INSTITUTE FOR SCIENCE EDUCATION AND COMMUNICATION
STEM EDUCATION, RESEARCH AND ENGAGEMENT

The Institute for Science Education and Communication (ISEC) is an international research group with experts in mathematics and science education and communication. It currently employs an Associate Professor (prof. dr. Avraamidou), an Assistant Professor (dr. Mali), a part-time lecturer (S. Telli), two postdocs, 13 PhD students and a professor emeritus (prof. Goedhart).

Internationally recognized researchers and graduate students conduct a research programme aimed at improving teaching and learning in mathematics, physics, chemistry and biology at primary, secondary and university levels. ISEC staff members teach courses in science education and communication as part of the master programme Science Education and Communication, in FSE bachelor degree programmes and the University College Groningen.

The overarching goal of the research program is to widen (increase the numbers) and diversify (increase the diversity) STEM engagement of all citizens in formal (*e.g*. university) and informal settings (*e.g*. community). This can be achieved through high quality university and school STEM education. We do that through different types of projects (*i.e.* exploratory research, curriculum design and evaluation with schools, impact evaluation of public engagement events) in collaboration with research units, NGOs and community centers (*i.e*. Beijum community centre), outreach teams (*i.e.* ScienceLinX) and schools (*i.e.* the Aletta Jacobs School of Public Health).

The research programme of the Institute is well aligned with the strategic vision both of the faculty and the university and it focuses on designing and enacting evidence-based STEM education, interdisciplinarity, life-long learning, and diversity and inclusion in science.

ISEC's mission is centered around three research areas:

1. STEM innovation and quality of school and university education
2. STEM teacher education
3. STEM public engagement

Goals

1. To improve the quality of STEM education in schools (primary through high school) and the university through the design, implementation and evaluation of innovative, evidence-based curriculum materials in collaboration with FSE institutes and other Faculties
2. To improve the quality of STEM teacher education program through research in collaboration with the teacher education department
3. To widen (increase the numbers) and diversify (increase the diversity) STEM engagement of all citizens in formal (e.g., university) and informal settings (e.g., community) in collaboration with ScienceLinX, PIE, museums and the business sector

Who are we?
We form an interdisciplinary team of researchers with expertise in STEM pedagogy, curriculum design, teacher preparation, and research with *complementary* expertise and experiences across STEM education, research, and engagement.
What do we do?
As a group we currently carry out various activities that include the design, implementation and evaluation of evidence-based interventions and innovations, which are designed to: (a) Enhance the quality of STEM teaching both in schools and the university (b) Enhance the quality of STEM teacher education (c) Support the general public's engagement with science
Who is our target group?
• STEM university students • STEM university lecturers • School students • School teachers • Preservice education teachers • General public

INTERNATIONAL RESEARCH PROFILE

The Institute has a strong international profile in STEM education as evidenced through EU projects Double Degree PhD contracts, Executive Board memberships, editorial board positions, invited book reviews in top-tier international journals and invited keynote talks at international conferences:

- **EU-projects**: As a group we either coordinate or serve as a partner on 7 EU-funded projects, which include collaborations with different countries in Europe (*e.g*. Finland, Hungary, Greece, Cyprus, Spain, Germany, Romania, UK).
- **Research collaborations**: We have current research collaborations with research groups in the US, UK, Spain, Greece, Austria, Singapore, Australia and Canada. We have published extensively with co-authors from different parts of the world including the US, UK, Denmark, Brazil, Spain, Cyprus, Greece, Sweden, Indonesia and Canada.
- **Double degree PhD contracts:** In the past two years we have set up Double Degree PhD contracts with the universities in the following countries: Singapore, Chile, Cyprus and Greece.
- Prof. Avraamidou serves as an Associate Editor for top-tier journals: *Studies in Science Education, Journal of Research in Science Teaching, Cultural Studies of Science Education.*
- Dr. Mali is affiliated with international scientific societies: *European Society for Research in Mathematics Education*, *Special Interest Group of the Mathematical Association of America on Research in Undergraduate Mathematics Education*, *International Group for the Psychology of Mathematics Education*.
- Prof. Avraamidou is currently a member of the Executive Board of the European Association of Research in Science Teaching (ESERA), with more than 2,000 members
- Prof. Avraamidou is a member of the European Federation of Academies of Sciences and Humanities, representing more than 50 academies from over 40 EU and non-EU countries. Since its foundation in 1994, ALLEA speaks out on behalf of its members on the European and international stages, promotes science as a global public good, and facilitates scientific collaboration across borders and disciplines, 2021-today.

OVERVIEW OF THE TWO SUB-RESEARCH GROUPS

GROUP 1: SOCIAL AND CULTURAL ISSUES IN MATHEMATICS EDUCATION: *TEACHING PRACTICE*

Dr. Mali's group engages with the concept of 'teaching practice' and its relation to the mathematical meaning students make; what the characteristics of teaching are and how teaching develops for promoting students' meaning in mathematics. Teaching practice is operationalized as the design, enactment and reflection on mathematics teaching. The goal of research in teaching practice is to contribute to an understanding of the rationale for decisions and actions and to create teaching repertoires for specific mathematical content. I take a micro- and a macro-analysis to the relationship between mathematics teaching and mathematical meaning making of the students. In the micro-analysis, I look at the relationships between teacher and student interactions in the classroom. The unit of analysis for interactions is observable actions of teachers and of students and the associated tools they are using in a certain learning environment, such as problem-solving classes, blended learning, inquiry-based learning, and chalk-and-talk teaching. As to the meaning making, I analyze student discourse to find evidence of the meaning students make in mathematics. In the macro-analysis of teaching, I bring in the relationship between mathematics teaching and students' meaning making factors from the wider socio-system cultures in which classroom teaching is situated. The teacher and the students belong in different communities such as university, family, wider social groups, classroom, and those communities have certain rules, such as the curriculum, peer pressures, and family structures. I look at how factors such as personal characteristics or community rules influence the teaching/making meaning relationship and what tensions emerge between teachers and students.

An example of a study in teaching practice is a project that I carried out in the past two years entitled: *The research mathematicians in the classroom: How their practice has potential to foster student horizon*. The lens through which meaning making is conceptualized in this project is the metaphor of horizon. Horizon is a unifying concept between university and school mathematics and includes elements of mathematical awareness beyond the content to be taught at school, elements of practice (mathematical and teaching) and, importantly, elements of reflection on both. Analysis of observational and interview data of teaching practice resulted in four categories of lecturers' teaching actions (i.e., drawing on examples, connecting mathematical areas, visualising, simplifying). These actions were also contextualised for professional development purposes, so lecturers learn the skill of fostering student horizon. An innovation of this project is the domain of knowledge from which the actions draw: lecturers' mathematical research.

Building on this work, Mali's research plan for the next five years includes longitudinal case studies of the teaching of both lecturers and schoolteachers aiming at fostering the mathematical meaning of students. This work is timely as it contributes to reducing the drop-out rates from mathematics programs of study and to encouraging more school students to study mathematics at university.

GROUP 2: SOCIAL, CULTURAL, AND GENDER ISSUES IN SCIENCE: *SCIENCE IDENTITY*

Prof. Avraamidou's group engages with the construct of 'science identity'. A key goal of science identity research is to contribute to an understanding of how science identity might serve in making science understanding and engagement meaningful and purposeful. A more radical goal, perhaps, is to make the case that science identity, as an ontological approach to learning, is what makes science learning both necessary and possible. In reviewing the literature on science identity research one thing becomes obvious: there is considerable diversity and variation along conceptualizations of science identity and how it develops over time and across contexts. We cherish this diversity of conceptualizations and we move intentionally and explicitly away from any effort to achieve a consensus or acquire a universal conceptualization of science identity; whether that is what a process of becoming a person should (instead of *might*) entail, or how a science person should (instead of *might*) act. That, in fact, would contradict the very nature of science identity as fluid, tentative, and dynamic. Instead, through my research I argue about the value of maintaining this diversity of what it means to become a science person as well as expanding the repertoire of equally valued science persons. We do so by invoking the (unique) self and science identity as fundamental processes inseparable from the place in which science (non)participation occurs. Our work is positioned alongside other researchers who conceptualize science identity as a constant process of *becoming* a science person, instead of a product, a certain desired outcome of being a certain kind of science person. Such positioning provides space for multiplicity, diversity, subjectivity, and hybridity to exist and to essentially acknowledge the infinite ways of becoming a science person - a process that is always bound within place or sociopolitical context.

An example of an identity-based research study is a project that Avraamidou carried out in the past 3 years with title: *Beyond gender: Intersectional identity as a lens to examining women's (non)-participation in science*. Grounded within a combined theoretical framework of intersectionality, identity, and narrative, the project examines the intersectional identities, lived experiences, and educational pathways of women in physics. A deeper and comprehensive understanding of how different identities (e.g., gender identity, racial identity, class identity, religious identity, parental identity, social class) and life-experiences might influence women's science careers trajectories allows us to shift the focus away from a deficit model where gender alone is considered.

Building on this work, Avraamidou's research plan for the next five years includes a longitudinal exploration of under-served children (6-11 years old, ethnic and religious minorities in the NL) and especially girls' development of strong science identities through a series of interventions (i.e., use of the science truck of the University of Groningen and specially-designed after-school programs for family engagement). This work will contribute significantly to an under-explored research area nationally and internationally, which has the potential of recruiting and utilizing talent in science in the long-term.

EXAMPLES OF CURRENT PROJECTS

Title	Type/Funding	Description	Collaboration	Goals
Using mobile augmented reality games to develop key competences through learning about sustainable development in secondary school	EU-Erasmus Erasmus+ KA2: Cooperation for innovation and the exchange of good practices	The project includes the design, implementation, and evaluation of mobile augmented reality games and related curricular materials in the context of secondary school science. The purpose of the project is to support teachers and students to develop key competencies in teaching and learning about sustainable development.	-Local secondary schools -Teacher Education	1, 2
ROOTS: Ik ben science	PhD project	ROOTS is a science enrichment, multilingual, community-based programme "Ik ben Science" is used to refer to the programme's aspiration to increase children's (8-13 years old) self-identification with science and to support them in developing an understanding of the diversity of STEM careers	-ScienceLinX - Faculty of Social and Behavioral Sciences -Beijum Youth Center -Zernike Institute for Advanced Materials -GELIFES	1, 3
Characterization of lecturers' and students' discursive actions with introductory proof-oriented mathematics courses	PhD project	In this project, the activity of proof teaching and learning is explored at the university level. The innovative exploration of the discursive actions, with which lecturers communicate mathematical meaning to first year students, is done through qualitative methods and the commognitive approach.	- Bernoulli Institute for Mathematics, Computer Science and Artificial Intelligence	1

MATHEMATICS EDUCATION

Mathematics lecturers' emotions and their role in the development of teaching actions

Dr. Angeliki Mali - personal project (2020-2024)

Lecturers' thoughts that underlie their teaching actions are closely connected with emotional situations that incite lecturers' decision making. From the perspective of sociology of emotion, this project uses ethnographic methods to explore emotional outbursts and changes in teaching actions that contribute to the development of lecturers' teaching for students' making of mathematical meaning. This project recognises that lecturers and students are regulated by emotions while engaging with the mathematics, and contributes to a deeper understanding of emotions as an irreducible aspect of the teaching and learning of mathematics.

Mathematics lecturers' teaching actions and their relation to actions of mathematical production in their own research

Dr. Angeliki Mali - personal project (2019-2023)

A goal of a mathematics department is to introduce the students to the processes of mathematical production. This innovative project uses ethnographic methods to identify and analyse the common ground between mathematical actions that are used in lecturers' teaching and research work. Insights into what constitutes mathematical production in undergraduate mathematics lectures offer a comprehensive understanding of the mathematical actions that crosscut the first years of a mathematics programme.

Characterization of lecturers' and students' discursive actions with introductory proof-oriented mathematics courses (2019-2023, PhD project)

Thomais Karavi, Supervised by Dr. Mali & L. Avraamidou

In this project, the activity of proof teaching and learning occurs in lectures while the gaze of the researcher is at the communication and language that appear in this context. The innovative exploration of the discursive actions, with which lecturers communicate mathematical meaning to first year students, is through qualitative methods and the commognitive approach. Light is shed on the established activity of proving, the discursive shifts when communication with students fails, and the discursive actions that foster growth of a shared understanding of mathematical production between the students and the community of mathematicians.

Fostering Indonesian prospective mathematics teachers' geometry proof competence (2017-2021, PhD project)

Lathiful Anwar, Supervised by Prof. Goedhart & Dr. Mali

In this quasi-experimental project, Indonesian prospective mathematics teachers are provided with Computer Algebra System tools and a variation of proof formats (e.g., flow chart, paragraph), aiming at fostering their reading comprehension and construction of proof in plane geometry. The outcome of the project is the development and test of a learning trajectory of Euclidean proof which promotes prospective mathematics teachers' proving skills and serves as teaching material for lecturers. The learning trajectory uses multiple proof formats that support the teachers' understanding of the logical status of statements and the critical ideas in a proof.

Professionalizing online and blended/hybrid education @ the University of Groningen (2021-2025, TAG PhD project)

Ha T. Nguyen, Supervised by Prof. Jan-Willem Strijbos (1st promotor; GMW, GION Education/Research), Prof. Hanke Korpershoek (2nd promotor; GMW, GION Education/Research), Dr. Angeliki Mali (1st copromotor; FSE, Institute for Science Education and Communication) & Dr. Jolien Mouw (2nd copromotor; GMW, GION Education/Research)

The project addresses urgent questions about the effectiveness and productive implementation conditions of different forms of online and/or blended/hybrid teaching. More specifically, the project aims to investigate which innovations are 'working' at the University of Groningen (UG), how they 'work', for whom they 'work' and under which conditions they 'work'. At the UG, teaching and learning is offered by a diverse lecturer population and it needs to be effective for a diverse student population. This project contributes to understand the working mechanisms of online and blended/hybrid teaching at the UG, leading to standards of high-quality online courses and to wider dissemination in existing professional development initiatives at the UG, like BKO or SKO.

The influence of logic reasoning education on reasoning skills: Logical reasoning as part of the new Maths C Exam Programme (2016-2021, NWO, PhD project)

Hugo Bronkhorst- Supervised by Prof. Goedhart

Learning to reason (logically) is of major importance for future life. As such, it is related with the 21st century skills framework. At present, the development of logical reasoning skills is undervalued in mathematics education. Recently, logical reasoning was introduced as a new topic in Dutch mathematics education for non-majors (mathematics-C for Culture & Society students). This design-based research project explores the ways 11th and 12th graders learn to reason logically. The focus is on the role of formalisations -like schemes and Venn diagrams - to support students in their reasoning.

SCIENCE EDUCATION

Beyond gender: Intersectional identity as a lens to examining women's (non)-participation in science 2017-2021

L. Avraamidou – personal project

Grounded within a combined theoretical framework of intersectionality, identity, and narrative, the project examines the intersectional identities and professional experiences of women in STEM with data drawn from in-depth interviews with 10 purposefully selected female professors (both novice and experienced ones across disciplines) at FSE.

University experiences of undergraduate physics students: a longitudinal study through social network analysis
September 2020 - June 2024

L. Avraamidou and J. Brouwer (Dept. of Education) – personal project

A group of 80 undergraduate students will be followed throughout their 4-year program in physics for the purpose of a study aiming to examine their experiences both in large-group lectures as well as mentoring sessions. Data collection will take place twice a year (month 5, month 10 of each year) for 4 years through a web-based survey. A related sub-study will examine through qualitative measures (interviews, once per year) a selected group of 5 purposefully selected female students' experiences in physics for the purpose of examining their sense of belonging throughout their studies.

Generation AI: Teaching Secondary School Students with/about Artificial Intelligence
EU- Erasmus+ KA2: Cooperation for innovation and the exchange of good practices
November 1, 2020 – October 30, 2022
Budget: 275, 400€

Coordinated by D. Heeg (PhD project)

The aim of this project is to provide professional development for secondary school teachers and preservice teachers to support them in understanding the complexities and basic principles of AI, computational thinking, and how they can be integrated in teaching science for the purpose of promoting creative problem solving, resilience, and design thinking.

Using Mobile Augmented Reality Games to Develop Key Competences through Learning about Sustainable Development (EU-Erasmus+ KA2, 2019-2021, 2019-2021; Budget: 287,000 euro)

Coordinated by L. Avraamidou

The project includes the design, implementation, and evaluation of mobile augmented reality games and related curricular materials in the context of secondary school science. The purpose of the project is to support teachers and students develop key competencies in teaching and learning about sustainable development.

Preparing Teachers and Students for a Digital World (EU-Erasmus+ KA2, 2019-2021; Budget: 286,000 euro)

Coordinated by L. Avraamidou

The project includes the design of an interdisciplinary STEAM (science, technology, engineering, arts, mathematics) program to empower students, school leaders, and communities to apply STEAM activities, robotics, and digital tools for the purpose of supporting them in developing 21st century skills. As part of the project, an innovative, interactive, open-access e-learning space will be developed which will provide a set of readily available resources for school teachers.

Identifying Aspects of the Learning Environment Conducive Towards the Productive Disciplinary Engagement of Undergraduate Students in Introductory Physics Courses (2020-2024)

Dr. May Lee, FSE fellow

The project investigates how the experiences of undergraduate students in physics lectures and/or tutorials (learning environments) affect their understanding of physics and personal engagement with physics-related disciplines. The main goal of this project is to identify aspects of the learning environment that support the learning and engagement of physics concepts for undergraduate students and to implement changes that support those identified aspects. This on-going project currently focuses on the learning environments associated with the introductory Electricity and Magnetism course. Some teaching assistants have already been interviewed to help me develop an understanding of the current structure of the learning environment from the instructional perspective.

Widening and diversifying citizen engagement with science (EU-H2020, 2020-2023; Budget: 1.1 million euro) PhD project, 2020-2024, Double degree with the University of Athens, GR

Nelly Marosi - Supervised by L. Avraamidou

ALL INTERACT: Widening and Diversifying Citizen Engagement in Science' is twofold: first, the researchers want to create new knowledge about how to transform potential citizen participation in science into actual engagement in scientific research. Next to that, they want to unveil new ways to engage societal actors, including young citizens and groups that have traditionally been excluded from science. The consortium consists of researchers from the University of Barcelona, the University of Oxford, the University of Helsinki, the University of Milano and the UG; the University of Barcelona is coordinator. The project will be carried out with a series of interventions in the different partner cities that engage citizens with science.

Broadening STE(A)M participation: An intersectional approach to promoting minoritized students' inclusion

2020-2024, PhD project, Double degree with the University of Athens, GR

Nelly Marosi - Supervised by L. Avraamidou

Situated within current geo-socio-political realities shaped by the massive influx of diverse migratory groups to Europe and the rise of racism and Islamophobia, this research study will explore Science, Technology, Engineering, Arts, and Mathematics (STEAM) participation and science identity of minorities. The purpose of the study is to explore how the engagement of minoritized students in a culturally relevant STEAM program might (a) enhance their academic achievement and sociopolitical consciousness; (b) shape the formation of their science identities. A secondary goal of the study is to examine how race, ethnicity, religion, class, and the migrant/refugee status intersect with science identity. Data will be collected from a culturally relevant STEAM after-school program with Muslim refugee children in Greece. The study follows a qualitative research paradigm and adopts an ethnographic case study. The data will be analyzed through content analysis and with the use of open coding techniques. From a theory perspective, the study will propose an evidence-based theoretical framework for after-school community-based programs that aim to support nondominant groups participation in science. From a research perspective, the findings will reveal the relationship between community-based science learning, science engagement, and self-identification with science.

Teacher learning at the boundaries of cross-curricular collaboration for supporting students' development of scientific media literacy

PhD project, 2020-2024, Double Degree with the National Institute of Education, Singapore

Edith Koh Hsing Dee - Supervised by L. Avraamidou

Through an intervention that involves english and science teachers in collaborative lesson design, this study aims to demonstrate the learning potential of cross-curricular work in Singapore by addressing the following three questions: a) What are the learning mechanisms evoked at the boundaries of interdisciplinary collaboration? b) What do the learning mechanisms reveal about what teachers learn? and, c) How do the process features of an interdisciplinary teacher design team bring about teacher learning?

ROOTS: Ik ben science!

2018-2022, PhD project

Theila Smith - Supervised by L. Avraamidou & M. Lopez-Lopez (Faculty of Social Sciences)

ROOTS is a science enrichment, multilingual, community-based programme that takes place at a youth center in Beijum. It draws on disciplines in science, technology, the arts, the environment, engineering and mathematics (STEAM). ROOTS is used to refer to the urgency of communities moving towards a more environmentally sustainable future. "Ik ben Science" is used to refer to the programme's aspiration to increase minoritized children's self-identification with science and to support them in developing an understanding of the diversity of STEM careers. The lessons are a cross-section of families, scientists and researchers engaging in activities that are sociocultural and sociopolitical contextually relevant to everyday life.

Morality in the context of socioscientific issues
2016-2022, PhD project

Tore van der Leij- Supervised by L. Avraamidou and prof. M. Goedhart
Contemporary sustainability issues speak for the need of comprehensive, multidisciplinary and interdisciplinary science teaching and learning that addresses goals at the personal, local and global level. An approach to this challenge is found in the context of teaching and learning socioscientific issues, with which dealing with morality aspects is inextricably linked. Despite its widely recognized relevance not many science teachers have experience in guiding and stimulating students' morality. This classroom-based project investigates 16-18 year old students' morality within the context of socioscientific issues, in a specially designed intervention for Dutch biology education. The key interrelated questions we seek to address are, how, in light of emerging sustainability issues, morality can be conceptualized in the science classroom, and how it can be developed.

Exploring pre-service physics teachers' development of physics identity through the use of Multiple Representations
2017-2021, PhD project

Nuril Munfaridah - Supervised by L. Avraamidou and prof. M. Goedhart

This project aims to examine the ways in which the use of multiple representations (MR), as classroom practice, in physics education, might support preservice teachers' development of physics identities. A classroom practice has been found that has an influence on the development of students' physics identity. A mixed-method case study design is adopted in this study with 61 preservice physics teachers from one of the public universities in Indonesia. The research questions of this study are: (a) How did preservice physics teachers' (PPTs) physics identities develop over a specially designed course incorporating the use of the MR approach? (b) How did a group of preservice physics teachers (PPTs) perceive their experiences in learning with the MR approach? (c) What is the relation between preservice teachers' conceptual understanding and self-views as a physics person?

Quantum Physics in Upper Secondary Schools – Why? What? How? The relation between learning quantum concepts and students' beliefs about Nature of Science.
2016-2021, PhD project

Kirsten Stadermann - supervised by prof. M. Goedhart

Quantum physics (QP) was recently incorporated in the pre-university secondary school curriculum in the Netherlands. Literature reports that teaching QP in secondary schools is challenging: Students have limited mathematical background, QP phenomena do not align with students' classical physical knowledge, and teachers might not be familiar with the subject.
More than in other parts of school physics, QP is intertwined with aspects of Nature of Science (NOS). To learn QP students for example must understand that earlier learned models of particles are no longer adequate. They are also confronted with phenomena such as wave-particle duality which have no single accepted interpretation. In this project, we investigate how the two goals of physics education (QP and NOS) mutually reinforce each other.

Enhancing secondary school students' interest in science and STEM careers: The role of career-based scenarios

2017-2021, PhD project, Double degree, University of Cyprus, CY

Irene Drymiotou - Supervised by L. Avraamidou
Theoretically framed within the area of Social Cognitive Career Theory, this research study explores a) the impact of career-based scenarios, as an instructional approach, on students interest in science and understandings of STEM careers; and b) students' self-views in relation to science and aspirations for STEM careers. More specifically, this study emphasises on nurturing students interest in science and developing awareness of STEM careers and further explores the ways in which the students view themselves in relation to science and STEM career aspirations. This is a four-year case study involving 16 students (13-17 years old) who participated in a classroom intervention for two consecutive years and they were then followed for two more years after the intervention. Data collection methods included two questionnaires and semi-structured interviews with the students during and after the intervention. The analysis used a combination of descriptive statistics and content analysis. The upcoming findings hold important implications for educational practice offering insights to inform the career-oriented curriculum design and further theorize about the development of students' self-view in relation to science to facilitate career decision making.

Teacher Training in STEM Teaching
ERASMUS+ project KA226: STEM Digital Distance Learning in University Teaching (STEM DIGITALIS)
2021-203 Budget: 294.000€

2018-2022, PhD project, Double degree with the University of Crete, GR
Argyris Nipyrakis – Supervised by L. Avraamidou
This PhD project aims to study teachers' views and design practices on STEM Integration, as well as the effect of collaboration on their STEM Integration views and design practices. In combination with correlated study implemented in the University of Crete about in-service STEM teacher professional development on Integrated STEM teaching, this project focuses on pre-service STEM teacher training in Integrated STEM teaching. In specific, pre-service primary/secondary teachers work collaboratively with peers and experts through a Learning Community framework in order to design, develop and experience STEM teaching material (e.g. physical/digital artefacts and/or experiments, along with related STEM lesson plans) in both curriculum topics and cutting-edge STEM topics such as Nanotechnology and Artificial Intelligence. Additional emphasis is given to the way that they integrate

Technology as well as the use of Technology that they implement. Data collection includes audio transcripts, the developed STEM teaching materials as well as reflection interviews about STEM Integration and collaboration. Due to the explorative nature of the study, qualitative content analysis methods are been applied. Upcoming findings aim to provide insights about S-T-E-M teachers' views and design practices on STEM Integration as well as how they evolve through a collaborative learning environment.

Navigating Epistemic Uncertainty in Science Communication: Towards Epistemic Justice (2021-2025, PhD project)

Valeria Cernei, supervised by Prof. Lucy Avraamidou, dr. Maarten Derksen, dr. Ivan Salinas Barrios

The covid-19 pandemic has brought to the fore the difficult relationship between science and its audience as manifested, for example, through the growing anti-science movement. In this project, I explore the role of science communication as a mediator of this relationship with a focus on the effects of uncertainty communication. Uncertainty communication has been linked to decreased public trust in scientific knowledge, and its exploration may provide valuable insights on the schism between science and its audience. Uncertainty is explored in two incarnations: (1) as operationalized in current science communication practices (deficient, technical, consensus, and scientific uncertainty) and (2) in a new conceptualization informed by virtue epistemology. This idea of uncertainty is based on the acknowledgment of the multiple epistemic systems operating at any given time. Within this theoretical framework, I assess the bearing different conceptualizations of uncertainty have on epistemic (in)justice (i.e., the exclusion, silencing, or systematic distortion of the knowledge of specific communities) and investigate the effectiveness of science communication initiatives in relation to (different types of) uncertainty communication. The main goal of this work is to synthesize the emerging evidence into a set of uncertainty communication practices aimed at facilitating the navigation of epistemic uncertainty and its subsequent communication.

Outdoor Science Education for a Sustainable Future - OTTER
(EU-2020, 2021-2024; Budget: 1.5 million euro)

Coordinated by L. Avraamidou. Postdoctoral researcher: N.H. Azevedo

The consortium involves participants from eight European Union countries and has the aim of improving the understanding of methods and pedagogies of Education Outside the Classroom. It aims to look at how these methods can help improve the acquisition of scientific knowledge and transferable skills in students, specifically in the field of environmental sustainability and plastic waste reduction. The project focuses on increasing interest in science topics among youth while contributing to the range of innovative educational projects and increasing scientific citizenship within the EU. In this consortium, we are in charge of develops and implements a comprehensive monitoring and evaluation plan, gathering and analysing data from all participants in the project – students, teachers, families, members of the public, researchers, other stakeholders. This analysis and synthesis of monitoring and evaluation results will be carried out in each partner country, including a perspective on gender and geographical differences, and the results will be synthesized to produce a comprehensive account of the project's impact. Otter will contribute to strengthening educational outside-the-classroom networks within Europe, connecting experts from different regions within the continent. Otter implementing actions aim to promote gender equality as a cross-cutting issue as well as researching relationships between students' gender and learning outcomes in terms of scientific knowledge and 21st-century skills.

ISEC Staff October 2021

Name	Position	**Graduation/end contract**
Jan - Secretary	0.7	
Lucy	Associate prof.	
Angeliki	Assistant Prof.	
Martin Goedhart	Emeritus prof.	
Annelotte	PhD student	December 2020
Irene	PhD	September 2021
Hugo	PhD	September 2021
Kirsten	PhD	January 2022
Lathif	PhD	January 2022
Nuril	PhD	January 2022
Theila	PhD	August 2022
Tore	PhD	August 2022
May	Research fellow	August 2022
Edith	PhD student	August 2022 DD -Singapore
Sibel	Part-time lecturer	August 2022
Argyris	PhD student	December 2022 DD - Greece
Thomais	PhD	September 2023
Nelly	PhD	June 2024 DD - Athens
Nathalia	postdoc	October 2024
Dagmar	PhD	December 2024
Valeria	PhD	August 2025 DD Chile
Andreas	PhD ENTEG, FSE Lucy: 3rd supervisor	August 2025 DD Cyprus
Aldine	PhD Martin:	DD Leuven
Ha	PhD Angeliki: daily supervisor	September 2025 Interdisciplinary TAG PhD project with the Department Educational Science (GION), Faculty of Behavioural and Social Sciences