



3rd ESERA SIG4 Science | Environment | Health
2022 Mini Conference in Obergurgl, Austria
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Collection of Abstracts

The conference is organised by Susanne Rafolt and Suzanne Kapelari (University of Innsbruck, Austria) and the ESERA SIG4 coordinators, Kerstin Kremer (Justus-Liebig-University, Germany) and Julia Arnold (University of Teacher Education Muttenz, Switzerland).

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Key Note

Tackling with current societal challenges: a perspective about teaching/learning climate change for fostering future thinking, agency and change making

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The global sustainability crisis is manifesting in many forms, including urgent environmental problems like climate change on top of them. Despite the growing attention from many corners, science at school still seems to fail in being supportive for students' making sense of these demanding socio-scientific questions. Indeed, the fact that almost half of national curricula all over the world don't refer explicitly to climate change issues (UNESCO, 2021) is a representative example of the delay that formal education has with respect to societal challenges. This clashes against directions designed by latest reports (e.g., OECD, 2018; Bianchi et al., 2022) which keep pushing the idea that dealing with the threatening challenges that characterise our era requires the development of knowledge and skills to navigate uncertainty and complexity of science as part of everyday-life. How can we support school students in transforming the base of knowledge and experiences to become agents of transformative change as current complex societal challenges require? We address this broader question through a set of studies framed and developed across several EU projects in which the research group in Physics Education of the University of Bologna was part from 2015 to date, aimed at promoting new forms of scientific literacy and skills to empower students to foster futures imagination and become agents of change. In the talk, I will offer a perspective concerning the approach developed in the last years about teaching/learning climate change for fostering future thinking, agency and change making.

Bianchi, G., Pisiotis, U., & Cabrera Giraldez, M. (2022). GreenComp The European sustainability competence framework, Punie, Y. & Bacigalupo, M. editor(s), EUR 30955 EN, Publications Office of the European Union, Luxembourg, 2022, ISBN 978-92-76-46485-3.

OECD. (2018). The future of education and skills - education 2030.

UNESCO (2021). Getting every school climate-ready: how countries are integrating climate change issues in education.

Poster

How to bring Environmental Health into the classroom. An experience in a teacher training courseÁlvaro, Nuria¹; Gavidia, Valentín¹; Mayoral, Olga^{1,2}¹Departamento Didáctica de las Ciencias Experimentales y Sociales, Spain²Jardí Botànic de la Universitat de València. Universitat de València, Valencia, Spain

It is becoming increasingly evident that there is a need to make citizens aware of the relationship between health and the environment (Zeyer & Dillon, 2014; Finn & O'Fallon, 2018; Gray & Lindsey, 2019; Zeyer & Dillon, 2019), as well as the role of educational institutions in providing such understanding. However, when this must be grounded in the educational reality, the question always arises of how to integrate it into the day-to-day teaching in a system with inertias that have led many teachers to simply follow the textbooks. In the poster we will firstly show the availability and characteristics of teaching resources in this field. Secondly, we will highlight the importance of specific teacher training so that these resources are used correctly and are useful and effective in the promotion of competences in Environmental Health in students. The results and discussion will be supported by the experience from the design and implementation of a teacher training course on Environmental Health Competences. The course was built on two fundamental pillars. On the one hand, the need to generate competences in this field, supported by the results obtained in previous research, and the ease of following a competence structure that would enable teachers to acquire the necessary tools. On the other hand, its implementation facilitated the implementation in their classrooms of the competence resources previously provided. Finally, we will analyse the teachers' opinions and evaluation of both this training course the teaching material provided.

Finn, S., & O'Fallon, L. R. (Eds.). (2018). Environmental health literacy. Springer.

Gray, K. M., & Lindsey, M. (2019). Measuring environmental health literacy. In *Environmental Health Literacy* (pp. 19-43). Springer, Cham.

Zeyer, A., & Dillon, J. (2014). Science | Environment | Health—Towards a reconceptualization of three critical and inter-linked areas of education. *International Journal of Science Education*, 36(9), 1409-1411.

Zeyer, A., & Dillon, J. (2019). Science | environment | health—the emergence of a new pedagogy of complex living systems. *Disciplinary and Interdisciplinary Science Education Research*, 1(1), 1-10.

Poster

The importance of self-efficacy for the successful transfer of S|E|H objectives from teacher education to classroom practice: Examining the carbon cycle self-efficacy among teacher studentsPeduzzi, Dunja¹; Kapelari, Suzanne¹¹Department of Subject-Specific Education - Area of Science Education, University of Innsbruck, Austria

The complex ecological, economic and social challenges of the twenty-first century place new demands on science education and science educators. The Science | Environment | Health pedagogy aims to meet these requirements by combining science education, environmental education and health education in a transdisciplinary manner (Zeyer and Dillon 2014). However, as Malandrakis et al. (2019) have argued for the concept of Education for Sustainable Development, whether student teachers will adopt a novel and demanding pedagogy like the evolving idea of Science | Environment | Health to their classroom practice depends on their “self-efficacy” (Bandura 1977) in this domain. Biogeochemical cycles, such as the carbon cycle, encompass each of the three “educational dimensions” (Zeyer and Dillon 2014, p. 1409) of the Science | Environment | Health pedagogy. They are complex systems (Rockström et al. 2009, Zeyer and Dillon 2019), all of which pose a risk to the environment and human health (Steffen et al. 2015). Therefore, this poster presents the results of a qualitative study of the carbon cycle self-efficacy of student teachers during and after a subject-didactic course on this topic at the University of Innsbruck. Aiming for triangulation (Bryman 2004), self-efficacy was assessed by two approaches: 1) qualitative nonparticipant observations in person of nonverbal and verbal behaviours during the course (Bottorf 2004) and 2) individual qualitative semistructured interviews (Mason 2004) with the student teachers five weeks after the end of the course.

Bandura, Albert (1977): Self-efficacy: Toward a unifying theory of behavioral change. In *Psychological Review* 84 (2), pp. 191–215.

Bottorf, Joan L. (2004): Observation, Types of. In Michael S. Lewis-Beck, Alan Bryman, Tim Futing Liao (Eds.), *The Sage encyclopedia of social science research methods*. Thousand Oaks, Calif: Sage, pp. 753–754.

Bryman, Alan (2004): Triangulation. In Michael S. Lewis-Beck, Alan Bryman, Tim Futing Liao (Eds.), *The Sage encyclopedia of social science research methods*. Thousand Oaks, Calif: Sage, pp. 1143–1144.

Poster

Value-oriented learning in vocational educationWogowitsch, Christine¹; Kapelari, Suzanne¹¹University of Innsbruck, Austria

The focus of my professional life lay in vocational education for sustainability and inspired me to research on and identify learning causes enabling students to deal with questions of value systems in terms of sustainability. Vocational educational research in Austria is characterized by questions of educational theory and educational policy (Dorninger & Gramlinger, 2019). Employer representatives expects prospective employees to have technology-based competences and be cooperative. (Fischer, 2021). According to Engweiler et.al. (2022) corporations seek staff reflecting upon post-materialistic values, such as environmental protection and tolerance and participating in creation. The PhD-thesis researched the potential for the development of value-systems in terms of sustainability in vocational education at a 3-year Viennese vocational school for economics from 2018 to 2021. The presented sub-study dealt with the question of how learners are enabled to contribute to activities and decisions based on these value-systems in their professional future. (Rieckmann, 2021), (United Nations, 2022). The curriculum (Bildungsdirektion Wien, 2022) serves as a general framework. Teachers (n=6; written survey) see themselves mainly responsible for the development of value systems with regard to their specific subjects taught, however commonly enlisted respect, social responsibility, cooperation and solidarity as most important values. According to the head teacher's representative, interviewed with a focus on central questions (Flick, 2019), covering issues of sustainability in education is utterly important, would require additional resources/quotas of lessons, however, since the abundance of tasks set by superior bodies ties up resources. Thus, a contracted course of action for sustainability education will not be instigated, however, all initiatives in this context will be appreciated. All respondents attach importance to sustainability education and the development of value-systems. In this context environmental certifications (ÖKOLOG , PILGRIM) selectively help build a setting for teaching.

Bildungsdirektion Wien. (6. Juli 2022). *hum Wien-Servicestelle der Wiener Humanberuflichen Schulen*. Von <https://www.humwien.at/home/images/Lehrplan1416/lehrplanNEUabSJ16/LPFW2016.pdf> abgerufen

Dorninger, C., & Gramlinger, F. (2019). *Österreich. Internationales Handbuch der Berufsbildung*. Leverkusen: Budrich.

Engweiler, C., Hasenstab, C., Schallhart, A., & Steinmüller, B. (11. Juli 2022). *Studie zu nachhaltigen und demokratischen Unternehmen basierend auf der ISEP-Umfrage „Nachhaltige Werte brauchen Strukturen“*. Von <https://www.schallhart.com/downloadfiles/Nh-demokratische-Unternehmen-Studie.pdf> abgerufen

Fischer, S. (2021). *Spannungsfeld Innovation in der Krise: Von der Vision zur Digitalen Transformation*. Wien: Wirtschaftskammer Österreich.

Flick, U. (2019). *Qualitative Sozialforschung*. Reinbeck bei Hamburg: Rowohlt.

Rieckmann, M. (18. Oktober 2021). Bildung für nachhaltige Entwicklung. Ziele, didaktische Prinzipien und Methoden. *merz-Zeitschrift für Medienpädagogik*, S. 10-17.

United Nations. (6. Juli 2022). *Do you know all 17 SDGs?* Von <https://sdgs.un.org/goals> abgerufen

Poster

Using the One Health Approach for curricular innovation in Education for Sustainable Development (ESD)

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The special interest group (SIG) Science | Environment | Health (S|E|H) within the European Science Education Research Association (ESERA) seeks to promote the inter- and transdisciplinary dialogue between science education, environmental education and health education (Zeyer & Dillon, 2019). In its latest book the SIG developed the idea to contribute towards a pedagogy for “complex living systems” (Zeyer & Kyburz-Graber, 2021) Mostly, innovative approaches are hard to transfer into practical teaching, even though the reasons for change are evident. Curriculum change is a very early and effective stage for change. Changes occur due to needs in the society. This project uses the One health approach to investigate limitations and benefits of curricular changes through experts and stakeholder focus group interviews in a co-creation process. The One Health approach was chosen because of its high relevance for health and sustainability education and its potential to promote an understanding of complexity and systems thinking in science education (Lerner & Berg, 2015). At the poster a curricular analysis concerning One Health Issues and One Health practices in the German standards document (KMK, 2020) as well as the German Curricular Framework Education for Sustainable Development (Siege & Schreiber, 2016) will be presented and further steps of analyses will be discussed.

Lerner, H., & Berg, C. (2015). The concept of health in One Health and some practical implications for research and education: what is One Health?, *Infection Ecology & Epidemiology*, 5:1, 25300.
<https://doi.org/10.3402/iee.v5.25300>

Sekretariat der Ständigen Konferenz der Kultusminister der Länder in der Bundesrepublik Deutschland (2020). Bildungsstandards im Fach Biologie für die Allgemeine Hochschulreife.
https://www.kmk.org/fileadmin/Dateien/veroeffentlichungen_beschluesse/2020/2020_06_18-BildungsstandardsAHR_Biologie.pdf

Siege, H., & Schreiber, J.-R. (2016). Education for Sustainable Development: Curriculum Framework : A Contribution to the Global Action Programme Education for Sustainable Development. Berlin: KMK.
https://www.globaleslernen.de/sites/default/files/files/link-elements/curriculum_framework_education_for_sustainable_development_barrierefrei.pdf

Zeyer, A., & Dillon, J. (2019). Science | Environment | Health – the emergence of a new pedagogy of complex living systems. *Disciplinary and Interdisciplinary Science Education Research*, 1(1), 9.
<https://doi.org/10.1186/s43031-019-0014-9>

Zeyer, A., & Kyburz-Graber, R. (2021). Science | Environment | Health - Towards a Science Pedagogy of Complex Living Systems. Springer International Publishing. <https://doi.org/10.1007/978-3-030-75297-2>

Poster

Pre-Service Biology Teachers' Behavioral Beliefs Influencing the Use of Alternative Medicine and Evidence-based Medicine (EBM)Schmidt, Elvira¹; Graf, Dittmar¹; Kremer, Kerstin¹¹Institute for Biology Education, Justus Liebig University Giessen, Germany

Health Literacy is a central goal of science education and especially of biology classes. Up to now, the topics Evidence-based Medicine (EBM) and Alternative Medicine (Pseudo Medicine) have only played a marginal role in German biology classes (Schmidt 2020) - even though the use of Evidence-Based-Medicine and Alternative Medicine have even widely utilized for years (Hamdorf 2018; Knopf et al., 2019) and have become more important with the Covid-19- pandemic (Danzer, 2021; Sucker-Sket, 2022). This trend emphasizes the need of investigating the variables that influence people's intention to use Alternative Medicine and Evidence-based Medicine. Therefore, a study was conducted among pre-service biology teacher students to determine the factors associated with the use of the medical forms. This focus group was selected because of the specific role of teacher beliefs for the design of biology lessons. Based on the Theory of Planned Behavior (Fishbein and Ajzen 2010), the study measures inter alia behavioral beliefs to use Alternative Medicine and Evidence-based Medicine. In order to quantify behavioral beliefs, the participants were asked to specify the most frequently perceived advantages and disadvantages of using the medical forms. These beliefs were used to develop health and science education materials in Alternative Medicine and Evidence-based Medicine (Schmidt & Graf 2020). Selected results from the survey will be presented and discussed on the poster.

Danzer, G. (2021). Der Mythos lebt ... auch in der Schulmedizin. In G. Danzer (Hrsg.), *Personale Medizin* (S. 239–255). Springer.

Fishbein, M. & Ajzen, I. (2010). *Predicting and changing behavior: The reasoned action approach*. Psychology Press.

Hamdorf, E. (2018). *Einstellungs- und Nutzungsanalyse bedeutender alternativmedizinischer Verfahren – eine explorative Studie mit Lehramtsstudierenden und Vergleichsgruppen: Dissertation Universität Gießen*.

Knopf, H., Sarganas, G., Grams, D., Du, Y. & Poethko-Müller, C. (2019). Anwendung von Arznei- und Nahrungsergänzungsmitteln im Kindes- und Jugendalter in Deutschland: Ergebnisse aus KiGGS Welle 2. *Bundesgesundheitsblatt, Gesundheitsforschung, Gesundheitsschutz*, 62(10), 1215–1224.

Schmidt, E. (2020). *Einflussfaktoren auf die Intention zur Anwendung von Medizin und Paramedizin unter besonderer Berücksichtigung der schulischen Gesundheitsförderung: Dissertation*.

Schmidt, E. & Graf, D. (2020). *Medizin und Wissenschaft: Grundlagen für eine sachgerechte Gesundheitsförderung - Praxismaterialien für den Unterricht*. Books on Demand. (<https://www.bod.de/buchshop/medizin-und-wissenschaft-elvira-schmidt-9783750487369>).

Sucker-Sket, K. (2022). Kassen geben 10 Prozent mehr für Arzneimittel aus. *DAZ.online*. Retrieved on April 20, 2022, from <https://www.deutsche-apotheker-zeitung.de/news/artikel/2022/01/31/kassen-geben-10-prozent-mehr-fuer-arzneimittel-aus>.

Poster

Potentials and limitations of inoculation theory for Science | Environment | Health issuesSchubatzky, Thomas¹; Haagen-Schützenhöfer, Claudia²¹University of Innsbruck, Austria²University of Graz, Austria

In the “post-truth” era, misinformation is increasingly present (Lewandowsky, Ecker, & Cook, 2017) and young people rely on social media as information sources. Teaching students strategies to counter such online misinformation hence becomes pivotal, especially regarding science, environmental and health issues. In the past, inoculation theory has shown to be a promising vehicle to effectively neutralize the influence of misinformation with adults (e.g. Banas & Rains, 2010; Cook, Lewandowsky, & Ecker, 2017). The basic idea of inoculation theory is that individuals can be “vaccinated” against misinformation attacks on their attitudes, similar to how individuals can be immunized against a virus (Compton, 2013). However, to this day, possible applications of inoculation theory for (secondary) education regarding Science | Environment | Health issues have not been the focus of research. Through the poster, we would like to start a discussion about whether inoculation theory can be seen as a fruitful approach to address misinformation in classrooms and where its limitations lie. To facilitate this exchange, we present results from previous studies where we applied ideas of inoculation theory in the context of climate change with Austrian adolescents (Schubatzky & Haagen-Schützenhöfer, under reviewb) in an experimental online-study and physics pre-service teachers (Schubatzky & Haagen-Schützenhöfer, under reviewa) in a teacher education seminar.

Banas, J. A., & Rains, S. A. (2010). A Meta-Analysis of Research on Inoculation Theory. *Communication Monographs*, 77(3), 281–311. <https://doi.org/10.1080/03637751003758193>

Compton, J. (2013). Inoculation theory. *The Sage Handbook of Persuasion: Developments in Theory and Practice*, 2, 220–237.

Cook, J., Lewandowsky, S., & Ecker, U. K.H. (2017). Neutralizing misinformation through inoculation: Exposing misleading argumentation techniques reduces their influence. *PLoS One*, 12(5).

Lewandowsky, S., Ecker, U. K.H., & Cook, J. (2017). Beyond Misinformation: Understanding and Coping with the “Post-Truth” Era. *Journal of Applied Research in Memory and Cognition*, 6(4), 353–369. <https://doi.org/10.1016/j.jarmac.2017.07.008>

Schubatzky, T., & Haagen-Schützenhöfer, C. (under reviewa). Debunking climate myths is easy - or is it? A case study with pre-service physics teachers. *Education Sciences*.

Schubatzky, T., & Haagen-Schützenhöfer, C. (under reviewb). Inoculating adolescents against climate change misinformation. *Fostering Scientific Citizenship in an Uncertain World - Selected Papers from the ESERA 2021 Conference*

Poster

**Combining Nature of Science and Science Identity in Outreach for Science | Environment
| Health pedagogy**Kurschildgen, Sophie¹; Arnold, Julia²; Kremer, Kerstin¹¹Institute for Biology Education, Justus Liebig University Giessen, Germany²Center for Science and Technics Education, School of Education FHNW, Switzerland

School science affects students' beliefs on science in various ways (Voitle et al., 2022). Recent research showed that the construct of science identity is of high relevance in understanding individuals' engagement with and learning about science. Science identity is shaped and influenced in multiple cognitive and affective ways and results in study choices and career opportunities (Avraamidou, 2022). One of the key goals of S|E|H pedagogy is to use the mutual benefit between health/medicine and science education to engage students of all backgrounds in a meaningful science learning experience with respect to health and the nature of science (Kremer & Durchgraf, 2021; Zeyer, 2012). But school science education is mostly limited to address professional scientific practices in an authentic way. Facing the challenge to gain students of diverse backgrounds for science issues we want to research specific features for developing identity in a health/medicine science context in this project. Following a co-design approach between the perspectives of students and researchers a specific format for a university-led student laboratory with digital features will be designed and evaluated. The project takes place in collaboration with the Lindau Nobel Mediatheque and contributes innovative, and authentic ways in which in-school and out-of-school settings can be connected to diversify experiences with science research. The poster presentation gives insights into the background of the project as well as first steps towards the design process.

Avraamidou, L. (2022). Identities in/out of physics and the politics of recognition. *Journal of Research in Science Teaching*, 59(1), 58-94. <https://doi.org/10.1002/tea.21721>

Kremer, K. & Durchgraf, L. (2021). Communicating new Scientific Paradigms: A Case Study on Scientists' Perceptions about Contemporary Metaorganism Science and Implications for Science|Environment|Health Pedagogy. In Zeyer, A., Kyburz-Graber, R. (Eds.). *Science|Environment|Health – towards a new pedagogy of complex living systems* (pp. 251-262). Springer, Cham. https://doi.org/10.1007/978-3-030-75297-2_13

Voitle, F., Heuckmann, B., Kampa, N. & Kremer, K. (2022) Assessing students' epistemic beliefs related to professional and school science. *International Journal of Science Education*. <https://doi.org/10.1080/09500693.2022.2059821>

Zeyer, A. (2012). A Win-Win Situation for Health and Science Education: Seeing Through the Lens of a New Framework Model of Health Literacy. In A. Zeyer & R. KyburzGraber (Eds.), *S|E|H – Towards a Renewed Pedagogy for Science Education*. Dordrecht: Springer.

Poster

Communicating the Metaorganism – Co-Design for a university-led STEM outreach eventClaussen, Christina¹; Enzingmüller, Carolin¹; Parchmann, Ilka¹; Kremer, Kerstin²¹Leibniz Institute for Science and Mathematics Education, Germany²Justus-Liebig-University Giessen, Germany

School science affects students' beliefs on science in various ways (Voitle et al., 2022). Recent research showed that the construct of science identity is of high relevance in understanding individuals' engagement with and learning about science. Science identity is shaped and influenced in multiple cognitive and affective ways and results in study choices and career opportunities (Avraamidou, 2022). One of the key goals of S|E|H pedagogy is to use the mutual benefit between health/medicine and science education to engage students of all backgrounds in a meaningful science learning experience with respect to health and the nature of science (Kremer & Durchgraf, 2021; Zeyer, 2012). But school science education is mostly limited to address professional scientific practices in an authentic way. Facing the challenge to gain students of diverse backgrounds for science issues we want to research specific features for developing identity in a health/medicine science context in this project. Following a co-design approach between the perspectives of students and researchers a specific format for a university-led student laboratory with digital features will be designed and evaluated. The project takes place in collaboration with the Lindau Nobel Mediatheque and contributes innovative, and authentic ways in which in-school and out-of-school settings can be connected to diversify experiences with science research. The poster presentation gives insights into the background of the project as well as first steps towards the design process.

Baram-Tsabari, A. & Osborne, J. (2015). Bridging science education and science communication research. *Journal of Research in Science Teaching*, 52 (2). 135-144.

Husher, K. 2010. "Building an Evaluation Framework for Australian Science and Maths Outreach Programs in Schools." The University of Newcastle.

Mayring, P. (2014). *Qualitative content analysis: theoretical foundation, basic procedures and software solution*. Klagenfurt.

McKenney, S., & Reeves, T. C. (2014). Educational design research. In *Handbook of research on educational communications and technology* (pp. 131-140). Springer, New York, NY.

Sadler, K., Eilam, E., Bigger, S. W., & Barry, F. (2018). University-led STEM outreach programs: Purposes, impacts, stakeholder needs and institutional support at nine Australian universities. *Studies in Higher Education*, 43(3), 586-599.

Varner, J. (2014). Scientific outreach: toward effective public engagement with biological science. *BioScience*, 64(4), 333-340.

Poster

Designing an interactive online application to teach lower-secondary-students (grade 8) about epilepsySommer, Martina¹; Simon, Uwe¹¹University of Graz

Epilepsy is one of the most common neurological diseases (Lerche & Weber, 2011). However, misconceptions and negative attitudes towards people with epilepsy still exist in Austria (Spatt et al., 2005). After examining knowledge and attitudes of high school students in Germany, Jansen et al. (2017) recommend education about epilepsy for all students. Simon, Gesslbauer & Fink (2016) already showed positive effects of a three-lesson teaching unit in upper-secondary classrooms. Targeting such an intervention at 14-year-old-students, who are still in compulsory education, could reach an even broader audience. Therefore, the goal of this project is to design, develop and evaluate an educational intervention about epilepsy while contributing to local theories. In order to do that, a content analysis of successful interventions was conducted. Two workshops with students of the target group were held to define their needs, interest and approaches to epilepsy. Based on those results and interviews with different stakeholder-groups (Tschudnig, 2020) a prototype of an interactive online tool was developed and reviewed by experts from different fields. Afterwards it was tested for practicality, appeal and consistency in one-to-one interviews with students (n=6) and is currently under revision. Another cycle with individual students is planned, before it is going to be tested and evaluated first in individual then in various classroom-settings. Ultimately the online application should be an easy, inexpensive and motivating way of bringing epilepsy into the biology classroom, while fostering digitalization and learning with digital media.

Jansen, P., Neiningner, M., Bernhard, M., Kiess, W., Merckenschlager, A., Bertsche, T., & Bertsche, A. (2017). Knowledge and attitudes about epilepsy: A survey of high school students in Germany. *Seizure*, 51, 139-144.

Lerche, H., & Weber, Y. (2011). Anfallsartige Erkrankungen. In M. Sitzer & H. Steinmetz (Hrsg.), *Lehrbuch der Neurobiologie* (S. 75-102). Elsevier.

Simon, U., Gesslbauer, L., & Fink, A. (2016). A Three-Lesson Teaching Unit Significantly Increases High School Students' Knowledge about Epilepsy and Positively Influences Their Attitude towards This Disease. *PLoS ONE*, 11(2), 1-13. <https://doi.org/10.1371/journal.pone.0150014>

Spatt, J., Bauer, G., Baumgartner, C., Feucht, M., Graf, M., Mamoli, B., et al. (2005). Predictors for Negative Attitudes toward Subjects with Epilepsy: A Representative Survey in the General Public in Austria. *Epilepsia* 46(5), 736-742.

Tschudnig, M. (2020). *Epilepsie im Schulunterricht - eine empirische Erhebung*. (Diplomarbeit). Karl-FranzensUniversität Graz, Graz

Poster

Discourse-oriented framing creates a social and everyday life context for the topic of antibioticsWalter, Hildrun¹; Beranek-Knauer, Heide¹¹Zentrum für Gesellschaft, Wissen und Kommunikation - "die 7. fakultät", University of Graz, Austria

One of the most urgent matters in current medicine is the preservation of antibiotic treatment options due to an increasing threat of antibiotic resistance in pathogenic microorganisms (European Commission, 2017). Therefore, it is important to develop science education programs that help to incite personal and social responsibility based on a better understanding of the socio-scientific nature of the issue. Evaluating an out-of-school laboratory course, in the here presented study (Beranek-Knauer et al., 2020), we investigated whether a flexible course introduction steered by an active discussion in small groups, so a targeted discourse-directed framing (DDF), positively changes the interest, motivation and emotion of the course participants in comparison to an introduction designed purely by the course instructors (IDF: instructor-directed framing). In this longitudinal study, 260 pupils participated and were divided into a DDF and an IDF group. A questionnaire was composed of three published instruments to measure awareness of science (BRAINS, Summers & Abd-El-Khalick, 2018), societal value (MATS, Hillman, Zeeman, Tilburg, & List, 2016), interest, emotions and perception of situational competences (Itzek-Greulich & Vollmer, 2017). For follow-up test, participants were additionally asked to draw a mind map on the topic of antibiotics. In comparison to the IDF, the DDF allowed participants to develop a more wide-spread perception of the topic including societal and personal implications. Further, it was shown that the hands-on laboratory course itself significantly enhanced interest, motivation and emotion of the course participants, however, no attitudinal changes towards science could have been detected.

Beranek-Knauer, H., Walter, H., Paleczek, D., Eder, L., Jungwirth, K., & Jungwirth, H. (2020). Discourse-directed framing as communication strategy alters students' concept of antibiotics and antibiotic resistance formation. *International Journal of Science Education, Part B*, 1–16. <https://doi.org/10.1080/21548455.2020.1844921>

European Commission. Commission notice - EU Guidelines for the prudent use of antimicrobials in human health C/2017/4326 (2017).

Hillman, S. J., Zeeman, S. I., Tilburg, C. E., & List, H. E. (2016). My Attitudes Toward Science (MATS): the development of a multidimensional instrument measuring students' science attitudes. *Learning Environments Research*, 19(2), 203–219. <https://doi.org/10.1007/s10984-016-9205-x>

Itzek-Greulich, H., & Vollmer, C. (2017). Emotional and motivational outcomes of lab work in the secondary intermediate track: The contribution of a science center outreach lab. *Journal of Research in Science Teaching*, 54(1), 3–28. <https://doi.org/10.1002/tea.21334>

Summers, R., & Abd-El-Khalick, F. (2018). Development and validation of an instrument to assess student attitudes toward science across grades 5 through 10. *Journal of Research in Science Teaching*, 55(2), 172–205. <https://doi.org/10.1002/tea.21416>

Poster

ChemoKnowings as part of Science | Environment | Health-Knowings in the AnthropoceneYavuzkaya, Merve¹; Sjöström, Jesper¹¹Department of Natural Science, Mathematics and Society, Malmö University, Sweden

In this contribution, I would like to unpack the construct ChemoKnowings as subject-specific knowings which could also be framed within Science | Environment | Health-Knowings in the Anthropocene era characterized by our unsustainable ways of living (Crutzen and Stoermer, 2000) and socio-ecojjustice problems. Given the situation, the purpose and the contents of chemistry education is dislocated from economic purposes with a focus on generic competence development (e.g., 21st century skills) towards being in and with the world (Biesta, 2022). As a contribution to this (re)thinking process, a vision-oriented didaktik model for promoting ChemoKnowings and chemical agency (i.e. ethico-socio-political action) was developed (Yavuzkaya, Clucas, and Sjöström, in press) based on a theoretical didaktik model (Herranen, Yavuzkaya, and Sjöström, 2021). Based on Carlgren's (2020) construct of powerful knowings, ChemoKnowings can be described as embodied knowledge that connects students to themselves and to the world, which promotes chemical agency. Also, I would like to present the didaktik model for promoting ChemoKnowings and chemical agency which can support teachers in their didaktik decisions and reflexive teaching. In addition, I would like to pose reflection questions to explore:

- SEH-knowings in the Anthropocene.
- What kind of empirical work can support the promotion of ChemoKnowings as SEH-knowings, and how?
- How can the didaktik model promoting ChemoKnowings be used in different settings?
- What can be other SEH-knowings in relation to other subjects?

As an example of empirical work, I will briefly mention another part of my doctoral project, focusing on chemistry teachers' perspective of knowledge in relation to Anthropocene era.

Biesta, G. (2022). *World-Centred Education: A View for the Present*. Routledge.
<https://doi.org/10.4324/9781003098331>

Carlgren, I. (2020). Powerful knowns and powerful knowings. *Journal of Curriculum Studies*, 1–14.
<https://doi.org/10.1080/00220272.2020.1717634>

Crutzen, P. J., & Stoermer, E. F. (2000). The Anthropocene. *Global Change Newsletter*, 41, 17.
<https://doi.org/10.1016/j.cub.2019.07.055>

Herranen, J., Yavuzkaya, M., & Sjöström, J. (2021). Embedding chemistry education into environmental and sustainability education: Development of a didaktik model based on an eco-reflexive approach. *Sustainability*, 13(4), 1746. <https://doi.org/10.3390/su13041746>

Yavuzkaya, M., Clucas, P. & Sjöström, J. (in press). ChemoKnowings as part of 21st Century *Bildung* and Subject Didaktik, *Frontiers in Education, section STEM Education*. <https://doi.org/10.3389/educ.2022.869156>

Round Table

Stereoscopic View and Co-Design in S|E|H-Pedagogy

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In the last ten years, important issues of the new S|E|H pedagogy have emerged and been elaborated by SIG-members (Zeyer & Kyburz-Graber, 2021). However, an issue of major importance to date is the integration of cognitive and affective aspects and perspectives from different fields, e.g. in decision-making processes. Accordingly, 1) the metaphor of stereoscopic view and terms like 2) co- design become more important. We want to take up these approaches and make them fruitful for S| E|H pedagogy.

1) Drawing from the philosophy of Wilfrid Sellars, humans conceive stereoscopic viewing in an ontological framework that provides two images of the world. One is the *scientific image*, which is things-oriented. The other image, called the *life-world image*, is people-oriented. This image is more holistic. Each of these two perspectives, taken separately, loses sight of certain aspects. The stereoscopic view makes use of both images, simultaneously.

2) Co-design in education can be seen as a structured and team-based process in which different actors (e.g. researchers, teachers, stake-holders) work together in defined roles to design an educational innovation. This structurally anchors the integration of different perspectives.

The goal of the roundtable is to provide an insight into the structure of stereoscopic view (Zeyer et al., 2022) and to get an input into co-design. In the workshop we will discuss the concepts as well as their potential for the application in S|E|H contexts. Finally, we want to develop an approach to serve as a foundation for future research and projects in our SIG.

Zeyer, A., & Kyburz-Graber, R. (2021). *Science | Environment | Health - Towards a Science Pedagogy of Complex Living Systems*. Springer International Publishing. <https://doi.org/10.1007/978-3-030-75297-2>

Zeyer, A., Nuria, Á., Claussen, C., Enzingmüller, C., Gavidia, V., Malmberg, C., ... Kremer, K. (2022). Two-Eyed Seeing and Scientific Holism in a New Science|Environment|Health Pedagogy. EdArXiv, <https://doi.org/10.35542/osf.io/ct546>

Round Table

**Planetary Health, One Health, SDGs and the 2030 Agenda
as part of the foundations of the S|E|H framework?**

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CONTEXT: During the last decade, the ESERA SIG 4 *Science|Environment|Health* (S|E|H) has been concerned with a genuine transdisciplinary dialogue between science education, environmental education and health education. Due to political and societal developments, other approaches such as *Planetary Health*, *One Health*, and *Sustainability Education* have gained importance and are resonating well throughout the science education community. The 2030 Agenda (UN, 2015), as the greatest commitment made by humanity to address the planetary emergency situation, has become an umbrella framework for addressing S|E|H, PH, OH, and SE.

AIM: The aim of this round table is to identify similarities, differences, and complementary ideas between S|E|H, PH, OH, and SE in the context of the 2030 Agenda, and to discuss the potential of these approaches for re-positioning the future work of the ESERA SIG 4. The initiation of a many-authors paper on this issue will be discussed.

PROCEDURE: The round table will include four parts:

- 1) For preparation, the participants will be kindly asked to read a reflective summary on the issues of S|E|H, PH, OH and SE.
- 2) Short stimulus presentations by the authors of the roundtable to introduce the core ideas and the procedure.
- 3) Focus groups – based on (research) interests – to identify key ideas of S|E|H, PH, OH and SE in relation to the 2030 Agenda.
- 4) Plenary discussion. “The role of S|E|H in relation to PH, OH, and SE within the 2030 Agenda for future science education research and practice”

Feinstein, N. W., & Kirchgasser, K. L. (2015). Sustainability in Science Education? How the Next Generation Science Standards Approach Sustainability, and Why It Matters. *Science Education*, 99(1), 121–144. <https://doi.org/10.1002/SCE.21137>

Lerner, H., & Berg, C. (2015). The concept of health in One Health and some practical implications for research and education: what is One Health? *Infection Ecology & Epidemiology*, 5(1), 25300. <https://doi.org/10.3402/IEE.V5.25300>

Montero-Pau, J., Álvaro, N., Gavidia, V., & Mayoral, O. (2020). Development of environmental health competencies through compulsory education. A polyhedral approach based on the SDGs. *Sustainability*, 12(8), 3215. <https://doi.org/10.3390/su12083215>

Stone, S. B., Myers, S. S., Golden, C. D., & Health Education Brainstorm Group, P. (2018). *Cross-cutting principles for planetary health education*. [https://doi.org/10.1016/S2542-5196\(18\)30022-6](https://doi.org/10.1016/S2542-5196(18)30022-6)

UN (2015). Transforming Our World: The 2030 Agenda for Sustainable Development. UN General Assembly, 25

September.2015.http://www.un.org/ga/search/view_doc.asp?symbol=A/70/L.1&referer=https://www.google.es/&Lang=.

Zeyer, A. (2022). "Teaching Two-Eyed Seeing in Education for Sustainable Development: Inspirations from the Science | Environment | Health Pedagogy in Pandemic Times," *Sustainability*, vol. 14, no. 6343, p. 12,.

Round Table

**Digital Media and Competency Development for Science | Environment | Health:
Defining, Developing and Researching 21st Century Skills**Büssing, Alexander¹¹Leibniz University Hannover, Institute of Science Education, Germany

Even when there is already a long tradition of research on digital media in science education, current research often concentrated on how digital media can foster learning with digital media (Hillmayr et al., 2020). This includes for example learning effects of utilizing digital media such as immersive virtual reality (Filter et al., 2020). While these studies are important to uncover the overall effects of digital learning environments, but they often stick to the classic differentiation of which hardware is used, which represents only a view on the surface of learning. From a pedagogical perspective, there is need for more normative view that includes deep structures and defines how and which subject-specific competencies can be fostered. For example, the post-truth era showed how critical thinking and misinformation are a major requirement for students for dealing with complex issues related to Science | Environment | Health (Keselman et al., 2021; Nally, 2022). But even if there are general definitions of digital competencies in different countries such as Germany (Kultusministerkonferenz, 2016), a further context- and subject-specific adaptation of these competencies for example for biology education is still missing (Kultusministerkonferenz, 2021). At the roundtable we intend to give an overview on the perspectives from different countries, which may be useful for uncovering how to define and develop these competencies. Finally, the roundtable aims to build an agenda with open issues for further research in digital media and competency development in the Science | Environment | Health framework.

Filter, E., Eckes, A., Fiebelkorn, F., & Büssing, A. G. (2020). Virtual Reality Nature Experiences Involving Wolves on YouTube: Presence, Emotions, and Attitudes in Immersive and Nonimmersive Settings. *Sustainability*, 12(3823), 1–22. <https://doi.org/10.3390/su12093823>

Hillmayr, D., Ziernwald, L., Reinhold, F., Hofer, S. I., & Reiss, K. M. (2020). The potential of digital tools to enhance mathematics and science learning in secondary schools: A context-specific meta-analysis. *Computers and Education*, 153(April), 103897. <https://doi.org/10.1016/j.compedu.2020.103897>

Keselman, A., Smith, C. A., Leroy, G., & Kaufman, D. R. (2021). Science Education as a Barrier Against “Fake Health News.” In *Science | Environment | Health* (pp. 225–250). https://doi.org/10.1007/978-3-030-75297-2_12

Kultusministerkonferenz. (2016). *Bildung in der digitalen Welt. Strategie der Kultusministerkonferenz*. Kultusministerkonferenz. https://www.kmk.org/fileadmin/Dateien/pdf/PresseUndAktuelles/2018/Digitalstrategie_2017_mit_Weiterbildung.pdf

Kultusministerkonferenz. (2021). *Lehren und Lernen in der digitalen Welt: Ergänzung zur Strategie der Kultusministerkonferenz „Bildung in der digitalen Welt“*. Kultusministerkonferenz.

Nally, D. (2022). Theorising post-truth in the COVID era. *Journal of Educational Change*, 23(2), 277–289. <https://doi.org/10.1007/s10833-022-09457-3>

Round Table

Critical thinking, politics and political participation in Science|Environment|Health – to describe and/or prescribe as a teacher?

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Atkinson, Lucy³; Dunlop, Lynda³; Kapelari, Suzanne²; Turkenburg-Van Diepen, Maria³

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³University of York, United Kingdom

Two ongoing research projects carried out by Halmstad University in cooperation with University of York and by University of Innsbruck aim to understand how science teachers approach politics in the classroom and how pre-service science teachers understand critical thinking. We argue that political participation and critical thinking needs to be at the heart of Science|Environment|Health (S|E|H) pedagogy to make effective change and find solutions to urgent social issues in a democracy. Critical thinking is crucial for negotiating socially urgent issues, such as climate change and pandemics, and debunking misinformation (e.g., Jiménez-Aleixandre & Puig 2022) and, thus, for civic education (e.g., ten Dam & Volman 2004; Glaser 1985; Oulton et al. 2004). Teachers need to create possibilities for young people to engage in actions to handle urgent societal challenges, that is political participation (Ekman & Amnå 2012). Science teachers might be reluctant to address politics and critical thinking both when it comes to prescribing and describing teaching content. However, especially in the context of S|E|H, neither science and school science nor critical thinking is independent of politics. Both S|E|H contents and critical thinking include descriptive and normative aspects and relate to conflict of interests and values. Therefore, teachers need to handle critical thinking, politics and political participation in a thoughtful way. The aim of the round table is to discuss future research about teaching critical thinking and politics in the science classroom and furthermore to consider theoretical and normative aspects - points of departure, conclusions and recommendations - in such research. First, the chairs will provide a short input. Then, participants discuss in small groups: 1) What kind of empirical research is needed? 2) How do we as researchers handle theoretical and normative aspects in research? Finally, all participants of the round table share their ideas.

Ekman, J. & Amnå, E. (2012): Political Participation and Civic Engagement: Towards a New Typology. *Human Affairs*, 22, 283-300.

Glaser, E. M. (1985): Critical thinking: educating for responsible citizenship in a democracy. *National Forum*, 65(1), 24-27.

Jiménez-Aleixandre, M. P. & Puig, B. (2022): Educating critical citizens to face post-truth: The time is now. In: Puig, B. & Jiménez-Aleixandre, M. P. (Eds.): *Critical thinking in biology and environmental education. Contributions from biology education research*. Cham: Springer, pp. 3–19.

Oulton, C., Day, V., Dillon, J. & Grace, M. (2004): Controversial issues – teachers' attitudes and practices in the context of citizenship education. *Oxford Review of Education*, 30(4), 489-507.

ten Dam, G. & Volman, M. (2004): Critical thinking as a citizenship competence: teaching strategies. *Learning Instructions*, 14, 359-379.

Round Table

The role of Science|Environment|Health-issues in *Bildung* – educational implications

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In this Round Table-discussion we (Sjöström & Yavuzkaya) will put some “meta-didaktik models” on the table and based on them open up for discussing the role of Science|Environment|Health-issues in *Bildung*, its potential implications for Subject Didaktik (Subject-Specific Education) and how it can be explored in research studies. One of the models will be a recently published vision-oriented didaktik model for promoting powerful knowings and agency in science education (Yavuzkaya, Clucas and Sjöström, in press). Some other models will be selected from a new Swedish textbook on Didaktik for *Bildung* (Sjöström & Tyson, 2022) and translated to English. We will start by short conceptualisations of *Bildung* and Didaktik, followed by a short presentation of the first selected “meta-didaktik model” followed by all round table-participants discussing it in relation to S|E|H-issues. This is then repeated for other meta-models, as many as there is room for.

Sjöström, J. & Tyson, R. (2022). *Didaktik för lärande och bildning*. Stockholm: Liber.

Yavuzkaya, M., Clucas, P. & Sjöström, J. (in press). ChemoKnowings as part of 21st Century *Bildung* and Subject Didaktik, *Frontiers in Education, section STEM Education*. <https://doi.org/10.3389/educ.2022.869156>