mai Lill Suhr Lunde
University of Oslo

CONDENSING MEANING: INTERMODAL AGGREGATION IN SECONDARY SCHOOL SCIENCE EXPLANATIONS
Len Unsworth; Len Unsworth
Australian Catholic University

FROM JELLY BEANS TO MITOCHONDRIA — USING STUDENT-CONSTRUCTED REPRESENTATIONS OF CELLS TO COMMUNICATE UNDERSTANDING OF CELL STRUCTURE AND CELLULAR PROCESSES
Mai Lill Suhr Lunde
Department of Teacher Education and School Research, University of Oslo

09:00 - 11:00  OP155 - STRAND 10 - EDUCATION POLICY STUDIES  Room G1
Chairperson(s): Pavels Pestovs

ACCESS TO ELITE PUBLIC SCIENCE HIGH SCHOOLS IN THE U.S.: OPPORTUNITY DISPARATE IMPACT, AND EQUAL PROTECTION
Angela Kelly; Keith Sheppard
Stony Brook University

THE IMPACT OF AUTHORITARIAN THINKING ON PUBLIC POLICIES AND SCIENTIFIC EDUCATION: A BRAZILIAN CASE
Michel Carnio; Marcos Cesar Danhoni Neves
Universidade Estadual de Maringá

BETWEEN NATIONAL POLICY AND CHILDREN’S IMAGINATION: CONCEPTUALIZING SCIENCE EDUCATION CURRICULA AND PRACTICES THROUGH A HISTORICAL LENS
Christina Siry; Kerstin te Heesen
University of Luxembourg

50 YEARS OF POLICY INFLUENCES ON UPPER SECONDARY PHYSICAL SCIENCES CURRICULA IN IRELAND
Damienne Letmon; Odilla Finlayson; Eilish McLoughlin
CASTel, School of Physical Sciences, Dublin City University, Ireland;

CHALLENGES TO IMPLEMENTATION OF REVISED SCIENCE AND MATH CURRICULUM IN LATVIA
Pavels Pestovs; Dace Namsone; Ilze Saleniece; Liga Cakane; Gatis Narvaiss
1University of Latvia; 2National Center for Education; 3Edurio Director

09:00 - 11:00  OP156 - STRAND 11 - METHODOLOGIES TO ASSESS SKILLS, VIEWS AND SELF-CONCEPT  Room G2
Chairperson(s): Maria Berge

WHAT MAKES STUDENTS FAIL WHEN SOLVING CHEMISTRY PROBLEM-TASKS: AN EYE-TRACKING ENHANCED STUDY
Martin Rusek; Martina Tóthová
Charles University, Faculty of Education

VOSAL: A QUESTIONNAIRE TO ASSESS PRE-SERVICE TEACHERS’ VIEWS OF SCIENTISTS, THEIR ACTIVITIES, AND LOCATIONS
Bianca Reinisch; Moritz Krell
Freie Universität Berlin
COMPARISON OF A PICTORIALLY-AIDED LIKERT SCALE AND A VISUAL DISCRETE SCALE TO ASSESS SELF-CONCEPT IN SCIENCE
Daniel Solis\(^1\); Nancy Longnecker\(^2\); David A. W. Hutchinson\(^2\)
\(^1\)Centre for Science Communication, University of Otago; \(^2\)The Dodd-Walls Centre for Photonic and Quantum Technologies, Department of Physics, University of Otago

PEER-ASSESSMENT AS A TOOL FOR REFLECTIVE FEEDBACK IN PRE-SERVICE TEACHER TRAINING
Lukas Rokos; Jan Petr; Radka Zavodská
University of South Bohemia in Ceske Budejovice, Faculty of Education

NORMS IN SUPERVISION: JOKES IN LIFE SCIENCE
Maria Berge\(^1\); Sofie Kobayashi\(^2\)
\(^1\)Umeå University; \(^2\)University of Copenhagen

09:00 - 11:00  OP157 - STRAND 3 - TEACHER STRATEGIES II  Room G3
Chairperson(s): Mekbib Alemu

HOW CAN EARTHQUAKES GET INTO A 5TH GRADE CLASSROOM?
Jérôme Santini\(^1\); Tracy Bloor\(^2\); Serge Quilio\(^3\); Gérard Sensevy\(^4\)
\(^1\)University of Côte d’Azur, France; \(^2\)University of Aix-Marseille, France; \(^3\)University of Western Brittany, France

USING CLASSROOM MANAGEMENT TO SUPPORT INCLUSIVE CHEMISTRY LEARNING
Felix Pawlak\(^1\); Katharina Groß\(^2\)
\(^1\)University of Cologne; \(^2\)University of Vienna

THE PROMOTION OF SCIENTIFIC THINKING THROUGH LOCATION-BASED QUESTIONS
Shadi Asakle; Miri Barak
Technion - Israel Institute of Technology

DESIGN AND DEVELOPMENT OF A CRITICAL AND CREATIVE THINKING SKILLS SCALE (EHCCT) FOR TEACHING THE SCIENCES IN SECONDARY SCHOOL
Diana Prado; Mercè Junyent
Universidad Autónoma de Barcelona

CHANGING PRIMARY SCHOOL (11-14S) TEACHER EDUCATION PEDAGOGY TO ENHANCE LEARNING OF STEM SUBJECTS: THE CASE OF ETHIOPIA
Vanessa Kind\(^1\); Mekbib Alemu\(^1\); Mesfin Tadesse\(^2\); Taha Rajab\(^3\)
\(^1\)University of Durham; \(^2\)Addis Ababa University; \(^3\)Durham University

09:00 - 11:00  OP158 - STRAND 13 - INTEGRATED SCIENCE AND STEM EDUCATION  Room G4
Chairperson(s): Lydia E Carol-Ann Burke

PRE-SERVICE SCIENCE TEACHERS’ IMPLEMENTATION OF ENGINEERING DESIGN INTEGRATED SCIENCE UNITS IN SCHOOLS
Frackson mumba; Vivien Chabalengula
University of Virginia

FINDINGS FROM A TRANSDISCIPLINARY AND CRITICAL CROSS-CULTURAL STEM (TC3-STEM) APPROACH FOR PREPARING PRE-SERVICE TEACHERS
Alberto J Rodríguez
Purdue University

INFUSING STEM INTO ORIENTATION PROGRAM FOR PRE-SERVICE PHYSICS TEACHER
Nurul Sulaeman; Yoshisuke Kumano
Graduate School of Science & Technology, Shizuoka University

INTERFACULTY INTERPRETATIONS OF STEM EDUCATION: ENGINEERING EDUCATORS AND TEACHER EDUCATORS WORK TOGETHER TO GENERATE STEM WORKSHOPS
Lydia E Carol-Ann Burke; Christina Phillips; Zoya Padarms
OISE, University of Toronto

09:00 - 11:00  OP159 - STRAND 14 - PEDAGOGICAL CONTENT KNOWLEDGE VI  Room G5
Chairperson(s): Hernan Cofre

SCIENCE TEACHING THROUGH THE EYES OF STUDENTS.
Eva Pennegård\(^1\); Nils Ekelund\(^2\)
\(^1\)Lund University; \(^2\)Malmö University
DEVELOPING SCIENCE TEACHER TRAINEES’GRADUATE ATTRIBUTES ALONGSIDE SUBJECT CONTENT KNOWLEDGE (CK) AND PEDAGOGICAL CONTENT KNOWLEDGE (PCK): VIEWS FROM SCIENCE-TEACHER EDUCATORS
Festo Kayima¹; Selina Mkimbili²
¹NTNU - Norwegian University og Sience and Technology; ²Mkwawa University College of Education, Tanzania

EXAMINING THE MASTER MODEL AS TOOL FOR SUPPORTING TEACHERS TO TRANSLATE RESEARCH EXPERIENCES INTO PRACTICES-BASED CURRICULUM
Kathleen Hill¹; Matthew Johnson²; Amanda Smith¹
¹Pennsylvania State University Main Campus; ²Pennsylvania State University

CAPTURING PEDAGOGICAL CONTENT KNOWLEDGE (PCK) FOR EVOLUTION IN BIOLOGY TEACHERS: A DESCRIPTION OF A NEW PAPER AND PENCIL INSTRUMENT
Hernan Cofre¹; David Santibañez²; Paola Nuñez³; Beatriz Becerra⁴; Claudia Vergara⁵
¹Universidad Católica de Valparaíso; ²Universidad Católica Silva Henríquez; ³Universidad católica de Valparaíso; ⁴Universidad Alberto Hurtado

09:00 - 11:00 OP160 - STRAND 14 - ELEMENTARY AND PRIMARY SCHOOL TEACHERS' PROFESSIONAL DEVELOPMENT
Room G6

Chairperson(s): Alison Mercier

FOSTERING LANGUAGE SKILLS IN PRIMARY SCHOOL SCIENCE CLASSROOMS: PRELIMINARY EVALUATION RESULTS OF A PROFESSIONAL DEVELOPMENT PROGRAMME
Rosa Hettmannsperger¹; Christine Sontag¹; Ilonca Hardy¹; Susanne Mannel¹; Katrin Gabler¹; Sofie Henschel¹; Birgit Heppt¹; Petra Stanat¹
¹Goethe-Universität Frankfurt; ²Humboldt-Universität zu Berlin; ³Institut zur Qualitätsentwicklung im Bildungswesen Wissenschaftliche Einrichtung der Länder an der H;

A NANOSCALE SCIENCE AND TECHNOLOGY TRAINING COURSE: PRIMARY TEACHERS’ LEARNING ON THE LOTUS AND GECKO EFFECTS
Leonidas Manoul¹; Anna Spyrtou¹; Euripides Hatzikraniotis²; Petros Karistoglou¹
¹University of Western Macedonia, Greece; ²Aristotle University of Thessaloniki

DISTRIBUTED EXPERTISE AND RELATIONAL AGENCY: EXAMINING THE WORK OF A SCIENCE TEACHER PROFESSIONAL DEVELOPMENT TEAM
Sara Wilmes; Christina Siry; Kerstin te Heesen; Nora Kneip; Sandy Heinericy
University of Luxembourg

A STEM PROJECT USING COLLECTIVE ARGUMENTATION
Barbara Crawford¹; AnnaMarie Conner¹; Tim Foutz¹; Roger Hill¹; ChanMin Kim²; David Jackson¹; Sidney Thompson¹
¹The University of Georgia; ²Pensylvania State University

ENHANCING SCIENCE’S THINKABILITY FOR ELEMENTARY TEACHERS: A SCIENCE CAPITAL APPROACH
Alison Mercier; Heidi Carfone; Dearing Blankmann
University of North Carolina at Greensboro

09:00 - 11:00 OP161 - STRAND 14 - DEEPENING TEACHERS’ ENGAGEMENT WITH SCIENCE CONTENT
Room G7

Chairperson(s): Ana Martins

“I DIDN’T KNOW HOW THAT COULD COME TO THIS CURRICULUM”: TEACHER GROWTH THROUGH THE DEVELOPMENT OF MATERIALS ABOUT NATURE OF SCIENCE
Haira Gandolfi
UCL Institute of Education

EVIDENCE-BASED TEACHER OWNERSHIP OF AN EDUCATION THROUGH SCIENCE PHILOSOPHY AND APPROACH TO SCIENCE TEACHING AT THE SECONDARY LEVEL
Valdmann Ana; Mia Rannikmäe; Jack Holbrook
Tartu University

THE IMPACT OF A STEM UNDERGRADUATE RESEARCH EXPERIENCE ON INSERVICE TEACHER CAREERS
Molly Fisher; Jennifer Wilhelm
University of Kentucky

SCIENCE TEACHERS’ METAVISUAL STRATEGIES FOR SCIENTIFIC MODELING
Jung-Yi Hung¹; Hsin-Yi Chang¹; Chin-Chung Tsai²
¹National Kaohsiung Normal University; ²Program of Learning Sciences & The Institute for Research Excellence in Learning Sciences, National
BRINGING BIOINFORMATICS TO SECONDARY EDUCATION: A WORKSHOP FOR SCIENCE TEACHERS
Ana Martins1; Leonor Lencastre2; Fernando Tavares1
1Faculty of Sciences of University of Porto; Research Center in Biodiversity and Genetic Resources; 2Faculty of Psychology and Educational Sciences of the University of Porto

09:00 - 11:00  OP162 - STRAND 17 - IMPROVING UNIVERSITY SCIENCE EDUCATION  Room G8
Chairperson(s): Marissa Rollnick

UNDERGRADUATE SCIENCE WRITING: FACULTY MEMBERS’ BELIEFS AND EXPERIENCES
Annelotte Lammers; Martin Goedhart
Institute for Science Education and Communication, University of Groningen

LEARNING ASSISTANTS’ TRANSFORMED VIEWS ON TEACHING AND THE TEACHER ROLE AFTER A TRAINING PROGRAMME
Anders Lauvland; Tor Ole Odder; Maria Vetleseter Bøe; Ellen Karoline Henriksen
University of Oslo, Dept. of Physics

A “TRICKLE-UP” APPROACH TO IMPROVING UNIVERSITY SCIENCE EDUCATION: EVALUATION OF A PCK-BASED PROFESSIONAL DEVELOPMENT COURSE FOR GRADUATE STUDENTS
Sara Petchey; Kai Niebert
University of Zurich

A SOCIOLOGICAL BASED INQUIRY TO ACCESS SCIENCE EDUCATION SUPERVISOR’S PREPARATION AND ACTIONS
Luciana Massa1; Marcelo Giordan2
1Universidade Estadual Paulista; 2Universidade de São Paulo

THE RELATIONSHIP BETWEEN PCK AND CK FOR TEACHING CHEMICAL BONDING: THE EXCLUSIVE DOMAIN OF TEACHERS?
Marissa Rollnick1; Bette Davidowitz2; Frackson Mumba3; Rene Toerien4
1University of the Witwatersrand; 2University of Cape Town; 3University of Virginia; 4Rondebosch Boys’ high School
**BANKS & CURRENCY**
The Euro (€) is the currency in use in Italy. Visa and Master Card are all widely accepted in shops and restaurants throughout the country.
Bank Opening Hours Mon Mon to Fri
8.30-12.30       14.30-16.30

**CLIMATE**
August weather is hot in Bologna but showers can occur.
Average temperatures range from 25 – 30 °C.

**ELECTRICITY**
Electric Current: 220 Volts AV

**EMERGENCY CONTACT DETAILS**
During the meeting, in case of an emergency of any kind, please contact the Registration Desk.
If you require medical services while resident in your hotel/accommodation, please contact your hotel/ accommodation reception who will be able to arrange a doctor on call.
Calling the following numbers from a fixed line is free of charge:

118: Ambulance
115: Fire-brigade
113: Polizia (Police)
112: Carabinieri (military police)

**SHOPPING**
General opening hours are Monday-Saturday from 09.30-19.30. Most major stores/shops open on Sunday

**SMOKING**
Italy has introduced a ban on smoking. Smoking is prohibited in public areas including all bars, nightclubs and restaurants. If required you should enquire whether your accommodation bedroom is a smoking or non-smoking room. Please use the smoking areas designated outside venues.

**TAXIS**
A licensed taxi must display a “TAXI” display panel on the top of the car's roof.

Average prices
Center / Station - Fiera (P.zza Costituzione) and vice versa: € 15.00 / 18.00
Airport - Fair (P.zza Costituzione) and vice versa: € 20.00 / 25.00

The use of the collective taxi, pre-organized, provides some facilitated rates in the presence of certain requirements:
• from a single point of departure to a single destination and is activated with a minimum number of 3 users. The discount provided is 60% (ie each user pays 40% of the trip) and the amount displayed on the taximeter is per passenger;
• from central station to the Congress center (P.zza Costituzione) and vice versa: fixed rate of € 4.00 / person (minimum 3 people).

To facilitate access to the service there is the possibility of using Taxiclick Easy application, which also allows you to pay for rides in the app upon registration of your credit card (http: / /www.cotabo.it/clienti/servizi/taxi-click/).

**TIPPING**
Tipping is a generally accepted practice in restaurants, bars, taxis and hotel porters. A service charge may be included in some restaurants and should be stated on the menu, but otherwise this is a discretionary item.
Congress Center Map
Sala Maggiore - Ground Floor
Congress Center Map
Centro Congressi - Ground Floor
Congress Center Map
Sala Maggiore - First Floor
Congress Center Map
Centro Congressi - First Floor
Congress Center Map
Sala Maggiore - Second Floor
Congress Center Map
Centro Servizi Fiere - Ground & First Floor
### Esera 2019 Programme

#### Conference Overview

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<td>Lunch (1h)</td>
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