2020

Center for Computing in Science Education

ANNUAL REPORT

CCSE

Center for Computing
in Science Education

Graphic design Maria Hammerstrøm
Photos Line Schibstad Foto

Contents

Summary

The Center for Computing in Science Education (CCSE) aims to become an 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.

IMPACT OF THE PANDEMIC

The activity of CCSE in 2020 has been strongly affected by the pandemic. We have made changes to our original plans to adapt to the new situation for teachers and students. For example, plans of summer institutes, workshops, courses for teachers and retreats had to be changed. However, the effect on the pandemic on the activity and impact of CCSE is not altogether negative. The move to digital learning environments has inspired the development of new learning materials and put more weight on student agency. This has increased the focus on proper pedagogical founding of learning materials and approaches. CCSE, and in particular KURT, has taken a leading role at the Faculty to help teachers adapt their materials, approaches and assessments to digital teaching using pedagogically sound principles. Building a culture for teaching and learning is clearly more difficult with social distancing, but we have still succeeded with some dissemination goals.

MIDTERM EVALUATION

CCSE had its midterm evaluation in 2020 and passed with excellent scores. We provided a self-evalution report and a new plan for the last five years (2021–2026) for the international evaluation panel. The panel performed a virtual visit to CCSE in October 2020 and CCSE was officially renewed for another five years in December 2020. The evaluation process, and in particular the virtial visit from the evalution panel, was a very useful and well-organized experience, which clearly will improve the quality of our activity. An immediate results is to reorganize the activity in the center into four work packages, which will be done in 2021. We also provide an overview of the new research plan of the center.

EDUCATION RESEARCH

In 2020 CCSE saw its first PhD student graduate – John Aiken – and several key contributions to the scientific discourse was introduced. For example, post-doc Tor Ole Odden has continued to pursue the use of computational essays to foster student agency and computational literacy. He has developed new assessments to measure student agency in computational essays and started to compare this across institutions. Tor Ole Odden has also applied methods of Natural Language Processing (NLP) to study trends and developments in the education research literature, initiating a new, exciting direction of research at CCSE. PhD-student John Aiken has broadened his studies of student pathways, with several cornerstone publications on the use of machine learning methods to address fundamental questions in education research. International collaboration has continued, but physical visits have been limited due to travel restrictions.

Computing and programming should be an essential skill in all science educations, and the contents and form of the educations should be changed accordingly.

CULTURE OF TEACHING AND LEARNING

CCSE personnel and KURT has contributed to several workshops focusing on various aspects of digital teaching and assessments. It has been important to ensure that new material developed for digital teaching incorporates sound pedagogical practices. In addition, it has been important to share experiences of teaching strategies, strategies to cultivate a good digital learning environment, and assessment practices, as we together has adapted to the demanding circumstances. We have continued to support the Learning Assistants program and work to extend this across the Faculty and eventually to the whole university.

DIGITAL LEARNING MATERIAL

CCSE has continued to support and develop digital learning materials. Digital learning progressions with integrated video, student activities, exercises and examples have been developed in pilots in some introductory courses. Both the doconce environment and the learning platform Canvas have been used to develop video-supported interactive courses in e.g. physics, chemistry and for school teachers.

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. Andreas Haraldsrud and Cathrine W. Tellefsen has also developed MOOCs for teachers on behalf of The Norwegian Directorate for Education and Training. These MOOCs provide a complete digital learning progression to give teachers a broader understanding of how programming can contribute deep learning and how to integrate programming in their own teaching in a meaningful way to support students' learning.

COMPUTATIONAL LITERACY IN THE HONOURS-PROGRAM

In fall 2020 the humanities students at the interdisciplinary Honours bachelor program at UiO piloted a course in programming for humanities students. This course was developed by Dag Haug and Øystein Linnebo in collaboration with Henrik Sveinsson from CCSE and students Eline P. Andersen and Karl Henrik Fredly. In addition, a new set of lectures on the introduction to AI from the perspectives of both the natural sciences and the humanities was developed and taught by honours students.

COMPUTATIONAL SKILLS FOR PHD-STUDENTS

CCSE is heading the development of training program in computational skills for PhD students. This is piloted in a small cohort of PhD-students in the CompSci MSCA COFUND. The program was announced in 2020 and the first students will start in 2021.

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. CCSE hosted a two-day site visit from other Circle-U university members in 2020, which has spawned several new joint development projects among the Circle-U partners. Both national and international dissemination have been restricted in 2020 due to the pandemic.

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 goal (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 goal (2026)

The center is an internationally leading hub for research-based approaches to CSE, with a strong educational research activity; an international repository for methods and materials; and strong student partnership. Full integration of CSE into 6 of 6 basic and 2 advanced physics courses, 4 of 4 math courses, and 2 astronomy courses. Extensions of CSE to 3 other disciplines at UiO. Adaptation of CSE at 2 external partners. A well-running school interaction program.

Perspectives on digital 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. We all need to become literate in the use of computing – to obtain computational literacy. We need to learn to think, argue, analyze and be creative using computing and programming. This does not mean that everyone should become computer scientists. Instead students should learn to use computers in their disciplinary context.

The key observation, that is often overlooked, is that computing extends the mathematical toolbox in a fundamental way. Since the mathematical toolbox has been a major constraint on the selection of topics, examples and exercises in a science like physics, this opens a completely new approach to disciplinary education. In addition, it also opens up education in other disciplines to modelling and simulation.

The focus on digital competence will increase in the years to come, with good reason. The advent of new technologies, represented by breakthroughs in machine learning and AI, and the rapid growth of new industries that require competence in computing and data science, will change all of society, including education. The Ministry of education introduced its strategy for digitization in higher education in 2017 and a new strategy for AI in 2020. These strategies point to the importance of digital competence at all levels in higher education – for researchers, students, teachers, and administration – and CCSE is used as a case example in the strategies. Similarly, EU's strategy for the digital single market points to the need for all professionals to master digital skills in their respective fields. CCSE is in a unique position to lead the digital transformation in education because we already have worked twenty years with a vision of how to integrate computing and digital competence 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.

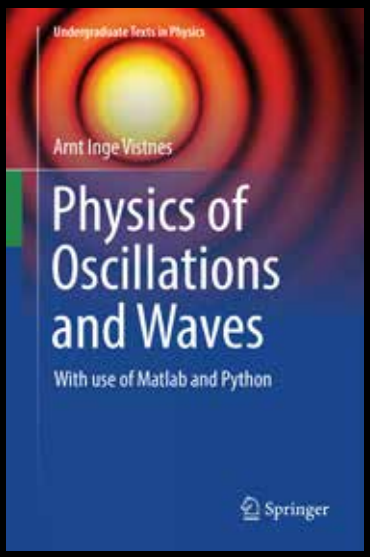
> **We need to learn to think, argue, analyze and be creative using computing and programming.**

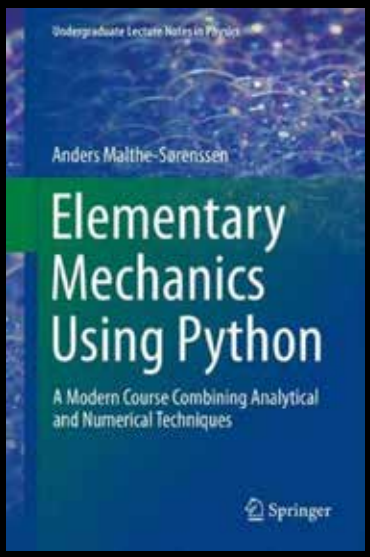
Higher education institutions should provide their students with a research-based education. If all educations integrate computing, this means that a university needs to have research activities and research-based competence in three related fields: (1) In the specific disciplinary field: For example, a bioscience education must build on high quality bioscience research; (2) In the 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 curriculums and educate tomorrows teachers.

Highlights 2020

CCSE TEXTBOOKS REACH HUNDREDS OF THOUSANDS OF DOWNLOADS FROM SPRINGER





Three textbooks written by personnel who have made deep contributions to CCSE have in 2020 been downloaded over 100.000 times each. This is a significant milestone for the digital dissemination of our learning material.

The book *A Primer on Scientific Programming with Python* by Hans Petter Langtangen has been downloaded over 270.000 times.

The book *Physics of Oscillations and Waves. With use of Matlab and Python* by Arnt Inge Vistnes has been downloaded over 130.000 times.

And the books *Elementary Mechanics Using Python/Matlab* by Anders Malthe-Sørenssen have been downloaded over 280.000 times.

SENIOR LECTURER CATHRINE WAHLSTRØM TELLEFSEN RECEIVED THE 2019 THON AWARD FOR EXCELLENT TEACHING IN MARCH 2020

The prize is 500.000 kr and is given to Tellefsen during the Thon prize ceremony in the University Aula on March 5. The prize was awarded Tellefsen for being an excellent teacher who also is genuinely engaged in helping others develop as teachers. She works systematically to "change the system" in order to improve the quality of education and teaching, in particular at the Faculty of Mathematics and Natural Sciences, but also at the university in general, nationally and internationally. She is the leader of the Center for Teaching and Learning in Science and a work package leader at CCSE. She is leading the ProFag initiative to provide professional development training for teachers and helping them integrate programming into their teaching to improve student learning in the disciplinary subject. She has also recently rewritten her textbook in Physics to include programming examples and problems.

We are very proud to have her as a central part of CCSE. Congratulations, Cathrine!

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/OvLutIsrgIo
(English)

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)

Bachelor-students who teach:
https://soundcloud.com/nokutpodden/den-om-studenter-som-underviser
(Norwegian)

Plans and Priorities

The main activities of the center will follow the previous action plan for 2021. However, several new developments that are timely and important will have impact on the priorities for the coming years. In 2021, we will therefore update and rewrite the action plan to reflect these changes. In addition, we have decided to reorganize the activity into four work-packages from 2022. The action plan will therefore be reorganized into four themes in 2020 to reflect the new plan for 2021-2026. The main aspects of these themes are listed in the following:

THEME 1: EDUCATIONAL DEVELOPMENT

Integration of computing and experimental methods: Experimental data collection and analysis will be integrated into the teaching workflow in introductory courses. The first year in the physics program will be redesigned to focus on the scientific workflow with data collection, modeling, computing, theory and statistical analysis.

Instructional methods: The Learning Assistants program will be extended. Students who develop learning material will be enrolled in the LA program, integrated into the teaching team, and closely supervised by pedagogically experienced faculty. Development of learning material will follow backward design principles. New approaches to researcher training in cross-disciplinary cohorts with common training in computing skills will be piloted and evaluated on 32 PhD-students in the CompSci Cofund project.

Learning material: We will expand development and support of docOnce as an infrastructure for modular learning material; we will build a community for authors through regular meetings, workshops and retreats; and adapt and develop textbooks and digital learning material to various domains in collaboration with domain specialists.

Assessment and evaluation: Standardized assessments will be developed and applied across study programs. Student evaluations will be reformed to be based on research-based principles. New digital assessment approaches for computational literacy will be developed, tested and disseminated.

Future plans: Original five and ten-year plans for CCSE with indications of successes. The ten-year goals will be changed to reflect experiences, new development and new priorities in the new center plan.

Present state (2016)	Five-year goals (2021)		Three-year results (2019)	Ten-year goals (2026)
Existing culture for CSE with some excellent teaching practices and strong student engagement.	The center has initiated a reseearch-based approach to curriculum change and methods in partnership with students.	→	Successful initiation of a research-based approach to curriculum change, methods and materials in partnership with students.	The center is an internationalle leading hub for research-based approaches to CSE, with a strong educational research activity; an international repository for methods and materials; and strong student parnership.
Full CSE integration in 2 of 6 basic physics courses and partical integration in other courses with the textbooks published internationally.	Full integration of CSE: in 4 of 6 basic physics courses, with two new textbooks, 2 of 4 math courses, and 1 astronomy course.	→	Successful integration of CSE: in 4 of 6 basic physics courses, with one new textbook, in 1 of 4 math courses, and 1 astronomy course.	Full integration of CSE into 6 of 6 basic and 2 advancded physics courses, 4 of 4 math courses, and 2 astronomy courses.
	A pilot extension of CSE into biology.	→	Successful integration of CSE in biology with new textbooks.	
	A pilot adaption by an external partner.	→	Successfull adapation at Univ. Southeastern Norway.	Extensions of CSE to 3 other disciplines at UiO.
	A pilot school interaction program.	→	An amibitious school reform program.	Adaption of CSE to 2 external partners.
The research basis for methods and approaches is sparse.	Pilot studies of learning outcomes and teaching methods in 3 courses.	→	Published studies of learning outcomes and teaching methods in 3 courses.	A well-running school interaction program.

THEME 2: EDUCATION RESEARCH

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, design-based studies in physics and the use of assessments, and address student evaluation studies, (ii) initiate studies of the impact of computing in mathematics in collaboration with Elise Lockwood at Oregon State University, and (iii) initiate studies of teacher training and professional development and impact of computing in school education. We will not continue the activity in learning analytics as we do not have the resources to build parallel programs in both qualitative and quantitative studies.

THEME 3: CULTURE FOR TEACHING AND LEARNING

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, continue with Summer Institutes for both internal and external participants.

To increase the computational proficiency of the teaching faculty, we will develop courses inspired by ProFag for university teachers. We will continue to develop CCSE into a meeting place for students and teachers interested in educational development through talks, workshops, hackathons and social activities.

THEME 4: DISSEMINATION

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.

ACTION PLAN

The activity in the center will be organized into four themes according to the following plan:

Action	Description	2022	2023	2024	2025	2026
Theme O: Management (A. Malthe-Sørenssen)						
AO.1	Annual progress reports	D	D	D	D	D
AO.2	Advisory board meeting	M		M		M
Theme 1: Educational development (L. Nederbragt)						
A1.1	Integration with experiments		D		D	
A1.2	Instructional methods					
A1.3	Learning material		M	M	M	
A1.4	Repository		M	M	D	
A1.4	Assessments and evaluations	M		M		
WP2: Education research (T.O. Odden)						
A2.1	Computational literacy (Res)	D	M	D	M	D
A2.2	Computing in math (PhD)		M		D	
A2.3	Computing in schools (PhD)		D	D		

Action	Description	2022	2023	2024	2025	2026
WP3: Culture for teaching and learning (C.W. Tellefsen)						
A3.1	Workshops and seminars	M	M	M	M	M
A3.2	Summer institutes	M		M		M
A3.3	Student projects					
A3.4	Teacher courses		M	M	M	M
WP4: Dissemination (K. Mørken)						
A4.1	TraCS PhD training				M	
A4.2	ProFag		M	M	M	M
A4.3	Cross-sector programs			M	M	M
A4.4	Non-science applications					

M = Milestone, D = Deliverable, Color intensity indicate stages

CCSE is in a unique position to lead the digital transformation in education.

WP1: Research-based development of learning material

Leader: Hjorth-Jensen

GOAL

Develop flexible learning material that deeply integrates the use of computing based on research-based pedagogy. Hereunder,
(1) Develop a repository of teaching material and evaluation methods;
(2) Develop textbooks and interactive and modularized material with integration of computational methods and programming examples;
(3) Study usage and effects using big data approaches, interviews, and observation;
(4) Provide writer support including writing groups and use of students to improve texts;
Develop CSE publishing tools; Build partnership with Springer on CSE book series.

ACTIVITIES

Textbooks

The center has continued to develop high quality learning material in the form of textbook. The textbook in Bios1100 will continue to be developed towards publication. This textbook is the first to provide an introduction to programming in a biological context. A first complete draft of a new textbook in Elementary electromagnetism using python/matlab was written in 2020 and will be published by Springer in 2021.

Electronic learning material

Several courses with integrated programming have developed digital learning progressions either with direct HTML using doconce or on Canvas. In Fys1120 a complete set of short videos of the main exposition and worked examples was developed and interspaced with exercises with hints, answer and solutions. This material was connected to tutorials, extended homework exercises and computational essays where students are allowed to ask and answer their own research questions. This work will continue in 2021 independently of the digital learning regime imposed by the pandemic.

Writer support

The center aims to support the development of learning material by developing a community for writers, by developing and supporting the essential infrastructure and tools for writing, publishing and use, and by distributing and publishing the results. The main tool for textbook development is docOnce, which is developed and supported by CCSE.

Student participation

Students play an important role in the development of learning material. CCSE financed 30 summer student scholarships in 2020. This was a significant ramp-up from previous years as a response to the pandemic. These scholarships are tools that we use to stimulate to the development of learning material and to engage students deeply in the development of new learning material. 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 2020, these resources were also used to introduce new learning material to the introductory courses in the honours program. For example, second-year honours-students developed introductory lessons over 2–3 days in machine learning and neural networks for first year students. These lessons were taught by the students in HON1000 in 2020.

TEXTBOOK ON PROGRAMMING FOR SCHOOL TEACHERS

Programmering i skolen is written for mathematics and science teachers in middle school and high school (8–13) in Norway. It is an introduction to programming for use in mathematics and science, and therefore uses examples and theory from these subjects throughout the book. The book includes a wide range of topics, from basic programming and data science to object-oriented programming and numerical methods. Python is used as the major programming language, but block based coding with Scratch and MakeCode for micro:bit is also addressed.

The book takes the teachers perspective throughout, and continuously focuses on what pupils typically find hard when learning new topics, and how to deal with that. Part of the book is dedicated to classroom methods, presenting a variety of activities that can be directly applied.

Programmering i skolen was published by Universitetsforlaget in the spring of 2020.

PLANS AND PRIORITIES FOR 2021

- Extend support to develop pedagogically sound digital learning progressions
- Extended use of JupyterHub and Jupyter notebooks
- Development of new material for courses in computational methods, introductory courses where there is currently sparse high-quality material
- Development of material in other disciplines such as for an introductory course in programming for the humanities and for courses in chemistry.
- Engaging students in testing and checking learning material to reduce errors and improve readability

ACTION PLAN

Action	Description	2017		2018		2019		2020		2021		Milestones and Deliverables
A1.1	**Repository for material and evalution methods**											
	Establish repository				D							Working repository
	Enable stakeholder feedback						D		D		D	Yearly usage reports in AO.4
A1.2	**Develop and test textbooks and interactive and modularized material**											
	Publish textbook 1: Fys216O: Thermal Physics (D = editions)						D				D	Published book
	Test and evaluate textbook 1 (teacher, students, PhD1, Postdoc)						M				M	Reports for A1.1; Adjusted material
	Publish textbook 2: Fys112O: Electromagnetism (D=editions)								D			Published book
	Test and evaluate textbook 2 (teachers, students, PhD1, Postdoc)										M	Reports for A1.1; Adjusted material
	Develop textbooks 3-6: Continuous development		o	o	o	o	o	o	o	o	o	Preliminary books
	Develop material for two math courses. Publish in repository						M				M	Material in repository
	Develop material for AST2OOO: Astrophysics. Publish in repository										M	Material in repository
A1.3	**Support research on effects of material using data, interviews & observations**									M		
	PhD1 Project		o	o	o	o	o	o	o	o		Research project of PhD1
	Postdoc Project			o	o	o	o	o	o	o	o	Research project of Postdoc
	Publish research articles on results						M		M		M	Publish 1 article/yr
A1.4	**Writer support**											
	Establish writer groups and organize yearly meetings		M		M		M		M		M	Yearly meetings
	Support writing escapes for textbook and material authors		M		M		M		M		M	Support 2-4/yr; Report through AO.4
	Systematic use of student evaluation to improve texts		M		M		M		M		M	Support 1-2/yr; Improved texts
	Develop and support 'doconce' - a writing tool for cross-platform publ.		D		D		D		D		D	Yearly releases
(New)	**Develop and support Jupyter and JypyterHub at UiO**		D									**Established JupyterHub@UiO**
	Establish partnership with Springer to publish book series				M							Initiated partnership

M: Milestone, D: Deliverable, o: Ongoing
Colors indicate progress. : according to plan, : adjustment, : delayed

Comments

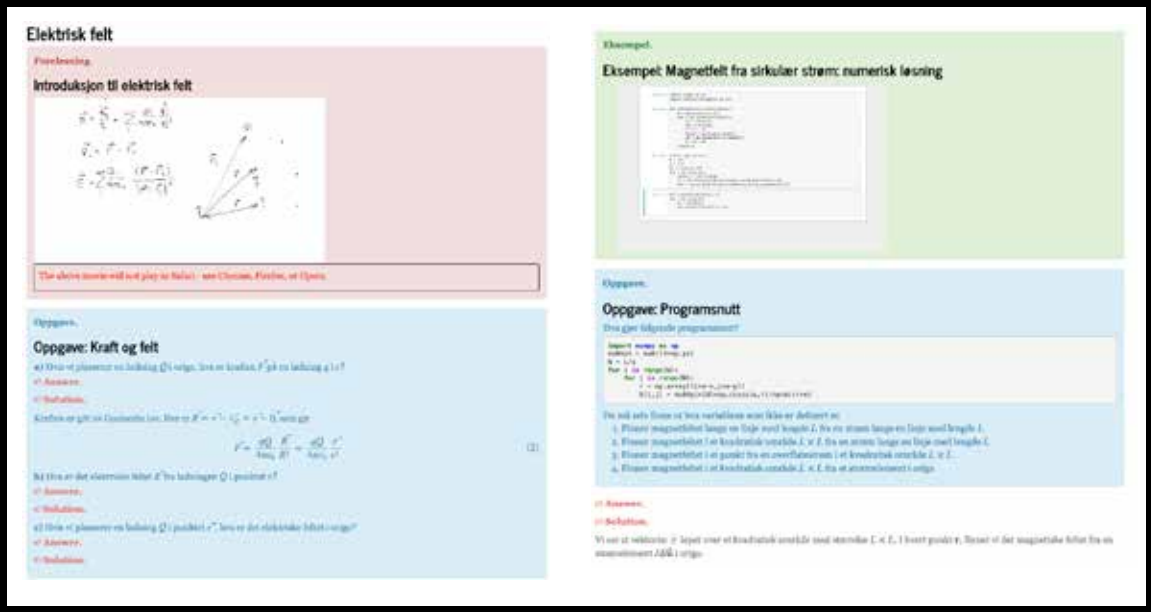
A1.1: The repository will in the first 5-year period be integrated with the PICUP project.
A1.2: Textbook development is progressing in Fys216O – Thermal Physics. A first draft has been developed in Fys112O – Electromagnetism. Texts in mathematics are continuously updated. New texts in computational physics and machine learning under development.
A1.3: PhD-student 1 addresses learning in Fys1OO1 – Introductory physics and BIOS11OO – Introduction to Computational Modeling for Bioscience. The post-doc is focusing on learning progressions, computational essays in Fys112O, and learning assistants.
A1.4: Most of the actions are proceeding according to plan. However, the activities that support writers have been postponed to ordinary meetings can occur after the pandemic.

DOCONCE DEVELOPMENT

The 'docOnce' package was developed by Hans Petter Langtangen to allow efficient modular development and distribution of learning materials. The underlying idea is that you write your text once, and then transform it into whatever form you need. The tool is particularly suited to develop learning material that includes mathematics and programming. The tool is widely used in our textbook projects and for producing learning material.

In 2020 'docOnce' was extended to also support digital learning progressions similar to that found in MOOCs, but with a robust and flexible solution for including programs, videos as well as hints, answers and solutions. Video lectures can be included with text and questions as illustrated in the figures. DocOnce is developed and supported by CCSE.

Presentations: Illustration of how docOnce can be used to produce MOOC type presentations – that also can be compiled as Jupyter Notebooks, Jupyter books or pdf's for printing.



WP2: Research-based development of methods and approaches

Leader: Malthe-Sørenssen

GOAL

Develop research-based methods and approaches for the integration of computing in a discipli-nary context. Hereunder,
(1) Student-active learning: Develop, apply and evaluate traditional and new learning methods in CSE courses;
(2) Develop and test research- and industry-near CSE cases in collaboration with stakeholders;
(3) Develop and study methods for assessing student work and collecting data for CSE courses;
(4) Develop and test methods that use inno-vative digital and physical learning environments;
(5) Develop, test and evaluate study programs and courses

ACTIVITIES

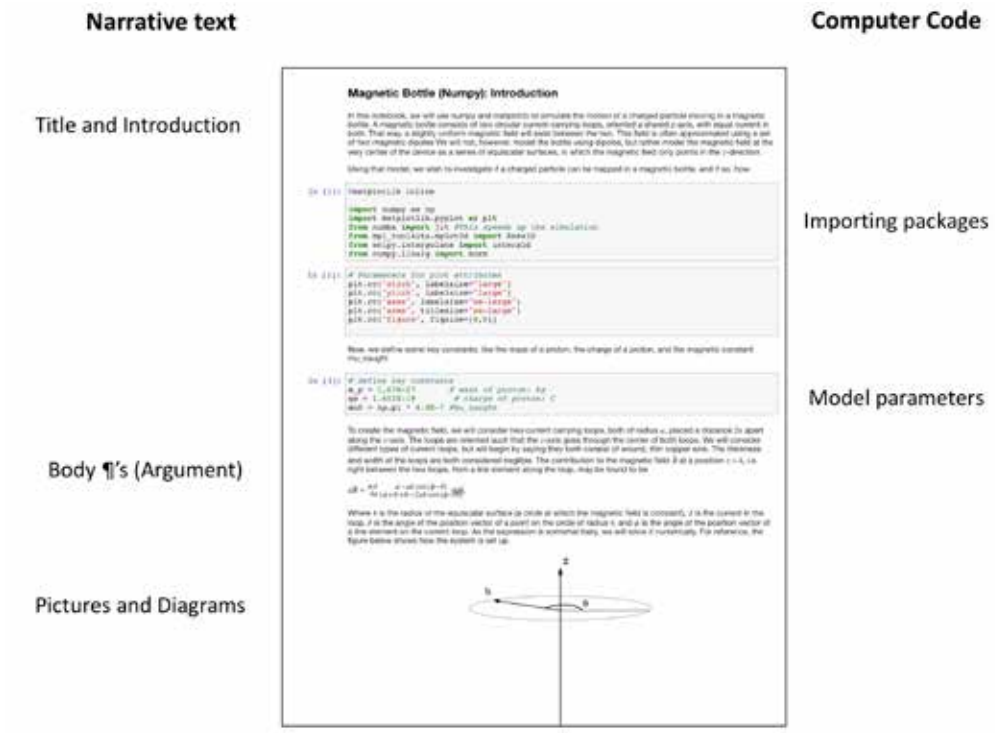
Student-active learning and learning assistants

CCSE and KURT (The Center for Teaching and Learning in Science) has been actively involved in promoting the use of student-active teaching methods in general. In 2020, this activity also included help and support on how to make pedagogically sound digital learning progressions and assessments in courses that were rapidly transferred to a digital learning spaces. To ensure that our activities in this area follow the same principles as we area teaching – activity – we have developed several projects that aims to include both teachers and learning assistants actively in student-active learning. One of these approaches is the Learning Assistant project, where learning assistants in selected courses are offered a pedagogical training program that runs in parallel with their teaching activities. This year a particular focus in the pedagogical training program was how to adapt group teaching and tutorials to a digital format. Because this is a new area to most teachers and LA alike, the pedagogical seminar series this year also included sessions where LAs could share and discuss experiences and practices. We have also developed several initiatives at the various departments to support and promote active learning methods.

Computational Essays and student agency in Fys1120

In the fall of 2018, members of the CCSE ran a pilot study to develop a new type of teaching tool known as a "computational essay" in UiO's intermediate electricity and magnetism course (Fys1120). A full implementation for 150 students were implemented in 2019. In 2020 the project was extended further and essential digital learning material, including a new textbook, were developed and used in the course. Computational essays are reports that use text, pictures, and computer code in order to explain a topic or present an argument. Participating students in the targeted course volunteered to do open-ended projects (either individually or in groups) in which they created a computational simulation to answer a question they found interesting. They then wrote narrative descriptions of their investigations in a computational notebook which incorporated their code. Students presented these essays to their peers in informal meetings at the end of the semester, and also took part in semi-structured interviews that focused on their views of computation as it related to learning science as well as their process of writing the computational essays. Analysis of these interviews is published and show that the students greatly appreciated the creative opportunities afforded by the open-ended structure of the programming project, reporting that it led to an increase in both learning and motivation.

During 2020 the focus of the project was extended to focus on student epistemic agency – how students are able to drive their own learning and exploration process by formulating and pursuing their own research questions. In 2020, we also planned an extended home exam with programming exercises, and all compulsory exercises were therefore reformed to focus on student agency. For example, in the first compulsory assignment students were asked to define their own problem and study the problem using a complex, numerical model and a simplified theoretical model, following principles and workflows similar to that found in research and development. However, we found that students were not sufficiently prepared to meet such an open question.



Computation essay: Illustration of a computation essay in Fys1120.

We therefore restricted the problems more through a "choose your own adventure" approach where students made a sequence of choices to determine the particulars of the problems they were studying – allowing both for some degree of choice, but also for a structure that would reduce the complexity of a free problem. The extended home exam was perceived as very difficult and long by the students and insights from student interviews, assessments and student evaluation of the exam is included in how the course is redesigned in 2021.

Standardized assessments

To gain more insight into student learning when we introduce changes in instructional design, we have started to introduce standardized tests at the beginning and at the end of large-enrollment courses. In 2018, we introduced a pilot of the CSEM test in introductory electromagnetism (Fys1120), and in 2019 and 2020 we rolled the test out for the whole class (170 students). The students were incentivized to participate in both the initial and final tests. However, preliminary results show that it is difficult to ensure sufficient student participation, even with incentives, to ensure that the results are representative and useful for instructional development.

Research seminar series

In 2020 CCSE the seminar series on instructional design and education research was continued, but adapted to a digital platform. The full list of talks can be found in the list of products. The seminar series have been well attended with participants from physics, chemistry, mathematics, computer science, biosciences, and education. The seminar series is providing an avenue to focus on research-based instructional design at the Faculty.

PLANS AND PRIORITIES FOR 2021

- Continue development of pedagogically sound digital learning material
- Extend the Learning Assistant project to more courses and publish results from UiO
- Extend research activity to mathematics and bioscience education research
- Extend the research seminar series and consolidate research group meetings
- Extend computational essay project to one additional large-enrollment (100+ student) class

ACTION PLAN

Action	Description	2017	2018	2019	2020	2021	Milestones and Deliverables
A2.1	**Student-active teaching using CSE**						
	Evaluate traditional learning methods for CSE courses (PhD1, students)		M	M	M	M	Reports for courses
	Develop student-active methods: project-based, tutorials, collaborative	o	o D	o o	D o	o D	Methods for 3 courses in repository
	Investigte and Evaluate effect of methods		M		M	M	Reseach articles; Repository entries
	Publish research articles on results				M	M	Published 1 article/yr
A2.2	**Research-near and work-life relevant education by integration of computing**						
	Develop and test cases in collaboration with stakeholders			M		M	Cases in repository; Research articles
	Develop and test data-based exposition and examples			M			Examples in repository; Research art.
	Develop and test research-near projects with stakeholders		M		M		Projects in repository; Research art.
	Publish research articles on results		M	M	M	M	Published 1 article/yr
A2.3	**Methods for assessing student work and collecting data**						
	Develop and test assessment methods: Digital exams			M		M	Exams from 2 courses in repository
	Develop and test assessment methods: Project-based courses			M		M	Projects from 2 courses in repository
	Pilot study of effect of new approaches in Fys-mek1110: Mechanics (PhD2)		o	o o	o M		Research article from study
	Pilot study of effect of new approaches in INF1100: Programming (Postdoc)			o	o o	o M	Research article from study
	Pilot study of effect of new approaches in Fys3150: Comp. Phys (PhD2)				o o	o o	Research article from study
	Use 'devilry.org/canvas' to collect, categorize and study student work				M		Data from 2 courses analyzed
(New)	**S-ASSESS Project**		o	o o	o o	o o	**Research project of Postdoc**
	Publish research articles on results				M	M	Published 1 article/yr
A2.4	**Methods using innovative digital and physical approaches**						
	Develop and test innovative digital collaboration using github			M			Use in 1 course, results in repository
	Support and test innovative use of 400 m² learning center				M		Use in 1 course, results in repository
A2.5	**Develop, test, and evaluate study programs and courses**						
	Evaluate effect of study program change 2016 to 2017 (PhD2)			M		M	Research (M1: physics; M2: biology)
	Establish semester committees for course coordination		M	M	M	M	Established; Reports for A0.4
	Establish impact evaluation committees with regular meetings		M	M	M	M	Established; Reports for A0.4
A2.6	**Appoint senior researcher to build and coordinate educational research**		M				Appointed

M: Milestone, D: Deliverable, o: Ongoing
Colors indicate progress. : according to plan, : adjustment, : delayed

Comments

A2.1: Student active methods are developed for Fys-mek1110, BIOS1100 and Fys2130. The PhD-student and master students will focus primarily on BIOS1100 – Introduction to computational modeling for bioscience, and Fys1001 – Physics for applications.
A2.2: Data-based methods are developed in the course Fys2160 – Thermal physics and Fys 1120 – Electromagnetism.
A2.3: This project has been financed with three new positions from the Norwegian Research Council (S-ASSESS) and started in 2019.
A2.4: The new learning center is used in BIOS1100 and git and github is used in Fys3150 – Computational Physics, and Fys-stk3155 – Data science and machine learning.
A2.5: This activity was not initiated in 2020 due to the pandemic.
A2.6: A full associate professor position was announced in 2020 and will be filled in 2021. The new professor will be central in developing the education research strategy at CCSE for the next center period (2022-2026).

WP3: Development of a culture for teaching and learning

Leader: Henriksen

GOAL

Develop a culture for teaching and learning across the science departments. Hereunder,
(1) Develop school-university transition program and investigate effects on recruitment, retention, and results;
(2) Improve student culture through student spaces, mentor programs and startup seminars;
(3) Develop teacher culture through annual teacher retreat, teaching in teams, workshops and seminars with focus on teaching, and learning and curriculum development;
(4) Develop quality systems and student evaluation methods to enhance constructive alignment and ensure quality development through systematic feedback and improvement;
(5) Promote teaching skills renewal through pedagogical courses, educational sabbaticals, and career goals for teaching proficiency and excellence.

ACTIVITIES

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. In 2020 we have focused on developing digital meeting places for teaching faculty and teaching assistants to address and share experience on teaching under the pandemic. Together with the Faculty and the Departments, 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).

Renewing first-year physics education

The bachelor program in physics has for a long time not had any physics courses in the first semester. Based on an initiative from among others Morten Hjorth-Jensen, the Department of Physics has initiated a process to redesign the first year of the physics program to integrate computing, experiments with realtime data collection, and statistics so that the complete scientific workflow can be introduced from day one. This is only possible with a simultaneous integration of computing in the experimental data collection and analysis. The first year program is still under development. We expect a first implementation to start in 2022.

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 2020 we arranged regular seminars with invited national and international speakers that were open for all teaching faculty and students. In addition, we organize a yearly Christmas seminar focusing on Computing in Science Education, which in 2020 was fully digital, but still had strong participation from teaching and research faculty.

Teaching assistant workshop

We consider the professional development of teaching assistant to be important and have developed biannual teaching assistant workshops that are compulsory. The workshops are designed to provide teaching assistant with basic pedagogical tools and skills needed to effectively teach smaller groups. The workshop is compulsory for teaching assistants. The workshop was in 2017 extended to include teaching faculty with great success – opening for sessions where teaching faculty and teaching assistants coordinate their activities at the beginning of the semester. Focus in 2020 has been on effective teaching strategies under the pandemic.

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 is directed by CCSE member by Cathrine W. Tellefsen and 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. 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 website. KURT also arranges a "journal club" where participants read, present and discuss international research concerning student-active learning, professional development of teaching assistants, and other topics of relevance for developing the teaching and learning culture – and skills - among UiO science teaching staff.

PLANS AND PRIORITIES FOR 2021

- Develop and provide online and physical in Python programming for teaching faculty
- Prepare summer institute on computational methods for bioscience teachers in 2022
- Continue to provide and improve teaching workshops for teaching faculty and teaching assistants

ACTION PLAN

Action	Description	2017		2018		2019		2020		2021		Milestones and Deliverables
A3.1	**School-university transition program**											
	Establish school-university transition base study				M							Report (PhD2)
	Develop and test adapted transition practices							M				Practices in repository; Research art.
	Study effects on motivation, retention and results										M	Research articles
	Publish research articles on results						M		M		M	Publish 1 articles/yr
A3.2	**Student-spaces, mentor programs and startup seminars**											
	Study student self-organization in student spaces							M				Research report
	Develop student-teacher off-curriculuar activities in student spaces			M								Initialize; Regular acticities
	Support and extend student-student mentor program	o	o	o	o	o	o	o	o	o	o	Report from mentoring programs
	Support startup seminars focusing on learning-to-learn, study strategies	o	o	o	o	o	o	o	o	o	o	Reports from seminars
A3.3	**Teacher culture development**											
	Establish annual teacher retreat to focus on sharing and development		M		M		M		M		M	Yearly retreats; Reports
	Organize regular educational workshops and seminars	o	o	o	o	o	o	o	o	o	o	Reported workshops and seminars
	Develop teaching teams for main introductory courses						M				M	Teams in 2 courses; Report
	Study effects on learning environment and student evaluations						o	o	o	o	o	Research (PhD2, Postdoc)
A3.4	**Quality systems and student evaluation methods**											
	Develop and test efficient web-based student evaluation system				M		D		D		D	M: Implement system; D: Reports
	Present and discuss student evaluations at teacher retreats				M		M		M		M	
	Develop effective group-based evaluation systems for courses								M		D	M: Implement; D: Reports
A3.5	**Promote teaching skill renewal**											
	Develop pedagogical courses and workshops for CSE skills				M		M		M		M	M: Reported courses
	Support educational sabbaticals for course development				D							Implemented at Faculty
	Establish career goals for teaching proficiency and excellence										M	Develop; Implement pilot
	Establish teaching academy of excellent teachers at Faculty									M		Established pilot

M: Milestone, D: Deliverable, o: Ongoing
Colors indicate progress. : according to plan, : adjustment, : delayed

Comments

A3.1: The school-university transition program has been replaced with ProFag (See WP5).
A3.2: Startup seminars are well functioning and will continue to be developed in 2021. Student-student mentor programs have been postponed because focus has been placed on learning assistants instead. The need for such programs will be reevaluated after the pandemic.
A3.3: Teaching days are running at several departments, including the Department of Physics. Teaching teams will gradually be introduced in 2021 and 2022 as new teachers are taking over courses. Teams will be strengthened through the Learning Assistants project.
A3.4: A group-based evaluation system is in use at the Department of Physics. CCSE has initiated a project to develop a research-based student evaluation system.
A3.5: A summer institute on the integration of computational methods into bioscience courses will be organized after the pandemic, possibly in 2022.

WP4: Student-driven activities

Leader: Tellefsen

GOAL

Develop a set of student-driven activities to engage students deeply in educational development. Hereunder,
(1) Establish student partnership board;
(2) Support educational research projects where students collaborate with pedagogical researchers;
(3) Support student development of material, exercises and case studies;
(4) Support that student teaching assistants develop, share and document expertise through mentoring, courses, and workshops;
(5) Support student-developed instruction initiatives such as short courses, seminar series and science competitions;
(6) Support student innovation projects;
(7) Support research activities for bachelor students;
(8) Support student internships in research and industry.

ACTIVITIES

Student development of curriculum

Bachelor- and master-level students contribute to curriculum development and the development of teaching practices through (1) direct development of learning material, (2) participation in teaching activities as teaching assistants, and (3) through student research activities. Bachelor- and master-students are hired to develop new learning material. In 2020 we received applications for and rewarded 700kkr for projects. However, in view of the pandemic situation there were additional needs to develop and adapt learning material to digital platforms. We therefore invested more than originally budgeted in student projects. For example, 13 honours students were hired to rapidly develop learning materials, lectures and exercises for the second-year students. The students developed a series of interactive lectures on machine learning with contents that were adapted to suit students both in natural science and the humanities. These elements were then taught by the students themselves.

Student research projects

Introducing students to research already in the bachelor program is a goal of CCSE. We provide students with relevant skills – computational methods – that make them attractive as research assistants already from the first year. We have therefore developed student research projects that hired 3 bachelor summer students in 2020. In addition, we have initiated several research and development projects where students are involved.

PLANS AND PRIORITIES FOR 2021

- Establish one fully student-directed project in 2021
- Extend student research projects to 10 students/yr
- Apply for additional funding for further summer student projects.

ACTION PLAN

Action	Description	2017		2018		2019		2020		2021		Milestones and Deliverables
A4.1	**Establish student partnership board**											
	Establish board, organize regular meetings and reports to leadership				M		M		M		M	Established; Meetings
A4.2	**Support educational research project using students**											
	Support use of students for in-class observation and reporting			o	o	o	o	o	o	o	o	Reports on use
	Support student-driven data collection and evaluation projects											Reports on use
A4.3	**Support student development of material**											
	Support 3-6 summer students/yr to develop exercises and cases	o	o	o	o	o	o	o	o	o	o	Reports on use; Results in repository
	Support 2-4 student blog/web projects/yr	o	o	o	o	o	o	o	o	o	o	Reports on use; Results in repository
A4.4	**Develop and document students' pedagogical expertise**											
	Organize biannual teaching assistant workshop		D	D	D	D	D	D	D	D	D	Workshops organized
	Support student-organized teaching retreats					M			M			Reported retreats
	Support student-driven pedagogical mentors									M		
	Implement qualification system for teaching assistants										M	Pilot implementation
A4.5	**Support student-organized courses, seminars and competitions**											
	Support student-developed instruction through scholarships	o	o	o	o	o	o	o	o	o	o	Report on use
	Establish and support student science competitions	o	o	o	o	o	o	o	o	o	o	Report on use
A4.6	**Support student innovation projects**											
	Support 2-4 student innovation projects/yr	o	o	o	o	o	o	o	o	o	o	Report on use
	Organize yearly student innovation meeting				M		M		M		M	Yearly meetings arranged
A4.7	**Support research activities for bachelor students**											
	Organize research projects for 2nd, 4th, 6th semester students	o	o	o	o	o	o	o	o	o	o	Yearly reports
	Support 1-3 student teams working on summer research projects	o	o	o	o	o	o	o	o	o	o	Yearly reports
A4.8	**Support 2-5 student summer internships in research or industry**	o	o	o	o	o	o	o	o	o	o	Yearly reports

M: Milestone, D: Deliverable, o: Ongoing
Colors indicate progress. : according to plan, : adjustment, : delayed

Comments

A4.1: The student partnership board has not yet been established. Priority has been given to build the school activity instead from 2018.
A4.2: Education research projects started in 2018 according to plan. First paper from student researcher published in 2018, 2 student papers were published in 2019, and 1 in 2020.
A4.3: Student development of material is proceeding according to plan.
A4.4: Teaching assistant workshops are organized. Student-driven activities in educational development will be postponed until good models have been found.
A4.5: Student-organized courses have not been prioritized in 2017-2019. Focus has been on education research and international student exchange. These elements were implemented in the honours-program in 2020.
A4.6 Student innovation has not been prioritized in 2017-2019. These projects will be reevaluated along with the action plan from 2022 after the pandemic.
A4.7: Research activities have been significantly extended through external funding.
A4.8: Summer internships have been financed through external financing from Thon foundation. However, no funding was provided by the Thon Foundation in 2020, limiting the extent of such projects in 2020 and 2021.

WP5: Dissemination, dialogue and communication

Leader: Mørken

GOAL

Develop and apply a research-based approach to dissemination locally, nationally and internationally. Hereunder,
(1) Disseminate learning material;
(2) Disseminate internally at UiO;
(3) Extend to other programs at UiO;
(4) Extend horizontally to other institutions nationally and internationally;
(5) Extend vertically to the school system.

ACTIVITIES

Extension beyond science

CCSE has played a central role in supporting and developing courses that integrate programming in the new honours program at UiO. In 2020 Dag Haug and Øystein Linnebo developed an introductory course in programming for students from the humanities. This course was piloted for the honours-students and will be expanded to a full course for all students in the humanities from 2021. In addition, Henrik Sveinsson develops a new course in data-driven projects for honours students starting early 2021. We will use experience from developing these courses in our further dissemination to other disciplines.

Partnership through Circle-U

CCSE is part of an Erasmus+ KA3 program that focuses on mapping out training in transferrable skills across the Circle-U university network. As part of that process, a group of experts from other Circle-U universities conducted a virtual site visit to CCSE in October 2020. The two-day site visit provided a good way to build contacts across the university network and has inspired several new collaborations among Circle-U partners. Our long-time goal is to develop courses in computing that span across all or most of the Circle-U partners.

International disseminiation

CCSE has an INTPART on partnership for computing in science education with Michigan State University, University of Colorado – Boulder, and Oregon State University. However, international exchange has been negligible in 2020 due to the pandemic. This activity will be expanded again after the pandemic.

School partnership

The school activity has continued to expand in 2020. (See box).

PLANS AND PRIORITIES FOR 2021

- Confirm CCSE as the national resource on computing in education and digital competence from schools to higher education and research
- Consolidate extension to bioscience also in second and third years
- Become recognized as the national leader for computing in school education

PROFAG – PROGRAMMERING I FAGENE (PROGRAMMING IN THE SUBJECTS)

During 2020 CCSE has improved the ProFag online resources. The improvement was driven by the corona pandemic and the fact that all our in-service teacher training courses had to change from physical classroom meetings to digital zoom meetings. The online resources now function as MOOCs with presentations, videos, problems and solutions. This enables the schools to work locally on their programming skills. In addition the online resources focus on the teaching of scientific programming with additional reflections on how computational thinking and programming can contribute to deeper learning in STEM subjects.

We have also expanded the portfolio of courses to include a higher lever course for teachers in upper secondary school. We now have three different MOOCs:

- ProFag:U introductory course for teachers in lower secondary school
- ProFag:vgs level 1 introductory course for teachers in upper secondary school
- ProFag:vgs level 2 advanced course for teachers in upper secondary school

The courses are given in agreement with our partnerships with the Education Department of Oslo City Council (Utdanningsetaten i Oslo) and Viken Council (Viken Fylkeskommune) – two of the largest school owners in Norway.

MOOCs for the Norwegian curriculum renewal

On behalf of The Norwegian Directorate for Education and Training we have developed the following MOOCs available to all teachers and school leaders in Norway:

- Programming and computational thinking in mathematics year 1–7 (primary school)
- Programming and computational thinking in mathematics year 8–10 (lower secondary school)
- Programming and computational thinking in mathematics year 11–13 (upper secondary school)

We are currently developing a MOOC for natural sciences in upper secondary school due to be published in 2021. In addition we have contributed to a general introduction to programming and computational thinking in schools year 1-10. This work has been led by The Norwegian Centre for Science Education.

Programming: In-service teachers learning to program at CCSE.

The MOOCs focus on the professional development of teachers. They are not programming courses, but are designed to give teachers a broader understanding of how programming can contribute deep learning. The ability to ask questions, explore and experiment are important for in-depth learning. Programming and computational thinking are tools to make this happen. In addition, the diversity in the classroom can more easily be met if the teachers have a larger toolbox to choose from. The MOOCs provide them with such a toolbox and focus on how they, as a team, can work on improving their teaching.

A newsletter on this work can be found here: https://www.mn.uio.no/kurt/english/about/news/competence-development-teachers.html

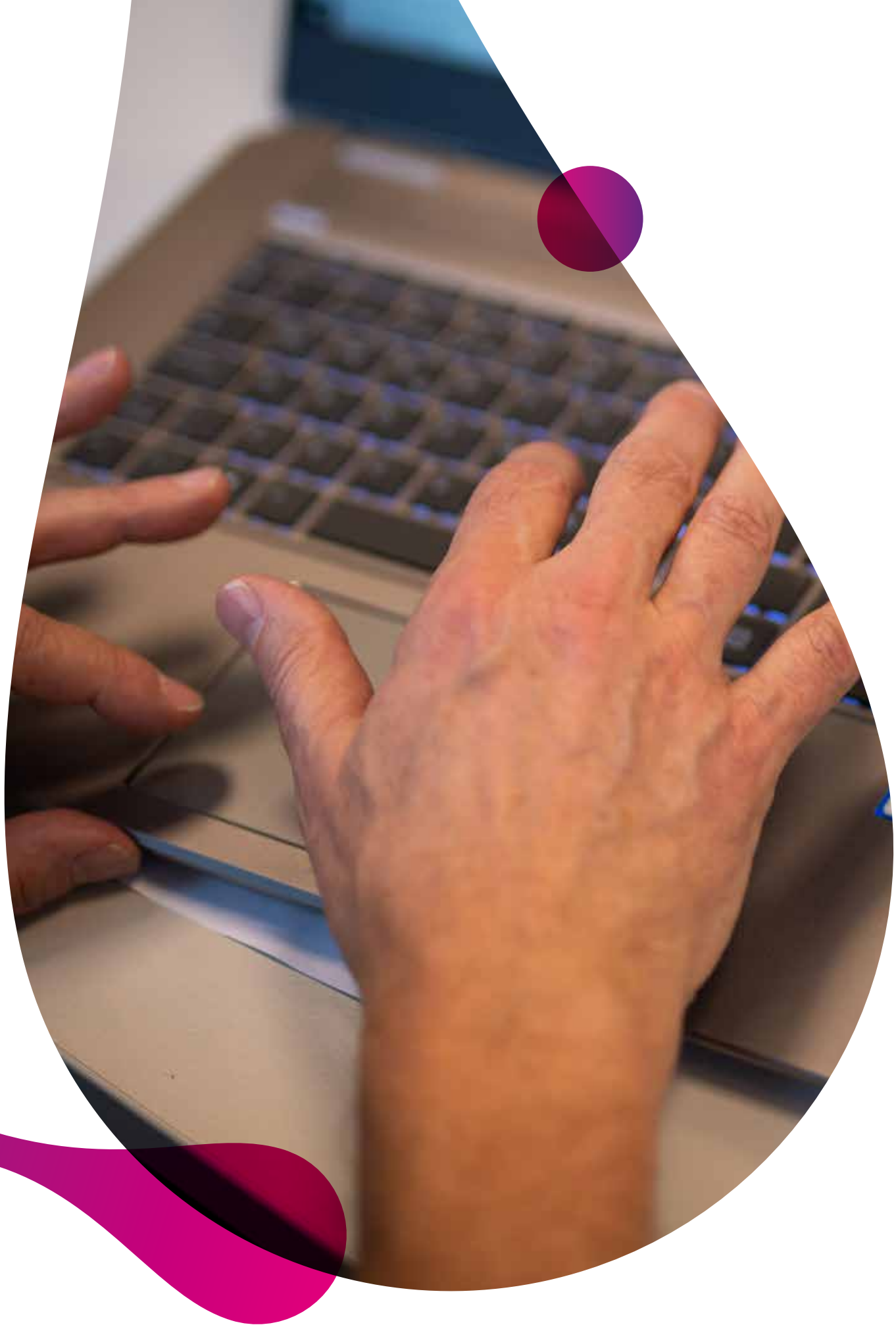
ACTION PLAN

Action	Description	2017		2018		2019		2020		2021		Milestones and Deliverables
A5.1	**Internal dissemination at UiO**											
	CSE workshop for UiO leadership at various levels	o	o	o	o	o	o	o	o	o	o	Workshops arranged
	CSE workshops on computational methods and practices for faculty				M		M		M		M	Workshops arranged
	CSE workshops on computational methods for teaching assistants			M		M		M		M		Workshops arranged
A5.2	**Extension to new programs at UiO**											
	Extension to bioscience program											
	Develop plans and study programs with department leadership		M									Plans developed
	Develop new introductory CSE course for biology students		o	o	M							Course implemented
	Develop new textbook for introductory courses		o	o	D					D		Preliminary textbook; Published text
	Integrate CSE into other biology courses						M		D		D	Initiate; Implemented in 2 courses
	Test pilot courses on biology student groups, evaluate and improve		M						M			Reports
	Evaluate and adjust CSE approaches in new courses								M			Reports
	Evaluate and review approach and study program design									M		Reports
	Extension to other programs (chemistry, geoscience)							o	o	o	M	Materials and texts in repository
A5.3	**Extension to other institutions**											
	Extension to University College of Southeast Norway											
	Develop introductory course and material for programming		o	o	o	D						Course developed
	Adapt material from UiO to local courses				o	o	o	D				Adapted material and texts
	Research and evaluate adaption, iterative improvement					o	o	o	M	o	o	Research (PhD1, Postdoc)
	Develop material for other University Colleges								o	o	M	Material (if applicable)
	Extension to other Universities											
	Support adaptation and extension through workshops and support			o	o	o	o	o	o	o	o	Reports on workshops arranged
	International extensions											
	Study application of material at Michigan State University		o	o	o	o	o	D	o	o	o	Research articles
A5.4	**School partnership**											
	Develop school visit program		o	o	o	o	o	M				Material developed
	Pilot school visit program with partner school						D		D		D	School program initiated
	Evaluate and improve visit program								o	o	M	Report from evaluation
	Extend program to other schools									o	M	Other schools included in program
	Research effect on recruitment, retention and exam results									o	D	Research (Postdoc)
	Research effect on school teachers									o	D	Research (Postdoc)

M: Milestone, D: Deliverable, o: Ongoing
Colors indicate progress. : according to plan, : adjustment, : delayed

Comments

A5.1: CCSE has developed workshops for leaders, teachers and students. This work is well on track. See product list for details.
A5.2: Extension to bioscience is progressing according to plan. Extension to chemistry and geoscience is gradually extended through student projects.
A5.3: A collaboration agreement between UiO and University College of Southeastern Norway (USN) is signed, and the progress at USN has been exceptional (see box). CCSE has initiated collaborations with most other universities in Norway, and have also actively communicated our results to possible international partners.
A5.4: The school exchange program has been postponed in order to coordinate with new developments in the school curriculum



Report from the CSE activity at USN

Ole Marius Lysaker and Randi T. Holta, USN

In spring 2018 the project «An engineering education for the future" was initiated at USN. The project involves a reorganization and coordination of the engineering education at the University of Southeastern Norway (USN) across three campuses. An important and new element of the new study programs is that all engineering students will have a 5 ECTS course in scientific programming in Python in the first semester. Furthermore, scientific programming will be used as a tool throughout the study program in courses in mathematics, physics and related subjects.

The Faculty for Technology, Natural Sciences and Maritime Sciences (TNM) consists of 6 institutes, Campus Porsgrunn, Campus Kongsberg and Campus Bakkenteigen. In total, TNM offers 6 bachelor engineering programs. Adding a 5 ECTS course in computing in the first semester therefore implied a complete redesign of all the engineering degrees at TNM. All courses and study programs had to be adapted to the new regime. The 450 students who started their studies fall 2020 now constitute the first cohort to follow the new study program.

ACTIVITES

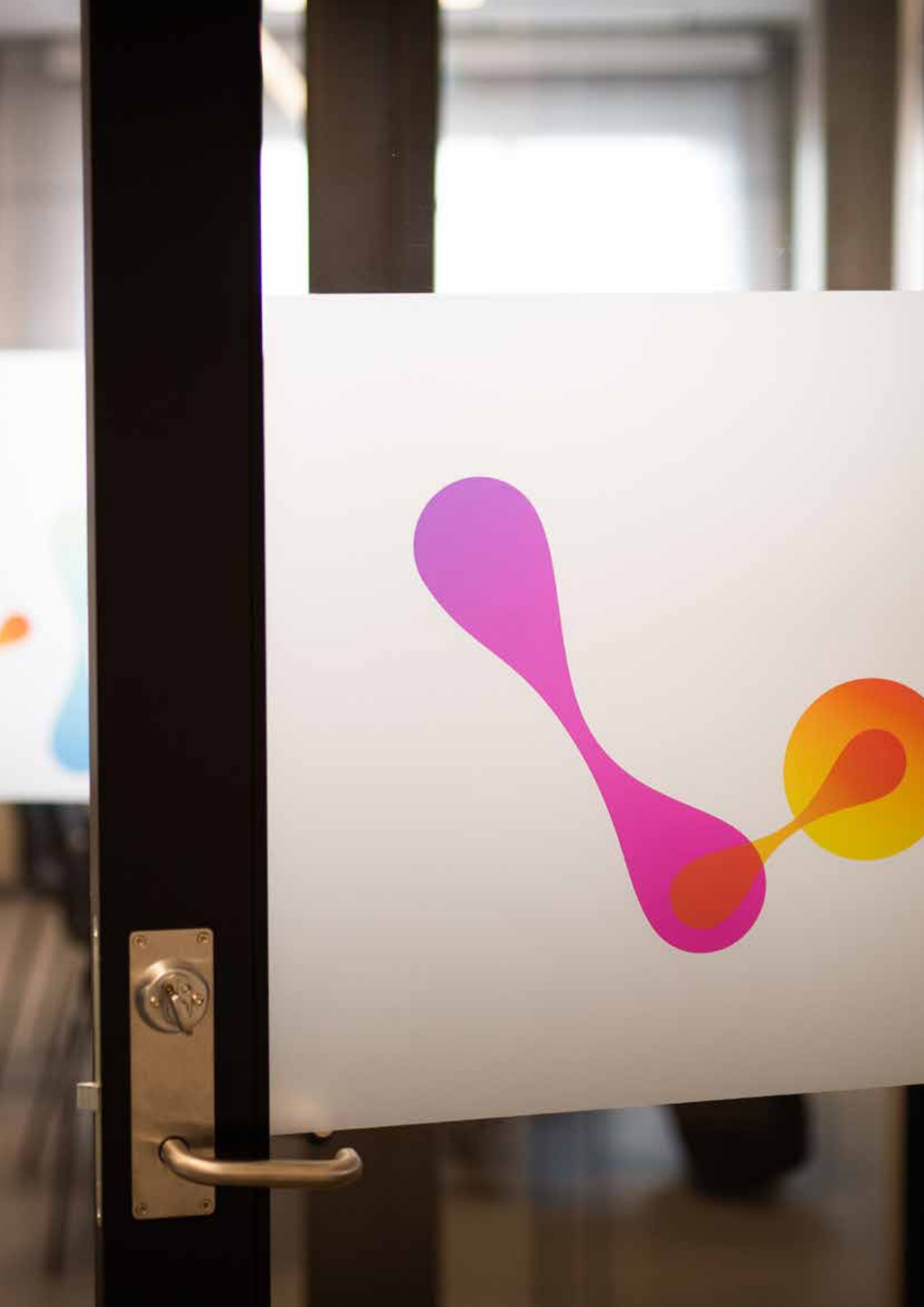
The year 2020 has been strongly affected by closed campuses, digital lectures, home exams and pandemic measures. Despite these challenges, we have provided a sound and comprehensive education program for the students with a range of course activities.

A milestone in 2020 was the rollout of "Python for computing" with 450 engineering students across 3 campuses on Zoom. The provide students with opportunities to meet and build a sound learning environment for cooperation and exchange of experiences, all group sessions were in small on-site groups.

Several courses for professional development in Python programming were taught in 2020:

- Applied Python programming for mathematics and science teachers in high school (Porsgrunn). Zoom. 7.5 ECTS. Spring 2020 (30 participants)
- Netbased course in Python programming for computing (Porsgrunn). Zoom. 5 ECTS. Target group: Unemployed with technological background. Financed by Diku. 3 separate courses with 30 participants each time.
- Basic programming for mathematics- and science teachers in high school (Porsgrunn). Zoom. 7.5 ECTS. Fall 2020. 20 participants. In addition, 10 participants from USN.
- Basic course in scientific programming (Kongsberg). Spring 2020 and fall 2020, 20 and 35 participants. Financed by Buskerud and Dekomp Viken.

In addition, a new textbook was written by Finn Haugen and Marius Lysaker, *Python for computations*, Fagbokforlaget, 2020.



Organization and management

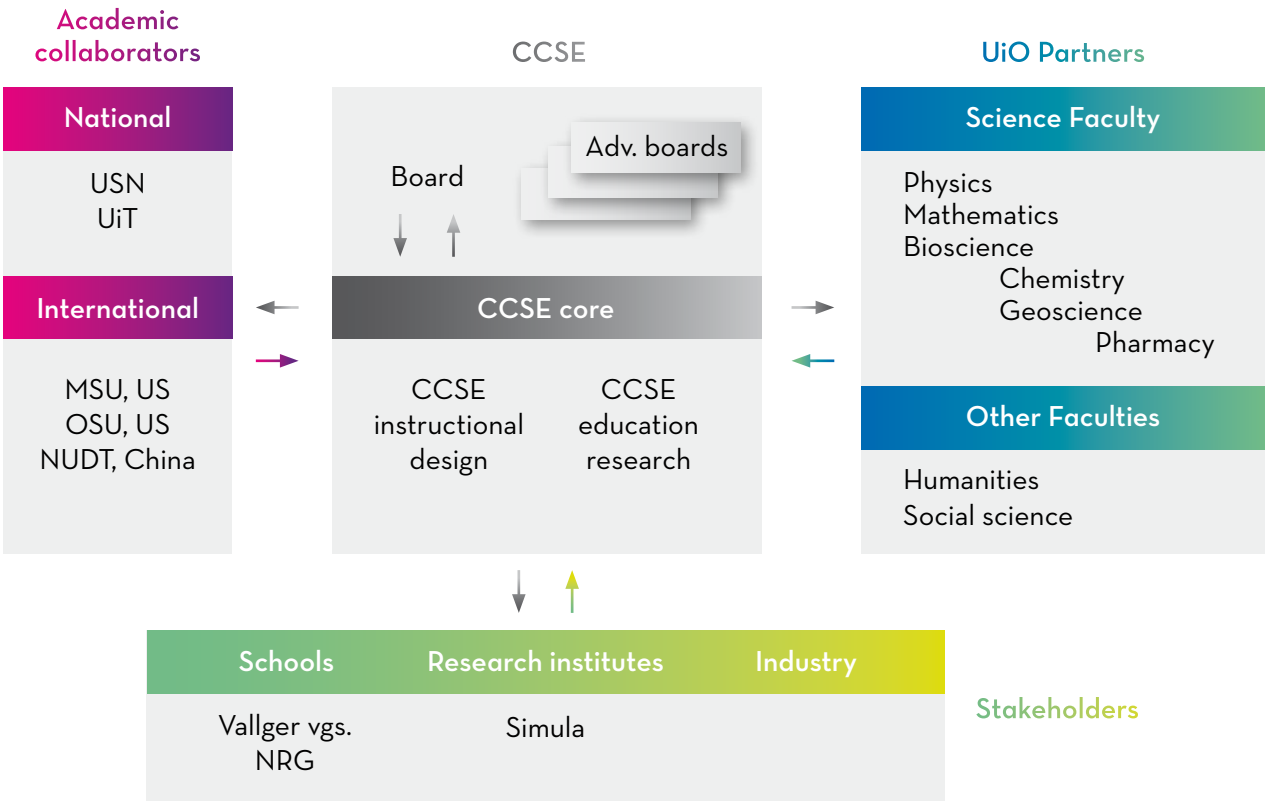
CCSE is directed by Professor Anders Malthe-Sørenssen and supported by an administrative leader, Tone Skramstad. The director is supported by a working group, with an advisory and coordinating function, consisting of the five work-package leaders, the administrative head, director of studies at the Faculty, 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. In addition, the Department of Physics provides an in-kind contribution in the form of compulsory work for PhD-students that is used for educational develop-ment. Two students have contributed to BIOS1100, one student contributes to BIOS1120 – Physiology, and one student contributes by the integration of computational exercises in FYS1001 – Introduction to physics.

The center has an education research group directed by Associate Professor Marcos D. Caballero and postdoc Tor Ole Odden. 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.



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, courses in computational physics (FYS3150) and machine learning (FYS-STK3155). He is a Fellow of the American Physical Society, Member of the Norwegian Academy of Science, winner of the Thon award, and has been awarded UiO's education award 3 times.

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 a member of the Norwegian Academy of Science, winner of the Thon award and winner of UiO's education award 2 times.

ELLEN KAROLINE HENRIKSEN
Professor of physics, WP3 leader, 20%
Ellen is section leader for the Education Research section at the Department of Physics, which is responsible for professional development for teachers. She has experience from education research focusing on motivation and identity of students in schools (1–13) and on the transition from school to university.

CATHRINE WAHLSTRØM TELLEFSEN
Senior lecturer, WP4 leader, 20%
Cathrine is the director of KURT – The Center for Teaching and Learning and Science. She has built up the ProFag activity – programming for disciplinary understanding in basic (school) education, the Summer Institutes, and promotes active learning at the Faculty. She is an experienced high-school teacher, author of a science textbook series for high-school, and winner of the Thon award.

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) and winner of the Thon 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

Associate 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

Senior lecturer in bioscience, 20%

Lex is a Senior Lecturer at the Department of Biosciences, and head of education and training for the Center for Bioinformatics. 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 leads the Advisory Council for eInfrastructure at UiO.

GULLA TORVUND

Bachelor student,
Honours program, UiO

Gulla is a student representative in the leadership group (2020–2021).

KARL HENRIK FREDLY

Master student,
CS program, UiO

Karl Henrik is a student representative in the leadership (2020–2021).

Education research

DANNY CABALLERO

Adjunct professor of physics education research, 20%

Danny is the Lappan-Phillips Associate Professor of Physics Education, Michigan State University, Leadership Faculty, CREATE for STEM Institute, Michigan State University, and Associate 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.

ELISE LOCKWOOD

Adjunct professor of mathematics education research, 20%; visiting professor, 2019

Elise is an associate professor of mathematics education research at Oregon State University and is starting in a 20% position at CCSE in 2020. She has NSF Career grant focusing on how computations affect student understanding of combinatorics. She spent her six-month sabbatical in 2019 at CCSE where she initiated research projects based on interviews with UiO students.

TOR OLE ODDEN

Post-doc

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.

JOHN MARK AIKEN

PhD-student/researcher

John defended his PhD dissertation in 2020 and has continued at CCSE as a researcher into 20212. He has long experience and a solid track record in physics education research. He has taught physics classes that integrate computing at several US and European institutions. He has published 15 papers on physics education research in international research journals. His work focuses the use of machine learning methods to develop a quantitative basis for physics education research studies.

SEBASTIAN WINTHER-LARSEN

PhD-student, S-ASSESS project

Sebastian has a master degree in both finance and computational physics. He has experience from teaching, both at schools and in higher education, and from scientific computing. His PhD-project focuses on using Evidence-Based Design (EBD) do develop a Conceptual Assessment Framework to assess computations in physics.

ODD PETTER SAND
PhD-student
Odd Petter has a background in computer science and astronomy. He thesis project will address how students learn from making mistakes with a particular focus on mistakes and how to learn from them in computational problem solving across contexts.

Other scientific staff

ANDREAS HARALDSRUD
Senior lecturer
Andreas has a background as a teacher at Valler high school where he has developed the course "Modellering og programmering X". He has written a textbook for this course and taken the initiate to get the course approved nationally. He is also teaching the introductory course in programming for chemistry students, is teaching in the ProFag contextual programming classes for teachers, and has recently written a textbook on programming for school teachers.

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 is a teacher in the ProFag project and has recently co-authored a text-book in programming for school teachers.

ALESSANDRO MARIN
Software engineer, S-ASSES project
Alessandro has a background as a data scientist, scientific programmer, and has a PhD in bioin-formatics. He has long experience with managing scientific software projects with both back-end and front-end experience. He is responsible for developing the software tools necessary for the S-ASSESS project, for developing and maintaining local software such as docOnce, and contributes with data-science expertise in research projects.

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	WP leader, 20% Course development, 20%	Professor	Physics, UiO
Ellen Karoline Henriksen	WP leader, 20%	Professor	Physics, UiO
Cathrine W. Tellefsen	WP leader, 20% Teacher education	Leader teacher education program	KURT, UiO
Lex Nederbragt	WP leader, 20%	Senior lecturer	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
Tor Ole Odden	Post-doc	Post-doc	CCSE
John Aiken	PhD-student/Researcher		CCSE
Odd Petter Sand	PhD-student		CCSE
Andreas D. Haraldsrud	Educational devel/research	Lecturer	CCSE
Alessandro Marin	Technical support	Senior engineer	CCSE
Instructional development			
Øyvind Ryan	Course development, 20%	Ass. Prof.	Math, UiO
Andreas Görgen	Course development, 20%	Professor	Physics, UiO
Dag Kristian Dysthe	Course development, 20%	Professor	Physics, UiO
Henrik Sveinsson	Course development, 10%	PhD-student	Physics, UiO
Mikkel Lepperød	Course development, 25%	PhD-student	Comp Sci, UiO

Name *(continued)*	Function	Position	Unit
Student representatives			
Gulla Torvund	Student representative		UiO
Karl Henrik Fredly	Student representative		UiO

External projects

Granting body	Project title	Project period	Funding	PI/partners
Intpart/NRC	US-Norwegian collaboration on fluid-consuming processes	2017-2021	4500 kkr	PI: Anders Malthe-Sørenssen
Thon stiftelsen	Student-driven research for improved science education	2018-2021	1500 kkr	PI: Danny Caballero
FinnUT/NRC	Structured assessment method for improved student learning	2018-2023	6000 kkr	PI: Anders Malthe-Sørenssen
Norgesuniversitetet	eAssess	2018-2020	1800 kkr	PI: Omid Mirmotahari, Dept. of Computer Science, UiO; CCSE is a partner
Intpart/NRC	International partnership for Computing in Science Education	2019-2022	4500 kkr	PI: Morten Hjorth-Jensen
EU Erasmus+ KA3	Innovating STE(A)M in Higher Education with Transdisciplinary Talent Programs	2020-2022	667 kEUR	Hanze University, University of Oslo (CCSE), 16 other partners including CCSE
EU Erasmus+ KA203 Strategic partnerships for higher education	Exploring how to build a joint European Campus based on innovative education for transferable skills	2020-2022	239 kEUR	PI:Aarshus University, Circle-U university alliance, UiO node: CCSE

Accounting 2020

Budget and Expenditures – Diku Funding 2020

Budget Diku funds	Expenditure 2020	Budget 2020
Personnel and indirect costs	4 622	3 446
Purchase of services	600	600
Equippment	200	200
Other operating expenses	828	961
Total	**6 250**	**5 207**

Budget and expenditure – 2021 to 2026

Full Time Employees (FTE)	Sum	2021	2022	2023	2024	2025	2026
DIKU	20,92	4,68	3,78	3,61	3,03	3,03	2,79
UiO	22,08	4,58	3,70	3,70	3,70	3,70	2,70
Total	**43,00**	**9,25**	**7,48**	**7,31**	**6,73**	**6,73**	**5,49**

Budget	Sum	2021	2022	2023	2024	2025	2026
DIKU	-29 082	-4 847	-4 847	-4 847	-4 847	-4 847	-4 847
UiO	-44 543	-10 483	-6 896	-6 985	-7 025	-7 149	-6 006
Total income	**-73 625**	**-15 330**	**-11 743**	**-11 832**	**-11 872**	**-11 996**	**-10 853**
Personell DIKU (excl. overhead)	18 443	4 701	2 979	2 962	2 614	2 672	2 515
Personell DIKU (overhead)	7 372	2 012	1 162	1 155	1 020	1 042	981
Personell UiO (incl. overhead)	31 313	6 253	5 096	5 185	5 225	5 349	4 206
Equipment	1 200	200	200	200	200	200	200
Transfer to USN	3 600	600	600	600	600	600	600
Student projects	6 000	1 000	1 000	1 000	1 000	1 000	1 000
Running costs	5 697	881	936	910	946	946	1 078
Total costs	**73 625**	**15 647**	**11 973**	**12 011**	**11 605**	**11 809**	**10 579**

List of products

AWARDS

Prize	Name	When
Excellent Teaching Practitioner and member of the Pedagogic academy at UiO	Anders Malthe-Sørenssen	2020
Excellent Teaching Practitioner and member of the Pedagogic academy at UiO	Morten Hjorth-Jensen	2020
The Olav Thon Foundation, National Prize for Excellence in Teaching	Cathrine Tellefsen	2020

Visitors to CCSE

Who	Topic	When
Associate Professor Matthew Berland, University of Wisconsin-Madison	Presentation of Physics educational research	24.01-31.01.2020
Professor Heather Lewandowski, University of Colorado Boulder	Presentation of Physics educational research	08.02-15.02.2020
Postdoctoral research assistant Carrie Weidner, Aarhus University	Presentation of Physics educational research	13.02.2020
Professor Lene Møller Madsen, University of Copenhagen	Presentation of Physics educational research	24.02.2020
Prof. Mark Guzdial and Ass. Prof. Barbara Ericson, University of Michigan	Presentation of Physics educational research	01.03-06.03.2020

Graduated PhD-students

Who	Topic	When
John Aiken	Thesis title: Understanding University Student Pathways Towards Graduation with Machine Learning and Institutional Data	25.09.2020

Dissemination – external events

THE ROLE OF CCSE

Topic	Where, for whom	Who	When
Introduction to CCSE	Innved4TS virtual site visit for Circle-U	Malthe-Sørenssen	15.10.2020
Computational physics and machine learning	Innved4TS virtual site visit for Circle-U	Hjorth-Jensen, Malthe-Sørenssen	15.10.2020
CCSE: administrative and leadership perspectives	Innved4TS virtual site visit for Circle-U	Mørken, Malthe-Sørenssen	15.10.2020
Computational thinking for humanists	Innved4TS virtual site visit for Circle-U	Linnebo, Sveinsson, Malthe-Sørenssen	15.10.2020
Computing in bioscience education	Innved4TS virtual site visit for Circle-U	Nederbragt	15.10.2020
Computational literacy and student agency	Innved4TS virtual site visit for Circle-U	Odden, Malthe-Sørenssen	16.10.2020
Final remarks and Q&A on CCSE activities	Innved4TS virtual site visit for Circle-U	Malthe-Sørenssen	16.10.2020
Developing a trans-disciplinary honours program at the University of Oslo	STEAM+ seminar	Malthe-Sørenssen	16.10.2020

CONTRIBUTIONS TO SEMINARS, WORKSHOPS AND CONFERENCES

Topic	Where, for whom	Who	When
Harvesting Canvas Data for Learning Analytics	Hub for Learning Analytics Research (HuLAR)	Alessandro Marin	27.01.2020
Harvesting Canvas Data for LA/ Topic Analysis on Science Education literature	Internal workshop organized by Crina Damsa on digital data collection and analysis	Alessandro Marin	13.10.2020
Computing in BioScience Education	CircleU site visit - Innoved4TS Oslo Site Visit: Computing in bioscience education	Lex Nederbragt	15.10.2020
Discussion of biologist, physicist and chemist, "Why does evolutionary biology need mathematics and computer science?"	Moscow Science Festival	Nils Christian Stenseth, Anders Malthe-Sørenssen, Arten Oganov	17.10.2020
Machine learning for teachers and students	UiO annual seminar series for high-school teachers	Malthe-Sørenssen	29.10.2020

WORKSHOPS AND CONFERENCES ORGANIZED BY CCSE

Topic	Where, for whom	Who	When
Computing in Science Education – Two-day Site Visit for Circle-U committee in Innoved4TS project	Two-day site visit for Circle-U committee in Innoved4TS project.	Malthe-Sørenssen, Hjorth-Jensen, Mørken, Tellefsen, Odden, Nederbragt, Torvund, Fredly	15.10.2020–16.10-2020
ProFag vgs 1 (high schools)	Course for 40 high school teachers	Tellefsen, Mørken	12.06.2018–20.12.2018
ProFag-U (middle school)	Course for middle school teachers	Tellefsen, Haraldsrud, Løvold, Gregers	10.10.2019–20.04.2020
ProFag-U (middle school)	Course for middle school teachers	Tellefsen, Haraldsrud, Løvold, Gregers	07.10.2019–23.04.2020
ProFag-U (middle school)	Course for middle school teachers	Tellefsen, Haraldsrud, Løvold, Gregers	17.10.2019–27.04.2020
ProFag-U (middle school)	Course for middle school teachers	Tellefsen, Haraldsrud, Løvold, Gregers	14.10.2019–30.04.2020
ProFag vgs 1 (high schools)	Course for high school teachers	Tellefsen, Haraldsrud, Løvold, Gregers	16.09.2019–19.03.2020
ProFag vgs 1 (high schools)	Course for high school teachers	Tellefsen, Haraldsrud, Løvold, Gregers	12.09.2019–16.03.2020
ProFag vgs 1 (high schools)	Course for high school teachers	Tellefsen, Haraldsrud, Løvold, Gregers	09.09.2019–26.03.2020
ProFag vgs 1 (high schools)	Course for high school teachers	Tellefsen, Haraldsrud, Løvold, Gregers	19.09.2019–23.03.2020

WORKSHOPS AND CONFERENCES ORGANIZED BY CCSE PERSONNEL

Topic	Where, for whom	Who	When
Nuclear talent course on machine learning in nuclear physics for the Erasmus+ program	European Master in Nuclear Physics, University of Basse-Normandie and GANIL, 45 lectures, 45 exercise sessions	Hjorth-Jensen	20.01–31.01.2020
Machine learning weeks as MSU-FRIB/NSCL	Machine learning applied to Nuclear Physics, Two daily lectures and one hour hands-on session, 25-30 participants, 20 one-hour lectures	Hjorth-Jensen	18.05–29.05.2020
Online nuclear talent course on machine learning applied to nuclear physics	European center for theoretical nuclear physics and related areas, Trento, Italy	Hjorth-Jensen, Bazin, Liddick, Kuchera, Ramanujan	22.06–03.07.2020

CONTRIBUTIONS TO POLICY AND THE PUBLIC DEBATE

Topic	Where, for whom	Who	When
Hvorfor programmering og algoritmer?	Danmarks læringsfestival	Knut Mørken	04.03-05.03.2020
IKT i alle fag	Presentasjon for arbeidsgruppe for ny nasjonal, digitaliseringsstrategi	Knut Mørken	17.04.2020

Dissemination – internal events

CCSE SEMINAR SERIES

Title	Who	When
Creative Agency: Making, Learning, and Playing towards Understanding Computational Content	Associate Professor Matthew Berland, Univ. of Wisconsin–Madison	27.01.2020
Using research-based approaches to transform upper-level physics lab courses	Professor Heather Lewandowski, University of Colorado Boulder	10.02.2020
Using a flow-based quantum visualization tool to enhance student learning: does it really work?	Postdoctoral research assistant Carrie Weidner, Aarhus University	13.02.2020
Students learning to do science - with a special focus on inquiry In collaboration with iEarth (SFU)	Professor Lene Møller Madsen, University of Copenhagen	24.02.2020
Teaching Computer Science to Reach a Broader Audience	Prof. Mark Guzdial and Ass. Prof. Barbara Ericson, University of Michigan	02.03.2020
Intentionally interdisciplinary: the design and implementation of Computational Mathematics	Dr. Devin W. Silvia, Director of Undergraduate Studies, Michigan State University	16.12.2020
Using Computation to Support Student Creativity and Agency in Science	Dr. Tor Ole Odden, post doc, CCSE	16.12.2020
Incorporation of scientific programming in the engineering studies at USN - Experiences and reflections	Professor Marius Lysaker, University of South Eastern Norway	16.12.2020

Continues on the following page

THE BI-WEEKLY ODD SEMINAR SERIES AT CCSE

The Open Discussions on Didactics (ODD) is a seminar series on Tuesdays at 14.00 every other week (odd week numbers) on Zoom.

The seminar will be maximum one hour, often closer to half an hour. 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 in our environment, we aim for seminars that introduce listeners to new ideas within a broad spectrum of aspects, and that invites reflection and discussion.

Presentations need not be mature and polished - to the contrary, we hope that as many as possible wants to share undigested observations and reflections in short presentations of varied form and topics. We hope to have enough contributions to frequently have the meetings as lightning talk sessions, where three different speakers will each give a 5-10 minute presentation followed by discussion.

Title	Who	When
Using topic modeling to analyze massive amounts of educational research literature	Post doc. Tor Ole Odden	03.11.2020
Three different lightning talks on educational research projects	Audun Skau Hansen, Department of Chemistry; Cathrine Wahlstrøm Tellefsen, KURT; Gabriel Balaban, Department of Informatics	17.11.2020
Discussion session - what does it really take to learn programming?	Professor Geir Kjetil Sandve, Department of Informatics	03.12.2020

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	Sand, Tellefsen	09.01.2020
REAL education seminar (English)	REAL education, seminar for teachers and faculty of Mathematics and Natural Sciences, UiO	Tellefsen	10.01.2020
Studentaktiv læring	Workshop på kurs i universitetspedagogikk	Tellefsen	11.03.2020
Scientific Teaching Seminar	In collaboration with iEarth for teachers in Geosciences	Tellefsen	25.05-28.05.2020
ITiCSE 2020; scientific programming in K12	Videobidrag til digital konferanse	Tellefsen	June 2020
REAL Prat (talk)	Samarbeid mellom emneansvarlig og gruppelærere	Tellefsen	09.06.2020
REAL Prat (talk)	Studiestart høst 2020	Tellefsen	11.06.2020
REAL education, seminar (Norwegian)	Teachers at Faculty of Mathematics and Natural Sciences, UiO	Tellefsen	13.08.2020
REAL education seminar (English)	REAL education, seminar for teachers and faculty of Mathematics and Natural Sciences, UiO	Tellefsen	14.08.2020
REAL prat (talk)	Digital hjemmeeksamen	Tellefsen	15.09.2020
Studentaktiv læring – workshop	Del av kurs i universitetspedagogikk	Tellefsen	16.09.2020

WORKSHOPS AND CONFERENCES AT CCSE

Topic	Where	Attendance	When
From quantum physics and ML to sales & trading at Scandinavia's largest bank (DnB)	Vilde Flugsrud, DnB	25	18.09.2020
PhD defence: Understanding University Student Pathways Towards Graduation with Machine Learning and Institutional Data	John M. Aiken, CCSE	50	25.09.2020
Presentation + gaming evening	Cecilie Mauritzen, Meteorologisk Institutt	25	02.10.2020
Presentation of research at SIMULA and master of science thesis projects	Xing Cai and Joakim Sundnes (SIMULA/IFI)	25	16.10.2020
Master projects in Computational Physics and Computational materials science	Morten Hjorth-Jensen, Sebastian Gregorius Winther-Larsen, Stian Bilek and Øyvind Sigmundson Schøyen, CCSE	25	23.10.2020
Fish abundance estimation using deep learning	Ingrid Utseth, Norsk Regnesentral	25	30.10.2020
Material Science, Neuroscience and molecular dynamics (mostly in physics and life science), from classical simulations to machine learning	Anders Malthe-Sørenssen, CCSE	25	06.11.2020
Computational Neuroscience	Gaute Einevoll, UiO and UMB	25	13.11.2020
Machine Learning in the real World	Signe Riemer-Sørensen, SINTEF	25	20.11.2020

RELEVANT MASTER THESIS PROJECTS

Topic	Student	Supervisors	Department	Period
Programming with Tychos in Physics 1	Andreas Fagerheim	Henriksen, Odden	Physics	2019-2020
Programming with VPython/Trinket in Physics 1	Jonathan Brakstad Waters	Henriksen, Odden	Physics	2019-2020
Biologistudenters motivasjon for beregningsorientert biologi etter innføring av krav om full fordypning i realfaglig matematikk	June Edvarda Eliassen	Nederbragt	Biosciences	2019-2020
Relevansen av kompetansen fra matematikk R2 i beregningsorientert biologi	Sofie Rudberg	Nederbragt	Biosciences	2019-2020

Publications

Scientifc publications

- Odden, T. O. B., Marin, A., & Caballero, M. D. (2020). Thematic Analysis of 18 Years of Physics Education Research Conference Proceedings using Natural Language Processing. Physical Review Physics Education Research, 16(1), 10142. https://doi.org/10.1103/PhysRevPhysEducRes.16.010142
- Odden, T. O. B., & Burk, J. (2020). Computational Essays in the Physics Classroom. The Physics Teacher, 58(252), 252–255. https://doi.org/10.1119/1.5145471
- Odden, T. O., & Malthe-Sørenssen, A. (2021). Using computational essays to scaffold professional physics practice. European Journal of Physics, 42(015701), 1–22. https://doi.org/10.1088/1361-6404/abb8b7
- John M. Aiken, Riccardo De Bin, Morten Hjorth-Jensen, Marcos D. Caballero, Predicting time to graduation at a large enrollment American university, PLoS ONE 15, e0242334 (2020)

Scientific talks and posters

- Odden, Tor Ole; Yadav, Aman; Tellefsen, Cathrine Wahlstrøm & Caeli, Elisa Nadire (2020). Integrating Computing into K-16 Education: Scaffolding Teacher and Student Learning in STEM Disciplines. Annual Conference on Innovation and Technology in Computer Science Education, ITiCSE. ISSN 1942-647X. s 517- 518. doi: 10.1145/3341525.3393961.

Books

- Andreas D. Haraldsrud, Henrik A. Sveinsson og Henrik H. Løvold, Programmering i skolen, Universitetsforlaget, 2020.
- Cathrine W. Tellefsen, textbook for Naturfag for VG1 (high school textbook in natural science), in which programming is integrated in both the textbook and in other learning materials, 2020.

Social media

- Facebook: www.facebook.com/CentreForCSE/
- Web: www.mn.uio.no/ccse/
- Blog: www.mn.uio.no/ccse/om/aktuelt/blogg/

Student activities

STUDENT DEVELOPMENT OF LEARNING MATERIAL

Course and topic	Student	Teacher	When
Course development	Sigbjørn Lundersgaard Foss	Tor Ole Odden	10.01.2020-30.06.2020
Course development	Åsta Dale	Lex Nederbragt	31.01.2020-17.08.2020
Tungregnemaskiner	Steinn Hauser Magnusson	Anders Malthe-Sørenssen	25.02.2020-30.06.2020
Transkribering	Aleksander Bye Pedersen	Odd Petter Sand	01.01.2020-31.05.2020
Transkribering	Ester Kristine Olsen	Odde Petter Sand	01.01.2020-31.05.2020
Transkribering	Astrid Johanne Sørnes	Tor Ole Odden	25.02.2020-14.04.2020
Honours program development	Davide Zapulli	Øystein Linnebo	01.01.2020-30.06.2020
Honours program development – AI course for new honours students	Anna Hjertvik Aasen, Iris Sørbye Bore, Simon Peder Halstensen, Thomas Lønn Hammer, Didrik Sten Ingebrigtsen, Henriette Johansen, Vala Margretardottir, Borgar Nilsen, Tor Magnus Næsset, Henrikke Gedde Rustad, Gulla Torvund	Henrik Anderson Sveinsson	15.06.2020-16.08.2020
STEAM+	Didrik Sten Ingebrigtsen	Ella Maria Cosmovici Idsøe, Anders Malthe-Sørenssen	10.03.2020-15.06.2020
Honours development, data-driven course for honours students	Erik Aashamar, Tiril Flatebø, Severin Schirmer	Henrik Anderson Sveinsson	15.06.2020-31.12.2020
Integration of data analysis and computation into teaching activities	Erin B. Bjørkeli, Benedicte Nyheim, Linda Tran, Pari Faraj,	Angela Lupattelli, Hedvig Marie Egeland Nordeng	01.06.2020-31.10.2020
Programmeringsspråksmodeller i IN1000 og IN1010	Annika Willoch Olstad	Siri Moe Jensen	15.06.2020-31.08.2020
Utvikle glasiologi-relaterte beregningsoppgaver	Victor Devaux-Chupin, Joschua Sommerkorn	Thomas Vikhamar Schuler	15.08.2020-30.11.2020
Development in biosciences	Oda Hovet, Hallvard Wæhler, Tiril Andersen Gjerstad,	Per Eugen Kristiansen, Lex Nederbragt	15.06.2020-31.12.2020

Continues on the following page

Course and topic *(continued)*	Student	Teacher	When
BIOS1100 – Introduction to computational models for Biosciences	Nicolai Haug	Lex Nederbragt	22.06.2020-31.12.2020
Kjemi: lage programmeringsoppgaver til matematikkemnet MAT1060	Richard Pedersen Patrono, Vasin Phumimas	Sissel Jørgensen, Simen Kvaal	15.06.2020-31.08.2020
Educational development for FYS4340	Magnus Reiersen, Mari Røsvik	Anette Eleonora Gunnæs	01.07.2020-31.07.2020
Educational development in MAT3500/MAT4500	Elias Fåkvam	Erlend Fornæss Wold	24.08.2020-20.11.2020
Educational development in IN1150	Tobias Østmo Hermansen	Roger Antonsen	15.06.2020-31.08.2020
Exercises for Fys1120 - electromagnetism	Sigurd Rustad, Bror Hjemgaard, René Alexander Ask	Anders Malthe-Sørenssen	22.06.2020-31.08.2020
Development of learning material for HON2200 – data driven projects	Eline Prytz Andersen	Henrik Anderson Sveinsson	12.01.2020-31.05.2020, 15.06.2020-31.08.2020
Development of learning material for HON2110 – Programming for humanistic studies	Karl Henrik Fredly	Henrik Anderson Sveinsson, Tor Ole Odden	12.01.2020-31.05.2020, 15.06.2020-31.12.2020

STUDENT RESEARCHERS

Theme	Students	Supervisors	When
Machine learning for materials science using molecular dynamics simluations	Johan Emil Linnestad Larsson, Mikkel Metzsch Jensen	Henrik Sveinsson, Even Nordhagen	22.06.2020-31.08.2020
Bio-inspired AI methods	Jakob Lange, Didrik Sten Ingebrigtsen, Elias Tidemand Ruud	Mikkel Lepperød, Alexander Johannes Stasik	02.07.2020-31.08.2020

UiO : University of Oslo

CENTRE FOR EXCELLENCE IN EDUCATION

Center for Computing in Science Education
A Center for Excellence in Education from 2016–2021

Center leader
Anders Malthe-Sørenssen

Contact address
Center for Computing in Science Education
Department of Physics, University of Oslo, Norway
P.O. Box 1048 Blindern, NO-0316 Oslo