

IHPST

International History,
Philosophy, and
Science Teaching Group



IHPST Biennial Conference

July 4-7, 2017, Hacettepe University, Turkey

Abstract Book

Editor: Dr. Hasan Özcan

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Abstract Book

Editor: Dr. Hasan Özcan



IHPST Biennial Conference 2017 Abstract Book

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Correspondence:

Dr. Hasan Özcan

Aksaray University

Faculty of Education

Department of Mathematics and Science Education

68100 - Aksaray / TURKEY

E-mail: hozcan@aksaray.edu.tr

Office: +90 382 288 33 64

Fax: +90 382 288 33 33

Website: <http://hasanozcan.com.tr>

IHPST Biennial Conference 2017

International History, Philosophy, and Science Teaching Group

July 4-7, 2017 / Ankara – Turkey

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14th International History, Philosophy and Science Teaching (IHPST) Biennial Conference

July 4-7, 2017

Hacettepe University, Ankara, Turkey

IHPST 2017 Program	July 4, 2017 Tuesday		July 5, 2017 Wednesday	July 6, 2017 Thursday	July 7, 2017 Friday
8.30 - 9.00	IHPST Council Meeting		Registration	Registration	Registration
9.00 - 9.30			Concurrent Session – 1	Concurrent Session – 3	Concurrent Session – 6
9.30 - 10.00					
10.00 - 10.30			Coffee Break	Coffee Break	Coffee Break
10.30 - 11.00					
11.00 - 11.30			Concurrent Session – 2	Plenary Session-2 (The Springer Lecture) Silke Ackermann, U.K.	Plenary Session-3 Gürol Irzik, Turkey
11.30 - 12.00					
12.00 - 12.30					
12.30 - 13.00			LUNCH	LUNCH	Closing Session LUNCH
13.00 - 13.30			Guided Tour	Concurrent Session – 4	IHPST Council Meeting
13.30 - 14.00	IHPST Council Meeting	Registration			
14.00 - 14.30					
14.30 - 15.00				Concurrent Session – 5	
15.00 - 15.30					
15.30 - 16.00					
16.00 - 16.30					
16.30 - 17.00					
17.00 - 17.30	Coffee Break			IHPST Membership Meeting (This meeting that is open to all conference participants)	
17.30 - 17.40	Welcome Remarks (Ayhan Yılmaz, Deputy Dean; Haluk Özen, Rector)				
17.40 - 18.30	Plenary Session-1 Zoubeida Dagher, USA				
18.30 - 19.00	Books Launch (Beyaz Ev Restaurant)				
19.15 - 19.30				Conference Banquet (Gala Dinner) (Günaydın Restaurant) Starts at 19:00	
19.30 - 20.00	Welcome reception & Dinner (Beyaz Ev Restaurant)				
20.00 - 20.30					
20.30 - 21.00					

* English is the official language of the conference.

** Guided Tour: Old Town, Ankara Castle, Rahmi M. Koc Museum

July 4, 2017

Time	Welcome Remarks (Ayhan Yılmaz, Deputy Dean; Haluk Özen, Rector)	Room
17.30 - 17.40		1

Plenary Session-1 Chair: Gultekin Cakmakci			
Time	Plenary Speaker	Title	Room
17.40 –19.00	Zoubeida Dagher, USA	Reconceptualizing the Nature of Science for Science Education: Premises, Challenges, and Future Directions	1

Books Launch Session Chair: Gurol Irzik		
Time	Speakers	Location
19.15 -19.30	Michael Matthews, Douglas Allchin, Glenn Dolphin & Calvin Kalman	Beyaz Ev Restaurant

Time	Welcome Dinner	Location
19.30 -21.00		Beyaz Ev Restaurant

July 5, 2017

Concurrent Session – 1a Chair: Zoubeida Dagher			
Time	Author(s)	Title	Room
9.00 -10.30	Selin Akgun, Busra Aksoz, Ebru Kaya, Sibel Erduran	Pre-Service Science Teachers' Understanding of Methods And Methodological Rules of Science	1
	Arzu Arslan Buyruk, Feral Ogan Bekiroglu	Supporting Inquiry Learning Environments With History of Science	1
	Deepika Bansal	Teaching Science, its History and Philosophy, and their Feminist Appraisals.	1

Concurrent Session – 1b Chair: Douglas Allchin			
Time	Author(s)	Title	Room
9.00 -10.30	Sule Aksoy, Devrim Guven	Learning from an Innovative Case Based Method of Assessment Tool: Science Teachers' Epistemic Understanding in Socio-scientific Issues Context	2
	Seda Çavus-Güngören, Ergin Hamzaoglu	Developing Pre-service Teachers' Knowledge about Teaching Nature of Science	2
	Breno Arsioli Moura, Douglas Allchin	Teaching Nature of Science for Scientific Literacy: a study of a short-term workshop	2

Concurrent Session – 1c Chair: Diego Romero-Maltrana			
Time	Author(s)	Title	Room
9.00 -10.30	Sevinç Nihal Yeşiloğlu, Betül Demirdöğen, Fitnat Köseoğlu	Development of Pre-Service Teachers Nature of Science Understanding During Learning cycle-based PCK-enriched Professional Development for Teaching Nature of Science	3
	Diego Romero-Maltrana, Elisa Anguita, Luís Díaz, Sergio Duarte	Analysis of Irzik & Nola's Family Resemblance Approach to the Nature of Science for Science Education	3

Concurrent Session – 2a Chair: Pierre J Boulous			
Time	Author(s)	Title	Room
11.00 - 12.30	Duygu Aysal Cin	Science Education at the School of Engineering (Mühendis Mektebi) in the Late Ottoman Empire (1909-1923)	1
	Aynur Tunc, Sule Bayraktar	Atomist Ideas In The Muslim World In 9th And 10th Centuries	1
	Pierre J Boulous	Newton, Diagrammatic Reasoning, and Inquiry	1

Concurrent Session – 2b Chair: Robert Carson			
Time	Author(s)	Title	Room
11.00 - 12.30	Hasan Bircan, Semra Sungur	Effect of Documentary Films on Students' Epistemological Beliefs	2
	S. Nazli Can, Ebru Z. Mugaologlu	The Effect of Evidence Based Nuclear Energy Instruction On Seventh Graders' Understanding And Argumentation Quality	2
	Robert Carson, Stuart Rowlands	Teaching Scientific Culture in a Post-Constructivist World	2

Concurrent Session – 2c Chair: Deniz Saribas			
Time	Author(s)	Title	Room
11.00 - 12.30	Douglas Allchin	Fake News, Trumping Facts, and Whole Science	3
	Ayşe Nur Keskin, Deniz Saribas	Investigating Undergraduate Students' Conceptual Understanding and Models of Climate Change	3
	Davut Saritas*	The Influence of a Movie Adapted from The History of Science on Science Teacher Candidates' Views About Science	3

* Concurrent Poster Session

July 6, 2017

Concurrent Session – 3a Chair: Glenn Dolphin			
Time	Author(s)	Title	Room
9.00 -10.30	Zekai Ayik, Bayram Costu	Understanding Progressive Nature of Science based on History and Philosophy of Science Perspective: Thomson, Rutherford and Bohr Atom Theory	1
	Kayahan Ince	Developing Eight Grade Students' NOS Views: Using Socio-Scientific Issues for Reflection	1
	Glenn Dolphin	Not your typical "Rocks for Jocks" course: Using the history of geology to teach undergraduate non-science majors about geoscience concepts and the nature of science	1

Concurrent Session – 3b Chair: Peter Heering			
Time	Author(s)	Title	Room
9.00 -10.30	Eda Erdaş Kartal, Nihal Doğan, Serhat Irez, Gültekin Çakmakçı, Yalçın Yalaki, Z. Berk Altınır, Zeynep Neslihan Köylü	A New Evaluation Model for Assessing Effectiveness of A Large Scale Continuing Professional Development Program About Nature of Science	2
	Peter Heering	Evaluating visitors' perceptions of historical experiments in a science center	2

Concurrent Session – 3c Chair: Calvin Kalman			
Time	Author(s)	Title	Room
9.00 -10.30	Onur Imren, Sibel Erduran, Liam Murray	Using Popular Video Games for Learning Scientific Practices	3
	Sahin Idin, Ismail Dönmez	An Implementation Study Relation to Experiments Created by Seventh Grade Students' in The Science Course	3
	Calvin Kalman, Mark Lattery	Issues in Science Education Informed by History & Philosophy of Science and Psychology	3

Plenary Session-2 (The Springer Lecture) Chair: Michael Matthews			
Time	Plenary Speaker	Title	Room
11.00 - 12.30	Silke Ackermann, U.K	In the Service of Religion? The display, and use in education, of 'Science in the Islamic World'	1

Concurrent Session – 4a Chair: Ebru Zeynep Mugaloglu			
Time	Author(s)	Title	Room
13.30 - 15.00	Fatma Belek, Betül Timur	Examination of Science Teacher Candidates' Thoughts About Fetemm Training Approach	1
	Barbara Zinn, Devin Mitchell	Developing a framework for high school students to express a personal ethical stance on science-related issues.	1
	Gaye Defne Ceyhan, Ebru Zeynep Mugaloglu	The Role of Cognitive, Behavioral and Personal Variables on Preservice Teachers' Plausibility Perceptions of Global Climate Change	1

Concurrent Session – 4b Chair: Yasemin Ozdem Yilmaz			
Time	Author(s)	Title	Room
13.30 - 15.00	Frauke Voitle, Julia Schwanewedel, Kerstin Kremer	Assessing students' epistemological beliefs about professional versus classroom science	2
	Ferah Ozer, Nihal Dogan, Yalcin Yalaki, Gültekin Çakmakçı, Serhat Irez	As Complicated As Rubik's Cube Is: How Difficult is to Change Middle School Students' NOS Views through a CPD	2
	Yasemin Ozdem Yilmaz, Fitnat Köseoglu	Science Teachers' And Science Centre Explainers' Epistemological Beliefs About Science	2

Concurrent Session –4c Chair: Michael Matthews			
Time	Author(s)	Title	Room
13.30 - 15.00	Peter Slezak	The Lessons of HPS: Intelligent Design in the Class-Room	3
	Nazime Özgür Tamdogan, M. Bahadır Aktan	Evaluation of Turkish-Islamic Scientists' and Scholars' Integration into Science Teaching and Learning	3
	Michael Matthews	Reflections on 25 years of Science & Education Editorship	3

Concurrent Session – 5a Chair: Deniz Peker			
Time	Author(s)	Title	Room
15.30 - 17.00	Busra Aksoz, Selin Akgun, Sibel Erduran, Ebru Kaya	Exploring Pre-Service Science Teachers' Understanding Social-Institutional Aspects of Science	1
	Maristela N Rocha, Ivã Gurgel	Freire and Wittgenstein in dialogue: towards a radical ethics for science education	1
	Deniz Peker, Ozgur Taskin	Turkish Enlightenment and Science Education	1

Concurrent Session – 5b Chair: Paulo Mauricio			
Time	Author(s)	Title	Room
15.30 - 17.00	Haira Emanuela Gandolfi	Different people in different places: students' knowledge about History of Science and the question of diversity in Science	2
	Feride Sahin, Salih Ates	Examination of The Relationship Between Seventh Grade Students' Science Literacy and Cognitive Style	2
	Paulo Mauricio	The first absolute scale of temperature and the intertwined aspects of experiment and theory in nature of science	2

Concurrent Session – 5c Chair: Julia Schwanewedel			
Time	Author(s)	Title	Room
15.30 - 17.00	Arzu S. Eryasar, Ahmet Kilinc, Serhat Irez, Sirin Yilmaz, Mehmet Demirbag, Çigdem H. Tosunoglu, Semanur Gungor, Muhammed M.Ozhan, Sule Caliskan, Zeynep N. Koylu	The Development of A Learning And Teaching Framework For SSI Based Science Education	3
	Deniz Saribas, Mehpare Saka	Pre-service science teachers' inclusion of critical evaluation in their teaching	3
	Julia Schwanewedel	"Learning Science Is About Facts and Language Learning Is About Being Discursive" - An Investigation of Students' Disciplinary Beliefs In The Context of Argumentation	3

July 7, 2017

Concurrent Session – 6a Chair: Gabor Zemplen			
Time	Author(s)	Title	Room
9.00 -10.30	Feral Ogan-Bekiroglu, Erol Suzuk	Examination of the Relationship between Pre-Service Physics Teachers' Domain Specific Epistemological Beliefs and their Knowledge of Subject Matter and Pedagogical Knowledge	1
	Friederike Trommler	Considering two opposing aspects of teleology: major learning obstacle in biology education & essential aspect of the nature of biology	1
	Gabor Zemplen	From Scientific Argumentation to Extended Controversies: on the multiple uses of historical case studies	1

Concurrent Session – 6b Chair: Robyn Yucel			
Time	Author(s)	Title	Room
9.00 -10.30	Dina Tsybulsky	Design-based research as an approach to development, implementation and assessment of learning programs that integrate HPS	2
	Gunkut Mesci	Factors Mediating Preservice Science Teachers' Abilities And Teaching Experiences to Enact Their PCK for NOS and NOSI	2
	Robyn Yucel	Knowledge is of something: Scientists' ontological and epistemological views about science	2

Concurrent Session – 6c Chair: Hasan Ozcan			
Time	Author(s)	Title	Room
9.00 -10.30	Hasan Ozcan	The Impact of Nature of Science Teaching on Preservice Science Teachers; Understanding of History of Science	3
	Cecilia Rennie	"We can explain": a critical analysis of World of Science ads	3
	Hasan Ozcan	What Preservice Science Teachers Believe in Philosophy of Science is it for?	3

Plenary Session-3 Chair: Fatih Tasar			
Time	Plenary Speaker	Title	Room
11.00 - 12.30	Gürol Irzik, Turkey	Epistemic Trust in Science and its Implications for Science Education	1

Dear IHPST 2017 Conference Participants,

I want to personally welcome you to the 14th IHPST Biennial conference, and thank you in advance for contributing to its success. By sharing your expertise via presentations and formal and informal discussions, you support the mission of our organization, which is dedicated to promoting scholarly endeavors informed by history, philosophy and sociology of science for the purpose of improving science education at all levels.

The conference's theme "*Looking back, looking forward: Achievements and perspectives in HPS studies in science education*" invites us to reflect on our respective research agendas with a future-oriented outlook. Recent advancements in science, technology, engineering and mathematics (STEM) fields and their impact on society pose new questions and challenges to those working at the intersection of HPS studies and science education. They prompt us to wonder what research questions in our interdisciplinary field are worth pursuing? For what purpose and to whose benefit? What research methods and analytical tools are best suited to explore such questions? How could these methods and tools be further refined to better inform educational theory and practice?

As you attend the conference's plenary and concurrent sessions, do your best to engage the speakers and probe the significance of shared ideas and their implications. Take the opportunity to expand your perspectives as you make new friends and reconnect with old ones. It is those friendly and thought-provoking interactions across the participants' diverse disciplinary backgrounds that distinguish IHPST conferences from others and make them most memorable. I wish each and every one of you a most productive and enjoyable conference and hope that you continue to be actively involved in the life of our vibrant organization for years to come!

Zoubeida R. Dagher

IHPST President (2015-2017)

Dear Colleagues,

A very warm welcome to the 14th International History, Philosophy and Science Teaching (IHPST) Biennial Conference. The theme of this years' conference "Looking back, looking ahead: Achievements and perspectives in HPS studies in science education" will frame the discussions and provide a forum for scholars to discuss, debate, and exchange ideas that contribute to fruitful HPS and science education insights. We hope this will be a major professional highlight for all of us.

It is safe to say that much of the "nature of science/scientific knowledge" literature in the field of science education has emerged in the past 40 years and has enjoyed a climax in the late 1990s and in the early 2000s. After so many years and the publication of several handbooks, books, numerous journal articles, and countless other forms of communications, we are now in a position to look back and evaluate the achievements and shortcomings of this body of research in educational settings at various teaching levels. Eventually, such an endeavor will enable us to look forward with confidence of the gained knowledge through scientific research.

This conference aims at bringing together researchers and policy makers in science education and in history, philosophy, and sociology of science who are interested in research and practice at the intersection of these disciplines.

We invited in particular contributions that address topics including but not limited to the following areas:

- Research on the contribution of the history, philosophy, and sociology of science for improving teaching, learning, and curricula in science and mathematics.
- Identification of research methods that have led to significant improvements in our understanding of the role of HPS in science education and implementation of HPS teaching.
- The extent to which research outcomes on the contribution of the history, philosophy, and sociology of science to science teaching depend on such contexts as culture, country, region, school level, sociological setting, demographics, utilized resources.
- The contribution of HPS studies to the intellectual and ethical development of individuals and cultures.
- Identification of future work to be done at the intersection of HPS & Science teaching and learning.

Spanning Europe and Asia, it can be said that Turkey has been the meeting place of many peoples and cultures throughout the centuries. Having colleagues from over 17 countries in Ankara at this conference has the potential to see each of our way of mutual understanding, respect and cooperation that is also much needed in today's world.

On behalf of the Local Organizing Committee of the Conference, we would like to thank everyone who has contributed this conference in different capacities and wish all participants a wonderful, rewarding and successful conference.

M. Fatih Taşar, Gazi Üniversitesi (Co-chair)

Gültekin Çakmakcı, Hacettepe Üniversitesi (Co-chair)

Hasan Özcan, Aksaray Üniversitesi (Co-chair)

Local Organizing Committee & Advisory Board Members

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M. Fatih Taşar, *Gazi Üniversitesi (Co-chair)*

Gültekin Çakmakçı, *Hacettepe Üniversitesi (Co-chair)*

Hasan Özcan, *Aksaray Üniversitesi (Co-chair)*

Zeki Bayram, *Hacettepe Üniversitesi*

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Gürol Irzık, *Sabancı Üniversitesi*

Serhat İrez, *Marmara Üniversitesi*

Fitnat Köseoğlu, *Gazi Üniversitesi*

Ebru Muğaloğlu, *Boğaziçi Üniversitesi*

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Zoubeida R. Dagher, University of Delaware, USA

Reconceptualizing the Nature of Science for Science Education: Premises, Challenges, and Future Directions

What does reconceptualizing the nature of science (NOS) imply for science education theory and practice? How does it influence the development of learning goals, curriculum scope and sequence, and assessment tasks? How does it impact research design and data analysis? I argue that the Expanded Family Resemblance Approach framework for reconceptualizing NOS (Erduran & Dagher, 2014) constitutes a paradigm shift in terms of articulating what NOS knowledge is of most worth in science education, and how this knowledge might be communicated, queried, or researched. It offers a set of coherent classes of NOS concepts around which curriculum sequences can be developed and research programs pursued. In making these arguments, I will first describe the framework's premises and discuss its challenges. Second, I will illustrate its empirical capacity to address a range of pedagogical and methodological issues. By expounding the framework's theoretical and empirical significance for science education, I aim to underscore its fruitfulness, capacity for promoting productive disciplinary engagement, and potential for supporting the development of scientific proficiency.



Silke Ackermann, Oxford University, UK

In the Service of Religion? The display, and use in education, of 'Science in the Islamic World'

'Islam' or 'Islamist' are words that we read in the papers almost daily – alas, frequently in a negative context, as un-reflected labels for an amorphous group of people or ideas.

'Islamic' or 'Islamicate' are labels that have been used to refer to objects – in an equally ill-defined way. The former is often used to refer to the origin of an object with a nebulous reference to religion, the latter was introduced in the 1970s to indicate a cultural rather than areligious context - whilst for most non-specialist an intended clarity frequently caused further confusion.

So what do our students understand when 'Islamic Science' is on the curriculum? What do our audiences expect when we invite them to join us in exploring 'scientific instruments from the Islamic World'? Or, even more generally, whom do we wish to educate in what precisely?

This presentation will reflect on these challenges in teaching on, and contributing to the understanding of, this multifaceted subject then and now – and how we might move on from here.

**Gürol Irzık**, Sabancı University, Turkey**Epistemic Trust in Science and its Implications for Science Education**

On the one hand, scientific knowledge acquisition requires an understanding of evidence and its bearing on scientific hypotheses and theories. On the other hand, much of our knowledge of substantive science content is based on the testimony of scientists and the epistemic trust we invest in them. These two claims are in tension. To my knowledge, the implications of this tension for science education were first discussed by Stephen Norris more than twenty five years ago. Since then Norris's important work triggered only some limited interest in the topic in the science education community, and so more work needs to be done. In order to resolve the tension fully and to explore its implications for science education, we need a careful account of what it means for nonscientists to invest warranted epistemic trust in scientists. In my presentation I first offer such an account by drawing on my previous work and illustrate it with a case study that can be used in the classroom. I then show how the aforementioned tension can be easily resolved once we have an account of epistemic trust at hand, with important implications about science teaching.

July 5, 2017**Concurrent Session – 1a****Chair: Zoubeida Dagher****Time: 9.00 -10.30****Room: 1**

Pre-Service Science Teachers' Understanding of Methods and Methodological Rules of Science

Selin Akgun, Busra Aksoz, Ebru Kaya, Sibel Erduran

selin.akgun@boun.edu.tr, busra.aksoz@boun.edu.tr, ebru.kaya@boun.edu.tr,
sibel.erduran@education.ox.ac.uk

The paper presents an investigation of pre-service science teachers' understanding of "methods and methodological rules of science" based on a theoretical framework proposed by Erduran and Dagher's (2014). The purpose of the study reported in the paper was to determine the changes in pre-service science teachers' understanding of methods and methodological rules of science before and after teacher education course focusing on nature of science (NOS). 15 pre-service science teachers from a public university in Europe participated in a funded project. Pre- and post-interviews were conducted with the participants. Qualitative research methods were used to analyze the effect of the intervention. Each interview was transcribed, and codes were identified. The findings indicate that before the intervention, pre-service science teachers had limited understanding of the methods and methodological rules of science. They viewed methods and methodological rules of science as data collection process, experimentation, modelling and controlling the variables before the intervention. After the intervention, they focused on diversity of scientific methods through the terms of hypothesis and non-hypothesis testing, theory laden evidence, and manipulation and non-manipulation. Overall, the results suggest that pre-service teachers' understanding of methods and methodological rules was enriched and improved.

July 5, 2017**Concurrent Session – 1a****Chair: Zoubeida Dagher****Time: 9.00 -10.30****Room: 1**

Supporting Inquiry Learning Environments with History of Science

Arzu Arslan Buyruk, Feral Ogan Bekiroglu

arzfizik@gmail.com, feralogan@yahoo.com

In this study, pre-service teachers created their own research questions and hypotheses, design their experiments, interpret the results in inclined plane and free falling activities. They created their own experiments first and the questions asked by the scientist were asked to the pre-service teachers then. The methods of scientists were compared and discussed in the class. Instead of getting ready the formulas and theories that scientists only produce, learning of scientists' inquiry process provided pre-service teachers to know their own inquiry process. Both groups mentioned the similarities and differences between scientists' questions and the processes they have undergone and the processes they have undergone in the development of science. The subjects and questions that did not come to the mind of the students with the examples given from the history of science strengthened the inquiry. Pre-service teachers have developed multiple perspectives from two directions. The first was to see the views of different scientists on the issues of motion and dynamic. The second one was the examination of the realities of the events of the same scientist in terms of physical reality. In addition to controlled experiments, pre-service teachers learned some methods as thinking experiments, idealization and reasoning.

July 5, 2017**Concurrent Session – 1a****Chair: Zoubeida Dagher****Time: 9.00 -10.30****Room: 1**

Teaching Science, its History and Philosophy, and their Feminist Appraisals

Deepika Bansal

deebans.88@gmail.com

History and philosophy of science have been shown to contribute immensely to a meaningful and effective science education. My initiation into this field of scholarly work and action happened through my engagement with feminist perspectives on science. Most of the latter kind of scholarship successfully explains the excesses and dynamics of science by recourse to its history. Focussing the feminist lens on the history and philosophy of science has brought to fore different dimensions of the ever-progressing scientific enterprise. Based on my experience of teaching elementary school science in a teacher education college, in this paper, I contend that teaching history and philosophy of science in its conventional form is not sufficient if students are to learn about nature of science and critical thinking. It is equally necessary that students are exposed to feminist perspectives on science, its history, and its philosophy. I argue that if science is to play a truly emancipatory role in societies which are divided along the axes of gender, class, caste, race or religion, then we must expand the notion of science education to include (feminist) theories about science as well.

July 5, 2017**Concurrent Session – 1b****Chair: Douglas Allchin****Time: 9.00 -10.30****Room: 2**

Learning from an Innovative Case Based Method of Assessment Tool: Science Teachers' Epistemic Understanding in Socio-scientific Issues Context

Şule Aksoy, Devrim Güven

saksoy@syr.edu, devrim.guven@boun.edu.tr

Functional understanding of nature of scientific knowledge and inquiry is crucial in science education in order to prepare citizens to make well-informed decisions about social and personal issues relating to science and technology. It is argued this functional understanding might be assessed better through authentic contextualized assessment tools (Allchin, 2011). In this study, 33 in-service science teachers' epistemic understanding was assessed contextually through socio-scientific issues based case of "autism and the measles vaccine". Participants were individually interviewed after reading the short case, which targeted understanding following dimensions relating to scientific epistemology; credibility of scientific evidence, reliability of scientific knowledge, disagreements among scientists, ethical dimensions of science, rational risk perception and decision making. Overlapping themes in the interviews were identified and the emergent codes were organized according to dimensions of scientific epistemology. Results of the study show that majority of participants preferred to examine different resources and to take expert ideas before making decision about the controversial issue. They also questioned the credibility of scientific evidence and the reliability of knowledge, but few of them talked about the interaction among scientists and ethical dimensions of science. Presentation will include analytic description of the case used and implications for research and practice will be discussed.

July 5, 2017**Concurrent Session – 1b****Chair: Douglas Allchin****Time: 9.00 -10.30****Room: 2**

Developing Pre-service Teachers' Knowledge about Teaching Nature of Science

Seda Çavus-Güngören, Ergin Hamzaoglu

sdacavus@gmail.com, erginhamzaoglu@gazi.edu.tr

Teaching and learning Nature of Science (NOS) is a very important topic in science education. However researches about how develop the teachers' Pedagogical Content Knowledge (PCK) in NOS is still open to investigation. This study was designed as a case study and focused on development of the pre-service science teachers' (PSTs) knowledge about teaching NOS. Participants consisted of 41 PST junior in two different classes. During one school semester the participants were enrolled in the "NOS and History of Science" course. The aim of this course is to educate and train PST about the NOS, and ways of teaching. Participants were engaged in different contextualized and de-contextualized NOS activities that explicitly addressing six target aspects of NOS. The training proceeds focused on how NOS is reflected to course content. The groups prepared lesson plan according to Common Knowledge Construction Model and Context-Based Approach. Then, they presented their lesson plans twice, an expert and a researcher provided feedback to each group regarding their presentation. Data resources included the pre-post open-ended questions about teaching NOS, participant journals and semi-structured interviews. Results showed that the PSTs knowledge about the teaching of NOS content, value of teaching NOS and the content of NOS teaching increased.

July 5, 2017**Concurrent Session – 1b****Chair: Douglas Allchin****Time: 9.00 -10.30****Room: 2**

Teaching Nature of Science for Scientific Literacy: a Study of a Short-Term Workshop

Breno Moura, Douglas Allchin

breno.moura@ufabc.edu.br, allch001@umn.edu

This presentation reports the results of a short (3 full-day) intervention held in a Brazilian university, aimed to orient in-service teachers to methods for teaching the nature of science (NOS) using historical cases, contemporary cases, and socioscientific issues. Our project contrasted with the opportunity provided with pre-service teachers in full semester length courses addressing NOS, offered by one of the authors in other university. We aimed to comprehend what could be achieved in a very short period in both promoting NOS education and orienting teachers to learning NOS on their own. In order to evaluate these goals, we collected their answers to a brief questionnaire sent after the last session, as well as written data obtained during the sessions. Our most significant findings are that: (1) inquiry-style engagement with teachers seems valuable in motivating them, by linking NOS to scientific literacy and concrete contemporary socioscientific issues; (2) having an occasion to try the methods in their own classes, with preliminary individual guidance and follow-up discussion, is important to teachers thinking about new proposals and ideas to discuss NOS issues; (3) the workshop had a positive and continuous influence on their practices months after the sessions. Other details about the results will be given at the presentation.

July 5, 2017**Concurrent Session – 1c****Chair: Diego Romero-Maltrana****Time: 9.00 -10.30****Room: 3**

**Development of Pre-Service Teachers Nature of Science Understanding During
Learning Cycle-Based PCK-Enriched Professional Development for Teaching Nature of
Science**

Sevinç Nihal Yeşiloğlu, Betül Demirdöğen, Fitnat Köseoğlu

nihalatalay@gazi.edu.tr, betuldemirdogen@gmail.com, fitnat@gazi.edu.tr

The purpose of this study is to investigate how pre-service chemistry teachers' nature of science (NOS) understanding changed after participating to Learning cycle-based PCK-enriched Professional Development for teaching NOS. The professional development mainly consisted of two parts: Learning NOS part and Learning how to teach NOS part and it was designed on the basis of the learning cycle model. We utilized case study design. Twenty eight pre-service chemistry teachers (six male and twenty two female) who were in their last semester of a five year chemistry teacher education program participated in the study. Views on Nature of Science Questionnaire Form-C, follow up interviews, worksheets and journal notes were used to collect data. Participants' NOS understanding was categorized using an already existing coding scheme which is naïve, transitional, and informed. Analysis of data revealed that vast majority of the participants had naïve and transitional views about most of the NOS aspects. Participants had the most difficulty in theory-law, sociocultural-embedded, and theory-laden aspects. However, they tackled most of the difficulties and challenges about understanding NOS through the end of professional development. Although substantial increase in informed views, participants still had problems in understanding empirical-based, sociocultural-embedded theory- law, and observation-inference. Implications for teacher educations are discussed.

July 5, 2017**Concurrent Session – 1c****Chair: Diego Romero-Maltrana****Time: 9.00 -10.30****Room: 3**

Analysis of Irzik & Nola's Family Resemblance Approach to the Nature of Science for Science Education

Diego Romero-Maltrana, Elisa Anguita, Luís Díaz, Sergio Duarte

diego.romero@pucv.cl elisa.anguita@gmail.com, wallpink@gmail.com,
sergio.duarte.m@gmail.com

In this document we attempt to contribute to the Family Resemblance Approach (FRA) to the Nature of Science proposed by Irzik & Nola by means of an analysis of some important features of FRA: its link to the "demarcation problem", and the number of categories adopted in the first of Irzik & Nola's paper. We clarify some misunderstandings present in the literature regarding the first point and provide a justification for the number of categories, at the same time we highlight an unmentioned hierarchy relation between the categories. We also discuss some implication of our contribution to the classroom.

July 5, 2017**Concurrent Session – 2a****Chair: Pierre J Boulos****Time: 11.00 -12.30****Room: 1**

Science Education at the School of Engineering (Mühendis Mektebi) in the Late Ottoman Empire (1909-1923)

Duygu Aysal Cin

aysal@itu.edu.tr

This paper deals with the science education rendered at the School of Engineering (Mühendis Mektebi) in the late Ottoman Empire (1909-1923) while focusing on its various aspects such as the course books and materials, rules and regulations of the school (for instance, the dress code), laboratories, internships undertaken by the students, technical visits of the students to the major industrial sites both in the Empire and abroad. Hendese-i Mülkiye (Civil School of Engineering) was converted into School of Engineering (Muhendis Mektebi) in 1909. Mehmed Refik (Fenmen), the first director of the school was an open minded intellectual and electric engineer, who worked hard for the school to be a contemporary one among its Western counter parts. For this purpose, he asked from the professors of the School to prepare course books in Ottoman Turkish for their courses and he ordered many course books and materials from abroad, ranging from Germany to Belgium. As the archival documents of Mühendis Mektebi reveal, we learn that the students worked in the laboratories, performed internships in various places such as Hedjaz Railways or Post and Telegraphy Administration and the students were taken to the technical visits by their professors to the major industrial sites both in the Empire and abroad. It was compulsory for the students to stay in the school dormitories. The Library of the school provided students with the course materials and the students received monthly salary. The research for this study is based on the archival research held at the Prime Ministry Ottoman Archives in Istanbul, Prime Ministry Republican Archives in Ankara and SALT Research in Istanbul. The study will also provide a lively environment of the Engineering School by presenting photographs from the student life and examples of course materials.

July 5, 2017**Concurrent Session – 2a****Chair: Pierre J Boulous****Time: 11.00 -12.30****Room: 1**

Atomist Ideas in the Muslim World in 9th and 10th Centuries

Aynur Tunc, Şule Bayraktar

aynurtunc@ybu.edu.tr, sulebayraktar@yahoo.com

In this work, we will examine the ideas of Muslim Philosophers' or so called Mutakallimun, who lived in 9th and 10th centuries, on the atom, structure and properties of atom as well as the origin of their atomist ideas. Mutakallimun, were the first theologian-philosophers in the history of Islam who sought to affirm theology on rational principles of Kalam. El Allaf, Razi, Cubbai, Muammer, Hisham al Fuvadi, Bakillani, Ibn Furek, Nazzam, Zakariya Razi, are among the thinkers of this period. First, the atomism in the Ancient Greek world is introduced. Second, the origin of the atomist ideas in the Islamic world will be discussed. Afterwards, atomist and non-atomist ideas of Muslim thinkers were introduced. Finally, atomism in the Greek, Indian, and Islamic world compared and contrasted.

July 5, 2017**Concurrent Session – 2a****Chair: Pierre J Boulos****Time: 11.00 -12.30****Room: 1****Newton, Diagrammatic Reasoning, and Inquiry**

Pierre J Boulos

boulos@uwindSOR.ca

The notion of science as inquiry and inquiry-based learning are standard fare in science education. For the purposes of this presentation, we take inquiry to be: A self-directed, question-driven search for understanding. Inquiry-based learning requires a set of questions that provide a framework for research, which may yield definitive answers to questions of limited scope or can be extended guided by questions that may not lead to definitive answers. Interestingly, the history of science has numerous examples of the "inquiry" method. For instance, Newton's famous "light and colours experiment" which was published in 1672 in the Philosophical Transactions of the Royal Society of London essentially asks "What is the nature of light?" Newton's Light and Colours experiment is a colourful example of the inquiry process - how and why Newton develops an experimentum crucis is illustrative of this. But what about the Principia? According to De Moivre: "In 1684 Dr Halley came to visit him at Cambridge. After they had been some time together, the Dr asked him what he thought the curve would be that would be described by the planets supposing the force of attraction towards the sun to be reciprocal to the square of their distance from it. Sir Isaac replied immediately that it would be an ellipse." Halley's question prompted Newton to formulate his ideas about mechanics and universal gravitation. The answer to Halley grew and became progressively more comprehensive until, in a remarkably short time (about 18 months) that included a breakdown, Newton had composed the three-volume work which first appeared in 1687. It underwent two revisions with the final third edition appearing in 1726, one year before his death. Arguably it is either the greatest scientific work ever to appear, or nearly so. I would argue that it is also one of the greatest philosophical works ever to appear. And yet, it's a curious fact that when the Principia was published (at Halley's expense) in 1687, it did not actually contain the demonstration that Halley had requested. The Principia (Prop XI-XIII Bk.1) shows that a planet moving in a conical orbit under the influence of a central force toward one of the foci is undergoing acceleration toward that foci with a magnitude proportional to the reciprocal of the squared distance, and hence is subject to an inverse-square force. This is the converse of Halley's question, which asked for a demonstration of the shape of an orbit given that the planet was subjected to an inverse-square force. Newton does conclude: "Therefore the major planets revolve in ellipses having a focus in the center of the sun; and the radii to the sun describe areas proportional to the times, exactly as Kepler supposed." Science as inquiry is understood qua inquiry through the lens of history and philosophy of science. The novice reading the Principia can rightly walk away not appreciating the "inquiry" component of Newton's project. What was the focus? What was the question that led to the Principia? What were the revisions to this question? What were the side-bar investigations needed? Universal Gravitation, in essence the Principia, is the conclusion of Inquiry - but to see the inquiry itself, that's where the narrative, the story behind the science, helps. Examples would include how Newton wrote De Motu, added Book II on motion through a medium, etc.

July 5, 2017**Concurrent Session – 2b****Chair: Robert Carson****Time: 11.00 -12.30****Room: 2**

Effect of Documentary Films on Students' Epistemological Beliefs

Hasan Bircan, Semra Sungur

hsnbircan@gmail.com, ssungur@metu.edu.tr

The present study aimed at investigating the effect of documentary films on 8th-grade students' epistemological beliefs in science. A pretest-posttest non-equivalent control group design was utilized. The four intact classes, taught by the same science teacher, were randomly assigned as experimental ($n = 61$) and control groups ($n = 62$). In the experimental group, four documentary films about cloning, energy, electricity, and recycling have been integrated into the science curriculum. Before watching each documentary film, a form including open-ended discussion questions related to the documentary targeting different aspects of epistemological beliefs have been distributed to students in the experimental group. After watching the documentary, students have completed the form and whole class discussions have been made. At the end of each documentary film session, a summary was made regarding the documentary and the aspects of scientific epistemological beliefs targeted. On the other hand, in the control group, regular curriculum has been followed. Epistemological Beliefs Questionnaire (EBQ, Conley, Pintrich, Vekiri, & Harrison, 2004) has been used to assess students' epistemological beliefs in science. Pre-test results showed that before the treatment, experimental and control groups were comparable in terms of their epistemological beliefs. Upon completion of the treatment, the EBQ was administered again to determine the effect of documentary films on students' epistemological beliefs. The post-test results showed that there was no significant effect of documentary films on students' epistemological beliefs. However, item level analyses suggested that, after the treatment, experimental group students were likely to have more sophisticated beliefs on some of the EBQ items.

July 5, 2017**Concurrent Session – 2b****Chair: Robert Carson****Time: 11.00 -12.30****Room: 2**

The Effect of Evidence Based Nuclear Energy Instruction on Seventh Graders' Understanding and Argumentation Quality

Şükrüye Nazli Can, Ebru Zeynep Mugaologlu

snazlicanal@gmail.com, akturkeb@boun.edu.tr

Citizenship education emphasizes the significance of evidence based thinking skills and understanding of socio-scientific issues. In science education, argumentation is one of the suggested methods to develop evidence based thinking skills especially while teaching socio-scientific (SSI) issues such as nuclear energy. The main aim of the study is to investigate the effect of evidence based nuclear energy instruction on seventh graders' understanding of nuclear energy and their argumentation quality. The sample of the study consisted of 110 7th graders. The present study is a quasi-experimental study. Nuclear energy was taught to all groups for four lessons that were designed based on three different methods. In experimental groups, model evidence link diagram developed by Lombardi and his colleagues were used to in order to design evidence-based instructions. Each student completed an understanding questionnaire about nuclear energy as pre and posttests. They also prepared a letter to the deputies about the construction of nuclear power plants before and after the intervention. In all groups, understanding of nuclear energy significantly improved. Moreover argumentation quality only increased in experimental group 1 and 2. However, only in experimental group 2 the increase was significant.

July 5, 2017**Concurrent Session – 2b****Chair: Robert Carson****Time: 11.00 -12.30****Room: 2**

Teaching Scientific Culture in a Post-Constructivist World

Robert Carson, Stuart Rowlands

rcarson@montana.edu, stuart.rowlands@plymouth.ac.uk

The overarching question this paper will reflect upon is "How well does current educational practice succeed in helping students come to a mature understanding of the nature of each of the major domains of knowledge, and of the nature of intellectual culture generally?" Education continues to shift its focus in the direction of discrete bits of knowledge and skills, as defined by standards, aligned with instructional objectives, evaluated by assessments, and regulated by a vast and increasing apparatus of big data. But where in the midst of this approach do we offer foundational perspectives that explain the phenomenon of humankind's cultural attainments, or discuss the ways in which mastery of the various intellectual disciplines serves to transform the human mind? This paper will draw upon historical and philosophical perspectives from four distinct cultural epochs in educational history in order to establish an ethical premise, and in order to examine the historical trendlines relative to those ethical principles. The first epoch is Classical Greece, and its discovery of distinct intellectual disciplines that formed the basis of liberal education. They viewed those disciplines from a novel perspective, having been perhaps the first community of intellectuals to develop both an aesthetic and an analytical appreciation of the effects intellectual culture has upon the human mind. The second epoch is the early 20th century, when the hegemony of classical liberal education faded, and was replaced by new 'progressive' forms of education. We will also look at the underlying philosophical commitments, some of which were derived from Romanticism and the essays of Rousseau. The third epoch will be the post WWII surge of commitment by governments and educationists that brought constructivism to full maturity, with a brief analysis of its virtues as well as its failings. The fourth cultural epoch is the present, a time when constructivism is waning and educational 'best practice' is being consolidated around the armature of standards, behavioral objectives, curriculum design, pedagogical strategies, assessments, and data analytics, essentially fulfilling the kind of educational vision derived from Demings' system of Total Quality Management. While the teaching and learning of each distinct intellectual discipline may indeed serve to equip the learner for useful employment, an equally important purpose is served by cultivating an overall understanding and appreciation for the human cultural achievement. We will discuss the linkages between these two complementary considerations, in the context of our modern scientific culture, and in the context of classical and contemporary considerations of democratic equality and citizenship.

July 5, 2017**Concurrent Session – 2c****Chair: Deniz Sarıbaş****Time: 11.00 -12.30****Room: 3**

Fake News, Trumping Facts, and Whole Science

Douglas Allchin

allch001@umn.edu

What do students, as future consumers and citizens need to know about the nature of science, scientific practices, or how science works? With a recent explosion of fake news, politicians denying scientific consensus (especially climate change), political gagging of scientists, and media pundits misrepresenting science, the task expands well beyond understanding scientific reasoning. Also relevant are concepts of expertise, testimony, credibility, conflict of interest, epistemic dependence, trust in communication channels, and more. I profile the role of a Whole Science perspective in supporting functional scientific literacy -- including the social dimensions of communicating science, error, and credibility - all critical elements that are omitted from the now antiquated "consensus view" of NOS and even the new NGSS's "scientific practices."

July 5, 2017**Concurrent Session – 2c****Chair: Deniz Sarıbaş****Time: 11.00 -12.30****Room: 3**

Investigating Undergraduate Students' Conceptual Understanding and Models of Climate Change

Ayse Nur Keskin, Deniz Sarıbaş

aysenurrparlak@gmail.com, denizsaribas@gmail.com

Having information about students' lack of understandings may lead educators to make educational attempts for conceptual change to occur. The aim of this study is to examine undergraduate students' conceptual models of climate change (CC) as well as their conceptual understanding about causes, impacts, and solutions of CC. For this purpose Global Climate Change Survey (GCCS) (Leiserowitz, Smith, & Marlon, 2010) was used. The survey includes 55 different types of items. For this study 15 of them were used. The results of this study shows that the students thought that depletion of ozone layer, toxic wastes, and acid rain have an impact on CC. This result also reveals that students might have thought whole environmental problems are equal to global warming. Students also seem to have been confused about causes of the CC. The same confusion appears in their interpretations of solutions of CC. Moreover, the students' conceptual models seem to be problematic. They believe that Earth's climate has been changing gradually and atmospheric CO₂ increasing linearly. This result indicates that they cannot thoroughly understand human-induced causes of CC, especially over the past 500 years. Implications are suggested including science activities such as conceptual change model to be used in science class to enable them differentiate CC and other environmental problems.

July 6, 2017**Concurrent Session – 3a****Chair: Glenn Dolphin****Time: 9.00 -10.30****Room: 1**

Understanding Progressive Nature of Science based on History and Philosophy of Science Perspective: Thomson, Rutherford and Bohr Atom Theory

Zekai Ayık, Bayram Costu

zekaiayik@harran.edu.tr, bayramcostu@gmail.com

Many researchers demonstrated the importance of history and philosophy of science (HPS) for understanding the nature of science (NOS) and its progress. The aim of this study is to facilitate pre-service science teachers' understanding of the NOS of through using a content prepared in the perspective of HPS. Several studies demonstrated that physics and chemistry textbooks have serious epistemological problems compared to current philosophy of teaching of science. This situation causes a lack of understanding the NOS and scientific progress. In a Lakatosian framework a big number of textbooks physics and chemistry used widely analyzed by Mansoor Niaz and his colleagues and almost all of them found lacking depicting of the NOS and scientific progress but Leon Cooper's textbook. Cooper's book was evaluated as adequate due to its content presentation in the perspective of HPS. In this study, 30 pre-service science teachers who has already taken general chemistry course in which one of the analyzed low graded textbook was used are participants. The study includes a pre-test, and instruction phase and a post-test same as pre-test. The tests prepared from VNOS test and the instruction is prepared according to Cooper's chapter of Atomic Structure. In the end the effect of an instruction prepared in the perspective of HPS on the understanding of the NOS and scientific progress will be evaluated.

July 6, 2017**Concurrent Session – 3a****Chair: Glenn Dolphin****Time: 9.00 -10.30****Room: 1**

Developing Eight Grade Students' NOS Views: Using Socio-Scientific Issues for Reflection

Kayahan İnce

kayahanince@outlook.com

The aim of this study is develop elementary or primary students' nature of science (NOS) views with the activities prepared on the basis of socio-scientific issues (SSI) and it is to determine how tolerant the students' changing NOS views are after a 10-week period. For this purpose, SSI-based NOS events were implemented for 35 eight grade students for 6 weeks. Qualitative approach was used to in this research determine students' views of the changing nature of science. Researcher collected data with VNOS-D, interviews to explore student's nature of science views. The research data are collected as VNOS-D, interviews and reflection papers after each event as pre-post test and permanence test. After the analysis whole data, results showed that students developed their NOS views. It was also found that SSI-based activities retention improved NOS views of students in some sub-dimensions. Moreover, the activities became more useful because of the nature of the SSI. The study showed that SSI-based NOS activities are effective in improving students' natural views of science and provide retention in some sub-dimensions.

July 6, 2017**Concurrent Session – 3a****Chair: Glenn Dolphin****Time: 9.00 -10.30****Room: 1**

Not Your Typical "Rocks for Jocks" Course: Using the History of Geology to Teach Undergraduate Non-Science Majors about Geoscience Concepts and The Nature of Science

Glenn R Dolphin

glenn.dolphin@ucalgary.ca

To challenge perceptions about the traditional "rocks for jocks" introductory geology course, and to address concerns of geoscience literacy, the instructor instituted a number of pedagogical strategies. The instructor historically contextualized three main geoscience topics: (1) the earth has a history, (2) that history is very, very long, and (3) the earth is a dynamic system, while a fourth topic explicitly addressed the nature of science (NOS). The very large (n=355) class divided into groups of 4-5 each, and participated in multiple collaborative discussions and written activities addressing both geologic content and NOS. Through a qualitative analysis of responses to instructor-created prompts, students expressed some differences in NOS understandings from the beginning of the course to the end. In the beginning-of-course descriptions, students referred to science in terms of "the scientific method", proving (or disproving) hypotheses, or following directions and mixing substances together (as in baking or cooking). At the end of the course, students characterized science more along the lines of a process based in assumptions, observations, and bias. They talked more about the process of iterations, building on prior knowledge to formulate an explanation for phenomena in the natural world. Future study will also focus on geoscience conceptual development.

July 6, 2017**Concurrent Session – 3b****Chair: Peter Heering****Time: 9.00 -10.30****Room: 2**

A New Evaluation Model for Assessing Effectiveness of A Large Scale Continuing Professional Development Program About Nature of Science*

Eda Erdaş Kartal, Nihal Doğan, Serhat Irez, Gültekin Çakmakçı, Yalçın Yalaki, Z. Berk Altınır, Zeynep Neslihan Köylü

erdaseda@gmail.com, nihaldogan17@gmail.com, sirez@marmara.edu.tr,
gultekincakmakci@gmail.com, yyalaki@gmail.com,
zk_brk@msn.com, zeynep-koylu@hotmail.com

The purpose of this study is to evaluate the effectiveness of a large-scale continuing professional development (CPD) program designed to improve teachers' nature of science (NOS) views, beliefs, and practices. In this project, a CPD program was implemented for a year with voluntary attendance of 18 middle school science teachers and their students. The intervention process with the science teachers consisted of ten monthly meetings over two semesters. Data were collected and evaluated based on 'five level evaluation model'. These levels are reaction, learning, beliefs, transfer and results. Teacher reactions about CPD program were collected making interviews at the end of the study using five open-ended questions. Teachers' learning about NOS was assessed by pre-post semi-structured interviews using VNOS-C. Teachers' beliefs about teaching and learning NOS were assessed using two likert-type scales as pre-post tests. Teacher's practices about NOS were assessed capturing videos during their classroom practices. The findings obtained from the project demonstrate that the CPD program was effective to improve teachers' NOS views, beliefs, and classroom practices.

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July 6, 2017**Concurrent Session – 3b****Chair: Peter Heering****Time: 9.00 -10.30****Room: 2**

Evaluating Visitors' Perceptions of Historical Experiments in a Science Center

Peter Heering

peter.heering@uni-flensburg.de

For several consecutive years, the Flensburg science center Phänomenta showed what was called the "Electrical Salon". This show was based on experiments from the history of electricity, namely the 18th century. In doing so, visitors were enabled to make their own experiences with devices such as an electrostatic generator, Leiden jars, and an electrophorus, to name just a few. Accompanied was this show with several empirical evaluations - mainly with Likert-scaled questionnaires, in some instances also accompanied by semi-structured interviews. In doing so, we aimed at understanding how visitors understood this approach, whether it was a historical, a scientific or a completely different learning activity. Moreover, we also analysed what was relevant for the visitors in their perception of the show, and how they experienced certain aspects such as the experiments, the context, the setting etc. Apart from that, we also interviewed in one year visitors of the Phänomenta who had not been to the "Electrical Salon" in order to develop some understanding why this approach was not attractive to them. In the presentation, the activity will be sketched and the development of the evaluation instruments as well as some of the findings will be described.

July 6, 2017**Concurrent Session – 3c****Chair: Calvin Kalman****Time: 9.00 -10.30****Room: 3**

Using Popular Video Games for Learning Scientific Practices

Onur Imren, Sibel Erduran, Liam Murray

onur.imren@ul.ie, sibel.erduran@education.ox.ac.uk, liam.murray@ul.ie

The use of video games for learning has dramatically increased in science education and has become a major focus of research during the past decade. Video games have some potential for multiple science learning goals including motivation for science learning, conceptual understanding and argumentation. A separate line of research concerns scientific practices. Scientific practices are one of the key areas of research in science education, also promoted in curriculum policy. The Next Generation Science Standards in the United States, for example, have promoted the teaching and learning of scientific practices in science education. Erduran and Dagher (2014) refer to «scientific practices» as an interrelated set of concepts including experimentation, classification, observation and how they contribute to data collection, analysis, modeling and explanation mediated by social certification processes such as argumentation. Although the definition of scientific practices is discussed in the literature, there is limited understanding of how they could be capitalised on in contexts where students are already immersed, such as video games. Therefore, in this study, we focused on 3 popular video games to investigate their potential for building learning of scientific practices. The paper discusses a research project guided by the question "How do middle school students engage in scientific practices in the context of playing video games?" 34 7th grade students from a public school in Turkey participated in this study. Qualitative and quantitative methods were used to investigate students' understanding and perceptions of scientific practices while playing video games. Results include observation that students create their plan by using observational data and prediction contrary to try and error method as they did in the beginning suggesting an impact on the use of a heuristic on scientific practices.

July 6, 2017**Concurrent Session – 3c****Chair: Calvin Kalman****Time: 9.00 -10.30****Room: 3**

**An Implemantation Study Relation to Experiments Created By Seventh Grade Students'
In The Science Course**

Sahin Idin, İsmail Dönmez

sahinidin@hotmail.com, ismaildonmezfen@gmail.com

The aim of this study is to investigate Turkish seventh grade students' knowledge on scientististsand their inventions.This study was carried out as a qualitative method, within this scope the research is a case study. The study was conducted with fourteen seventh grade students in a middle school, which is located in Ankara.For this purpose, students were asked for preparing an experiment in the face of scientists' inventions, and it was asked for a video record for their experiments. It was investigated, which experiments were done, which scientists were choosen by students, which was the first criteria while determining experiment, by watching videos, which were created by students. Document analysis, observations and interviews techniques were used, triangulation, to vary of thedata. It's seen that fourteen different experiments were prepared by students, and all the students used a western scientist's invention in their experiment. There have not been prepared any experiments based on a eastern scientist's invention, in the study. It has been understood from the interviews conducted with students that they basically considered firstly, western scientists's inventions because they first investigated their science textbook. There have been given some recommendations at the end of the study.

July 6, 2017**Concurrent Session – 3c****Chair: Calvin Kalman****Time: 9.00 -10.30****Room: 3**

Issues in Science Education Informed by History & Philosophy of Science and Psychology

Calvin Kalman, Mark Lattery

Calvin.Kalman@concordia.ca, lattery@uwosh.edu

This talk attempts to put forward a framework for dealing with students who enter classes with knowledge, spontaneously acquired or intuitive that is contrary to knowledge presented in class and that cannot be treated by refutation. It is posited that some students come to class with knowledge-in-pieces described by diSessa and others have coherent alternative theories as described by Posner, Strike, Hewson, and Gertzog. Students in the class are at different stages of intellectual development. The goal of science instruction is therefore to provide scaffolding activities flexible enough to nurture the growth of the student's functions regardless of their starting point. Students' actual learning of material is profoundly affected by their approach to learning. Students need to critically examine their own ideas and compare them to the ideas presented in the textbook and by the teacher. Students' learning is further complicated by the role of cognitive dissonance in the difficulties students have in transcending their misconceptions to learn scientific principles. Perhaps students have dropped out of courses not because of a lack of ability, but rather because their epistemology is not suitable for them to succeed. Cognitive dissonance then causes the student to misread the textbook and mishear the teacher.

July 6, 2017**Concurrent Session – 4a****Chair: Ebru Zeynep Muğaloğlu****Time: 9.00 -10.30****Room: 1**

Examination of Science Teacher Candidates' Thoughts About STEM Training Approach

Fatma Belek, Betül Timur

fatma.belek.1993@gmail.com, betultmrgmail.com

One of the goals of science and scientific literacy is to educate individuals in the 21st century Science, Technology, Engineering and Math they need the manufacturer's questioning and creative individuals. This study is the thesis work. The subject of the thesis work of prospective teachers science and technology STEM education approach to examine their thoughts and against those thoughts to develop STEM education activities. Therefore the purpose of science thesis work of prospective teachers STEM education approach in the process of learning and Professional training in their lives is to use efficiently. The sample of thesis research at Çanakkale 18 March University Faculty of Education Science Teacher candidates. Prospective teachers STEM education was conducted to determine the thoughts for the case study. Study of a three; 'teacher self-sufficiency belief scale' scale and science for thoughts to STEM education orientation scale survey. Science teacher candidates will be applied to the polls the last test to be applied in the form of preliminary test and 5 weeks for the duration of the set 10 Pcs STEM activity. Teacher candidates with 10 randomly selected teachers through semi-structured interview. As a results of the research STEM activities, science teacher candidates attitudes is influenced in a positive direction. The polls say that preliminary tests the final test results are examined. It is worth noting the development of the latest test results.

July 6, 2017**Concurrent Session – 4a****Chair: Ebru Zeynep Muğaloğlu****Time: 13.30-15.00****Room: 1**

Developing a Framework for High School Students to Express a Personal Ethical Stance on Science-Related Issues

Barbara Zinn, Devin Mitchell

zinnb@aisj.co.il, mitchelld@aisj.co.il

Our study aims to provide a safe environment for high school students to explore ethical aspects of science-related issues. They come from a wide variety of cultural and religious backgrounds, there are many nationalities with both expatriate and local students. In the Middle Years Program of the International Baccalaureate one of the criteria for science relates to the impact of science on everyday life and has students reflect on examples of science applications such as cloning and fertility treatments, as well as the ethical decisions facing the individual scientist. Choosing how society remembers a scientist is important in that it instructs students on the importance of ethical behavior. In our effort to educate the whole person, it is important to lead students to grapple with ethical questions in a safe environment. We are at the beginning of developing such a framework in science, which will have a transfer of knowledge to other disciplines. It is incumbent on every school to provide a framework for students to explore complicated ethical questions.

July 6, 2017**Concurrent Session – 4a****Chair: Ebru Zeynep Muğaloğlu****Time: 13.30-15.00****Room: 1**

The Role of Cognitive, Behavioral and Personal Variables on Preservice Teachers' Plausibility Perceptions of Global Climate Change

Gaye Defne Ceyhan, Ebru Zeynep Muğaloğlu

gdceyhan@syr.edu, akturkeb@boun.edu.tr

The philosophy of science is concerned with the nature of scientific knowledge and how we acquire it. Engaging students explicitly in evaluating their plausibility perceptions through reasoning and argumentation may increase students' understanding of nature of science (NOS). One of the fundamental variables in developing conceptual understanding is plausibility. Reasoning, problem solving and decision-making are among the objectives of the National Science Curriculum in Turkey. These skills are crucial in critical evaluation processes, which have an important place in understanding NOS while learning complex issues like global climate change (GCC). The purpose of this study is to investigate the role of preservice teachers' cognitive, behavioral and personal characteristics on their plausibility perceptions of GCC. The sample of the study is 199 senior pre-service teachers in a public university in Turkey. Five instruments were used to investigate the research question and multiple regression analysis was used to explore the predictors of the criterion variable. The results revealed that understanding, degree of willingness to act and need for closure were predictors of plausibility perceptions of GCC. These predictor variables explained 31% of the variance in participants' plausibility perceptions of GCC where cognitive variable had the largest contribution in explaining the variance.

July 6, 2017**Concurrent Session – 4b****Chair: Yasemin Özdem Yılmaz****Time: 13.30-15.00****Room: 2**

Assessing Students' Epistemological Beliefs about Professional Versus Classroom Science

Frauke Voitle, Julia Schwanewedel, Kerstin Kremer

voitle@ipn.uni-kiel.de, schwanewedel@ipn.uni-kiel.de, kremer@ipn.uni-kiel.de

Fostering students' understanding of the Nature of Science by classroom instruction has often proved to be challenging and is highly unlikely to be achieved by implicit approaches (Abd-El-Khalick et al. 1998; Lederman, 2010). Sandoval (2005) argues that the difficulties in changing students' views of professional science by instruction might be due to the disparity between students' epistemological beliefs about professional science and about classroom science. To explain the processes and outcomes of science education Sandoval (2005) as well as Hogan (2000) demand explicit research on the classroom-related science epistemologies and comparison of these beliefs to the epistemologies towards professional science. To this day, students' epistemological beliefs about classroom science have not explicitly been investigated and therefore specific assessment instruments are not available. Based on the established instrument of Conley et al. (2004) that assesses epistemological beliefs in science we developed a questionnaire to assess and compare students' epistemological beliefs towards professional as well as classroom science. The adapted questionnaire could shed some light on the relationship and development of these presumably different epistemologies. The presentation gives an introduction to the theoretical assumptions on epistemological beliefs about professional and classroom science, outlines the adapted questionnaire and aims at initiating a discussion about its theoretical foundation and possible options for its implementation and related research efforts.

July 6, 2017**Concurrent Session – 4b****Chair: Yasemin Özdem Yılmaz****Time: 13.30-15.00****Room: 2**

As Complicated As Rubik's Cube Is: How Difficult is to Change Middle School Students' NOS Views through a CPD*

Ferah Ozer, Nihal Dogan, Yalcin Yalaki, Gültekin Çakmakçı, Serhat Irez

ferahozer@yahoo.com, nihaldogan17@gmail.com, yyalaki@gmail.com,
gultekincakmakci@gmail.com, sirez@marmara.edu.tr

The importance of teaching nature of science(NOS),as part of scientific literacy,was emphasized by many researchers so far(Matthews,2002).Despite the emphasis on the importance of teaching NOS,many studies have shown that students hold naïve views of NOS(Abd-El-Khalick, 2004; Deng et. al, 2011).Science teachers play a key role in improving students' views of NOS.Continuing Professional Development (CPD) programs are considered to remedy enhancing teachers' NOS views,should they are designed effectively(Akerson& Hanuscin,2007).Also,studies reveals that more studies are conducted on the effects of CPDs on teacher learning and their classroom practices than on the effects of those programs on students' views (Garet et.al, 2001).The studies about the attained features-changed views of CPDs on indirect beneficiaries,namely students,are very limited.Thus,the present study aims to investigate the influence of a CPD on 5th,6th and 7th grade students' views about NOS and reveal the link between the views of teachers and students after providing a large-scale CPD to science teachers.It's possible to infer from the specific case results that when teachers' views on NOS changed positively,students' views generally also changed positively,depending on many factors.Referring to the factors and complexity of the impact process,the Rubik's Cube model metaphor is generated to reveal the difficulties and factors aside during the process.

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July 6, 2017**Concurrent Session – 4b****Chair: Yasemin Özdem Yılmaz****Time: 13.30-15.00****Room: 2**

Science Teachers' and Science Centre Explainers' Epistemological Beliefs About Science

Yasemin Özdem Yılmaz, Fitnat Köseoğlu

yasemin.Özdem@gop.edu.tr, fitnatks@gmail.com

Science centres not only provide unique opportunities to interact with science but these are also places where epistemological messages regarding science are conveyed to visitors. These messages gain importance when the visitors are students at primary and secondary levels. In Learning in Science Centres (LISC) (BILMER Project, TÜBİTAK (114K646) project, we develop models of professional development (PD) for teachers and science centre explainers, so they can collaborate to benefit from science centres in portraying non-positivist image of science to the students. As part of the project, the purpose of this study was to investigate science teachers' and science centre explainers' epistemological beliefs about science as a result of one week of PD. The data were collected from 20 science teachers and 15 explainers by means of nature of science questionnaire and follow-up interviews, field notes as well as pre- and post-PD interviews. Based on the findings of the content analysis, we concluded that science teachers' and explainers' realized that they usually had positivistic beliefs about science, but they questioned those beliefs during the workshops.

July 6, 2017**Concurrent Session – 4c****Chair: Michael Matthews****Time: 13.30-15.00****Room: 3**

The Lessons of HPS: Intelligent Design in the Class-Room

Peter Slezak

p.slezak@unsw.edu.au

The "wedge" strategy of ID advocates eschews Biblical arguments, relying instead on the supposedly "irreducible complexity" of life to infer an intelligent designer. Accordingly, the response must be more subtle than dismissing ID as Creationism in a new guise. We are inevitably confronted by fundamental questions in the philosophy of science bearing on both educational and wider social philosophy. Following Laudan's (1983) seminal discussion of the 'Demise of the Demarcation Problem', the grounds for distinguishing the good, the bad and the bogus must be more subtle (see Good & Slezak eds. 2011 *Sci & Ed*, 20: 401-409). Authoritative pronouncements from scientists will not help to diminish the appeal of such seductive theories. Essentially the same Teleological or Design Argument has been advanced by scientists such as Paul Davies (1992) to explain the "fine tuning" of the universe. While open to objections familiar since David Hume in the 18th Century, such views cannot be excluded from the explanatory enterprise on principled grounds. Above all, it is difficult to see how the goals of a scientific education could be better achieved by prohibiting a consideration of the apparent intellectual force of such arguments.

July 6, 2017**Concurrent Session – 4c****Chair: Michael Matthews****Time: 13.30-15.00****Room: 3**

Evaluation of Turkish-Islamic Scientists' and Scholars' Integration into Science Teaching and Learning

Nazime Özgür Tamdoğan, M. Bahadır Aktan

nazime.ozgur@hacettepe.edu.tr, mbaktan@hacettepe.edu.tr

It is a well know shortage that current science education systems including the teaching programs and the books are much away from the nature and the history of the science by the lack of knowledge especially about the Turkish, Persian, Indian, and Arabian Islamic Scientists in teaching. The drawbacks for the mentioned problem and the evaluation of possible ideas coming from science teachers and experts, the scientists working at history and philosophy of science and science teaching departments, are the aims of the current study. Both qualitative and quantitative research methods were used in the study. A detailed analysis of the history and the teaching of science literature was conducted. Then, a preliminary study about scientists and their contributions to history of science was therefore carried out to determine emerging historical names among the participant teachers' (n=144) and experts' (n=25) views. 18 Turkish-Islamic historical names were commonly emerged from the data. Furthermore, the study was enlarged with the help of survey and interview techniques. Both the science teachers and the experts surveyed and interviewed to understand which of these emerging Turkish-Islamic scientists and scholars should be taught and integrated into science teaching programs, curriculums and science textbooks. Based on the science teachers' and the experts' opinions, the findings were reported and suggestions about the proper integration of the Turkish-Islamic scientists into the science teaching programs is assessed and evaluated.

July 6, 2017**Concurrent Session – 4c****Chair: Michael Matthews****Time: 13.30-15.00****Room: 3**

Reflections on 25 years of Science & Education Editorship

Michael Matthews

m.matthews@unsw.edu.au

These reflections range over some distinctive features of the journal *Science & Education*, they acknowledge in a limited way the many individuals who over the past 25 years have contributed to the success and reputation of the journal, they chart the beginnings of the journal, and they dwell on a few central concerns - clear writing and the contribution of HPS to teacher education. The reflections also revisit the much-debated and written-upon philosophical and pedagogical arguments occasioned by the rise and possible demise of constructivism in science education. Although constructivism has ebbed, and the term has almost disappeared from education conference programmes and journal indexes, a lot of what it stood for has reappeared under the guise of 'Cultural Studies of Science'. The AERA conference has a 'cultural and historical' research special interest group that is holding more sessions at the 2015 conference than the parallel constructivist research group. Consistent with the pattern of science educators following trends in science studies research, in 2006 two researchers - Ken Tobin and Wolf-Michael Roth - both of whom had 'moved on' and 'abandoned' constructivism started a Springer journal titled *Cultural Studies in Science Education*

July 6, 2017**Concurrent Session – 5a****Chair: Deniz Peker****Time: 15.30 -17.00****Room: 1**

Exploring Pre-Service Science Teachers' Understanding Social-Institutional Aspects of Science

Busra Aksoz, Selin Akgun, Sibel Erduran, Ebru Kaya

busra.aksoz1@gmail.com, selinakgunn@gmail.com,
sibel.erduran@education.ox.ac.uk, ebru.kaya@boun.edu.tr

The paper reports on a study with pre-service science teachers using Erduran and Dagher's (2014) framework on nature of science (NOS). This framework defines NOS as a cognitive, epistemic and social-institutional system. The aim of the study was to determine pre-service science teachers' understanding of social-institutional aspects of science before and after a teacher training intervention. Participants were 15 pre-service science teachers from a public university in Europe. Quantitative and qualitative research methods were used to analyze the data collected as part of the intervention. A questionnaire (including 70 items including the social-institutional aspects of science) with reliability of alpha 0.79 was developed and applied to participants before and after the intervention. Furthermore, pre- and post-interviews were administered to participants. The interview data were analyzed by using qualitative methods. Each interview was transcribed and coded. The analysis of t-test shows that there is a significant difference between pre-service teachers' pre and post understanding of social-institutional aspects of science. The post-intervention results show that they held more informed understanding of social aspects of science including financial aspects, scientific ethos and professional activities. The findings suggest that pre-service science teachers' understanding of social-institutional aspects of science improved following the intervention.

July 6, 2017**Concurrent Session – 5a****Chair: Deniz Peker****Time: 15.30 -17.00****Room: 1**

Freire and Wittgenstein in Dialogue: Towards a Radical Ethics for Science Education

Maristela N Rocha, Ivã Gurgel

maristela.rocha@usp.br, gurgel@usp.br

The need for a more ethical and critical society is one of the main motivations for recent developments in science education. Participatory methodologies, socio-scientific issues and the inclusion of meta-level content are examples of this concern. However, the definition of guidelines for educational practices that are coherent with those purposes is not an elementary task. In particular, it is indispensable to investigate forms of sharing the scientific and nature of science knowledge without transforming education in indoctrination. In this direction, this work shifts the focus from the 'ethical content to be taught' to the ethical quality of educational practices through a dialogue between Freire's and Wittgenstein's epistemology. Freire emphasized the need for a radical ethics that could sustain the coherence between theory and practice. Educators wishing a more democratic society should also guarantee students' freedom - their right to say their own words through dialogue. Wittgenstein, in turn, connected language and knowledge to practice, and saw freedom as the possibility to expand worldviews. We argue that a rapprochement between both authors allows us to see the world-pictures attached to knowledge as the place where authentic dialogue can occur, and, consequently, contributes to outline ethical criteria for science education practices.

July 6, 2017**Concurrent Session – 5a****Chair: Deniz Peker****Time: 15.30 -17.00****Room: 1**

Turkish Enlightenment and Science Education

Deniz Peker, Ozgur Taskin

peker_deniz@columbusstate.edu, omuo zgurtaskin@gmail.com

This paper reviews the development of Turkish enlightenment from the late Ottoman Empire reform movements to today's Turkey. We first provide an overview of the Ottoman Context by presenting social, economic, and religious differences between the Ottoman society and European societies where the original Enlightenment emerged and discuss the reasons why enlightenment efforts were initially delayed and later slowed down in different periods of the history. We provide a chronological description of the long lasting modernization and reform movements of the late Ottoman Empire and Turkey with a focus on the social and political backdrop of these reform movements. We conclude our work by drawing from some of the earlier and contemporary writing regarding the Turkish modernization project by connecting it to science education.

July 6, 2017**Concurrent Session – 5b****Chair: Paulo Mauricio****Time: 15.30 -17.00****Room: 2**

Different people in Different Places: Students' Knowledge About History of Science and the Question of Diversity in Science

Haira Emanuela Gandolfi

haira.gandolfi.15@ucl.ac.uk

This exploratory research investigated secondary students' knowledge about different scientists and countries' contributions to Science, aiming at answering the following research question: "In which ways are students aware of the history of scientific development carried out by different people in different places of the world?" An open-ended survey, consisted of questions related to naming scientists and countries involved in scientific research today and in the past, was applied to 103 students (64% girls, 36% boys) from years 8, 9 and 10 (aged 12-15) in two secondary state schools in London, UK. Preliminary results showed a large disconnection between knowing the names of scientists and actually knowing about their work and backgrounds, hinting to an emphasis on an illustrative and decontextualized approach towards History and Philosophy of Science (HPS) in these schools. In addition, the lack of diversity found in these students' answers, both in terms of gender and ethnicity, unravels the impacts of presenting an acultural and homogeneous image of Science to students, which can directly influence their view on who can participate in and contribute to scientific research. Possible contributions to this scenario grounded on different and intercultural perspectives towards HPS are also addressed.

July 6, 2017**Concurrent Session – 5b****Chair: Paulo Mauricio****Time: 15.30 -17.00****Room: 2**

Examination of The Relationship Between Seventh Grade Students' Science Literacy and Cognitive Style

Feride Şahin, Salih Ateş

feride_celik84@hotmail.com, sates0@yahoo.com

The purpose of this study is to determine whether there is a relationship between 7th grade students' science literacy scores and Field Dependent, Field Intermediate and Field Independent (FD /FINT/ FI) cognitive styles and whether cognitive styles of students are a significant predictor of science literacy. The sample of the study is composed of 796 students in the province of Ankara who are studying in the seventh grade in the academic year of 2015-2016. Demonstrated Science Literacy Test (SL-D) was used to determine the level of science literacy of the students. As a result of the research, the cognitive style was found to be a statistically significant predictor of the students' literacy levels, $R^2 = 0.203$, $F(1,794) = 202.550$, $p < .00$. In addition, it has been found that there is a statistically significant difference in favor of field independents among field dependent, field intermediate and field independent students' mean science literacy scores ($F(2, 793) = 84,050$; $p < .05$). It can be argued that cognitive styles are a powerful predictor of science literacy as a result of research and that field independent learners have higher scores on science literacy test. The results of the research are similar to the related literature defined science literacy as science achievement.

July 6, 2017**Concurrent Session – 5b****Chair: Paulo Mauricio****Time: 15.30 -17.00****Room: 2**

The First Absolute Scale of Temperature and The Intertwined Aspects of Experiment and Theory in Nature of Science

Paulo Mauricio

paulo.asterix@gmail.com

The productivity of some surpassed theories in setting the ground from which new results, still valid today, emerged, have its counterpart in the productivity of some students' misconceptions as is defended by some authors. This leads us to proceed to a brief analysis of some results that spring from Sadi Carnot's theory of heat. Namely, we develop an account of William Thomson's thermodynamic scale developed under the framework of Sadi Carnot theory of heat, clarifying the meaning attributed to the term absolute in that scale. One of the main results obtained by Carnot in his 1824 *Réflexions* was the relation between temperature differences and the work performed in the engine bears his name. This allowed William Thomson to develop and present an absolute scale of temperature in the sense that it was substance independent. Moreover, the historical development of the science of heat allows us to explore the intertwined relation between theory and experiment surpassing the ancillary role of experiment that philosophy of science attributed to experimentation until some years ago, and which is reflected both in textbooks and Lederman's *Nature of Science* items.

July 6, 2017**Concurrent Session – 5c****Chair: Julia Schwanewedel****Time: 15.30 -17.00****Room: 3**

The Development of a Learning and Teaching Framework for SSI-Based Science Education

Arzu S. Eryasar, Ahmet Kilinc, Serhat Irez, Sirin Yilmaz, Mehmet Demirbag, Çigdem H. Tosunoglu, Semanur Gungor, Muhammed M.Ozhan, Sule Caliskan, Zeynep N. Koylu

arzu_sonmez1@hotmail.com, akilinc@uludag.edu.tr, sirez@marmara.edu.tr,
sirinyilmaz87@gmail.com, mtdemirbag@gmail.com, cigdem.han@marmara.edu.tr,
semanur.gungor@hotmail.com, mmo200793@gmail.com, suleecaliskan@gmail.com,
zeynep-koylu@hotmail.com

The purpose of present study was to develop a learning and teaching framework for SSI-based science education. To this end, we used the results of three stepping stone studies: a comprehensive literature review of 140 articles on SSI in science education, a delphi study with 35 experts who possess expertise in communicating, researching and teaching SSI-based science education and an interview study with 20 scientists who produce scientific knowledge about selected SSI contexts. The results of these studies were put together by an epistemic amalgam. The developed learning and teaching framework includes four parts: 1) vision, 2) goals, 3) pedagogical approach, and 4) learning areas and outcomes. We believe that this framework may open new doors for science teachers, teacher educators, textbook writers and curriculum makers.

July 6, 2017**Concurrent Session – 5c****Chair: Julia Schwanewedel****Time: 15.30 -17.00****Room: 3**

Pre-service Science Teachers' Inclusion of Critical Evaluation in Their Teaching

Deniz Sarıbaş, Mehpare Saka

denizsaribas@gmail.com, mehpiresaka@gmail.com

Scientific literacy requires understanding how scientists evaluate competing explanations and that analyzing ideas through a critical evaluation process in which they ask questions, search for evidence and make judgements about the relationships between evidence and alternative explanations about natural phenomena is a fundamental practice of scientists. Therefore, it is necessary to include evidence-based thinking and evaluation experiences into teacher education. The aim of this study was to investigate whether or not pre-service science teachers effectively include critical evaluation in their teaching and which techniques they use in their teaching is more effective regarding inclusion of critical evaluation into their teaching. The analyses of the pre-service science teachers' instructional designs showed that the use of competing theories that the students link ideas and evidence seem to have been more beneficial to let the students critically evaluate the ideas than other techniques. The findings of this study indicate the necessity of using MEL diagrams in teacher education programs and encourage pre-service teachers to integrate these tools into their teaching besides other techniques such as concept maps and scientific practices such as experimentation, observation, graphing, models, etc. for creating citizens who critically evaluate competing explanations and make-decisions based on evidence.

July 6, 2017**Concurrent Session – 5c****Chair: Julia Schwanewedel****Time: 15.30 -17.00****Room: 3**

**“Learning Science Is About Facts and Language Learning Is About Being Discursive” -
An Investigation of Students' Disciplinary Beliefs in The Context of Argumentation**

Julia Schwanewedel

schwanewedel@ipn.uni-kiel.de

Argumentation is considered crucial in numerous disciplines in schools and universities because it constitutes an important proficiency in peoples' daily and professional lives. However, it is unclear whether argumentation is understood and practiced in comparable ways across disciplines. On the basis of the assumption that there is a link between students' beliefs and abilities, we empirically examined how students perceive argumentation in science and language lessons. Specifically, we investigated students' beliefs about the relevance of discourse and the role of facts. Data from 3,258 high school students from 85 German secondary schools were analyzed with multigroup multilevel structural equation modeling in order to disentangle whether or not differences in argumentation across disciplines exist and the extent to which variation in students' beliefs can be explained by gender and school track. Besides qualitative content analyses of students' written answers on characteristics of argumentation in science and language lessons were conducted. Results showed that students perceived the role of facts as highly relevant for science lessons, whereas discursive characteristics were considered significantly less important. In turn, discourse played a central role in language lessons, which was believed to require less knowledge of facts. These differences were independent of students' gender. In contrast, school track predicted the differences in beliefs significantly. Our findings lend evidence on the existence of disciplinary school cultures in argumentation that may be the result of differences in teachers' school-track-specific classroom practice and education. Implications in terms of a teacher's role in establishing norms for scientific argumentation as well as the impact of students' beliefs on their learning outcomes will be discussed at the conference.

July 7, 2017**Concurrent Session – 6a****Chair: Gabor Zemplen****Time: 9.00 -10.30****Room: 1**

**Examination of the Relationship between Pre-Service Physics Teachers' Domain
Specific Epistemological Beliefs and their Knowledge of Subject Matter and Pedagogical
Knowledge**

Feral Ogan-Bekiroğlu, Erol Süzük

feralogan@yahoo.com, szkerol@gmail.com

The purpose of this study was to examine the relationship between pre-service physics teachers' physics related epistemological beliefs and their knowledge of physics and pedagogical knowledge. Qualitative research methods were used to collect and analyze the data. A semi-structured interview protocol developed by the researchers was used to interview with the participants. The students' epistemological beliefs in five dimensions were categorized from least sophisticated to most sophisticated based on the codes derived from the related literature. The following conclusions can be drawn from the study: First, pre-service physics teachers do not have the highest level physics epistemological beliefs which are necessary for conceptual change, understanding nature of science, and engaging in scientific inquiry process. Second, pre-service teachers' physics knowledge is related with their beliefs about real-life applicability, nature of knowing and learning, and source of ability to learn. Examples from history of physics may help enhancing students' epistemological views about the efficacy of hard work and good study strategies. Third, pre-service physics teachers' pedagogical content knowledge which can be developed by the physics education courses is correlated with their physics epistemological beliefs generally and their beliefs about evolving knowledge as well as source of ability to learn specifically.

July 7, 2017**Concurrent Session – 6a****Chair: Gabor Zemplén****Time: 9.00 -10.30****Room: 1**

Considering Two Opposing Aspects of Teleology: Major Learning Obstacle in Biology Education & Essential Aspect of the Nature of Biology

Friederike Trommler

trommler@uni-muenster.de

This contribution focuses on strategies for dealing with teleology in the science classroom. We review current views about teleology in biology education, and relate them to perspectives on teleology in the philosophy of biology. Against this background, we describe future directions for dealing with teleology in biology education. Both, biology education and philosophy of biology reject teleological explanations that assume goal-directed developments in ontogenesis and in phylogenesis. However, beyond that, in philosophy of biology, teleology is also considered an important methodological category in biology. Understood non-literally, teleology aids to conceptualize organisms as organized systems. In biology education, teleology is mainly understood literally so that biology educators demand its elimination from the biology classroom. In this contribution, we argue that biology education should take both aspects of teleology into account: On the one hand teleology can be a learning obstacle if students understand teleological explanations literally, and on the other hand teleology represents an essential aspect of the nature of biology. Given the possibility to understand teleological explanation not only literally but also non-literally in an adequate way, banning teleological language altogether is not a good strategy in dealing with teleology. Instead, science educators should initiate meta-discourses that illustrate how biologists interpret teleological formulations non-literally and how they differ from literal interpretations of teleological formulations. These meta-discourses about teleological formulations aim to counteract misconceptions that might be reinforced by teleological formulations. Biology educators should make it clear that biological mechanisms provide causal explanations and that biological functions are instrumental categories that aid biologists in conceptualizing living systems at higher levels of organization. Also, meta-discourses about teleology are meant to foster students' understanding of the nature of biology as the science that conceptualizes organisms as organized systems.

July 7, 2017**Concurrent Session – 6a****Chair: Gabor Zemplen****Time: 9.00 -10.30****Room: 1**

From Scientific Argumentation to Extended Controversies: on the Multiple Uses of Historical Case Studies

Gábor Zemplén

zemplen@filozofia.bme.hu

I outline two approaches, an atomistic and a holistic one that are available when historical controversies are used in classrooms. I use Newton's first optical controversy as a case study and provide two argument-reconstructions, one that portrays the conversion to Newtonian optics as rational, and the other that portrays Newton's scientific community (reacting with various forms of criticisms) as rational. Without trying to pass judgement, the benefits of the two reconstructions are discussed. The atomistic approach yields results that help content-uptake, and is amenable to a philosophical stance that treats statements as mini-theories. It also helps the introduction of arguments schemes that can help the understanding and appreciation of the methodological development of empirical science. The holistic approach has the advantage that a broader range of scientific representations can be meaningfully studied (including optical diagrams and changing pictorial conventions), and lexical changes can also be discussed, like the neologisms that Newton introduced (including his 'spectrum' and concept of 'refrangibility'). Although "there is an increasing emphasis on resting the science curriculum on a more appropriate balance between science process and citizenship skills, and factual or content knowledge of science." (Jiménez-Aleixandre and Erduran 2008, p. 19) this balance is hard to find, when the reconstruction tailored to fit content knowledge conflicts with the one more suitable to portray the science process.

July 7, 2017**Concurrent Session – 6b****Chair: Robyn Yucel****Time: 9.00 -10.30****Room: 2**

Design-Based Research as an Approach to Development, Implementation and Assessment of Learning Programs that Integrate HPS

Dina Tsybulsky

Dina.tsybulsky@mail.huji.ac.il

The current article presents a design-based research aimed at developing a learning unit that introduces high-school students to historical and philosophical narratives in biology research, and authentic inquiry such as is conducted in university research labs today. The unit we designed for this research included visits to the authentic research labs preceded and followed by study of the history and philosophy of science in class. The main aim of the learning unit was to provide the students with deep understanding of the various aspects of the nature of science. The study yielded many results and conclusions, and at the summative stage we were able to define (1) the main benefits of the learning unit for students, teachers and university researchers; (2) factors supporting the positive effect of the unit and factors that might harm it; (3) the strengths and weaknesses of the learning unit and ways to overcome the difficulties. Important conclusions of the study are that design-based research is an effective and appropriate way to develop, implement and assess a learning unit that integrates HPS, and that this kind of integrated learning unit does, indeed, lead to deeper student insight about the nature of science.

July 7, 2017**Concurrent Session – 6b****Chair: Robyn Yucel****Time: 9.00 -10.30****Room: 2**

Factors Mediating Preservice Science Teachers' Abilities and Teaching Experiences to Enact Their PCK for NOS and NOSI

Gunkut Mesci

gunkut.mesci@giresun.edu.tr

This study utilizes Magnusson et al.'s (1999) model of PCK as the framework. The purpose of this study is to examine possible factors mediating preservice science teachers' abilities and teaching experiences to enact their PCK for NOS and NOSI? This is an exploratory multiple case study of two preservice science teachers' (Charlie and Rose) experiences and developments during a teacher development program. Data is collected in the form of open-ended surveys, interviews, observations, lesson plans, video materials, and teaching documents. All data were analyzed in three stages, and uploaded into Hype-research software program for coding the data, category generation, and emergent themes. According to data analysis, both Charlie and Rose improved their understandings of almost all of the NOS and NOSI aspects throughout their research experience, taking a NOS/NOSI course, and teaching practice. Rose and Charlie successfully integrated components of their pedagogical content knowledge to create learning opportunities for their students. They relied upon their knowledge of subject matter, representations, instructional strategies, assessment, and curriculum to create opportunities which engaged students in making and testing predictions as well as supporting claims and conclusions with evidence. Also, some additional factors such as, teacher self-efficacy, lesson planning, or general pedagogical knowledge appeared to impact their teaching practicum. This study provides a description of how PCK for NOS and NOSI can develop over time, and what factors mediate preservice teachers' abilities and teaching experiences to enact their PKC for NOS and NOSI.

July 7, 2017**Concurrent Session – 6b****Chair: Robyn Yucel****Time: 9.00 -10.30****Room: 2**

Knowledge is of Something: Scientists' Ontological and Epistemological Views About Science

Robyn Yucel

r.yucel@latrobe.edu.au

The new 'post-truth' era and its accompanying 'alternative facts' threatens the credibility of science and the robustness of science education. Now, more than ever, science education has an important role to play in empowering students to value evidence and reason and to equip them to assess the credibility of scientific knowledge. If students are encouraged to develop relativistic views about science, there is a danger of undermining their confidence in the credibility of scientific knowledge. However, claims to certainty of scientific knowledge also potentially undermine the credibility of science because they cannot be upheld. Science education needs to be informed by a philosophical framework that can accommodate the fallibility of scientific knowledge without dispensing with a notion of truth. This paper proposes that critical realism, as it has emerged from Roy Bhaskar's transcendental realism (Bhaskar, 1975), achieves this by making a clear distinction between ontological and epistemological commitments in science, and by doing so, offers a comprehensive and coherent account of the practice of science which avoids many of the problems associated with empiricism and relativism. Data from interviews with scientists will be presented in order to illustrate how scientists can hold compatible positions of ontological realism and epistemological fallibilism.

July 7, 2017**Concurrent Session – 6c****Chair: Hasan Özcan****Time: 9.00 -10.30****Room: 3**

**The Impact of Nature of Science Teaching on Preservice Science Teachers;
Understanding of History of Science**

Hasan Özcan

hozcan@aksaray.edu.tr

In this study, the opinions of the science teacher candidates on nature of science are investigated, about what is history of science, what concepts they are related to, what purpose does it serve for. For this purpose, a data collection tool was administered for validity reliability studies, for a conceptual understanding test consisting of 4 questions and semi-structured interviews were used. The sample given in the study consists of 48 science teacher candidates and the data was collected after the nature of science education and analyzed by content analysis. According to the results obtained during the study, teacher candidates often describe the history of science as a scientific time-series or discoveries, however they have focused on the present-day science and the benefits of the history of science with the nature of science course. Before it was considered: linking the history of science with only the concepts of science, history and discovery, by students. After the training it has been determined that, the scientific knowledge is related to the variable structure and paradigm concepts.

July 7, 2017**Concurrent Session – 6c****Chair: Hasan Özcan****Time: 9.00 -10.30****Room: 3**

"We can explain": a Critical Analysis of World of Science ads

Cecilia Molinari de Rennie

cecilia.rennie@hotmail.com

Advertising is one of the main ways in which scientific content and (mis) representations of science are disseminated in our culture. Since the representation of science in advertisements serves ideological purposes, they frequently contradict the image of science promoted in educational settings. One way to deal with this dissonance is to subject the discourses of advertising to a critical analysis, revealing the ideological workings that underpin them and the aesthetic and discursive resources used to conceal these ideologies. In this presentation I apply the tools of critical multimodal analysis to a small corpus of advertisements for the Canadian organisation World of Science. My choice of object has the added interest that the product advertised is science itself, and the great visibility of the campaign justifies considering it a relevant sociocultural event. My analysis reveals an interesting contradiction between the idea of science as an exciting process of discovery and the old positivistic representation of science as an unquestionable "seal of truth". On the basis of these findings and my previous research, I suggest that a critical analysis the discourses of science in texts of popular culture could be productively used in the construction of scientific citizenship.

July 7, 2017**Concurrent Session – 6c****Chair: Hasan Özcan****Time: 9.00 -10.30****Room: 3**

What Preservice Science Teachers Believe in Philosophy of Science is it for?

Hasan Özcan

hozcan@aksaray.edu.tr

This study was conducted to investigate the paradigms of science teacher candidates about philosophy of science. Philosophy has always been a difficult concept to understand as content and perception. In this regard, the question of what philosophy of science is for was asked 37 science teacher candidates those forming the sample of the study. The questions are directed both within a questionnaire and with the supporting interviews. The study is a case study from qualitative research methods. The data was analyzed by content analysis, and the descriptive analysis in which the views of the prospective teachers were asked especially used in the report writing. Findings gathered from prospective teachers in the results of the study can be listed as follows: science philosophy, as in the questioning of the human being itself, likewise scientists does the work of questioning science and the processes of science. The philosophy of science makes the present situation compare with the previous stages, paradigms; Science philosophy is an instrument that illuminates our path in scientific processes and enables us to self-evaluate.

July 5, 2017**Poster Session****Time: 9.00 -12.30****Room: Hall**

The Influence of a Movie Adapted from The History of Science on Science Teacher Candidates' Views About Science

Davut Sarıtaş

davutsaritas@gmail.com

The Science in general, is what scientists do. For this reason, the history of science is a unique tool for understanding science itself. The history of science and the association of philosophy reveal many important works that are cornerstones of the philosophical view to the historical adventure of science. In science education literature, the necessity and effectiveness of philosophical and historical perspectives are expressed. On the other hand, the effective role of the media in developing views and understanding is indisputable. The media channels, especially movies, recommended in teacher education. In this context, motion picture films can also be used in developing understanding of science. This work is carried out on basic problems that as whether a motion picture adapted from a life story of a well-known scientist can affect the notion of teacher candidates about science. The study with a total of 72 science teacher candidates has semi-experimental design. In the study, the qualitative data were collected through the structured interview form prepared by the author. After applying the interview form for preliminary purposes, the movie was watched with the students. Following the movie, the interview form was applied again. Pre- and post- activities views of participants were analysed. According to results, especially in the views on the factors externally affecting the science (such as culture-social structure-individual psychology), change is remarkable. (e.g. "Scientific ideas have been affected by their social and historical milieu"/ "Scientific knowledge is the product of imagination and creativity")

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