Center for Computing in Science Education

Annual report 2025

CCSE

Center for Computing
in Science Education

Summary

The Center for Computing in Science Education (CCSE) has established itself as international hub for the research-based integration of computing in science education. Computing – using computers to solve problems – has changed research and industry. And the use of digital technologies is expected to impact all of society. However, computing is not yet fully integrated in the contents of educations – neither in the sciences nor in other disciplines. CCSE wants to change that. Computing and programming should be an essential skill in all science educations, and the contents and form of the educations should be changed accordingly. This requires new learning materials and new teaching methods and approaches. These materials and methods should be based on research on how students learn computational modeling and how computational modeling affects learning of the specific discipline.

Education research: Education research at CCSE in 2025 is gradually shifting its focus to the impact of AI on teaching and learning. Associate professor Andreas Haraldsrud is focusing on the impact of AI in chemistry education, PhD-student Karl Henrik Fredly is addressing student understanding and agency from computational essays, with a particular focus on students' use of AI tools, and Jan Fredrik Olsen tests out AI-supplemented teaching methods and their impact on student learning in introductory math courses at Lund University. PhD-student Helene Lane uses text embeddings as a tool for qualitative text analysis in physics education research. This year adjunct professor Danny Caballero from Michigan State University edited a book on the integration of computations into the undergraduate physics curriculum with contributions from Tor Ole Odden and Ben Zwickl from CCSE. Our main focus in 2026 will be the impact of AI technologies on teaching, learning and assessment and the use of AI technologies in education research.

Culture of teaching and learning: CCSE personnel and KURT has continued to contribute to workshops and meetings focusing on digital teaching and assessments. The CCSE biweekly seminar series continue to focus on issues in teaching and education research. We have also continued to develop, support and expand the Learning Assistants program, which now is growing to become integrated in study programs across the university through a collaboration between KURT and the Center for Teaching and Learning (LINK) at the University of Oslo.

Learning materials and approaches: CCSE has continued to support and develop new learning approaches and new learning materials. Tor Ole Odden has been involved in the design of tutorials, exercises and AI bots used across several physics courses in the bachelor program. Anders Malthe-Sørenssen has designed new learning activities for the active learning classroom for third semester students. Lex Nederbragt has introduced an interactive AI assistant for teaching students programming in bioscience. Andreas Haraldsrud has written a new textbook for introductory programming for chemistry students. Vidar Skogvoll at KURT has continued to develop the LA program and disseminate how to use of AI effectively in teaching and learning. All these activities contribute to build a significant portfolio of examples that forms the basis for successful dissemination.

Computational literacy in schools: CCSE and KURT has continued its effort to help teachers prepare for integrating programming in various school courses. From 2020, programming is integrated in mathematics, the sciences, and other subjects at schools. We have continued our effort to train teachers in programming through our nationally recognized brand, ProFag. From 2022, we have also started associated education research activities in collaboration with KURT. In 2025 these activities has focused on the integration of AI in teaching, with particular focus on mathematics and natural science in high schools.

Computational skills for PhD-students: The MSCA Cofund CompSci PhD program started in 2021. The vision has been to train a new generation of computationally proficient researchers to renew research and industry across Europe. In total, 31 students have been hired for the program, and we have developed two new courses in advanced computational science and in advanced machine learning and artificial intelligence. The courses have been piloted on two cohorts of CompSci students and will become part of the regular contributed curriculum for PhD students across all disciplines. The first PhD students graduated from the program in 2025, and the successful candidates have already started postgraduate careers in both academia and outside.

Dissemination: CCSE has continued its dissemination efforts both nationally, in collaboration with the University of Southeastern Norway, and internationally through the Circle-U university network. We are also starting both Nordic and European networks that focus on AI in education and the use of AI for education research, that will be integral to our work over the coming years.

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Mission and goals

Vision

CCSE will become an international hub for research-based integration of computational methods in education.

Goals

- Develop research-based learning materials with deep integration of computing
- Develop research-based methods and approaches for integrating computing in curriculums
- Transform student learning and teaching culture
- Engage students through student-driven projects and practices
- Disseminate and adapt practices across disciplines nationally and internationally

Realizing the vision: from the present state to the ten-year goal

Present state (2016)

Existing interdepartmental culture for CSE with some excellent teaching practices and strong student engagement. Math and programming integrated in first semester. Full CSE integration in 2 of 6 basic physic courses and partial integration in other courses. Two textbooks have been published internationally. The research basis for methods and approaches is sparse.

Five-year goals (2021)

The center has initiated a research-based approach to curriculum change and teaching and learning methods in partnership with students. Full integration of CSE in 4 of 6 basic physics courses, with two new textbooks, 2 of 4 math courses, and 1 astronomy course. A pilot extension of CSE into biology; a pilot adaptation by an external partner; a pilot school interaction program; and pilot studies of learning outcomes and teaching methods in 3 courses.

Ten-year goals (2026)

The center is an internationally leading hub for research-based approaches to CSE, with a strong educational research activity and student partnership; Full integration into 6 basic and 2 advanced physics courses, 4 math courses, 4 bioscience courses, 1 course in humanities; Extensions to 3 other disciplines at UiO; Adaptation at 2 external partners. A nationally leading role in the integration of computing in teacher training.

Perspectives on digital and AI competence

Digital competence has become an important skill in society, industry and education. However, what actually constitutes digital competence in often unclear. At the Center for Computing in Science Education we have a clear vision for how to reform education to ensure students are prepared to face tomorrows challenges: We need to integrate the use of computers to solve problems – computing and programming – into all aspects of education across disciplines and across the entire educational ladder. Students need to learn how to work effectively with machines – computers – that are becoming gradually more intelligent. However, what it means to work with computers is dramatically changing with the advent of new AI models such as large language models and agent models. Therefore, we all need to become literate in the use of computing – to obtain computational literacy – as well as develop knowledge and skills needed to effectively use AI tools. We need to learn to think, argue, analyze and be creative using computing and AI approaches. This does not mean that everyone should become computer scientists and AI specialists. Instead, students should learn to use computers and AI in their disciplinary context.

The focus on digital and AI competence needs to increase in the years to come. Students need to be able to use these technologies to become effective workers, but also to understand their advantages and disadvantages. This need was clearly stated in the ministry's white paper on AI in higher education in 2020. CCSE is in a unique position to lead the digital transformation and integration of AI technologies in education because we already have worked twenty years with a vision of how to integrate computing into education. We have experience with how digitization can and will change the content of education, the practice of teaching, and the methods of research. However, developing teaching and assessment methods that teach students to use AI models in effective ways – as tools for their practice as well as to support their learning based on fundamental insights and knowledge of how learning actually is supported – is now becoming a field that needs urgent attention. In particular, a research and evidence-based approach to the integration of AI into educational practices is urgently needed, and CCSE with its combination of education research, evidence-based practices and insights into what practices are important for student learning, is in prime position to take a lead in this field.

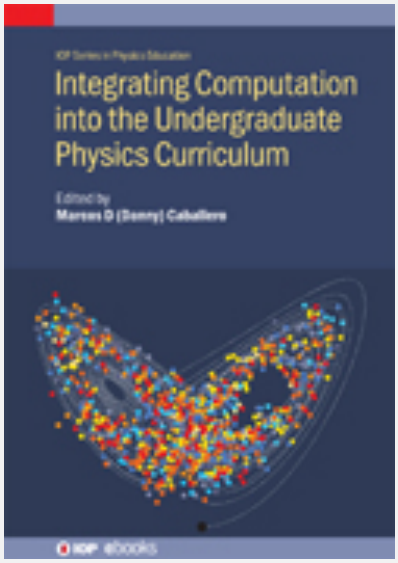
Higher education institutions should provide their students with a research-based education. If all educations integrate computing and AI, this means that a university needs to have research activities and research-based competence in three related fields: (1) In the specific disciplinary field: For example, a bioscience education must build on high quality bioscience research; (2) In the relevant computational field: An education with a computational element must build on a strong research activity in this area; and (3) In education research. Only the largest institutions are able to build top research activities in all these areas and provide high quality, research-based education that integrates the computational and digital perspectives.

We are convinced that the approach and strategy of CCSE will become more important as more and more stakeholders, institutions and students realize the importance of an up-to-date education with a modernized curriculum. The growing digital divide – between parts of the population that have digital access and master the digital technologies and the rest will only widen. The only realistic solution is to address this challenge through education. We need to include digital skills – deep, non-trivial skills – throughout the education. However, this requires a new generation of teachers and researchers who can build computational and AI curriculums and educate tomorrows teachers. CCSE is taking a leading role in training these researchers and teachers.

Highlights 2025

CCSE research highlight

In 2025, Danny Caballero (who has a 20% appointment with the CCSE) published the book Integrating Computing into the Undergraduate Physics Curriculum. The book, published by IOP Physics Publishing, contains 14 chapters, of which five are authored by CCSE faculty. Caballero provides both an opening and a concluding chapter that frame the collection as a whole. Benjamin Zwickl, who also has a 20% appointment with the CCSE, contributed two chapters co-authored with Charles Lusignan and Aaron McGowan that focus on integrating computation into upper-division physics laboratory courses. Associate Professor Tor Ole B. Odden contributed a chapter titled Teaching scientific writing using computational essays. In this chapter, he examines how computational essays (documents that integrate narrative text, equations, figures, and executable code, which have been heavily researched through the CCSE) can be used to create authentic opportunities for scientific writing in physics courses.



Key CCSE personnel receive honors

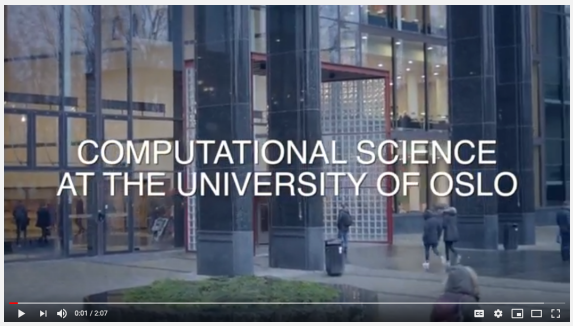
In 2025, Lex Nederbragt was recognized as a dosent (the highest level position on the lecturer track), Andreas Haraldsrud was recognized as an associate professor, and Tor Ole Odden was recognized as a Distinguished Educator. Lex Nederbragt and Marius Lysaker recived the Olav Thon prize. Congratulations to them all – we are proud of you!



Photo: Jarli/Jordan, UiO

Illustrative films and podcasts about CCSE and integration of computing

Two films that illustrate how computing is integrated into the bachelor educations at UiO have been published. The target audience is prospective students and the general public.
Film: Computational science at the University of Oslo: https://youtu.be/0vLutIsrgIo (english)
Film: Computational methods in study programs at UiO: https://youtu.be/T6Wa59E7S-Y (norwegian)



Podcast: Research projects for bachelor-students: https://soundcloud.com/nokutpodden/den-om-forskende-bachelorgradsstudenter (norwegian)
Podcast: Bachelor-students who teach: https://soundcloud.com/nokutpodden/den-om-studenter-som-underviser (norwegian)

Plans and Priorities

The main activities of the center from 2022 and onwards follow the action plan for 2022-2026 with four main work packages.

Theme 1: Educational development (2022-2026)

Integration of computing and experimental methods: Experimental data collection and analysis will be integrated into the teaching workflow in introductory courses starting with the first year of the physics bachelor program in 2023. In 2026, particular focus will be placed on extending pedagogies and material for teaching large classes in the Active Learning Classroom (ALC) in the Department of Physics.

Instructional methods: The Learning Assistants program will be extended across the natural sciences and also beyond the natural sciences. Students who develop learning material will be enrolled in the LA program, integrated into the teaching team, and closely supervised by pedagogically experienced faculty. In 2026, we will continue the development of direct instruction methods in introductory courses test new learning approaches that includes AI in various forms.

Learning material: We still support docOnce as an infrastructure for modular learning material, but will consider transitioning to other, more broadly supported tools that are in development internationally; we will build a community for authors through meetings, workshops and retreats; and adapt and develop textbooks and digital learning material to various domains in collaboration with domain specialists. New learning material will be developed for use in the active learning classroom in the physics program. These methods and approaches will then be disseminated to other programs that want to develop active learning in large-class situations in a Norwegian context.

Assessment and evaluation: The initial assessments developed for assessing computational thinking in computational essays will be distributed and used in a broader context and in more courses that employ activities that are similar to computational essays. AI-based assessment methods, with particular focus on formative assessment, will be developed and implemented. We will continue to help reshape student evaluations to be based on research-based principles.

Theme 2: Education research (2022-2026)

The education research activity will continue the work initiated in the first period. The center resources will be used to (i) extend studies of computational literacy, (ii) continue studies of

Action	Description	2022 i	2022 ii	2023 i	2023 ii	2024 i	2024 ii	2025 i	2025 ii	2026 i	2026 ii
Theme 0: Management (AMS)											
A0.1	Annual progress reports	D01		D01		D01		D01		D01	
A0.2	Advisory board meeting			M02				M02			
Theme 1: Educational development (LN)											
A1.1	Integration with experiments				M11				D11		
A1.2	Instructional methods										
A1.3	Learning material				M13		M13		M13		
A1.4	Repository						M14		D14		
A1.5	Assessments and evaluations		M15				M15				
Theme 2: Education research (TOO)											
A2.1	Computational literacy (Res)				M21				D21		
A2.2	Computing in math (PhD)				M22				D22		
A2.3	Computing in schools (PhD)			M23			D23				
A2.4	Computing in chemistry (PhD)				M24				D24		

Action	Description	2022 i	2022 ii	2023 i	2023 ii	2024 i	2024 ii	2025 i	2025 ii	2026 i	2026 ii
Theme 3: Culture for teaching and learning (TS)											
A3.1	Workshops and seminars	M31		M31		M31		M31		M31	
A3.2	Summer institutes	M32				M32				M32	
A3.3	Student projects										
A3.4	Teacher courses			M34		M34		M34		M34	
Theme 4: Dissemination (KM)											
A4.1	TraCS PhD training							M41			
A4.2	ProFag			M42		M42		M42		M42	
A4.3	Cross-sector programs					M43				D43	
A4.4	Non-science applications					M44				M44	

M = Milestone, D = Deliverable, Color intensity indicate stages
AMS = A. Malthe-Sørenssen, LN = L. Nederbragt, KM = K. Mørken
TOO = T. O. Odden, TS = T. Skramstad

D01: Annual progress report; M02: Advisory board meetings
M11: Implementation in physics; D11: Learning material published
M13: Textbooks and digital materials published (phys., bio., phys.)
M14: Repository structure assessed; D14: Repository launched
M15: Assessments in intro courses (physics, chemistry)
M21: PER handbook entry; D21 Comp. literacy workshop in Oslo
M22: Midway eval of PhD student; D22: PhD project finished
M23: Midway eval of PhD student; D23 PhD project finished
M24: Midway eval of PhD student; D24 PhD project finished

M31: Annual workshops and bi-weekly invited seminars
M32: Biennial summer institutes (bio, chem., humanities)
M34: Annual pedagogical/computing courses (phys, bio, chem, humanities)
M41: First cohort finished.
M42: Reports on yearly activities in ProFag (teacher courses)
M43: Development of cross-sector program: D43: Launch of cross-sector program
M44: Semi-integration of computing in study programs (philosophy, economics)

the impact of computing in across domains, and (iii) initiate studies of teacher training and professional development and impact of computing in school education. The research activity will gradually shift to focus more on the impact of AI on teaching and learning and the development and application of AI-based text processing tools, such as the use of text embedding methods from large language models, in a joint effort between CCSE and INTED – Center for interdisciplinary education. We consider CCSE to be in a unique position to develop an internationally leading research activity in this field and to take a nationally leading role on how to integrate AI into domain educational programs. A PhD-student focusing on Natural Language Processing, Helene Lane, was hired in 2024 and a PhD-student focusing on the foundations of these methods, Ane Kristine Espeseth, was hired in 2025.

Theme 3: Culture for teaching and learning (2022-2026)

We will continue with teacher and student activities that have been effective: biannual workshops for teachers and LAs; education seminars at all involved departments; teaching teams in large courses, continue and extend the teacher training initiated by KURT, the Center for teaching and learning in science and technology at the Faculty for mathematics and natural sciences.
Together with KURT, CCSE will continue to develop a common meeting place for students and teachers interested in educational development through talks, workshops, hackathons and social activities. The goal over the coming two-year period is to merge the activities from theme 3 into the regular activities of KURT in order to make the efforts from CCSE into a permanent part of the institution. We will organize bi-weekly meetings at CCSE throughout 2026 focusing on challenges and opportunities in educational development projects and the use of AI in both education research and educational development.

Theme 4: Dissemination (2022-2026)

Dissemination will follow and expand on the activity from the first period. We will build on our success in disseminating practices to bioscience, teacher education, and through select international partnerships. We will widen the focus with an ambition to reach: (i) across levels from 1-13 through BSc, MSc, PhD, and post-graduate education; (ii) across contexts, from science to humanities, social sciences and beyond, (iii) across institutions nationally and internationally; and (iv) across sectors to impact education, research institutes, government, industry, business and startups. We will in 2026 focus on disseminating results on the use AI in teaching and educational development and on the use of text embeddings from large language models for education research and build a strong Nordic and European partnership for these activities.

Theme 1: Educational development

Leader: Lex Nederbragt

Goals (2022-2026)

Develop evidence-based instructional methods, learning materials and assessment and evaluation practices that support the integration of computing in courses and education programs. Hereunder, (1) Develop methods for fully integrated courses that combine theory, computing, experiments and analysis, (2) Initiate integration of statistics, data science and AI, (3) Extend the learning assistants programs, (4) Develop textbooks and interactive and modularized material with integration of computational methods and programming examples; (5) Develop and introduce standardized assessment of computational literacy, assessment methods that integrate computational methods, and evidence-based student assessment tools; (6) Strengthen our efforts to ensure that a diverse range of students have the opportunity to develop computational literacy.

Activities in 2025

Textbooks

The center has continued to develop high quality textbooks, interactive learning material and examples and exercises for courses. The textbook in *Elementary electromagnetism using Python* was used as the main textbook in 2025 and is published by Springer in 2026. A textbook on *Thermal and statistical physics using Python* is under preparation for publication with Springer and was used as the main textbook in 2025. The textbook *Programmering for naturvitenskap og matematikk* was published in 2025 and is used as the main textbook in scientific programming (see box). A major effort has been made over several years to develop high-quality textbooks and learning materials in advanced courses. This material is open access and used in courses at the University of Oslo and internationally. This provides a lasting legacy for the high-quality learning materials developed at CCSE.

Vidar Skogvoll and Andreas D. Haraldsrud are working on the book *Learning With AI,* a textbook on how principles from cognitive learning psychology can be used to say something about how AI can and should be used in education. The goal is for it to be published in the autumn of 2026 and to include many perspectives: what teachers need to know about AI, how AI affects society and schools, how AI can be used in reading and writing instruction, and for training various skills. To make the book as practice oriented as possible, the aim is to include concrete AI prompts and teaching activities that teachers can use directly in the classroom.

Electronic learning material

Several courses with integrated programming have developed digital learning progressions. The learning materials for *Algorithmic thinking for the humanities* and Data-driven projects for honours students are published as open access Jupyter books and were used as the main learning materials in 2025. These projects are unique internationally and contribute to build both legacy and a unique international brand for CCSE.

Learning assistants

The use of learning assistants – students who lead learning activities in smaller groups – have been gradually strengthened and broadened at the University of Oslo and is actively being extended to other institutions nationally and internationally. CCSE is gradually becoming a national hub for the development of learning assistant methods in Norway, and we are contributing to build a Nordic and European learning assistants activity. The use of learning

assistants is developed in close collaboration with KURT and with the Center for interdisciplinary education, INTED, which are developing the learning assistant model into a model for interdisciplinary facilitators.

Student participation

Students play an important role in the development of learning material. CCSE financed 36 student scholarships in 2025. Teachers and departments can apply for resources that they use to hire a student to develop new learning material that integrates computing in a course. In 2025, these resources were used to develop new learning material for the new course on quantum technology for the physics program as well as for courses in chemistry, pharmaceutical science and bioscience.

Plans and priorities for 2026

- Extend support to develop learning approaches and activities to be used in the large active learning classrooms and experiment on new methods of instruction.
- Integrate AI tools for teaching and programming across courses.
- Extend the learning assistants program beyond the natural sciences in collaboration with the university-wide center for teaching and learning
- Engage students in testing and validation of learning materials

Action plan

Action	Description	i	ii	i	ii	i	ii	i	ii	i	ii
Theme 1: Educational development (LN)		2022		2023		2024		2025		2026	
A1.1	Integration with experiments				M11				D11		
A1.2	Instructional methods										
A1.3	Learning material				M13		M13		M13		
A1.4	Repository						M14		D14		
A1.5	Assessments and evaluations		M15				M15				

M11: Implementation in physics; D11: Learning material published

M13: Textbooks and digital materials published (phys., bio., phys.)

M14: Repository structure assessed; D14: Repository launched

M15: Assessments in intro courses (physics, chemistry)

Comments

A1.1: Experimental integration piloted in Fys1100 and Fys1120 will be continued and extended in 2026.
A1.2: Methods for large active learning classrooms developed and tested.
A1.3: Textbook development is progressing in Fys2160 – Thermal Physics., Fys1120 – Electromagnetism, Programming for chemistry as well as in statistics for computer scientists. A wide range of advanced texts are in development and are used as textbooks in advanced courses such as in Fys3150 and Fys-stk3155.
A1.4: New material is added to the open international repository at compadre.org
A1.5: Assessments for computational literacy have been developed for computational essays and used across two institutions in Norway and the US.

New textbook on programming for the natural sciences and mathematics

Programming for Science and Mathematics is an introductory book to programming aimed at students in mathematical and natural science subjects in higher education. The book uses examples, exercises and theory from the subjects chemistry, biology, earth sciences, physics and mathematics to show how programming, modelling and numerical methods can be a useful tool within various disciplines. Emphasis is also placed on how students can handle, sort and visualise data, and both traditional statistics and machine learning are covered. The book also contains some advice on how generative artificial intelligence can be used in a learning-productive way when learning programming. It is based on experiences and research at CCSE, and is an updated and future-oriented introductory book that aims to meet the student at home in the subject to which he or she feels a sense of belonging.

A custom chatbot for BIOS1101

The introductory programming course for bioscience students, BIOS1101, teaches basic Python for data analysis and modelling. The curriculum deliberately limits students to elementary constructs (e.g., explicit loops instead of list-comprehensions, plain `print()` before the introduction of f-strings).

In the 2024 course evaluation many students admitted using ChatGPT. Their feedback highlighted that the model supplied "advanced" solutions, often far more sophisticated than the material they have learned. Thus, their chatbot usage offered them little pedagogical value and may even have undermined their learning.

For 2025, we decided to attempt to provide a **customized AI-based learning assistant**. The goal was to harness the convenience of large-language models while constraining their output to the syllabus and the students' current level of knowledge.

The university's GPT UiO service, which permits fine-grained instruction of the underlying model, was chosen as the platform. CCSE secured two bachelor students to develop the solution. The team built on an existing "AI as a learning assistant" prompt created by KURT and added three key features:

1. **Socratic dialogue** – the bot never gives a direct answer; it first asks probing questions to guide the learner toward the solution.
2. **Syllabus awareness** – a week-by-week summary of taught topics (e.g., "Week 34: `print`, variables, integers, floats, strings – no f-strings") is embedded in the instruction. The bot begins each session by asking the student for the current week number and then limits its code to concepts introduced up to that point (e.g., "DO NOT use f-strings before week 37").
3. **Shareable instruction** – the prompt can be saved and distributed via a link, allowing all students to load the same configuration into their instance of GPT UiO.

After several iterations, the final prompt proved effective: it kept the model's output within the pedagogical boundaries while still providing useful scaffolding. At the end of the semester, 63 of the 120 enrolled students responded to a feedback survey. Their usage fell into five main categories:

- Clarifying problem statements and receiving hints for the next step.
- Interpreting error messages.
- Explaining difficult concepts.
- Preparing for the exam.
- Generating additional practice questions.

Overall, the reception was positive. Students appreciated that the assistant respected the syllabus and that it was always available. The Socratic style was praised for encouraging active problem-solving, though a minority expressed frustration at the difficulty of obtaining a quick, direct answer, and some noted that the responses were occasionally lengthy.

We were positively surprised that a single, static weekly-based instruction performed so well; we had expected to have to update the prompt each week with new material. The experiment also revealed that only a minimal amount of explicit programming knowledge needed to be inserted into the prompt, enabled by the model's vast pre-training on general Python code. For more complex subjects, however, we anticipate embedding fuller textbook excerpts into the instruction would be needed (something now supported by GPT UiO).

All in all, we think this tailor-made chatbot has worked very well. We offered the students a tool that led to the sensible use of AI: to support their learning. And we will further develop this tool in the future. However, the wording 'we offered' is important here: it was up to the students to use the chatbot, rather than asking regular ChatGPT (or other models) for a solution.

This is something we see as an important aspect of AI in education: we should focus even more on teaching students how to learn, on the metacognitive aspect. This is not new, and we have been discussing this for years, but generative AI brings this need to the forefront even more.

This is a summary, partially generated with the help of GPT-OSS 120B through GPT UiO, of a longer blog post that can be found at https://lexnederbragt.com/blog/2026-02-13-a-chatbot-for-bios1101.

Theme 2: Education research

Leader: Tor Ole Odden

Goal (2022-2026)

Develop research-based methods and approaches for the integration of computing in a disciplinary context. Hereunder, (1) extend studies of computational literacy across science disciplines, (2) initiate studies of the impact of computing in mathematics in collaboration with Elise Lockwood at Oregon State University, (3) initiate studies of teacher training and professional development and impact of computing in school education; (4) establish education research studies of the impact of computing in chemistry, and (5) extend the research portfolio through external funding to develop a foundation for computational science education research.

Activities in 2025

Research on computation in science education

The CCSE research group consistes of Associate professor Andreas Haraldsrud (Chemistry Education), PhD-student Karl-Henrik Fredly (Physics Education), PhD-student Henning Myhrehagen (Physics/Science Education), PhD-student Jan-Fredrik Olsen (Mathematics Education), PhD-student Helene Lane (Physics Education), and PhD-student Ane Kristine Espeseth (AI). The research team had weekly research-group meetings throughout the semester, with regular discussions on the topic of computational literacy and the impact of AI across these different disciplines. All researchers are currently working on articles around their respective research projects.

Qualitative analysis at scale through natural language processing

During 2025, the CCSE group have extended their work on the use of AI and text embedding methods in education research in general and physics education research in particular. The text embedding methods have been extended from studies of literature to also address their use for analyzing interview and survey data.

Research on Generative AI in science education

Several members of the group have begun to pilot projects on the applications of generative AI to science education, especially related to scientific programming. Haraldsrud and Fredly have both initiated data sub-projects on this topic, examining how ChatGPT can be used to support problem-solving in Chemistry and computational essays in physics, respectively.

Plans and priorities for 2026

- Continue existing studies of computational literacy in physics, chemistry, mathematics, and pre-college science education, with the goal of submitting 1-2 articles from each project in the course of 2026
- Publish existing work on deductive use of NLP methods for qualitative data analysis, and build a collaboration with Michigan State University and Rochester Institute of Technology. Hire PhD student to extend and apply the method to other datasets and research problems

Action plan

Action	Description	i	ii	i	ii	i	ii	i	ii	i	ii
Theme 2: Education research (TOO)		2022		2023		2024		2025		2026	
A2.1	Computational literacy (Res)			M21				D21			
A2.2	Computing in math (PhD)			M22				D22			
A2.3	Computing in schools (PhD)		M23			D23					
A2.4	Computing in chemistry (PhD)			M24				D24			

M21: PER handbook entry; D21 Comp. literacy workshop in Oslo

M22: Midway eval of PhD student; D22: PhD project finished

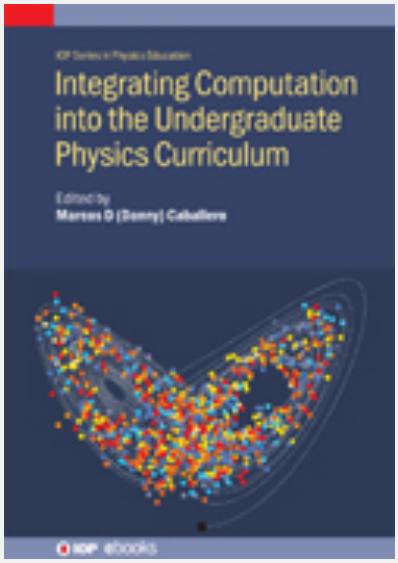
M23: Midway eval of PhD student; D23 PhD project finished

M24: Midway eval of PhD student; D24 PhD project finished

Comments

A2.1: Published high-impact book chapter on computational literacy.
A2.2: Activity started in 2023, but planned in 2022.
A2.3: Project started with new PhD student in 2021/2022.
A2.4: Project ongoing with PhD-student Andreas Haraldsrud. Finished in 2025.

Book on Integrating Computing into the Undergraduate Physics Curriculum



In 2025, Danny Caballero (who has a 20% appointment with the CCSE) published the book Integrating Computing into the Undergraduate Physics Curriculum. The book, published by IOP Physics Publishing, contains 14 chapters, of which five are authored by CCSE faculty. In his contributions to the volume, Caballero provides both an opening and a concluding chapter that frame the collection as a whole.

These chapters situate computing as a core scientific practice in physics and emphasize that, despite its centrality to physics research, its integration into undergraduate instruction remains highly uneven. Instead of advocating for a single model, language, or toolset, Caballero frames the volume as a collection of instructor narratives that foreground local goals, constraints, and institutional contexts. He highlights recurring themes across the chapters such as alignment between computational activities and disciplinary learning goals, instructor preparation, and curricular tradeoffs, and argues that meaningful integration of computing requires sustained, context-sensitive instructional design. In the concluding chapter, he synthesizes lessons from across the volume and points toward future directions, including the potential implications of generative AI for computational practice and physics instruction.

Benjamin Zwickl, who also has a 20% appointment with the CCSE, contributed two chapters co-authored with Charles Lusignan and Aaron McGowan that focus on integrating computation into upper-division physics laboratory courses. Drawing on multi-year implementations at a single institution, these chapters examine how computational work can be aligned with core laboratory learning goals such as modeling, experimental design, data analysis, and technical skill development.

The authors identify a set of instructional decisions that shape how computation functions in lab contexts, including decisions that are specific to laboratories, such as how computational work is interleaved with hands-on experimentation and how students collaborate on code while working in lab pairs. Through detailed case studies from electronics, modern physics/advanced lab, and physical optics courses, the chapters illustrate how computation can open new experimental possibilities, support richer modeling and uncertainty analysis, and enable more rapid cycles of exploration and sensemaking, while also discussing persistent challenges related to student workload and instructional support.

Associate Professor Tor Ole B. Odden contributed a chapter titled Teaching scientific writing using computational essays. In this chapter, he examines how computational essays (documents that integrate narrative text, equations, figures, and executable code, which have been heavily researched through the CCSE) can be used to create authentic opportunities for scientific writing in physics courses. The chapter introduces the core features of computational essays, surveys examples from physics instruction, and synthesizes findings from several published studies examining their use. Odden emphasizes how computational essays can be adapted to serve different instructional goals, such as conceptual explanation, model development, or scientific argumentation, while making students' reasoning visible and closely aligning writing practices with disciplinary norms.

In all, this book serves as a concise, educator-facing synthesis of current perspectives and approaches to integrating computing into undergraduate physics instruction, and provides a set of concrete, research-informed examples that align closely with CCSE's broader work on computational literacy and curriculum development.

Case: Studying the development of computational literacy among physics master students

Karl Henrik Fredly began his PhD in physics education research at the Center for Computing in Science Education (CCSE) in 2022. Having completed his Master's in computational physics at the University of Oslo (UiO), Fredly was well positioned to investigate how students transition from coding novices to professional researchers. His work focuses on the upper-level development of programming skills and, more recently, how generative AI is changing how students learn computational modeling. While computation is now an integral part of physics research, most educational research has historically focused on introductory courses. There remains a significant gap in understanding how students move beyond simple scripts to the complex, collaborative programming required in industry and academia.

In his recently published paper in *Physical Review Physics Education Research*, which was featured as an Editors' Suggestion, "Physics computational literacy: Programming, modeling, and collaboration at the journeyman level," Fredly interviewed 13 Master's students to map this development. Using the Physics Computational Literacy (PCL) framework, the study describes computational literacy at the "journeyman" level, a stage where students are no longer just following rigid rules but are beginning to develop the situational intuition and wide toolkit of an expert.
The research identified two distinct shifts in student competence. Firstly, students reported that while introductory courses provided a good foundation, the most significant development occurred in large, project-based courses like the astronomy course AST2000 or the computational physics course FYS3150. These courses forced students to write larger, more complex code, and divide coding tasks between multiple people. Together, these challenges forced students to engage with the programming in ways that made them much more adept.

"After COMP-FYS, I learned that, okay, now I have such large projects, which require so much code and so many files, that I can't have an overview in my head of what's going on here."
"It's a very good argument for group projects too, I think. Because you see how others code, and then you get a lot of inspiration"

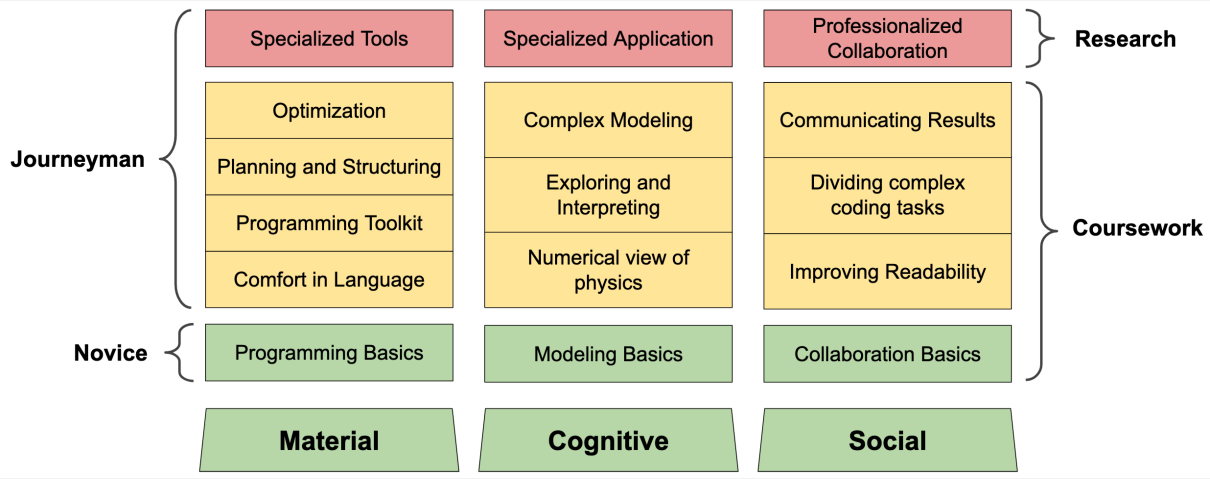
The second distinct transition occurred during the Master's thesis. Here, students developed specialized "research competence". They began to use specialized tools such as machine learning frameworks or remote clusters and learned to adapt their coding style to established research group conventions. The paper goes on to describe this journeyman-level computational literacy across three pillars.

- Material Pillar: Students move from knowing basic syntax to fluently planning, writing and optimizing code while effectively using a wide range of tools like VS Code and version control.
- Cognitive Pillar: Students develop a "numerical view of physics," where they reflexively think of how to discretize a problem or analyze complex data, as well as familiarity with a range of general modeling strategies and specialized numerical methods.
- Social Pillar: Students learn to prioritize code readability and learn the difficult task of dividing complex coding work within a team. One student described this more mindful collaboration strategy like this:

  "When I collaborate with these computational projects, I normally begin by kind of assessing what kind of role I should have. In some cases, I might be the dig deep into a problem kind of guy. So you have the other people doing the very high-level stuff. And then we see that, oh, this for loop doesn't compute the right calculations. Can you do that? And then in another case, I might see that, OK, this other guy is really good at that. So I can be the general structure guy. So I can create these big files and try and kind of piece things together"

The landscape of computational physics is currently facing a new set of challenges and opportunities with the introduction of generative AI. While the interviewed students in the current study were only

beginning to experiment with generative AI tools like ChatGPT, Fredly's current work focuses on how students now integrate these tools into the modeling process.



Theme 3: Culture for teaching and learning

Leader: Tone Skramstad

Goal (2022-2026)

Develop a culture for teaching and learning across the science departments. Hereunder, (1) organize biannual workshops for teachers and LAs; (2) organize education seminars at all involved departments; (3) facilitate teaching teams in large courses, (4) continue and extend student educational development project, (5) continue and extend the teacher training initiated by KURT including Summer Institutes for both internal and external participants.

Activities in 2024

Developing teacher culture

The development of a strong teaching and teacher culture is important to improve the quality of the education and eventually also for student learning. Together with the Center for Teaching and Learning in Science (KURT), we organize day-long seminars every semester where we focus on teaching and learning, called “Real Utdanning” (aimed mainly at faculty) and “Real undervisning” (aimed mainly at teaching assistants).

Seminars

CCSE is working systematically to build a culture for teaching and learning by establishing meeting-places to exchange experiences on teaching practice and be inspired and informed on education research. In 2025 we arranged the ODD seminars, which are regular seminars organized every odd week with invited national and international speakers that were open for all teaching faculty and students. In addition, we organized a network for introductory programming teachers to share experiences between teachers who are introducing programming to students in various education programs. We also organize a yearly Christmas seminar focusing on Computing in Science Education, which in 2025 again was organized in our own facilities.

Center for Teaching and Learning in Science (KURT)

In order to support the Faculty’s activities to promote professional development in teaching, the Faculty has established a Center for Teaching and Learning in Science (KURT). KURT includes participants from all the departments at the Faculty for mathematics and natural sciences. The center aims to be the hub for professional teacher development at the Faculty and is an integral part of the sustainability strategy for CCSE. The activities organized by KURT range from speaking at seminars on the use of student active methods to publishing hands-on tips on teaching on the web-site.

Biannual seminars

KURT organizes biannual seminars for teachers and group teachers. REAL Undervisning is one of several contributions to MN's work on teaching culture. The purpose of REAL Undervisning is to raise awareness among MN educators, including group teachers, about their role, facilitate exchange of experiences across departments and subjects, and inspire good teaching. REAL Undervisning offers an English-language version called "REAL Teaching" the following day. The English-language version has a dedicated section on learning culture at MN. In 2024, the topics have been varied, with a particular focus on the use of artificial intelligence in education and active learning. In addition, we organize REAL Prat. The goal here is to initiate exchange of experiences and reflection on current educational topics.

Plans and priorities for 2026

- Continue seminar series for teaching staff
- Collaborate with teachers that use and plan to use active learning classrooms
- Continue to provide and improve teaching workshops for learning assistants

Action plan

Action	Description	i	ii	i	ii	i	ii	i	ii	i	ii
Theme 3: Culture for teaching and learning (TS)		2022		2023		2024		2025		2026	
A3.1	Workshops and seminars	M31		M31		M31		M31		M31	
A3.2	Summer institutes		M32				M32				M32
A3.3	Student projects										
A3.4	Teacher courses				M34		M34		M34		M34

M31: Annual workshops and bi-weekly invited seminars

M32: Biennial summer institutes (bio, chem., humanities)

M34: Annual pedagogical/computing courses (phys, bio, chem, humanities)

Comments

A3.1: Workshops and seminars are listed in the tables at the end of the report.
A3.2: Summer institutes have not been prioritized in the period 2022-2026.
A3.3: Student projects are listed in the tables at the end of the report.
A3.4: Teacher courses are listed in the tables at the end of the report.

Developing a culture for teaching quantum mechanics

In June 2025, CCSE hosted a two-day visit by Corinne Manogue and Tevian Dray, emeritus faculty from Oregon State University, who were invited as a pair. Manogue (physics) and Dray (mathematics) have a long history of collaborative work on upper-division curriculum development and mathematics–physics education research, particularly through the *Paradigms in Physics* program at OSU.

The visit consisted of an ODD seminar on 2 June followed by a workshop on 3 June, and was designed as a single, integrated event. Across the two days, the focus was on how students make sense of upper-level quantum mechanics and related mathematical structures, and on instructional design choices that support conceptual understanding alongside formal and computational work.
In the ODD seminar, Manogue and Dray presented results from their education research, drawing on classroom studies and interviews to examine how students interpret quantum concepts and how mathematical formalisms are taken up (or misinterpreted) in physics contexts. The seminar emphasized the value of coordinated math–physics perspectives when designing instruction for advanced courses.

The following day's workshop built directly on this foundation, focusing on concrete classroom activities from the Paradigms curriculum. Participants examined examples of active, discussion-based tasks used in upper-level quantum mechanics, with attention to how these activities structure student reasoning, integrate computation, and connect mathematical representations to physical meaning. Discussion centered on transferability to other institutional contexts and on tradeoffs involved in redesigning established courses.
The visit aligns closely with ongoing curriculum development at UiO, particularly within the Kvanteteknologi (quantum technology) bachelor program, where quantum mechanics, mathematics, and computation are core aspects of pedagogy. The event provided concrete reference points for instructional design choices relevant to UiO's emerging quantum technology education pathways.

Marius Lysaker at USN receives the Thon Prize

Marius Lysaker is a professor in mathematics at the Department of Process, Energy, and Environmental Technology whitin the Faculty of Technology, Natural Sciences, and Maritime Sciences, University of South-Eastern Norway (USN). He teaches mathematics, algorithmic thinking, and programming in the engineering program and is based at the Porsgrunn campus. Additionally, he teaches several continuing education courses aimed at the industry. He has supervised numerous master's and PhD students at USN in the field of modeling and simulation.

Over time, Lysaker has collaborated with CCSE (Center for Computing in Science Education), a center for excellence in teaching. It is largely due to this collaboration that he was awarded the title of Distinguished Educator. He has also published the textbook "Python for Realfag" (Fagbokforlaget), which is currently used at several universities.

Theme 4: Dissemination

Leader: Knut Mørken

Goals (2022-2026)

Develop and apply a research-based approach to dissemination locally, nationally and internationally. Hereunder, we aim to reach (i) across levels from 1-13 through BSc, MSc, PhD, and post-graduate education; (ii) across contexts, from science to humanities, social sciences and beyond, (iii) across institutions nationally and internationally; and (iv) across sectors to impact education, research institutes, government, industry, business and startups.

Activities in 2025

Teacher education

In order to disseminate our practices widely, we work to disseminate practices to schools and schoolteachers. In particular, we are working to establish sustainable dissemination practices to reach the large number of teachers that need to update their computational skills and didactic competence to integrate the use of computing across school subjects. From 2024 we started to include use of generative artificial intelligence in ways that lead to better student learning. We show how we can use what we know about learning processes in order to use AI productively, in particular in combination with programming, mathematics and natural science. In addition, we have been discussing how AI can help us reach our goal of improved domain-specific understanding through programming, and what pitfalls that exist. The experience from these courses provided the basis for a new set of courses for school teachers in 2025 – ProFag:AI – Programming for domain learning with AI.

Plans and priorities for 2026

- Confirm CCSE's position as a national and international hub for the integration of computing in education through national and international partnerships
- Continue extension beyond the sciences at UiO and through Circle-U
- Contribute as partner in EU programs to disseminate practices widely across Europe
- Build European and Nordic partnerships for AI in education and education research.

Action plan

Action	Description	i	ii	i	ii	i	ii	i	ii	i	ii
Theme 4: Dissemination (KM)		2022		2023		2024		2025		2026	
A4.1	TraCS PhD training							M41			
A4.2	ProFag			M42		M42		M42		M42	
A4.3	Cross-sector programs					M43				D43	
A4.4	Non-science applications					M44				M44	

M41: First cohort finished.

M42: Reports on yearly activities in ProFag (teacher courses)

M43: Development of cross-sector program: D43: Launch of cross-sector program

M44: Semi-integration of computing in study programs (philosophy, economics)

Comments

A4.1: The first cohort of CompSci PhD-students finished their degrees in 2024

A4.2: We will continue dissemination through our professional development programs for teachers

A4.3: Cross-sector collaborations will be strengthened through entrepreneurship programs for students
A4.4: Extension to non-science subjects will be pursued partnership through summer student projects and student entrepreneurship opportunities.

Malthe-Sørenssen to lead the Malthe-Sørenssen expert committee on AI

Anders Malthe-Sørenssen was called to head the national expert committee on AI in higher education. The committee consists of nine experts and will provide an analysis of the impact of AI on higher education, including how learning outcomes must be adjusted to adapt to AI, how learning approaches will change with AI and how methods for assessment must be adapted in an age of AI. The committee has delivered a preliminary report with recommendations in December 2025. The recommendations include clear advice on the need for controlled exams to supplement home exams, a recommendation to start exploring the use of AI in grading and a recommendation to test and evaluate the use of AI systems to produce explanations for grading decisions. The committee visited 5 institutions nationally in 2025 to gather input for the report and conducted a trip to OECD to ensure the committee is updated on similar international efforts. The committee will deliver its final report in November 2026.


Foreløpige vurderinger

Notat fra utvalget om kunstig intelligens i høyere utdanning, med anbefalinger om eksamen, sensur og karakterbegrunnelse

Oversendt Kunnskapsdepartementet 16. desember, 2025, og publisert åpent på malthesorenssenutvalget.no

Report from the CSE activity at USN

Marius Lysaker and Jarle Tommy Bjerkholt, USN

TNM is a faculty consisting of six institutes localized at Campus Porsgrunn, Camus Kongsberg and Campus Bakkenteigen. In total, TNM offers six bachelor engineering program: building engineering, machine engineering, computer engineering, electronics engineering and chemistry engineering. All the engineering programs have a common course platform in the sciences that includes: Programming for computing (5 ECTS), Mathematics 1 (10 ECTS); Physics (10 ECTS); Mathematics 2 (10 ECTS); and Statistics (5 ECTS).

Python is the preferred tool in the sciences at USN/TNM. In the first semester, students get a general introduction to programming through the subject "Programming for computing". In the second semester they follow Mathematics 1 and Physics, where Python now forms an integral part of the subjects. This is followed by Mathematics 2 in the third semester and statistics in the fourth semester.

During 2024 we introduced activities to focus on programming for first year students. The weekend 16th to 17th of November, over 140 engineering students participated in a coding workshop at USN. The workshop lasted from 10 to 18 both days and was organized in parallel at three campuses at Bakkenteigen, Porsgrunn and Kongsberg. The workshop varied between lectures and group sessions, in combination with social activities and quizzes.

Here is an overview of various activities carried out at USN:

- EVU-course PY1010 *Python-programming for the sciences* started in September 2025 and lasted until April 2026. The course is workshop based and taught over zoom. In total 150 participants are attending the course, which is taught by Finn Haugen and Marius Lysaker with student assistants.

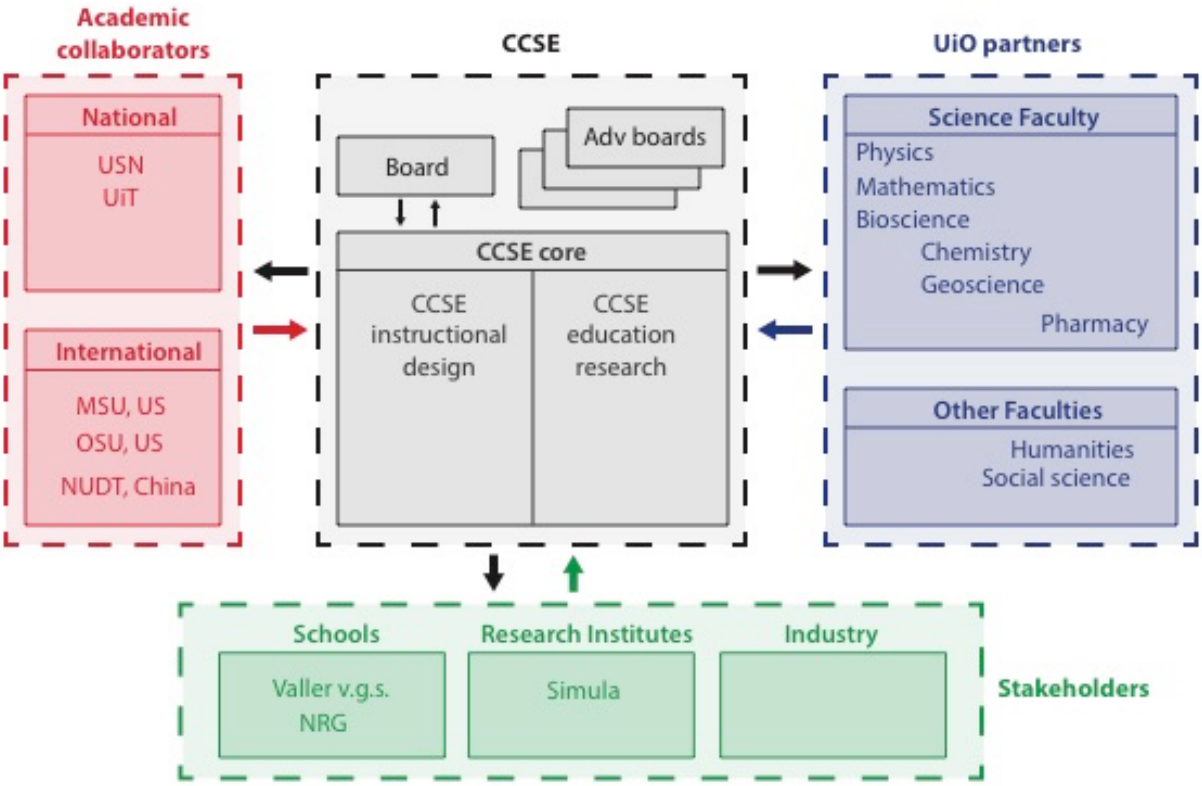
- Finn Haugen and Marius Lysaker have published a new textbook «Helt Python». Helt python av Finn Aakre Haugen, Marius Lysaker (Pocket) - Norli Bokhandel. The book provides an introduction to Python programming with focus on computing.

- The engineering days were organized September 18, 2025 with visting from middle and high schools in the region. About 300 students and teachers participated. Marius Lysaker gave a workshop on coding and AI.

- In 2025 Marius Lysaker was awarded the Olav Thon Prize for excellent education. The nomination was based on his work on algorithmic thinking and computational programming at USN. The collaboration with CCSE is thoroughly documented in the nomination and has been a central part of the work to integrate computational programming at USN.

Organization and management

CCSE is directed by Professor Anders Malthe-Sørenssen and supported by an administrative leader, Tone Skramstad. The director is supported by a working group, with an advisory and coordinating function, consisting of the five work-package leaders, the administrative head, director of studies at the Faculty, and a student representative.
The center has a board with representatives from the four main departments, Departments of Physics, Mathematics, Computer Science and Bioscience, a student representative, and two external representatives. The board will have two meetings a year.
The various departments provide contributions to the center in the form of in-kind contributions. For example, the Department of Physics provides a 20% in-kind resource for each of the teachers in the six main courses in physics. This in-kind contribution represents the time teachers use for educational development.
The center has an education research group directed by associate professor Tor Ole Odden and associate professor Marcos D. Caballero. The group has regular group meetings, and organize invited seminars and researcher visits to CCSE.
Additional advisory boards will be established to support the education research activity, evaluation, and input from stakeholders and students.



Personnel

Leadership group



Tone Skramstad ***(administrative head)***.
Tone comes from a position as manager for the Observatory and has extensive experience from administrative positions at the University of Oslo. She is also an author of a book about the history of the Observatory. In CCSE she is in charge of outreach and communications as well as being the head administrative officer.



Morten Hjorth-Jensen ***(professor of physics, WP1 leader, 20%)***
Morten is a computational physicist focusing on applied quantum mechanics, quantum computing, and machine learning. He has developed the computational science master program. He is a Fellow of the American Physical Society, Member of the Norwegian Academy of Science, winner of the Thon award, winner of UiO's education award 3 times, and a Distinguished Educator and was elected a Fellow (honorary member) of the AAAS in 2025.



Anders Malthe-Sørenssen ***(professor of physics, director CCSE, 35%)***
Anders has extensive cross-disciplinary research, educational and innovation leadership experience. He has developed two master programs, UiO's honours program, courses and textbooks in mechanics, thermal physics, percolation theory, and electromagnetism. He is the vice-president of the Norwegian Academy of Science, winner of the Thon award, winner of UiOs education award 2 times, and a Distinguished Educator.



Knut Mørken ***(professor of mathematics, WP5 leader, 20%)***
Knut is a founder of CSE and developed and wrote a textbook for the course in numerical calculus (MAT-INF1100). He is the leader of the InterAct project to reform the study programs at the Faculty using a backward-design approach, and the leader of the bachelor program in mathematics. He is the dean of education (2018-2020), winner of the Thon Award, and winner of NOKUT's honorary award.



Hanne Sølna ***(leader of the study section, MN Faculty, 20%)***
Hanne is the leader of the study section at the Faculty and have been a key driver for the CSE project since 2003. She has broad experience from organizing and developing education transformations and strategy processes. She is also a key driver for the InterAct reform.



Geir Kjetil Sandve ***(professor of informatics, 20%)***
Geir Kjetil has a background in statistics and leads a bioinformatics group at the Department of Informatics. He has for several years been responsible for the introductory course in programming for computer science students, IN1000. He introduced Python programming in this course and developed methods to use assessments to systematically improve teaching.



Lex Nederbragt ***(docent in bioscience, 20%)***
Lex is a Dosent at the Department of Biosciences. He leads the implementation of CSE in the bachelor degree at the Department of Biosciences and is responsible for BIOS1100, the introductory course in programming for biology students. He has extensive experience as a Software Carpentry instructor. He is a Distinguished Educator.

Education research



Danny Caballero ***(adjunct professor of physics education research, 20%)***
Danny is the Lappan-Phillips Professor of Physics Education, Michigan State University, Leadership Faculty, CREATE for STEM Institute, Michigan State University, and Adjunct Professor at CCSE. He is PI of several large NSF-funded projects on the integration of computing into high-school and university educations. He is *the* leading international researcher on the effects of computational modeling on physics education outcomes.



Tor Ole Odden ***(associate professor in physics education research)***
Tor Ole finished his PhD in Science Education Research at the University of Wisconsin – Madison. The topic of his PhD-research was on sensemaking. He is heading the Learning Assistant project at CCSE, studies computational literacy and the effects of computational essays, and develops a data-driven study of the historical development of education research. He is a Distinguished Educator.



Ben Zwickl (adjunct professor of physics education research, 20%)
Ben is an associate professor, School of Physics and Astronomy, Rochester Institute of Technology, and the Co-Director for the Center for Advancing Scholarship to Transform Learning. His research has focused on many aspects of physics, such as preparing students for the quantum workforce, communication skills in STEM and learning in complex environments such as lab courses.



Elise Lockwood ***(adjunct professor of math education research, 20%)***
Elise is a professor of mathematics education research at Oregon State University. She has received an NSF Career grant focusing on how computations affect student understanding of combinatorics and is a 2025 Presidential Early Career Award for Scientists and Engineers (PECASE) honoree.



Helene Lane ***(PhD-student)***
Helene is a PhD student from 2024, addressing the use of large language models as a research tool in physics education research and the impact of large language models on physics learning.



Karl Henrik Fredly ***(PhD-student)***
Karl Henrik is a PhD-student from 2022, addressing computational literacy. He has a master's degree in Computational Science focusing on education research and computational literacy.



Henning Myhrehagen ***(PhD-student)***
Henning is a PhD-student from 2022, addressing the impact of computational methods and programming on school teacher education programs.



Jan-Fredrik Olsen ***(PhD-student)***
Jan-Fredrik Olsen is a senior lecturer at Lund University and have been a visiting CCSE on a sabbatical leave from 2023 to 2024. He has long experience with teaching mathematics at Lund, and is now pursuing a PhD project on the impact of computing on students understanding of mathematical concepts.



Ane Kristine Espeseth ***(PhD-student)***
Ane is a PhD student from 2025, addressing how the internal dynamics of large language models impact their use of physics concepts, when solving standard physics education problems.

Other scientific staff



Andreas Haraldsrud ***(associate professor)***
Andreas is an Associate Professor of Chemistry, with a particular interest in teaching and research in biochemistry and physical chemistry. With a PhD in chemistry education, he focuses particularly on how computational simulations, artificial intelligence and models can support students' conceptual understanding in chemistry. He also teaches scientific programming and artificial intelligence to teachers and students, develops learning resources for both secondary and higher education. He is a Distinguished Educator.



Henrik A. Sveinsson ***(tenure-track post-doc, 20%)***
Henrik has a background in computational physics. He is the project leader for UiO's new honours-program, for which he is also developing and teaching courses in programming for humanists (HON2110) and data-science projects for honours-students (HON2200). He has developed computational content and taught oscillations and waves (FYS2130) and electromagnetism (FYS1120). He has co-authored a textbook in programming for schoolteachers.

Personnel

Name	Function	Position	Unit
Center personnel			
Anders Malthe-Sørenssen	Center leader	Professor	Physics, UiO
Tone Skramstad	Head of administration	Office manager	CCSE
Knut Mørken	WP leader, 20%	Professor	Math, UiO
Morten Hjorth-Jensen	Course development, 20%	Professor	Physics, UiO
Lex Nederbragt	WP leader, 20%	Dosent	Biosciences, UiO
Geir Kjetil Sandve	Course development	Professor	Informatics, UiO
Hanne Sølna	Administrative mentor	Director of studies	Faculty Adm, UiO
Education research group			
Danny Caballero	Education research (20%)	Adjunct Professor	MSU/CCSE
Elise Lockwood	Education research (20%)	Adjunct Professor	OSU/CCSE
Ben Zwickl	Education research (20%)	Adjunct Professor	RIT/CCSE
Tor Ole Odden	Education research	Associate Professor	CCSE
Karl Henrik Fredly	PhD-student	PhD	CCSE
Helene Lane	PhD-student	PhD	CCSE
Henning V. Myhrehagen	PhD-student	PhD	KURT, CCSE
Ane Kristine Espeseth	PhD-student	PhD	CCSE
Andreas D. Haraldsrud	School development & ed research (25%)	Associate Professor	KURT, CCSE
Jan-Fredrik Olsen	PhD-student	Senior lecturer	Lund University
Instructional development			
Øyvind Ryan	Course development, 20%	Associate Prof.	Math, UiO
Dag Kristian Dysthe	Course development, 20%	Professor	Physics, UiO
Henrik Sveinsson	Course development, 10%	PhD-student	Physics, UiO
Mikkel Lepperød	Couse development, 10%	Researcher	Physics / Simula
Anders Kvellestad	Course development, 25%	Researcher	Physics, UiO
Anders Hafreager	Couse development, 20%	Associate Prof.	CCSE, UiO
Student representatives			
Juval Somer	Student representative (from Aug 2024 to present)		UiO
Frida Lien	Student representative (from Oct 2024 to June 2025)		UiO
Simona Gruodyte	Student representative (from Aug 2025)		UiO
Maximillian Andre Engenes	Student representative, CCSE board		UiO
Kristoffer Alvarez Sandaune	Substitute student representative, CCSE board		UiO

External projects

Granting body	Project title	Project period	Funding	PI/partners
EU DIGITAL 2022 SKILLS 03	DIGIWIND	2024-2027	9.662 MEUR	DTU and 9 other partners including CCSE
IKTpluss/NRC	Maxsense	2022-2027	3300 kkr	PI: Anders Malthe-Sørenssen
Intpart/NRC	Bio-inspired Neural Networks for Artificial Intelligence systems: A US-Norway collaboration converging Neuroscience and AI	2020-2025	5709 kkr	PI: Anders Malthe-Sørenssen
CTM/Erasmus+	Computational thinking makes sense of mathematics	2024-2026	463 kkr	PI: Jan-Fredrik Olsen

Accounting 2025

Budget and Expenditures 2025

NOK - Norwegian kroner	Budget 2025 HK-dir	Actual 2025 – HK-dir	Actual 2025 – UiO	Total
Personnel and indirect costs	4 212 737	3 560 017	4 828 245	8 388 392
Purchase of services				
Equipment	200 000	200 000		200 000
Other operating expenses	400 000	450 858	124 453	575 311
Student projects			1 183 401	1 183 401
SUM	**4 812 737**	**4 211 005**	**6 136 099**	**10 347 104**

List of products

Awards

Prize	Who	When
Member of the AAAS Honorary Fellows, American Association for the Advancement of Science	Morten Hjorth-Jensen	2025
Honored with the Presidential Early Career Award for Scientists and Engineers (PECASE), the highest award given by the U.S. government to outstanding early-career scientists and engineers	Elise Lockwood	2025
Distinguished Educator and member of the pedagogical academy at UiO	Tor Ole Odden	2025

Visitors to CCSE

Who	**Postition/From Where**	**When**
Lauren Barth-Cohen	Associate Professor (University of Utah, USA)	25.-27.02.2025
Jan-Fredrik Olsen	Senior Lecturer (Lund University, Sweden)	12.-14.03.2025
Tevian Dray	Professor Emeritus (Oregaon State University, USA)	02.-06.06.2025
Corinne Manogue	Professor Emerita (Oregaon State University, USA)	02.-06.06.2025
Jan-Fredrik Olsen	Senior Lecturer (Lund University, Sweden)	16.-17.06.2025
Tim Atherton	Professor (Tufts university, Massachusetts, USA)	15.-17.09.2025
Juan Manuel Scarpetta Ramirez	Master's student (Universidad del Valle, Colombia)	15.09-31.12.2025
John Henry Reina	Associate Professor (Universidad del Valle, Colombia)	01.10-31.12.2025
Jan-Fredrik Olsen	Senior Lecturer (Lund University, Sweden)	07.-10.10.2025
Jan-Fredrik Olsen	Senior Lecturer (Lund University, Sweden)	10.-13.11.2025
Jan-Fredrik Olsen	Senior Lecturer (Lund University, Sweden)	09.-12.12.2025
David Weintrop	Associate Professor (University of Maryland, USA)	09.-12.12.2025

Dissemination – external events

The role of CCSE

Topic	where, for whom	who	when
Quality in higher education	Ministry of Education	Malthe-Sørenssen	11.06.2024
Gjør KI deg dummere	Arendalsuka, DN teltet	Malthe-Sørenssen	15.08.2024
Experiences from interdisciplinary education and research	UiO Leadership Meeting	Malthe-Sørenssen	12.09.2024
Experience from the CompSci cofund project	NMBU	Malthe-Sørenssen	17.10.2024
Gjør KI oss dummere	Hovedbibliotektet, Bergen	Malthe-Sørenssen	12.11.2024
Gjør KI oss dummere	Forskningsparken, Kongsvinger	Malthe-Sørenssen	13.11.2024
Gjør KI oss dummere	IT-avdelingens juleseminar, UiO	Malthe-Sørenssen	29.11.2024

Contributions to seminars, workshops and conferences

Topic	Where, for whom	Who	When
Examining Nuances of Subtraction and Division in Counting Problems	Annual Joint Mathematics Meetings. Seattle, WA	Lockwood, Caughman, Reed	January 2025
Integrating Computing into Mathematics Education: A Case of Python Programming in Combinatorics	University of Milan, Mathematics Department Colloquium	Lockwood	February 2025.
Developing computational tools to support students' mathematical thinking	Lund University, Mathematics Department Seminar	Lockwood	March 2025
The NSF CAREER Award, Review Criteria, and the Importance of "Grantsmanship	Oregon State University, College of Science Workshop	Lockwood	March 2025
A review of 1250 articles from Physical Review Physics Education Research using Natural Language Processing	American Physical Society Global Physics Summit, Anaheim, CA	Odden, Lane, Skogvoll, Tyseng, Mjaaland, Kreutzer, Malthe-Sørenssen	March 2025
My Favorite Research: Investigating Subtleties of the Multiplication Principle	Oregon State University. Math Education Seminar.	Lockwood	April 2025
"Influential Research in Undergraduate Mathematics Education: The International Journal of Research in Undergraduate Mathematics Education." Workshop on Building Capacity in the Scholarship of Mathematics Education: Supporting the Next Generation of Researchers	Fields Institute. Toronto, Canada	Lockwood	April 2025
Workshop: Lære med kunstig intelligens	MNT-Konferansen, Trondheim, Norway	Skogvoll, Odden	May 2025
A review of 1250 articles from Physical Review Physics Education Research using Natural Language Processing	SIG KINA, Digital	Odden, Lane	May 2025
ChatGPT as improv artist, blurry JPEG, or conceptual blender: Models for LLM "cognition"	Lund University Mathematics Education Seminar, Lund, Sweden	Odden	May 2025

A review of 1250 articles from Physical Review Physics Education Research using Natural Language Processing	UiO Center for Interdisciplinary Education (INTED) Internal Seminar, Oslo, Norway	Odden, Lane	May 2025
Assessment in Physics with Computational Essays	HK-DIR: Vurdering for fremtiden (Norwegian Department of Higher Education: Assessment for the Future), Digital	Odden	May 2025
How has physics education research developed over the last 20 years?	Invited talk for seminar at UiTromsø and the research group «Science education in higher education»	Lane	June 2025
Building a Learning Assistant Network at the University of Oslo	Seminar on Physics Teaching and Learning Assistant Training in Finland, Tampere, Finland; Digital	Odden	August 2025
Comparing LDA and Embeddings for Automated Reviews of Physics Education Research Literature	2025 European Science Education Research Association (ESERA) Conference, Copenhagen, Denmark	Odden	August 2025
Integrating Computing into Mathematics Education: A Case of Python Programming in Combinatorial Contexts	Invited Talk. Annual Meeting of the Irish Mathematical Society	Lockwood	August 2025
Exploring Connections between School and University Mathematics in Ireland: Conversations about Facilitating and Assessing Problem Solving." Two-day professional development workshop for the Fulbright Specialist Program	Maynooth University, Kildare Ireland	Lockwood	August 2025
Generative AI and Conceptual Blending	UiO Honors Program Lecture, Oslo, N0orway	Odden	September 2025
KI i fysikk: Mellom snarvei og selvstendig læring	SFU Nettverkssamling, Bergen, Norway	Odden	September 2025
Task Design to Foster Rich Student Engagement in Mathematics Courses." Two-day professional development workshop for the Fulbright Specialist Program	Two-day professional development workshop for the Fulbright Specialist Program. Maynooth University, Kildare Ireland	Lockwood	September 2025
Counting is Hard' but It's Rewarding and Fun: Insights from a Research Program in Combinatorics Education	University of Galway, Mathematics Department Colloquium	Lockwood	September 2025
How Do We Account for Equivalent Outcomes? Insights into Subtraction and Division in Combinatorics?	Texas State University, Mathematics Education Seminar	Lockwood	October 2025
'Hva betyr det å lære fysikk i ei tid med kunstig intelligens?	Norwegian National Conference for Digitalization in Higher Education (UHDIG25), Bergen, Norway	Odden	October 2025
We Are All Cyborgs Now: Teaching Physics with AI	EXCITED (Norwegian Center of Excellent IT Education) Open Webinar, Digital	Odden	October 2025

The LA-seminar	Lund University, Sweden	Skogvoll	October 2025
GPT UiO as a learning assistant in BIOS1101	Utdanningskonferansen 2025, UiO	Nederbragt	November 2025

Workshops and conferences organized by CCSE personell

Topic	Where, for whom	Who	when
ProFag vgs 2	Course for upper secondary school teachers	Haraldsrud, Myhrehagen	V25
ProFag KI	Course for upper secondary school teachers	Haraldsrud, Myrehagen, Skolglund	V25, H25
NAT3000	Course for upper secondary school teachers	Haraldsrud, Myrehagen	V25, H25

Dissemination – internal events

CCSE seminar series

Title	Who	When
Workshop: Re-envisioning Upper-Level Quantum Mechanics	Corinne Manogue, Professor Emerita, Oregon State University	03.06.2025
How to move from ideas to research results to commercialization	Elin Melby and Ellen Kleveland from Veksthuset and Inven2	03.06.2025
Quantum seminar	For invited participants	24.11.2025
Situating High School Data Science in the Lives of Students: The API Can Code Project	David Weintrop, Associate Professor, University of Maryland	10.12.2025
Computer Programs as Semiotic Resources: An Example from Combinatorics	Elise Lockwood, Professor in Department of Mathematics, Oregon State University and adjunct professor of math education research, 20%, at CCSE	10.12.2025
How Physics Professors Use and Frame Generative AI Tools	Vidar Skogvoll, Senior Lecturer, KURT/UiO	10.12.2025
How students use AI for computational modeling in physics	Karl Henrik Fredly, Doctoral Research Fellow, CCSE/UiO	10.12.2025

The bi-weekly ODD seminar series at CCSE

We have in 2025 continued the Open Discussions on Didactics (ODD) seminar series that were established in 2020. The seminars are on Mondays every other week (odd week numbers). It is an informal arena to present and discuss learning theory, educational research and teaching experiences within computational science. To cater to the highly heterogeneous backgrounds and interests of students, teachers and researchers connected to the CCSE environment, we have aimed for highly varied seminars within a broad spectrum of aspects, in a form that invites reflection and discussion.

The series has been well attended, with typically 10-30 attendants per meeting and a good variation in who has attended the different meetings. Seminars have been given both by local researchers in the CCSE environment and external speakers. On demand we offer the possibility to participate via Zoom.

Title	Who	When
Student's Sensemaking about Conceptual and Procedural Inconsistencies in an Introductory Physics Lab	Lauren Barth-Cohen, Associate Professor in the Department of Educational Psychology at the University of Utah	26.02.2025

The role of the computer in balancing processes-based and numerical-based conjecturing and generalizing activity in mathematics	Elise Lockwood, Professor in Department of Mathematics, Oregon State University and adjunct professor of math education research, 20%, at CCSE	13.03.2025
Integration of programming in science and physics: What does it look like?	Henning Vinjusveen Myhrehagen, Doctoral Research Fellow, CCSE/KURT	19.05.2025
Integrals in mathematics and physics	Tevian Dray, Professor Emeritus of Mathematics, Oregon State University	02.06.2025
Becoming a teacher: research into science teacher professional identity and the gender perspective in STEM education	Cristina García Ruiz, Postdoctoral Research Fellow, University of Málaga	11.08.2025
Teaching quantum science and technology to bachelor students: New study direction and course development	Marianne Etzelmüller Bathen, Associate Professor, UiO	09.09.2025
Agency and making for computational learning	Tim Atherton, Professor in Physics & Astronomy at Tufts university, Massachusetts	15.09.2025
To use, or not to use, thematic analysis – that is the question	Ellen Karoline Henriksen, Professor, UiO	06.10.2025
We Are All Cyborgs Now: Teaching Physics with AI	Tor Ole Odden, Associate Professor, CCSE (UiO)	20.10.2025
Unveiling Trends: A Novel Approach for Systematic Content Analysis	Amanda Jean Bowerman, Doctoral Research Fellow, INTED (UiO)	03.11.2025
Book project: Learning with AI	Vidar Skogvoll, Senior Lecturer, KURT, UiO	17.11.2025
Beyond GPT-UiO: Which AI tools should we use in our teaching?	Karl Henrik Fredly, Doctoral Research Fellow, CCSE (UiO)	01.12.2025

CCSE educational development activities (policy and teaching)

Topic	Where, for whom	Who	When
REAL education, seminar (Norwegian)	Teachers at Faculty of Mathematics and Natural Sciences, UiO	Haraldsrud, Mørken, Gregers, Skogvoll	16.01.2025
REAL education, seminar (Norwegian)	Teachers at Faculty of Mathematics and Natural Sciences, UiO	Gregers, Haraldsrud, Skogvoll	14.08.2025
Learning Assistant Pedagogical Training	Learning Assistants at Faculty of Mathematics and Natural Sciences, UiO	Skogvoll	Spring and Fall 2025

Workshops and conferences at CCSE

Topic	Where	Attendance	When
Workshop: Re-envisioning Upper-Level Quantum Mechanics	CCSE, UiO	15	03.06.2025
Quantum seminar	CCSE, UiO	20	24.11.2025
Computing in Science Education Annual Christmas Seminar	CCSE, UIO	55	10.12.2025

Workshops about AI by Vidar Skogvoll, Senior Lecturer at KURT, UiO

Topic	Where	When
AI workshop for master's students	Physics Department, UiO	16.01.2025

Talk on AI and learning	FagFokus	07.04.2025
Talk on AI in research	IIF Rikshospitalet	25.04.2025
Workshop on productivity with AI	UiO's communication breakfast	27.05.2025
Workshop on productivity with AI	The administrative group at IFI (Department of Informatics)	04.06.2025
Talk on AI and learning	VID Specialized University	18.06.2025
Workshop on productivity with AI	The faculty administration at the Faculty of Law	19.06.2025
AI workshop for master's students	The Department of Pharmacy	20.08.2025
Presentations on AI	For first-year students at the programme seminar	01.09.2025
Workshop on productivity with AI	AI for communication staff at the Faculty of Educational Sciences	30.09.2025
Two workshops on AI and learning	SEED (NTNU)	02.10.2025
Talk on AI	For a unit at the Faculty of Medicine	15.10.2025
Talk about AI and learning	Lund University	23.10.2025
Workshop on AI and learning	The "Naturfagets helter" conference	26.10.2025
Workshop on AI and learning	For science teachers in Sør-Trøndelag	29.10.2025
Talk on AI and productivity	IIF Rikshospitalet	06.11.2025
Talk on AI and learning	For science teachers in Buskerud	12.11.2025
Talk on AI and learning	For programme leaders for the bachelor's and master's programmes at MED (Faculty of Medicine)	17.11.2025
ODD seminar about book project	ODD seminar at CCSE	17.11.2025
Talk on AI	Oslo University Hospital	18.11.2025
Recording of a film on AI and learning	The Oslo School System	19.11.2025
Talk on AI and research for ITS	Department of Teacher Education and School Research	24.11.2025

Seminars series on Quantum Technologies, many-body physics, machine learning and quantum machine learning (or just qGAP)

Topic	Who	Date
Quantum Computers on Liquid Helium	Jonas Boym Flaten and Oskar Mathias Leinonen, Doctoral Research Fellows, UiO	31.01.2025
Journal club about the paper: Free-Fermionic Topological Quantum Sensors	Gunnar Felix Lange	07.02.2025
Journal club on the paper: Multiparameter Estimation Perspective on Non-Hermitian Singularity-Enhanced Sensing	Kishore Thapliyal, Postdoctoral Fellow, UiO	14.02.2025
Introduction to Tensor Networks	Viktor Svensson, Postdoctoral Fellow, UiO	21.02.2025
Book: A Computational Introduction to Quantum Physics	Sølve Selstø, Professor, OsloMet	28.02.2025
Making sense of sensing?	Morten Hjorth-Jensen, Professor, UiO	07.03.2025
Experimental critical quantum metrology with the Heisenberg scaling	Morten Hjorth-Jensen and Gunnar Felix Lange, Professor, UiO	14.03.2025
Efficient Realizations of Certain Sparse Unitaries	Franz Georg Fuchs, Senior Research Scientist at Sintef and leader of the Gemini Center on Quantum Technology	28.03.2025
The mathematics of useless quantum channels	Alexander Müller-Hermes, Associate Professor, UiO	04.02.2025
How Close Are We to Real Applications of Quantum Extreme Learning Machines?	Shaukat Ali, Chief Research Scientist, Simula	11.04.2025
Experimental Dissipative Quantum Chaos	Kristian Wold, Doctoral Research Fellow, OsloMet	25.04.2025

Quantum Tech and Finance	Maxim Kartamyshev, Norges Bank Investment Management ("Oljefondet")	16.05.2025
Quadratic Coupling for Non-Classical States: Protocols and Error Correction with Superconducting Circuits	Francesco Pietro Massel, Professor, USN	23.05.2025
How can topology and geometry of electrons alter optical properties of quantum matter?	Wojciech Jankowski, Doctoral Research Fellow, University of Cambridge	28.05.2025
Altermagnets and Odd-parity-wave magnets	Anna Birk Hellens, Postdoctoral Fellow, Johannes Gutenberg Universität Mainz	05.06.2025
Near-Term Classical Communication over Quantum Channels and Quantum Error Correction	Tamás Havas and Olai Mostad, Doctoral Research Fellows, Simula UiB	06.06.2025
Detecting quantum phase transitions through semidefinite-programming relaxation	David Jansen, Postdoctoral Research Fellow, ICFO	02.09.2025
Entanglement and thermodynamic analysis of a noisy N-qubit cavity-driven quantum battery	Juan David Alvarez Cuartas, visiting master's student, Universidad del Valle, Colombia	16.09.2025
Physics-inspired algorithms for quantum computing, part 1	Morten Hiorth-Jensen, Professor, CCSE/UiO	30.09.2025
Physics-inspired algorithms for quantum computing, part 2	Morten Hiorth-Jensen, Professor, CCSE/UiO	07.10.2025
Doping-induced RVB spin liquids in frustrated Mott insulators	Cecilie Glittum, Postdocotral Research Fellow, UiO	21.10.2025
Theoretical modelling of optical lineshapes in the dilute limit for point defects in semiconductors	Vytautas Zalandauskas, Postdoctoral Reaserach Fellow, UiO	28.10.2025
Recognize the lion by its claw	Zhao Zhang, Postdoctoral Fellow, UiO	04.11.2025
How spatially separated Majoranas protect quantum information	Viktor Svensson, Postdoctoral Fellow, UiO	11.11.2025
Quantum synchronization with quantum trajectories	Joakim Bergli, Professor, UiO	17.11.2025

Student activities

Course and topic	Student	Teacher	When
Develop computational exercises and tutorials for the physics course FYS2140 - Quantum Physics	Carl Fredrik Nordbø Knutsen	Vidar Skogvoll	22.08.2024-31.08.2025
Machine learning models for numerical weather prediction	Alessio Maurizio Canclini	Andreas Haraldsrud	01.05-31.12.2025
Project: Integration of Object-Oriented Programming in BIOS1100	Astrid Helene Solveig Moberg	Lex Nederbragt, Per Eugen Krisitiansen	01.04-30.11.2025
Project: Integration of Object-Oriented Programming in BIOS1100	Bror Johannes Tidemand Ruud	Lex Nederbragt, Per Eugen Krisitiansen	01.04-30.11.2025
Project: Integration of Object-Oriented Programming in BIOS1100	Ellen Beate Tysvær	Lex Nederbragt, Per Eugen Krisitiansen	01.04-30.11.2025
Development of the study option "Bioinformatics and Computational Biology"	Elisabeth Vesterheim Knutsen	Jonas Paulsen, Lex Nederbragt	01.05.2025-28.02.2026
Development of the study option "Bioinformatics and Computational Biology"	Karla Mercedes Marimon Gonzalez	Jonas Paulsen, Lex Nederbragt	01.05-31.12.2025
Development of the study option "Bioinformatics and Computational Biology"	Sarah Fullmer	Jonas Paulsen, Lex Nederbragt	01.05-31.12.2025
Development of the study option "Bioinformatics and Computational Biology"	Thora Mathilde Lillehaug	Jonas Paulsen, Lex Nederbragt	01.05-28.02.2026
Cosmology with interactive Python programs	Eric Ludvigsen	David Fonseca Mota	21.07-24.08.2025

Cosmology with interactive Python programs	Håvard Skåli	David Fonseca Mota	12.06-10.08.2025
Develop teaching material for FYS5429	Fredrik Nyseter Kortgaard	Morten Hjorth-Jensen	14.07-14.08.2025
Analysis of survey data	Halvor Tyseng	Jan-Fredrik Olsen	01.01-31.03.2025
Analysis of survey data	Jonas Mjaaland	Jan-Fredrik Olsen	01.01-31.03.2025
Analysis of survey data	Markus Fleten Kreutzer	Jan-Fredrik Olsen	01.01-31.03.2025
Buiding an exercise set for a PID controller	Hishem Olav Kløvnes	Tor Ole Odden	23.06-08.08.2025
Develop teaching material on the Bayesian brain hypothesis for the project "Predictive Coding in NeuroAI."	Håkon Kjelland-Mørdre	Mikkel Lepperød	16.09.2024-15.06.2025
Develop a manual for gromacs simulation of synthetic proteins	Jonas Båtnes	Anders Malthe-Sørenssen	16.06-10.08.2025
Transforming Images into 3D Avatars: A MAXSENSE Approach	Jonatan Kjekshus Winsvold	Anders Malthe-Sørenssen	16.06-17.08.2025
Project "Build a database and platform to help students improve skills in mathematics and logic courses using AI"	Lars Aadnesen	Trung Tuyen Truong	28.04-31.10.2025
Project "Build a database and platform to help students improve skills in mathematics and logic courses using AI"	Thuan Quang Tran	Trung Tuyen Truong	28.04-31.10.2025
Development of a wiki page: by the students, for the students	Majd Ahmad Suud Awad	Osman Gani	11.03-30.09.2025
Develop teaching material on transformer models for FYS5429	Oda Solesvik Oppedal	Morten Hjorth-Jensen	01.07.2025-31.01.2026

Publications

Scientific publications

Caramaschi, M., & Odden, T. O. B. (2025). Analyzing the history of physics education in the USA and Europe through natural language processing. Physical Review Physics Education Research, 21(2), 020153. https://doi.org/10.1103/wfvw-hkyy

Haraldsrud, A., & Odden, T. O. B. (2025). Bridging Artificial Intelligence and Real Intelligence: Self-Scaffolding Computational Modeling with Generative AI in Chemistry. Journal of Chemical Education. https://doi.org/10.1021/acs.jchemed.5c00657

Mingyar, M., Odden, T. O. B., & Willoughby, S. D. (2025). Exploring Query-Driven Centroiding and Embedding Strategies for Automated Thematic Analysis in Physics Education. 282–287. https://www.per-central.org/items/detail.cfm?ID=17154

Odden, T. O. B. (2025). Teaching scientific writing using computational essays. In M. D. (Danny) Caballero (Ed.), Integrating Computing into the Undergraduate Physics Curriculum. IOP Publishing. https://doi.org/10.1088/978-0-7503-5372-4

Odden, T. O. B., & and Zwickl, B. (2025). How physics students build computational literacy by creating computational literature. Journal of the Learning Sciences, 34(5), 700–742. https://doi.org/10.1080/10508406.2025.2494791

Odden, T. O. B., & Hansen, A. S. (2025). Physics Intuition About Vectors Can Help Us Understand Generative Artificial Intelligence. The Physics Teacher, 63(3), 173–176. https://doi.org/10.1119/5.0149555

Tyseng, H., Timmann Mjaaland, J., Kreutzer, M. F., & Odden, T. O. B. (2025). DANTE: Deductive Content Analysis Using Text Embeddings. In ECAI 2025 (pp. 5155–5158). IOS Press. https://doi.org/10.3233/FAIA251443

Cook, J. P., Richardson, A., Payne, H., Wilson, C., Reed, Z., & **Lockwood, E.** (2025). Analyzing students' productive use of equivalence transformations. *Journal of Mathematical Behavior, 81.* https://doi.org/10.1016/j.jmathb.2025.101285

Lockwood, E. & Caughman, J. (2025). New Directions for Research on Domain-Specific Aspects of Proof: The Case of Combinatorics and Graph Theory. In M. Savic & K. Weber (Eds.) *New directions in proving: Honoring the legacy of John and Annie Selden*. Springer.

Olsen, J. F., **Lockwood, E.**, & Odden, T. O. B. (In press). Between the trivial and the impossible: CHAT as an analytic lens to study the role of programming in mathematical research. To appear in the proceedings of the 14th Congress of the European Society of Research in Mathematics Education. Bolzano, Italy, February 2025.

Lockwood, E. & Reed, Z. (In press). Generalizing in combinatorial problem solving: Process-based or numerical-based approaches. To appear in the proceedings of the 14th Congress of the European Society of Research in Mathematics Education. Bolzano, Italy, February 2025.

Lockwood, E., Reed, Z. K., Caughman, J., & Cook, J. P. (In press). Examining ways in which students engage with sets of outcomes in combinatorics. To appear in the proceedings of the 31st Annual Conference on Research in Undergraduate Mathematics Education. Alexandria, VA, February 2025.

Olsen, J. F., Odden, T. O. B., & **Lockwood, E.** (In press). Exploring discrepancies in mathematicians' use of programming in teaching and research. To appear in the proceedings of the 31st Annual Conference on Research in Undergraduate Mathematics Education. Alexandria, VA, February 2025.

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