1st REASON International Spring School

Measuring Scientific Reasoning and Argumentation

Venue: Faculty of Psychology and Education (LMU)

March 5 – March 7, 2015

Program

Organisation

Welcome address of Professor Dr. Martin Wirsing, LMU Vice President:

Welcome to Ludwig-Maximilians-Universität München - the University in the heart of Munich. LMU is recognized as one of Europe's premier academic and research institutions. Since our founding in 1472, LMU has attracted inspired scholars and talented students from all over the world, keeping the University at the nexus of ideas that challenge and change our complex world. From distinguished research grant winners to undergraduate students, all members of the LMU Munich community are engaged in generating new knowledge for the benefit of society at large. The International Doctoral Program "Scientific Reasoning and Argumentation" (REASON) is a good example of LMU's effort to establish excellent conditions for inter- and transdisciplinary collaborations across various fields of knowledge, as it brings together researchers from Psychology, Biology, Mathematics, Medicine, Computer Science, and Social Work. May your participation at the Spring School advance your methodological repertoire in this important area of research and help you generate important scientific insights in the development and facilitation of scientific reasoning and argumentation!

Welcome address of Professor Dr. Annette Leonhardt, Dean of the Faculty for Psychology and Education:

As the Dean of the Faculty for Psychology and Education at the Ludwig-Maximilians-Universität München, I welcome you to the First International Spring School of the International Doctoral Program "Scientific Reasoning and Argumentation" (REASON). Even before REASON has been established, scientific reasoning and argumentation has been an important research topic at this faculty. With the start of the REASON program in October 2013, the faculty has substantially increased its research efforts in this area, and promotes interdisciplinary collaborations with other faculties of LMU (e.g., Faculty for Mathematics, Computer Science, and Statistics; Faculty for Biology; Medical Faculty) as well as with the Technical University of Munich and the Katholische Stiftungsfachhochschule München. The goal of this research endeavor is to reach a rich understanding of how scientific reasoning and argumentation develops and how it can be facilitated in different age groups and subject matter domains. By hosting the First International Spring School on "Measuring Scientific Reasoning and Argumentation", the Faculty hopes to help PhD students extend their methodological repertoire and to strengthen further national and international collaborations with outstanding scientists in the area of scientific reasoning and argumentation.

Welcome address of the REASON Spring School Organization Committee:

The International Doctoral Program "Scientific Reasoning and Argumentation" (REASON) warmly welcomes you to its First International Spring School! Scientific Reasoning and Argumentation (SRA) is currently a hot topic in a variety of disciplines, such as Psychology, Mathematics Education, Biology Education, Medical Education, Computer Science, and Social Work. The main focus of the REASON program is on advancing scientific understanding of how SRA develops, and how it can be facilitated in different domains, social contexts and by aid of digital media. To be able to run such research, profound SRA measurement skills are indispensable. Therefore, the theme of the First International Spring School is "Measuring Scientific Reasoning and Argumentation". We are proud that we were able to recruit renowned international experts in the field to present keynote talks and workshops on different methodological challenges and solutions in this area. We are also very glad that it was possible to assemble a very international and interdisciplinary group of PhD students to participate in the Spring School. We hope that you enjoy the event and that you develop new ideas and skills regarding the measurement of SRA in the context of your PhD project.

Organization Committee

| Frank Fischer | Maryam Alqassab | Andras Csanadi | Markus Bolzer | Ingo Kollar |

Thursday, March 5

09:00 – 09:30 h — Newspaper Reading Hall

Registration and coffee

09:30 – 10:00 h — Newspaper Reading Hall

Welcome and overview of the agenda

Chairs: Prof. Dr. Frank Fischer & PD Dr. Ingo Kollar

10:00 – 11:15 h — Newspaper Reading Hall

Keynote: "What needs to develop in the development of scientific reasoning?"

Abstract: Since the pioneering work of Inhelder and Piaget (1958) and until fairly recently, research on the development of scientific thinking has focused narrowly on students' mastery of control of variables and rudimentary experimental design. Scientific thinking is central to science, certainly, but not specific to it. Here I argue for the need for a broader, more comprehensive approach to what develops and what needs to develop in the development of scientific thinking.

Presenter: Prof. Dr. Deanna Kuhn (Columbia University, USA)
Chair: Prof. Dr. Beate Sodian (LMU, Germany)

11:15 – 13:00 h — Newspaper Reading Hall

Get-together and Lunch

13:00 – 16:30 h — Room 1305

Workshop 1: "Analyzing talk of collaborative learners"

Abstract: This introductory workshop is particularly addressing students' novel to the analysis of verbal data. We will discuss and practice the analysis of processes of (computer-supported) collaborative learning processes on the basis of verbal data. We will start from basic considerations of sampling and organizing verbal data. Moreover, we will discuss the unit of analysis and problematize segmentation and granularity of segments from thick descriptions and propositional analyses to analysis of sequences of arguments and discourse structures. We will discuss and practice developing and applying coding schemes, incl. walking through the quality criteria for such a qualitative-quantitative approach of analyzing verbal data. Finally, we will discuss recent and potential future developments of analyzing talk of collaborative learners, such as automatization of verbal data analysis, measuring convergence in talk, and analyzing learning in communities.

Presenter: Prof. Dr. Armin Weinberger (Universität des Saarlandes, Germany)

13:00 – 16:30 h — Building 13a (Room 046)

Workshop 2: "Using generalized linear models (GLMs) to analyze argumentation data"

Abstract: Because much argumentation data are composed of counts or rubric scores reflecting an ordinal scale of measurement, use of generalized linear models (GLMs), involving Poisson or ordinal regression, and/or which adjust for skew, are often applicable to argumentation data. These techniques also potentially provide more statistical power, which is important given modest levels of reliability often associated with argumentation coding. GLM techniques can now be implemented in SPSS and most other statistical software. This workshop will give participants a conceptual overview of GLM techniques, a discussion of my research studies on argumentation which used these techniques, and step-by-step instructions on how to use these techniques in SPSS. If there is time, I will also give a brief overview of Generalized Estimating Equations, which can be used to control for statistical dependencies among observations.

Presenter: Dr. E. Michael Nussbaum (University of Nevada, USA)

Thursday
March 5

16:30 – 17:00 h   **Newspaper Reading Hall**

Coffee break

17:00 – 18:30 h   **Newspaper Reading Hall**

Poster Session I:

Poster I-1:   "Developing multiple-choice questions for measuring scientific reasoning in medical education"
Presenter: Daniela Luminita

Poster I-2:   "Enhancement and measurement of scientific thinking abilities in primary school children"
Presenter: Julia Schiefer

Poster I-3:   "There is always more than one perspective! - How to foster critical and elaborated scientific reasoning and argumentation"
Presenter: Monja Thiebach

Poster I-4:   "The development of physics knowledge in elementary school: relations with cognitive skills"
Presenter: Peter Edelsbrunner

Poster I-5:   "Fostering scientific reasoning with worked examples in a simulation-based learning environment"
Presenter: Juliane Kant

Poster I-6:   "Laypeoples' understanding of tentativeness"
Presenter: Danny Flemming

Poster I-7:   "The influence of the IBSE training on Polish teachers' reasoning skills"
Presenter: Karol Dudek

Poster I-8:   "'Whom to believe?' – Epistemic trust within judgments about scientific information"
Presenter: Friederike Hendriks

Poster I-9:   "Experimental skills of biology pre-service teachers"
Presenter: Meta Kambach

Poster I-10:   "The impact of peer feedback on mathematical scientific reasoning"
Presenter: Maryam Alqassab

Poster I-11:   "Fostering scientific reasoning and argumentation (in higher education)"
Presenter: Katharina Engelmann

Poster I-12:   "Probation officers on probation - Analysis of social worker´s scientific reasoning and argumentation"
Presenter: Christian Ghanem

Poster I-13:   "Belief revision and argumentation from evidence in pre-schoolers"
Presenter: Özgün Tuncer

Poster I-14:   "Influence of scientific reasoning tasks in biology classrooms on students' cognitive knowledge structure"
Presenter: Jigna Navani

Poster I-15:   "High performers in science: The relation of individual student characteristics, perception of teaching and learning motivation"
Presenter: Stefanie Schmidtner

Chair: Prof. Dr. Birgit Neuhaus (LMU, Germany)

Friday, March 6

09:00 – 10:15 h   Newspaper Reading Hall

Keynote: "Collaborative reasoning in massive open online courses (MOOCs)"

Abstract: Research on Massively Open Online Courses (MOOCs) is an emerging area for real world impact of technology for analysis of social media at a large scale. Automated analyses enable context-sensitive interventions that offer just-in-time support where it is needed. In our MOOC research we have developed both theory-driven metrics using supervised machine learning to analyze such constructs as motivation, cognitive engagement, confusion, attitude towards course affordances, relationship building, and relationship loss as well as bottom-up exploratory techniques using lightly supervised probabilistic graphical models. In this talk I will focus specifically on analysis of collaborative reasoning in problem solving MOOCs (e.g., computer programming or math courses) and how survival analyses using both bottom-up and theory-driven approaches point to the important role of collaborative reasoning in a MOOC context in keeping students over time. I will report on interventions adapted from classroom studies of computer-supported collaborative learning that were developed to provide more opportunities for such experiences in the MOOCs.

Presenter: Dr. Carolyn Rosé (Carnegie-Mellon University, USA)
Chair: PD. Dr. Ingo Kollar (LMU, Germany)

10:15 - 10:45 h   Newspaper Reading Hall

Coffee break

10:45 – 12:15 h   Newspaper Reading Hall

Poster Session II:

Poster II-1: "Measuring the skills that predict learning in middle school science"
Presenter: Paulette Vincent Ruz

Poster II-2: "How can long-term retention during inquiry learning be promoted?"
Presenter: Anne Erichsen

Poster II-3: "Analyzing and supporting reasoning during a historical inquiry"
Presenter: Michiel Voet

Poster II-4: "The influence of question wording on children's responses to scientific questions"
Presenter: Jonathan Halls

Poster II-5: "Visual expertise in fluid physics: Expanding perception in engineering students"
Presenter: Katherine Goodman

Poster II-6: "Resolving disagreements found in multiple, conflicting documents in authentic online environments"
Presenter: Randi Zimmerman

Poster II-7: "Actions of argumentation in whole class discussion: a study in a mathematical classroom"
Presenter: Kaouthar Boukafri

Poster II-8: "Characterising and promoting secondary students' scientific reasoning and conceptual change in science"
Presenter: Guanzhong Ma

Poster II-9: "Supporting model-based collaborative learning and reasoning with networked tablet computers"
Presenter: Lisa Hardy

Poster II-10: "Differential effects of emotions on divergent and convergent processing during mathematical Argumentation"
Presenter: Sandra Becker

Poster II-11: "Social and cognitive antecedents of teacher students' scientific reasoning"
Presenter: Andras Csanadi

Poster II-12: "Conceptualizing and supporting awareness of argumentative collaboration in CSCL"
Presenter: Maria Fysaraki

Poster II-13: "Consensus and confusion in testing scientific reasoning - A review"
Presenter: Ansgar Opitz

Poster II-14: "Scaffolding the development of medical students' ward round scripts with engagement and structure reflection prompts in a computer-supported learning environment"
Presenter: Esther Beltermann

Poster II-15: "Peer assessment of direct performance on scientific reasoning and argumentation tasks in higher education"
Presenter: Ji-Hye Kim

Chair: PD Dr. Johannes Bauer (TUM, Germany)

12:15 – 13:15 h   Newspaper Reading Hall

Lunch

13:15– 16:30 h   Room 1305

Workshop 3: "Mining discussions for learning"

Abstract: The key insight communicated through this tutorial is that if we can understand the connection between socio-psychological processes and language by means of the social signals encoded in them, we can structure computational models of language interactions more effectively. This tutorial will be composed of a theoretical component and a hands on component. In the theoretical component, I will give an overview of work related to the connection between discourse and learning. In the hands-on component, I will offer instruction on use of a freely downloadable tool for facilitating the application of machine learning to natural language data called LightSIDE that provides a convenient GUI environment for novice users of text classification technology easily run text extraction and classification experiments. On top of that, LightSIDE serves as a vehicle for dissemination of new techniques for effective application of machine learning to text mining, including novel feature extraction techniques.

Presenter: Prof. Dr. Carolyn Rosé (Carnegie-Mellon University, USA)

13:15– 16:30 h   Room 1205

Workshop 4: "Assessing scientific thinking"

Abstract: How do we assess individuals' capacity, as well as disposition, to think scientifically? The content we ask them to think about can be wide-ranging, certainly, but so are the skills. They range from the most fundamental of coordinating claims and evidence and inductive inference, to distinguishing evidence and explanation, distinguishing anecdotal and statistical evidence, coordinating multiple causes, and engaging in scientific argumentation to support, challenge, and weigh claims. Detecting patterns in large sets of behavioral data can be informative. But here we advocate as an essential supplement, and illustrate, close investigation of the reasoning underlying individuals' judgments.

Presenters: Prof. Dr. Deanna Kuhn & Toi Sin Arvidsson (Columbia University, US)

16:30 – 16:45 h   Newspaper Reading Hall

Coffee break

16:45 – 18:00 h   Newspaper Reading Hall

Keynote: "Integrative argumentation: a research program and agenda)"

Abstract: Integrative arguments address counterarguments through refutations, weighing, or creative designing. This talk will discuss the importance of integrative argumentation to social and scientific reasoning and decision making. The talk will also address how the concept of integrative arguments evolved from my prior work on helping students generate counterarguments, and the relationship to prior work by Leitão and others. The various manifestations this concept can take in different subject domains (including science), and the implications for measurement (i.e., coding) and future research endeavors, will also be examined.

Presenter: Dr. E. Michael Nussbaum (University of Nevada, USA)
Chair: Prof. Dr. Frank Fischer (LMU, Germany)

19:00- open end   Social event at Hofbräuhaus

Saturday, March 7

09:00 – 09:15 h	**Newspaper Reading Hall**

Welcome

09:15 – 12:15 h	**Room 1305**

Workshop 5: "Using eye-tracking to capture cognitive processing"

Abstract: The workshop "Using eye tracking to capture cognitive processing" is an introductory workshop. Starting with the provision of information about the history and types of eye trackers and important measures, various fields of application are introduced. The goal of the workshop is to establish a basic understanding of eye tracking methodology and, building on this, to enable the learners to develop operationalizations of cognitive processes that are relevant in their own research. Examples of current eye tracking research in the learning sciences will be presented. The participants will have the opportunity to get some hands-on experience with a head-mounted eye tracker and the corresponding analysis software.

Presenters: PD Dr. Christof Wecker & Dr. Markus Bolzer (LMU, Germany)

09:15 – 12:15 h	**Room 1205**

Workshop 6: "Understanding normativity and its relevance for epistemology"

Abstract: Measuring successful scientific reasoning, we will argue, might profit from investigating agents' appreciation of social and normative aspects of action, knowledge, and belief in social interactions. Normativity is typically understood as involving some kind of "oughtness" and generality: Agents ought to perform certain acts or refrain from doing so, not just in particular situations, but in analogous contexts, too. How can we measure an understanding of normativity and what is its importance for understanding epistemology? In this workshop, we will look at key psychological foundations of normativity – most notably collective intentionality (e.g., the ability to engage in shared intentional activities) – and methods from developmental psychology used to assess children's understanding of normativity. We will focus on children's spontaneous verbal and non-verbal reactions to norm violations in social interactions and explore interrelations between normativity and epistemology.

Presenter: Dr. Marco Schmidt (Max Planck Institute for Evolutionary Anthropology, Germany)

12:15 – 13:00 h	**Newspaper Reading Hall**

Lunch

13:00 – 14:30 h	**Newspaper Reading Hall**

Poster Session III:

Poster III-1: "Using scientific information as argument in a class inquiry about biodiversity - A sociocultural account"
Presenter: Charlène Bélanger

Poster III-2: "Developing scientific thinking: a comprehensive approach through argumentation"
Presenter: Toi Sin Arvidsson

Poster III-3: "Student reasoning from data tables: Data interpretation in light of student ability and prior belief"
Presenter: Abigail Bogdan

Poster III-4: "Are they getting better? Developing a framework to assess historical causal reasoning"
Presenter: Uddhava Rozendal

Poster III-5: "Fostering secondary students' productive disciplinary engagement in scientific argumentation"
Presenter: Yann Shiou Ong

Poster III-6: "Ontologies of ecological relations in family forest walks: A case study"
Presenter: Priya Pugh

Poster III-7: "Assessing students' scientific argumentation about ecology"
Presenter: Anna MacPherson

Poster III-8: "Understanding students' reasoning and use of evidence in the construction of models of inheritance"
Presenter: Ronald Rinehart

Poster III-9: "A reason to battle: Cooperative multi-player Online Battle Arenas foster hypothetic-deductive reasoning and argumentation skills"
Presenter: Carlos Diaz

Poster III-10: "Scientific observation in preschool - First results from an intervention study"
Presenter: Janina Klemm

Poster III-11: "Research on mathematical argumentation: A descriptive review of PME proceedings"
Presenter: Daniel Sommerhoff

Poster III-12: "Watching people fail: Improving diagnostic competence by providing feedback on observed erroneous diagnoses"
Presenter: Christian Strobel

Poster III-13: "Which factors facilitate elementary school children's analysis of covariation data?"
Presenter: Andrea Saffran

Poster III-14: "Pre-service teachers' evidence-based argumentation competence – Can a training of heuristics improve argumentative quality?"
Presenter: Sandra Wenglein

Chair: Prof. Dr. Stefan Ufer (LMU, Germany)

14:30 – 15:00 h   Newspaper Reading Hall

Farewell

Notes