Center for Computing in Science Education

Annual report 2017

CCSE

Center for Computing
in Science Education

Abstract

The Center for Computing in Science Education (CCSE) aims to become an international hub for the research-based integration of computing into 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 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. However, material and methods should be based on research on how students learn computational modeling and how computational modeling affects learning of the specific discipline. Therefore, CCSE needs to develop a related research activity in computational science education research.

In 2017 the center become operational, personnel was hired and all activities were initiated. We have started to build a research group in computational science education research. An internationally leading researcher in the field, Professor Danny Caballero from Michigan State University, was hired in an adjunct position, and two new PhD-students and a postdoc has been hired. Four grant applications have been submitted to highly competitive national programs – drawing up a framework for the research activity. Three applications have been granted with a total budget of 13 million kr, and the fourth application is currently under review. This provides the research group with an excellent opportunity to build a strong activity in the coming years.

The center has contributed to develop a culture for teaching and learning. CCSE personnel is contributing to workshops, seminars, courses and retreats at the Department of physics, at the Faculty, at the University of Oslo, nationally and internationally. We are actively teaching student-active teaching methods and are building a portfolio of courses in computational methods for teachers and faculty.

The Faculty of Mathematics and Natural Sciences renewed all its study programs in 2017. CCSE personnel have been central in the InterAct process whereby all study programs were redesigned according to principles of backward design and constructive alignment. All study programs also integrate computing and provide an introductory course in scientific programming – adapted to the specific disciplinary context – in the first semester. This provides a foundation that subsequent courses can build on – allowing integration of computational approaches throughout the study program.

We are particularly proud that the new study program in bioscience includes a programming course in the first semester. The University of Oslo (UiO) is, as far as we know, the first university to provide such a course and such an integration of computing in bioscience. This is an exciting pilot that will be studied in our research activity and continuously improved through our instructional development practices.

Digitization will be an important theme in education in 2018 and the coming years. CCSE has the experience and competence to drive digitization in education – and as a Center for Excellence in Education we have a mandate to do it. We are happy to take on this challenge and help transform education to fully integrate computing in 2018.

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 is becoming more and more important 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 very 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. And this requires a deep digital competence. 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 makes possible 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 2018, with good reason. The advent of new technologies, represented by breakthroughs such as Alpha Zero, 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. This strategy points to the importance of digital competence at all levels in higher education – for researchers, students, teachers, and administration. 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.

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. Hence, only the largest institutions will be able to provide high quality, research-based education that integrates the computational and digital perspectives.

We are convinced that the approach and strategy of CCSE will only 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 – and is already a significant challenge across Europe. 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.

We are looking forward to 2018 – the year of deep digital competence.

Highlights from 2017

Digital competence

The concept of digital competence and its importance for government and industry has grown to become one of the main themes in education in 2017. The Ministry of Education introduced its digitization strategy for higher education, and the call for programming in schools and universities from students and employers have been clear. CCSE provides a clear solution – integrate the use of computers to solve problems, computing, into the curriculum across educations. In 2017 CCSE personnel have contributed with our insights into many events organized by universities, stakeholders, NGUs, student-organizations and industry – nationally and internationally. We expect many of these interactions to lead to longer term collaborations and partnerships on how to build educations for a digital future.

Center establishment

The main focus in 2017 has been the establishment of the center. Administrative routines have been introduced, working groups and boards have been selected, funding schemes have been established and reports and contacts have been formed with partners nationally and internationally. The student-based activities, including student involvement in curriculum development and student research projects, have more than doubled. The position of the center as a source of competence has been established within the university and with governmental bodies. We expect the establishment period to last until we move into new localities in 2018.

Computational science education research group

A goal of the center is to develop a research activity to address the effects of the integration of computing in science education, and in 2017 we established computational science education research group. To ensure a rapid build-up of competence, we have developed a partnership with Michigan State University professor Marcos D. Caballero. He is a world-leading researcher on the effects of integrating computational methods in physics education and holds an adjunct position at the center. In addition, Associate professor Christine Lindstrøm joined us in an adjunct position. She has a background in student-active learning from physics education research from the University of Sydney and the University of Colorado, Boulder. We have hired two PhD-students. John Aiken, who has extensive experience from physics education research, and Odd Petter Sand, with a master in astrophysics. We also secured two grants from the Thon foundation for student-active research projects, and one grant from FinnUt, the Norwegian Research Council's education research program. This demonstrates that our research activity already is meeting a high national and international standard.

Culture development and the Christmas seminar

The annual Christmas seminar in 2017 was a great success with over 80 faculty present and presentations from top international researchers as well as internal presentations on instructional development. The seminar is becoming the University's main meeting point for educational development.

Programming for bioscience students

2017 saw the introduction of new bachelor programs in all science disciplines at UiO, and all programs include a computational aspect – including bioscience. CCSE has played

a central role in the development of the new introductory course in computational modelling in bioscience – BIOS1100 – a first semester course that is compulsory for all bioscience students. The course is based on a new textbook written by four PhD-students in neuroscience who all have backgrounds in computational physics. The textbook is the first to provide an introduction to programming in a biological context and is accepted for publication by Springer. The course was taught by Lex Nederbragt using novel, student-active methods in the new learning laboratory at the Department of bioscience. The course and the learning laboratory was a focus of the Minister of Education's visit to UiO in October 2017. Two MSc-students and one PhD-student will study the implementation of computational approaches in BIOS 1100. We are excited about the future of computing in all sciences at UiO.

Student research projects

CCSE received two grants from the Thon foundation to develop student research projects. In 2017 12 bachelor-students were involved in research projects of more than one months duration. This is possible because our students have acquired relevant programming and computing skills early in their studies, and therefore have can contribute meaningfully already after one year. The project also provides students with a chance to experience the world of research and to demonstrate other aspects of their skills and abilities early on.

Professor Knut Mørken received the 2017 Thon award for excellent teaching.

The prize is 500.000 kr and was given to Professor Mørken during the Thon prize ceremony in the University Aula on March 2nd. The prize was awarded Mørken for his visionary work as an educator. Mørken is the founder of the InterAct program at the University of Oslo. The program aims to redesign the education based on constructive alignment between what students need to learn to meet tomorrows demands, the learning outcomes of study programs and courses, and the learning activities. He has advocated reverse design of study programs – starting from the wanted outcomes and the main objectives, and then designing the detailed contents. He has been a key driver for the implementation of Computing in Science Education at the University of Oslo, where he has provided an essential mathematical perspective to the curricular reform. He has also developed new courses and textbooks that integrate computing in math education, and he has worked to develop a strong learning environment so that students can develop personally as well as professionally throughout their education. Knut Mørken is the leader of the bachelor program in mathematics and is a popular communicator of educational design practices nationally and internationally. We are very proud to have him as a central part of CCSE. Congratulations, Knut!

Lessons Learned

The activity of the center is progressing nicely and according to plans. However, there are some challenges we are experiencing – expected or not – that will inform our activities over the coming years.

Research

The ambition to develop an internationally visible research activity is a bold proposition, which requires strategic planning and hiring, partnerships and resources similar to that of other research initiatives. We have spent significant time on building partnerships and developing the research portfolio, and consider this a good investment. However, high quality research is difficult to direct – we must therefore carefully consider how research is directed and stimulated to ensure it contributes to instructional development, culture and dissemination.

Instructional development

We have a very active core group who contributes actively to course and material development. A challenge is to extend this group and ensure that teachers who are recruited to the most important courses can be motivated to contribute to development. More development should also be done by seniors and not only by PhD- and summer students. The development group should also be widened to include more faculty in chemistry, bioscience, mathematics and computer science.

Culture for learning and teaching

The culture in the core group is strong, but we need to continue to work to include a wider range of faculty in seminars, courses and workshop. Many faculty do not have updated skills in computational methods – workshops and summer institutes are therefore important tools. We must also ensure that the whole department and the whole Faculty feel that CCSE is a common good that contributes to improve teaching for all.

Documentation

We need to improve documentation of improvements in teaching and student learning – and to establish both baseline and continual measurement practices. This must involve improved usage of measurement tools and custom-made surveys.

Plans and Priorities for 2018

The main activities of the center will follow the action plan. However, several new developments that are timely and important will have impact on the priorities for 2018.

Digitization

The growing important of digitization will affect the activities of the center. We will focus on redefining the interpretation of "digital competence" to ensure it includes aspects such as programming, computing and data science. A significant national and international challenge is to educate teachers and to re-educate the workforce. This requires a combination of disciplinary, computational and educational competence that we have in CCSE, but which is not present in many other institutions. We will therefore establish a European network to educate the teachers of tomorrows teachers, to build competence in computational science education research, and to educate PhD-students to meet this need for competence across Europe. We will also focus on professional development for teachers with particular focus on computational proficiencies.

School collaborations

Several schools in the Oslo area has started to integrate computing by offering a new course in Modeling and programming, or by integrating computational aspects and programming into math and sciences courses. This provides an opportunity to study the effect of computational modeling vertically across 8-10, 11-13 and higher education. We are in a unique position to develop curriculum, implement instructional practices, and study effects on student learning. We will therefore hire the teacher responsible for the new course in an adjunct position at the center, contribute to develop learning material for schools, and build courses for professional development for teachers.

Computing in mathematics education

We will extend our collaboration with Elise Lockwood at Oregon State University and build a mathematics education research activity with focus on the effects of computing. The goal is that this will have a positive impact on instructional development and curricular design in mathematics.

New localities – establishing a hub for computational teaching

CCSE will move into their new localities in 2018. This is an opportunity to build CCSE as a hub for educational development at the Faculty and as a meeting place for teachers and students. In 2018 we will prioritize to build new traditions in our new localities.

Culture development – increasing the impact

We will also focus on including more teaching faculty and students in the activities at CCSE to broaden its impact: We will actively recruit for workshops and seminars, and include more of the teachers in research and Scholarship of Teaching and Learning (SoTL) activities.

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

A major objective of the center is to develop high quality learning material. The material should demonstrate how the integration of computing can change the exposition, examples, exercises and activities of the subject matter. This material must be developed by highly qualified teachers who also master computational methods and approaches. Typically, textbooks are written and continuously improved over years. Our ambition is that this incremental development and improvement should be based on research into how the learning material is used by teachers and students and how that use affects student learning. Thus, the development of material should be paired with the education research activity of the center.

Writer support

The center supports 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 (see box), which is developed by CCSE, and we provide introductory workshops for teachers who want to use docOnce.

Textbook: Waves and oscillation.

Associate professor Arnt Inge Vistnes has developed the textbook Waves and oscillations that fully integrates the use of computing in this classical field of mechanics. This opens for a more research-near text with modern methods and examples that are interesting and useful for the student. For example, the student learns to solve the wave equation in one and two dimensions also in non-trivial situations, and modern methods of analysis, such as the use of wavelets are both explained, implemented and applied to relevant problems. The textbook is accepted for publication by Springer and was translated from Norwegian to English in 2017.

Infrastructure and distribution

CCSE has initiated and supported the introduction of Jupyter notebooks. A Jupyter notebook is a document that combines text with markup, mathematics, images, and runnable code – including complete programs. The notebook can be edited by students so that the can include their own comments and notes as well as their own programs. Exercises and projects are often distributed in notebook form, so that students can finish the notebook and hand it in. We also encourage students to use notebooks as their working tools. In the course Fys1210 – Electronics with student projects, student use Jupyter notebooks in all aspects of their laboratory work: They program pre-laboratory exercises, they

collect measurement data from experiment, and they present their results – all directly in notebook format. The notebooks are handed in and feedback is provided in notebook form to the students. In the course BIOS1100 all material is distributed in notebook form, and students hand in exercises in notebook form. CCSE has supported a university-wide hosting service for Jupyter notebooks through JupyterHub at UiO. JupyterHub provides a web-based interface for students to work on notebooks and run programs using only a web browser. Thus, students do not need to install any specialized software on their computers. This simplifies the "bring-your-device" approach, because students can use any device in the classroom. This platform also greatly simplifies the distribution of material.

Student participation

Students play an important role in the development of learning material. CCSE financed 20 summer student scholarship in 2017. 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. (See box). 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. Priority is given to courses that need to transform. For example, in 2017 6 of 20 student projects were awarded to bioscience courses, where students have developed programming exercises for biology students in the introductory programming course as well as in subsequent courses. Students present their results in a workshop after the summer and teachers and students present their results at the annual CCSE conference to disseminate the results and inspire other teachers.

Research basis for curriculum development

The research basis for new learning material will be investigated by the research education activity of the center. The first project to address student learning and feedback directly is the S-ASSESS project, where a structured assessment method is developed to address student learning directly. In addition, PhD-students and student researchers will address student learning of computational methods in various science context.

Repository

The original plan for CCSE was to develop a national and international repository for learning material that integrates computational methods across sciences. However, through our collaboration with Michigan State University, we have become involved in their NSF-financed Partnership for Integration of Computation into Undergraduate Physics (PICUP) project (http://gopicup.org). One goal of this project is to provide an international repository for learning material that integrates computing in physics. We have therefore postponed the introduction of the CCSE repository to evaluate how best to interface with the PICUP project as well as with other disciplines and Norwegian and European communities.

Plans and priorities for 2018

- Initiation of writing workshops for teachers who develop new curriculum
- Extended use of JupyterHub and Jupyter notebooks
- Funding for writing retreats for teachers
- Development of new material for courses in computational methods, introductory courses where there is currently sparse high quality material, material for second-semester courses in bioscience and material for second- and third-semester courses in mathematics.

- Engaging students in testing and checking learning material to reduce errors and improve readability

Action plan

WP1: Research-based development of teaching material (Leader: Hjorth-Jensen)											
A1.1	Repository for material and evalution methods										
		Establish repository			D						Working repository
		Enable stakeholder feedback				D		D		D	Yearly usage reports in A0.4
A1.2	Develop and test textbooks and interactive and modularized material										
		Publish textbook 1: Fys2160: 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: Fys1120: 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	Preliminary books
		Develop material for two math courses,. Publish in repository				M				M	Material in repository
		Develop material for AST2000: 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		Research project of PhD1
		Postdoc Project		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		Yearly meetings
		Support writing escapes for textbook and material authors	M		M		M		M		Support 2-4/yr; Report through A0.4
		Systematic use of student evaluation to improve texts	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		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

Comments

A1.1: The repository development has been delayed to coordinate with the PICUP project.
A1.2: Textbook development is progressing in Fys2160 – Thermal Physics, but has been delayed in Fys1120 – Electromagnetism.
A1.3: PhD-student 1 has started an is focusing on Fys-mek1110 – Introduction to mechanics and BIOS1100 – Introduction to Computational Modeling for Bioscience. The postdoc starts in 2018.
A1.4: Most of the actions are proceeding according to plan. However, the repository has been delayed to coordinate with the PICUP project.
A1.5: Activities that support writers have been delayed, primarily due to scheduling challenges for the relevant authors. Jupyter and docOnce activities are as planned.

DocOnce development 2017

We aim to develop new learning material that combines text, illustrations, mathematics and programs. The material should be flexible and modular and easily be transformed to any distribution. To meet these requirements, Hans Petter Langtangen developed the formatting and transformation tool 'docOnce'. 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 text for learning material that includes mathematics and programming. The tool is widely used in our textbook projects and for producing learning material. Five textbooks have already used the tool and four new textbooks under development at CCSE is using it as part of the development.

DocOnce has full support for both LaTeX and Jupyter notebooks – and it is fully programmable, which is well appreciated in a center that aims to integrate the use of programming. The tool also simplifies the workflow using collaborative tools such as git. For example, if you write a text, you can compile that text into a LaTeX file which a published will use for typesetting, you can compile it into plain html or more advanced html-type formatting such as Sphinx. In addition, you can compile the text into a Jupyter notebook - which is an editable document that also contains runnable code and dynamic visualizations. Jupyter notebooks are used for distribution of course material, exercise and student hand-ins in the new course BIOS1100 and in several physics and chemistry courses.

The continued development of docOnce is therefore important for CCSE. We have therefore hired a part-time developer, Kristian Hustad, to support docOnce and continue docOnce development. He will also provide docOnce courses as part of our support to faculty and students that develop learning material and textbooks.

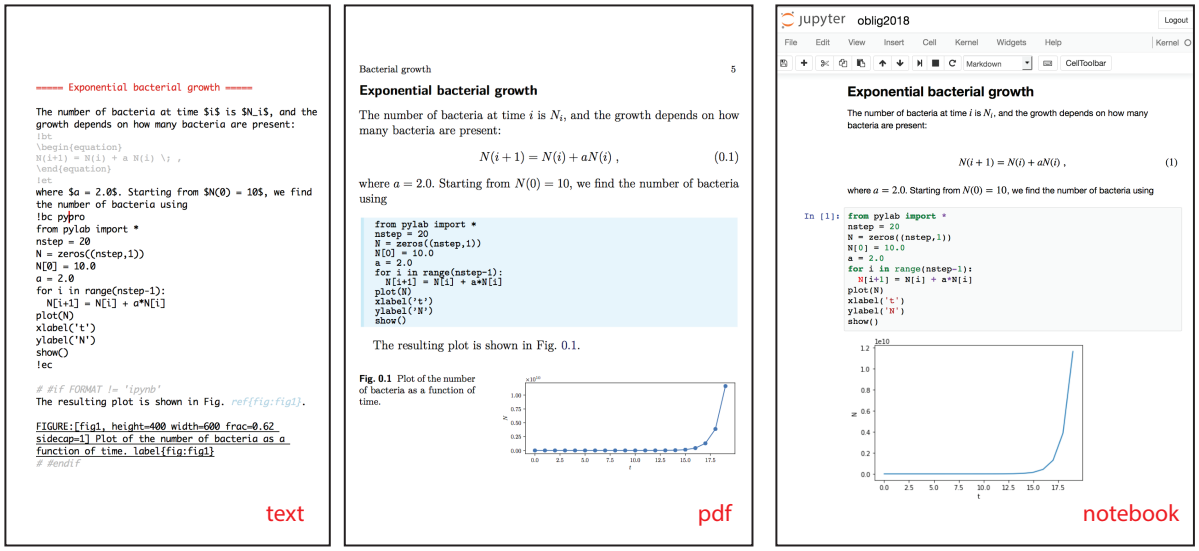


Fig. 1: Illustration of the docOnce text file (left), the corresponding compiled pdf (center) and the corresponding Jupyter notebook (right).

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 disciplinary 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 innovative digital and physical learning environments; (5) Develop, test and evaluate study programs and courses

Activities

Student-active learning

CCSE and KURT (The competence center for teaching in science and technology) has been actively involved in promoting the use of student-active teaching methods in general. In addition, we are working to study and implement student-active teaching methods in science courses. We have started a project with the introductory course in numerical mathematics, MAT-INF1100 - a 500-student yearly course. In Fys-mek1110 – a 350-student introductory course in mechanics – we are involving student teachers to help develop new learning material and to establish a program to improve group teaching and prepare teaching assistant better. Student-active learning methods was introduced into the new programming courses for biology students.

International collaboration

We have established a collaboration between CCSE and the Physics Education Research Lab at Michigan State University. Associate professor Marcos D. Caballero has an adjunct position at CCSE and contributes with student supervision and research. Caballero heads the NSF-funded project "The Partnership for Integration of Computation into Undergraduate Physics" (PICUP) which seeks to expand the role of computation in the undergraduate physics curriculum. PICUP organizes yearly summer faculty development workshops for physics teachers from US higher-education institutions. In these workshops, Caballero and coworkers introduce the participants to the methods and approaches that can be used to introduce computational methods in physics courses. The workshop consists of both tutorial sessions and projects where teachers work on developing their own computational curriculum. CCSE aims to introduce similar workshops in Norway and Europe starting in 2018.

Education research

CCSE are building an education research activity to provide a research-based background for the integration of computing in various discipline-based contexts.

Student partnership

Students take an active role in both teaching and the development of teaching practices. Bachelor-students in the teacher program contribute to the professional development program for teaching assistants. We have also started to include students in education research projects. PhD-student John Aiken have initiated a student-driven project where bachelor and master students with a computational background apply modern statistical and machine learning method to analyse data from the use of video lectures. This initiative will be continued in 2018 through a recently funded project on "Student-driven

research for improved science education", where bachelor-students will apply non-linear statistical methods and machine learning to understand student learning in introductory science courses. This project will involve approximately 10 students yearly in educational research and will also provide students with a broad introduction to quantitative as well as qualitative research methods used in education research.

Plans and priorities for 2018

- Establish teams of key teachers who will lead development of research-near and work-life relevant examples
- Initiate project on assessment method for computational problem solving (S-ASSESS)
- Develop workshop program on computational methods for teachers
- Develop summer workshops for teachers coordinated with PICUP
- Establish working group to address changes in study programs
- Initiate student research projects and hire first round of student researchers

Action plan

WP2: Research-based development of methods and approaches (Leader: Malthe-Sørenssen)											
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				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 m^2 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

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 biosciece.
A2.2: Data-based methods are developed in the course Fys2160 – Thermal physics, and CS3100 – Data science and machine learning.
A2.3: This project has been financed with three new positions and will start in 2018.
A2.4: The new learning center is used in BIOS1100 and git and github is used in Fys3150 – Computational Physics, and CS3100 – Data science and machine learning.
A2.5: This activity will be initiated in 2018.
A2.6: The research group will be developed gradually by adjunct positions and education of PhD-students and postdocs.

The S-ASSESS project

CCSE was in 2017 awarded a 6 million kroner grant from the Innovation in the public sector funding scheme of FinnUt, the education research program of the Norwegian Research Council (NRC). The grant went to the project "Structured assessment system for improved student learning".

Providing students with timely feedback – assessment – is important for student learning. Assessments may be formative – aimed at providing feedback to help students improve – or summative – focused, instead, on evaluating student learning. Assessment methods must be based on research to ensure that they contribute to learning in a constructive manner.

The goal of this project is to develop, validate and implement an assessment system to be used for teacher-, peer- and self-assessment for general courses as well as for courses that integrate computing. The system will structure the way assessments are performed to ensure research-based feedback to students and more valid and reliable grading of exams. We will accumulate structured data on student learning that will be used to improve and automate feedback.

To ensure a research-based assessment system, we need research to develop and validate effective assessments and to develop assessment structures, such as rubrics or checklists, that are adapted both to traditional scientific concepts and understanding as well as concepts and understanding linked to a computational approach to science.

The project is developed in collaboration with the Department of Informatics and is closely linked to the 1.8 million kr eAssess-project granted by Norgesuniversitet, in which CCSE is a partner.

The grant will finance two postdoc positions that will work on the research needed to realize the innovation. In addition, CCSE, the faculty and the Department of physics will jointly fund a software developer to develop the web infrastructure for the project.

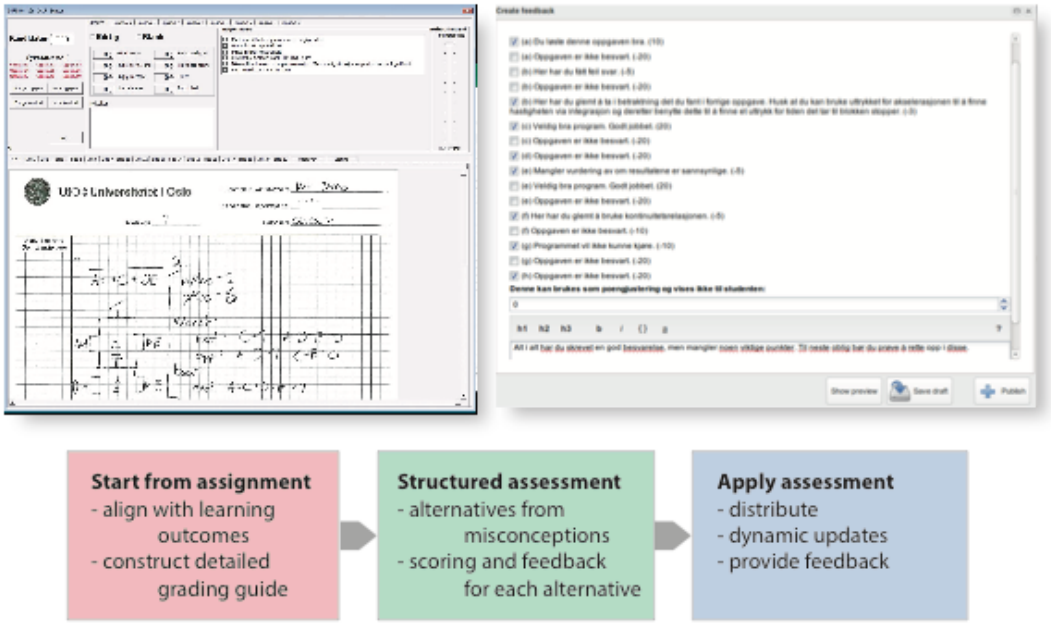


Fig. 2: Illustration of checkbox-based assessment structures from UiO courses.

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

InterAct

InterAct is a project for educational change at the Faculty for Mathematics and Natural sciences. The project aims at introducing new, cross-disciplinary study programs based on the challenges we expect students to meet during a lifelong career. The program focuses on four areas: active learning, teacher culture, learning environment and backward design. The project is based on the concept of constructive alignment. The idea is to start with a clear vision for what students should have learned when they finish a study program. For example, the new physics program started from a discussion of what it meant to be a scientist, then what it meant to be a physicists, which subsequently lead to the overall learning outcomes for the study program. The general learning outcomes included both disciplinary outcomes, cross-disciplinary outcomes, and generic skills. Finally, learning outcomes in specific courses are designed to be aligned with the general learning outcomes. In 2017 the project has resulting in new study programs for all sciences at the Faculty. The focus now is to ensure that teaching methods and assessments also are aligned with the learning outcomes, and to continue to build a culture for teaching and learning at the Faculty.

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 2017 we have focused on establishing several meeting places for teaching faculty and teaching assistants. Together with the Faculty and the Departments, we have contributed to establish day-long seminars where we focus on teaching and learning, called “Real Utdanning” (aimed mainly at faculty) and “Real undervisning” (aimed mainly at teaching assistants). KURT (Competence-center for teaching in science and technology) and CCSE has contributed to teacher seminars at various departments at the Faculty as well as a cross-faculty meeting. In addition, we have organized two one-day teaching seminars at the Department of physics (May and October), and a half-day seminar on language for learning and as a generic skill in the Faculty’s bachelor programs. A seminar on “Physics teacher competence and the culture for teaching and learning in physics departments”, with guest speakers from Uppsala University, was arranged in October.

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 2017 we arranged several 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. The focus of this seminar in 2017 were on international experiences with the integration of computing in physics and mathematics – with top international speakers. In addition, we had a session on computing in schools. We also invite teaching faculty and students who have received summer student support to present their results and experiences with reforming education at the university. The seminar had more than 80 participants from teaching faculty from across the whole university. This seminar is currently the most active meeting place to discuss innovation in teaching and education at the university.

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 effective 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. We had 270 participants in August, and 180 in January. We also arranged a seminar for English speaking teachers with 30 participants in January.

Competence-center for teaching in science (KURT)

In order to support the Faculty's activities to promote professional development in teaching, the Faculty established a Competence centre in STEM teaching (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 web-site. KURT also arranges a "journal club" where participants read, present and discuss inrternational 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 2018

- Develop and provide workshop in Python programming for newbies
- Organize summer institute on scientific teaching focusing on student active method in collaboration with University of Minnesota
- Teach the course "Physics education research and practice" (10 ECTS) – a new course that provides an introduction to Physics education research methods and practices.
- Continue to provide and improve teaching workshops for teaching faculty and teaching assistants

Action plan

Action	Description	Milestones and Deliverables
WP3: Development of a culture for teaching and learning (Leader: Henriksen)		
A3.1	School-university transition program	
	Establish school-university transition base study	Report (PhD2)
	Develop and test adapted transition practices	Practices in repository; Research art.
	Study effects on motivation, retention and results	Research articles
	Publish research articles on results	Publish 1 articles/yr
A3.2	Student-spaces, mentor programs and startup seminars	
	Study student self-organization in student spaces	Research report
	Develop student-teacher off-curriculuar activities in student spaces	Initialize; Regular acticities
	Support and extend student-student mentor program	Report from mentoring programs
	Support startup seminars focusing on learning-to-learn, study strategies	Reports from seminars
A3.3	Teacher culture development	
	Establish annual teacher retreat to focus on sharing and development	Yearly retreats; Reports
	Organize regular educational workshops and seminars	Reported workshops and seminars
	Develop teaching teams for main introductory courses	Teams in 2 courses; Report
	Study effects on learning environment and student evaluations	Research (PhD2, Postdoc)
A3.4	Quality systems and student evaluation methods	
	Develop and test efficient web-based student evaluation system	M: Implement system; D: Reports
	Present and discuss student evaluations at teacher retreats	
	Develop effective group-based evaluation systems for courses	M: Implement; D: Reports
A3.5	Promote teaching skill renewal	
	Develop pedagogical courses and workshops for CSE skills	M: Reported courses
	Support educational sabbaticals for course development	Implemented at Faculty
	Establish career goals for teaching proficiency and excellence	Develop; Implement pilot
	Establish teaching academy of excellent teachers at Faculty	Established pilot

Comments

A3.1: The school-university transition studies will be initiated in 2018 in collaboration with Valler high school and Andreas Haraldsrud who will have an adjunct position at CCSE in 2018-2019. This project is currently not part of the PhD-students' scientific projects, but a MSc-student starting in 2018 will look into implementation of computational approaches in upper secondary school physics, with CCSE personnel among the supervisors.

A3.2: Startup seminars are well functioning and will continue to be developed in 2018. Student-student mentor programs will be developed in 2018.

A3.3: Teaching days have been established at several departments, including the Department of Physics. Teaching teams will gradually be introduced in 2018 and 2019 as new teachers are taking over courses.

A3.4: A group-based evaluation system is in uses at the Department of Physics. New effective web-based evaluation systems will be investigated in 2018.

A3.5: A new pedagogical course on physics education research will be provided in 2018, a summer institute will be developed focusing on bioscience education, and new courses on basic digital skills including introductory Python programming will be introduced in 2018.Data-based methods are developed in the course Fys2160 – Thermal physics, and CS3100 – Data science and machine learning. The establishment of teaching proficiency standards will have to wait for the University of Oslo's central decision on it excellent teaching practitioner status system.

The ReleQuant-project develops digital, research-based learning resources in general relativity and quantum physics for high school physics. The project is directed from the Department of Physics, UiO, and is a collaboration with NTNU, the Norwegian Center for Science Education, and four university schools in the Oslo-area. Practicing physics teachers and teacher students are included in the work through the subproject, ReleQuant Competence.

ReleQuant combines:

- development and testing of learning resources
- research on the students motivation and learning processes in physics
- research on how competence is created in the interplay between teacher students, physics teachers, and researchers

ReleQuant integrates research faculty at UiO in the development work. This has contributed to inform physics researchers about the knowledge and skills students bring with them from school and how discipline-based didactic research can provide valuable insights into studenets understanding, learning processes and motivation. Furthermore, the project has tested how bachelor-students (in this case science teacher students) can be included in ongoing research projects at the department.

http://www.mn.uio.no/fysikk/forskning/prosjekter/relekvant/

www.viten.no - se "Kvantefysikk" og "Generell relativitetsteori"

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. Every year, CCSE publishes calls for summer student development projects for teaching faculty. The departments coordinate the applications. The applications are evaluated by the CCSE working group and prioritized depending on how well they align with the objectives of CCSE and the quality of the project. In 2017 we received applications for 1.4 million kroner and rewarded 1.0 million kroner for projects, providing the departments with 20 summer student projects. The teaching faculty are then responsible for finding students for the projects. The students are hired directly at CCSE and we have meetings with all students at the beginning and end of their working period. In 2017 20 students worked on curriculum development in subject areas such as nuclear physics, introductory chemistry, fluid mechanics, introductory astronomy, introductory geoscience, and in several bioscience courses. In biosciences, support was provided to develop exercises for BIOS1100 – Introduction to computational modelling in bioscience. The students who were involved in developing material, were also hired as teaching assistants in the course. In addition, summer students were hired to develop exercises in subsequent courses in bioscience, such as the first course in physiology. Students are teachers presented their results and experiences from the application of the results at the annual CCSE Christmas seminar.

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 12 bachelor students in 2017 (See box). In addition, we have initiated several research and development projects where students are involved. Professor Ellen K. Henriksen has together with associate professor Maria V. Bøe coached two science teacher studetns to implement student-active learning elements in two bachelor-courses: FYS1001 – Introduction to physics, and FYS-MEK1110 – Introduction to mechanics. Professor Ellen K. Henriksen has also involved students in research and educational development in the ReleQuant project (see box). We have also hired

bachelor- and master-students to contribute to data processing using machine learning and data science methods to study large-scale educational data such as learning data from the usage of video lectures in large-enrolment classes.

Plans and priorities for 2018

- Engage students in supervision and student selection for research projects
- Continue summer student projects with focus on Jupyter notebook applications
- Develop short courses in research methodology in education research for student researchers
- Initiate student-student activities: student competitions, student-driven courses.
- Develop basis for qualification system for teaching assistants
- Extend student research projects to 20 students/yr

Action plan

WP4: Develop, test and disseminate student-driven activities (Leader: Tellefsen)										
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	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	Reports on use; Results in repository
	Support 2-4 student blog/web projects/yr	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	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	Report on use
	Establish and support student science competitions	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	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	Yearly reports
	Support 1-3 student teams working on summer research projects	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	Yearly reports

Comments

A4.1: The student partnership board has not yet been established. Priority has been given to build the education research activity in 2017.
A4.2: Education research projects will start in 2018 according to plan.
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. Focus has been on education research.
A4.6 Student innovation has not been prioritized in 2017.
A4.7: Research activities have been significantly extended through external funding.
A4.8: Summer internships have been financed through external financing from Thon foundation.

Cross-disciplinary Grand challenges for students – Thon project 2017-2020

The student research project Cross-disciplinary grand challenges for student was funded by the Thon foundation with 1.5 million kr for the period 2017-2020. The project is a collaboration between professors Bjørn Jamtveit at the Njord center at Department of Geosciences, Marianne Fyhn at the CINPLA center at Department of Bioscience, and Anders Malthe-Sørenssen at CCSE and the Njord center, Department of Physics.

The goal of the project is to expose students to high quality research early in their careers. Students in their first, second and third years are invited to participate in bold research projects that are on the borderline between physics and geoscience and physics and neuroscience. Because students at UiO learn programming and computational methods already in the first semester, they have the knowledge and skills needed to contribute meaningfully to research projects already in the first year.

In 2017 12 students were selected to participate in research projects during the summer. The students were grouped into three groups, one group addressed fundamental problems in friction, one group addressed shock and fragmentation processes near earthquakes, and one group developed tools for the analysis of neurophysiological data. The students were given a general introduction to research practices and specific instruction on the use of computational research methods and tools used for the project. All students presented their results in a common workshop at the end of the summer.

Four students have continued with the research project also during the fall semester – continuing to develop their research project towards a publishable result. One of the students was invited for an extended research stay with our collaborators at the world-leading Collaboratory for Advanced Computing and Simulations at the University of Southern California.

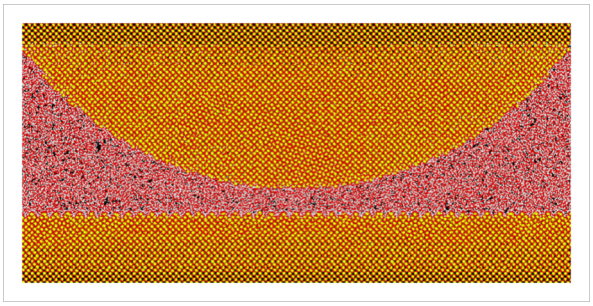


Fig. 3: Picture from initial workshop with summer students; Illustration from simulations of a silicate nano-indentor in water by Anders Johansson.

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

CCSE has a major role to play in how to define and develop computational skills

The importance of digital skills is increasing and stakeholders from government to industry are focusing more on digital competence and digital skills from school through university education. CCSE has a unique approach since we are focusing on digital skills in a disciplinary context. We have experience in how to integrate computing and what new opportunities open as computational methods are integrated in the curriculum and in teaching practices. CCSE therefore stands to take a leading role in defining what constitutes digital competence and how to integrate digital competence in disciplinary educations. This has pushed the center to the forefront of the development of a digital education. CCSE has been frequently used to provide input on digital skills and education within the Faculty, at the University of Oslo, nationally and internationally. (See the product list for an overview of activities).

New bachelor programs with integrated computing

We work systematically with the leadership at the Faculty of Mathematics and Natural Sciences (MN-Faculty) to revise and develop all educational programs at the MN-Faculty. In the Fall of 2017, all the bachelor programs welcomed students to new or revised programs. All the bachelor programs now have a Computing in Science Education (CSE) component, and also the Master's program in teacher education. The Program in Bioscience has taken a radical approach in that the first-semester programming class is framed as a biocscience class, with all programming constructs being motivated by problems from bioscience.

Developing a culture for learning among staff at the Faculty

We have worked systematically to develop a culture for sharing and learning among staff, particularly when it comes to education. This includes making sure the weekly meetings with all heads of education, as well as various seminars, take place in this kind of atmosphere. In 2017 this has also included revising all mandates for the various education committees at the MN-Faculty, emphasizing the importance of developing the collegial fellowship to take responsibility for education development

New life science building

CCSE has been involved in planning the auditoriums and large common area in the new life science building, which received final funding by the government in 2017. This has been done by attempting to align the physical learning environment with the underlying values of the general learning culture mentioned above.

Extension to mathematics education and computational thinking

CCSE has established a collaboration with Elise Lockwood, assistant professor of Mathematics Education Research at Oregon State University. Elise has recently obtained an NSF-career grant focused on making use of computational thinking and programming in

teaching combinatorics. We have also worked to develop the Bachelor Program in Mathematics with Computer Science to strengthen and extend the integrated, computational perspective in the modules that make up the program.

Extension beyond science

We have initiated work to develop learning material for introductory courses in economics. One summer student with a background both in economics and in computational physics has developed examples and exercises that integrate computing in economics and finance. We have also contributed to define digital competence in humanities, law studies and social sciences through seminars and joint applications for funding. The basic topic has been how to encourage and approach educational development, including the use of computers and computing. We expect this activity to expand significantly in 2018.

External dissemination

CCSE personnel has been invited to a number of seminars at external institutions, both nationally and internationally. Many institutions in Norway, Europe and the US are in the process of developing new curriculums or establishing activities in computational science, and CCSE are in a position to contribute and help this development. We have initiated close partnerships with both the University College of Southeastern Norway (USN) and with the University of Tromsø (USN). We expect to have a formal collaboration agreement with USN in place in early 2018. We are also exploring a collaboration with OsloMet on digital competence for teachers. In 2018 we plan to initiate a European partnership to develop the competence needed to educate the next generation of teachers and researchers with computational competence.

School partnership

A pilot course in computational mathematics has been developed by Andreas D. Haraldsrud, a teacher at Valler Upper Secondary School. The course is being taught by Andreas and a colleague this school year and the course has received attention both in the media and by the government (the prime minister visited the school to see the course first-hand). In the coming school year this course will be offered at 50 schools throughout the country. This link will be strengthened in that Andreas Haraldsrud will join the CCSE in an adjunct position from 2018.

Plans and priorities for 2018

- Confirm CCSE as the national resource on computing in education and digital competence from schools to higher education and research
- Extend development of extension to bioscience
- Establish school partnership programs starting with key partner schools
- Establish collaboration agreements with at least one national institution
- Ensure the education research activity have a clear profile at international research conferences in Physics education research.
- Provide incentives for students to be involved in dissemination activities

Action plan

Action	Description	Milestones and Deliverables
WP5: Dissemination, dialogue and communication through partnerships (Leader: Mørken)		
A5.1	Internal dissemination at UiO	
	CSE workshop for UiO leadership at various levels	Workshops arranged
	CSE workshops on computational methods and practices for faculty	Workshops arranged
	CSE workshops on computational methods for teaching assistants	Workshops arranged
A5.2	Extension to new programs at UiO	
	Extension to bioscience program	
	Develop plans and study programs with department leadership	Plans developed
	Develop new introductory CSE course for biology students	Course implemented
	Develop new textbook for introductory courses	Preliminary textbook; Published text
	Integrate CSE into other biology courses	Initiate; Implemented in 2 courses
	Test pilot courses on biology student groups, evaluate and improve	Reports
	Evaluate and adjust CSE approaches in new courses	Reports
	Evaluate and review approach and study program design	Reports
	Extension to other programs (chemistry, geoscience)	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	Course developed
	Adapt material from UiO to local courses	Adapted material and texts
	Research and evaluate adaption, iterative improvement	Research (PhD1, Postdoc)
	Develop material for other University Colleges	Material (if applicable)
	Extension to other Universities	
	Support adaptation and extension through workshops and support	Reports on workshops arranged
	International extensions	
	Study application of material at Michigan State University	Research articles
A5.4	School partnership	
	Develop school visit program	Material developed
	Pilot school visit program with partner school	School program initiated
	Evaluate and improve visit program	Report from evaluation
	Extend program to other schools	Other schools included in program
	Research effect on recruitment, retention and exam results	Research (Postdoc)
	Research effect on school teachers	Research (Postdoc)

Comments

A5.1: The school-university transition studies will be initiated in 2018 in collaboration with Valler high school and Andreas Haraldsrud who will have an adjunct position at CCSE in 2018-2019. This project is currently not part of the PhD-students' scientific projects.

A5.2: Extension to bioscience is progressing according to plan. Extension to chemistry and geoscience is piloted in 2017, and will be extended in 2018.

A5.3: The collaboration agreement between UiO and University College of Southeastern Norway (USN) is under preparation. However, introductory programming courses and material for these have been developed in collaboration between CCSE and USN, and the material has been published.

A5.4: The school exchange program has been delayed in order to coordinate with new developments in courses (the new course in Programming and modelling).

Introduction to computational modelling in biology – BIOS1100

The study program in bioscience was redesigned for the new study program in bioscience starting 2017 at UiO. In this program, skills in computational modelling and programming are included as a learning objective. Students therefore learn to program already in the first semester, and programming and computing are also used in many other courses throughout the program to ensure that students learn to develop and use these skills in their disciplinary context. The Department of bioscience is the first to introduce such as a clear computational perspective in the study program in Norway and probably also internationally.

The first semester programming course BIOS1100 – introduction to computational modelling in biology – introduces students to programming in a biological context. Students are introduced to a sequence of biological problems that require computational methods to be addressed. The problems and their sequence have been selected to provide students with a gradual introduction to computational concepts and skills. They start with bacterial growth, continue with plant growth, inheritance and DNA sequencing.

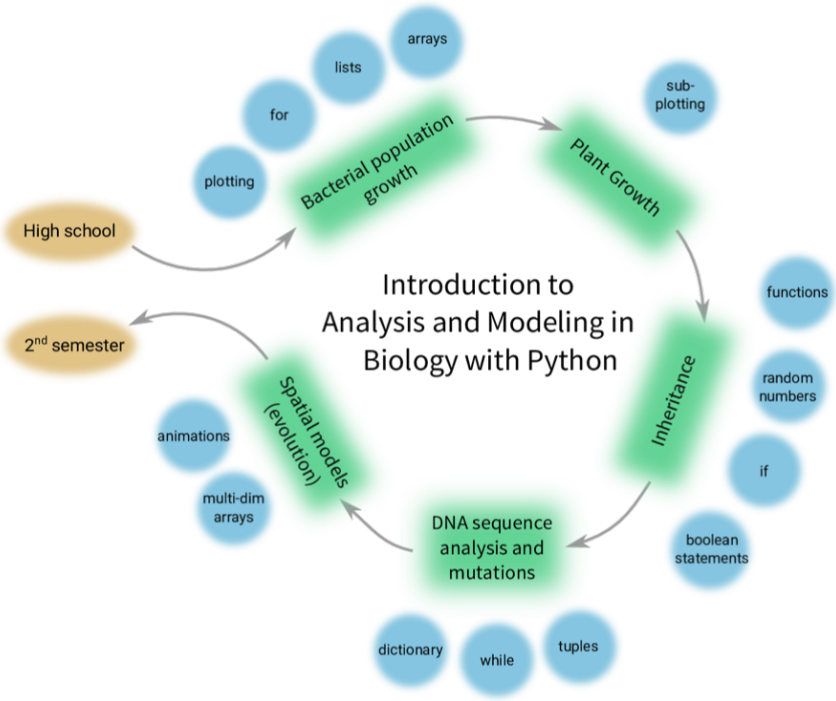


Fig. 4: Textbook authors, from left: Andreas Solbrå, Simen Tennøe, Svenn-Arne Dragly, Milad Mobarhan.

The textbook was developed over two years by four PhD-students in computational neuroscience – all with backgrounds in computational physics: Simen Tennøe, Andreas Solbrå, Milad Mobarhan, og Svenn-Arne Dragly and all supported by CCSE (see Figure B). PhD-students are a significant resource for CCSE. Eight PhD-students at the intersection between physics and bioscience use their compulsory work (25% of four-year positions) to develop learning material for CCSE.

The learning material and the teaching approach was first tested on a small group of students in spring 2017. Feedback from this pilot round was used to improve texts, exercises and activities.

Three summer students financed by CCSE worked on developing additional exercises for the course.

Teaching consisted of a large-classroom lectures with live coding and large group sessions with several student-active activities in the new learning laboratory at the Department of bioscience. This room consists of 10 tables, each with 6 chairs and a common screen for each table. Various quizzes and student problems were solved in groups as well as individually.

Fig. 5: Learning laboratory at Department of Bioscience. (Photo: Lex Neder-

The learning material was distributed using JupyterHub and written using docOnce to produce both pdf and Jupyter notebooks. Exercises were also distributed and solved as notebooks so that students could work only using a web browser without any software installation.

BIOS1100 students were visited by both the Minister of Education and by the Labour party's parliamentary group in 2017 – allowing students to share their experiences directly with the politicians.

Fig. 6: Minister of Education in discussion with UiO rector Svein Stølen and CCSE director Anders Malthe-Sørenssen (Photo: Ola Sæther, Uniforum)

Based on student feedback from the first semester, more effort will be placed on establishing a clear motivation for programming by inviting leading researcher to share their experience and explain why computing and programming is important in bioscience.

R&D-based education at CCSE

Student-active learning and R&D based education at CCSE

Physics education research have rigorously documented the effect of student-active teaching methods, yet these methods are sparsely used[1]. This has motived researchers to develop a research-based approach to dissemination that takes into account the many complexities of educational change[2]. Our dissemination strategy builds on these research-based recommendations. We therefore strive to provide easily modifiable materials; disseminate research ideas in addition to curriculum since users often modify methods; adapt approaches to realistic situational constraints; and involve faculty as partners and provide support.

Based on these insights, CCSE and KURT (the Competence center for teaching in science) have initiated a set of measures to disseminate the use of student-active teaching. Research findings are presented at faculty workshops; we partner directly with teachers in important courses to develop student-active methods and include teacher students in mentoring and instructing teaching assistants (TA) both during the TA workshops, and in individual and group sessions. We are developing a week-long Summer Institute, in collaboration with University of Minnesota, where teachers engage in both understanding research and applying it to their specific situations over an extended time period. Similar initiatives are developed to teach computational methods and how they can be used in student-active teaching scenarios. This development depends on the close collaboration between experienced instructors, didactic researchers, education researchers.

Added value of R&D based education at CCSE

A particular strength of the integration of computational methods is that it also changes the dynamics of the learning situation: The students learn tools that allow them to address research-based problems early on, apply work flows that are the same as found in research, and engage in discussions with peers and instructors on issues that are open and exploratory instead of closed and binary (right/wrong) as often found in science curriculums. This is an essential component of our vision and philosophy – the integration of computing opens new opportunities for student activities that previously could not be pursued.

The learning material and approaches that are developed by students and teachers are designed to encourage and simplify student activities and peer discussion. However, this depends on a strong research-basis in computational methods related to the particular discipline. The examples and problems must be developed by researchers that master both the computational and disciplinary aspects of the field. In addition, the research education group provides direction as to what approaches are fruitful, and studies the effects of methods and materials directly. Interactions between teaching faculty – with the relevant research background – and education researchers will be facilitated by the

[1] Henderson, C. & Dancy, M. H. Impact of physics education research on the teaching of introductory quantitative physics in the United States. *Phys. Rev. Spec. Top. - Phys. Educ. Res.* **5,** 020107 (2009).

[2] Henderson, C., Dancy, M. & Niewiadomska-Bugaj, M. Use of research-based instructional strategies in introductory physics: Where do faculty leave the innovation-decision process? *Phys. Rev. Spec. Top. - Phys. Educ. Res.* **8,** 020104 (2012); Dancy, M. & Henderson, C. Pedagogical practices and instructional change of physics faculty. *Am. J. Phys.* **78,** 1056–1063 (2010).

center through workshops and summer institutes. In these situations, we can also provide example and scaffolds for examples and exercises that can be adapted to the specific situations.

Several student-active methods have recently been introduced in BIOS1100 – Introduction to computational modelling in bioscience. Students solve quizzes in small groups in the learning laboratory, and work with combinations of computers and physical props to learn programming concepts. Initial results from interviews with students in the course, as preparatory studies for research into student understanding performed by PhD-students at CCSE, showed that a non-significant group of students lacked basic skills that were needed to succeed in the course. A well-known method from Software Carpentry – live coding where an instructor writes code and all students write the same code on their individual computers – was therefore introduced. The effects of these practices will be addressed as part of the education research groups activities.

Measuring effects of R&D based education

In our plans for an evaluation and impact framework, we addressed the challenge of developing meaningful indicators for student learning in courses with integrated computing. We are applying input and output indicators for student production, grades and evaluations and for teacher and teaching assistant participation in workshops and seminars. However, real insights into student learning depends on effective assessment tools that address both the learning process as well as learning outcomes. There are many standardized assessments from physics education research. We will apply these tests systematically, but these assessments do not measure effects related to computational modelling. This is the reason we have initiated the S-Assess project, which will be a focus of the education research group at CCSE.

Structural measures taken to develop R&D based education and student engagement

CCSE have initiated several measures to develop R&D based education. The summer student projects, where teaching faculty are provided with summer students that can help them translate their disciplinary experience in defining good problems into computational problems provide a good starting point and a good stimulus for teaching faculty. However, we need to ensure the use of these students are more systematically coupled to summer institutes and teacher workshops. Student-driven projects, including student researcher and students performing education research, will help with student engagement and will provide teaching faculty with insight into student thinking. A broader use of think-aloud interviews and analysis of student learning activities in classrooms will also provide teachers with more insight into the learning process and help teachers improve and direct their research. This provides a direct coupling between the education research activity and instructional development.

Organization and management

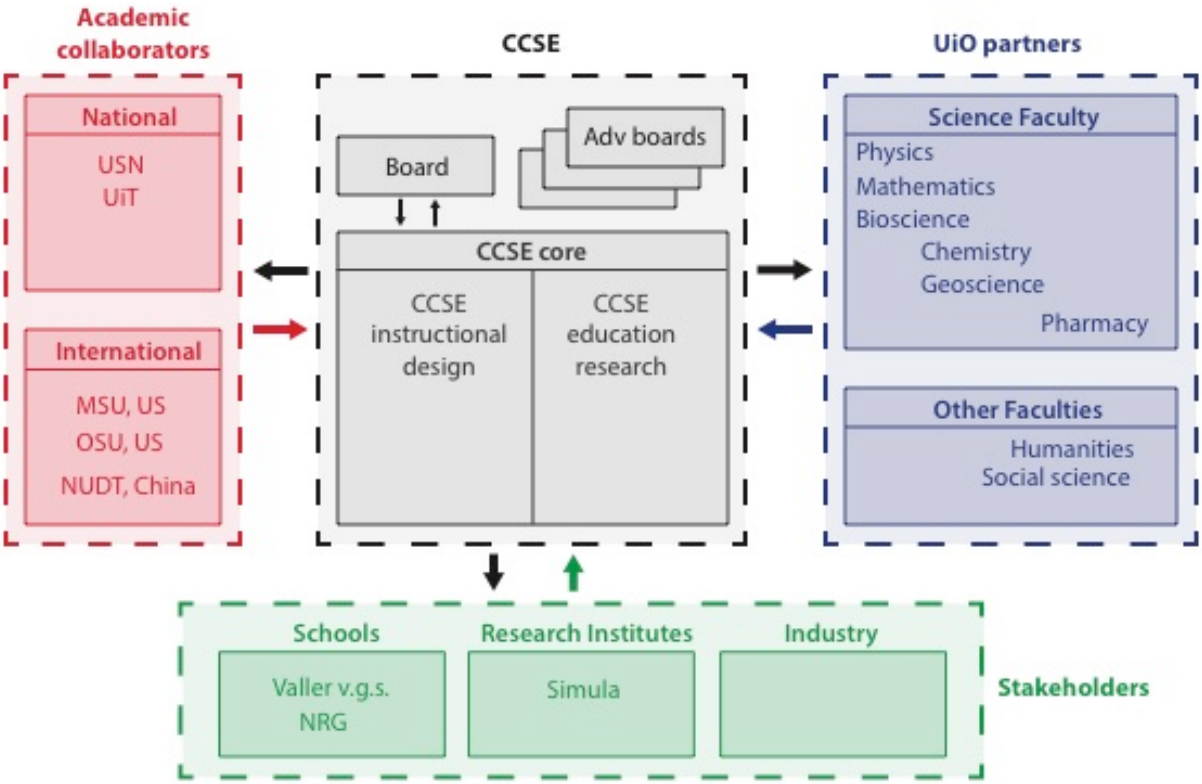
CCSE is directed by Professor Anders Malthe-Sørenssen and supported by an administrative leader, Sunniva Rose. The director is supported by a working group, with an advisory and coordinating function, consisting of the five work-package leaders, the administrative head, director of studies at the Faculty, 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, but has only to a small degree been realized in 2017. 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 development. 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 director Malthe-Sørenssen. 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.



New employees 2017

Sunniva Rose *(administrative head)* joined CCSE after finishing her PhD in nuclear physics. She has long experience in outreach and communication of science using both traditional and social media platforms. She has a popular blog where she communicates science with her own personal style. She is frequently used lecturer and often participates in radio and tv shows. In CCSE she is in charge of outreach and communications as well as being the head administrative officer.

Marcos Daniel Caballero *(adjunct professor, 20%)* has conducted research at the intersection of computation, physics, and education over that last nine years. As a PhD student at Georgia Tech, Caballero conducted the first large-scale studies of students' abilities to construct computational models in a course using the Matter & Interactions curriculum. As a postdoctoral researcher, he integrated computation into middle-division Classical Mechanics at the University of Colorado Boulder. Caballero joined the Physics and Astronomy faculty at Michigan State University to lead the physics arm (PERL@MSU) of MSU's widely-respected discipline-based education research program. Caballero provides a strong international and education research perspective to the CCSE initiative.

Christine Lindstrøm *(adjunct professor, 20%)* has a Master in Education and a PhD in physics education research from the University of Sydney with focus on the use of scaffolding in introductory physics education. She was a postdoc at the Physics Education group at the University of Colorado at Boulder, and she is currently an assistant professor at the universities OsloMet and NTNU where she is responsible for university teacher education. Her main research focus is on student-active learning methods. She is a supervisor for PhD-students and postdocs at the center.

Odd Petter Sand *(PhD-student)* started as a PhD-student in August 2017. He has a background in computer science and astronomy. He has experience as a school teacher as well as lecturer for a large enrollment astronomy course, AST1010, at the University of Oslo. He thesis project will address student learning of computational methods in the introductory programming course BIOS1100.

John Mark Aiken *(PhD-student)* started as a PhD-student in October 2017. Even though he is a PhD-student, 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, provided professional development workshops for high school teachers and taught courses using the scale-up approach. He has worked on understanding how high school students conceive computational models and investigated how students in MOOCs interact with different course materials and video lectures. He has published 12 papers on physics education research in international research journals. His PhD-project focuses on how STEM students make decisions to stay in their major, switch to other majors, or leave STEM altogether.

Personnel

Name	Function	Position	Unit
Center personnel			
Anders Malthe-Sørenssen	Center leader	Professor	Physics, UiO
Sunniva Rose	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
Hanne Sølna	Administrative mentor	Director of studies	Faculty Adm, UiO
Education research group			
Danny Caballero	Education researcher (20%)	Adjunct Professor	MSU, CCSE
Christine Lindstrøm	Education researcher (20%)	Adjunct Professor	OsloMet, CCSE
John Aiken	PhD-student		CCSE
Odd Petter Sand	PhD-student		CCSE
Instructional development			
Øyvind Ryan	Course development, 20%	Ass. Prof.	Math, UiO
Andreas Gorgen	Course development, 20%	Professor	Physics, UiO
Dag Kristian Dysthe	Course development, 20%	Professor	Physics, UiO
Henrik Sveinsson	Course development, 10%	PhD-student	Physics, UiO
Lex Nederbragt	Course development, 20%	Sen. Engineer	Biology, UiO
Svenn-Arne Dragly	Course development, 25%	PhD-student	Physics, UiO
Andreas Solbrå	Course development, 25%	PhD-student	Physics, UiO
Milad Mobarahn	Course development, 25%	PhD-student	Biology, UiO
Simen Tennøe	Course development, 25%	PhD-student	Com Sci, UiO
Marte Julie Sætra	Course development, 25%	PhD-student	Physics, UiO
Solveig Næss	Course development, 25%	PhD-student	Biology, UiO
Elise Thompsen	Course development, 25%	PhD-student	Biology, UiO
Student representatives			
Didrick Kruse	Student representative		UiO
Jonas Fløde	Student representative		UiO

External projects

Granting body	Project title	Project period	Funding	PI/partners
Intpart/NRC	US-Norwegian collaboration on fluid-consuming processes	2017-2019	4500 kkr	PI: Anders Malthe-Sørenssen
Thon stiftelsen	Cross-disciplinary grand-challenges for students	2017-2019	1500 krr	PI: Anders Malthe-Sørenssen, Marianne Fyhn, Bjørn Jamtveit
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	2018-2022	6000 kkr	PI: Anders Malthe-Sørenssen
Norgesuniversitetet	eAssess	2018-2020	1800 kkr	PI: Omid Mirmotahari, Dept. of Computer Science, UiO; CCSE is a partner

Accounting 2017

(Please note that these financial records do not reflect the activity. We have not yet been able to extract internal financing or external financing beyond the Nokut allocation. The numbers will be updated).

Cost plan

	Budget	Result	Deviation
Personnel	1 733 556	1 857 000	123 444
Overhead	1 888 944	769 000	-1 119 944
Running costs	1 229 500	866 000	-363 500
Total	4 847 000	3 492 000	-1 360 000

Funding plan

	Budget	Result	Deviation
UiO inkind	6 193 163	?	
Nokut	4 847 000	?	
Total	11 040 163	?	

Comments

We have used less in 2017 than in the original budget, primarily because PhD-students started later than originally expected, and the postdoc starts first in 2018. We have taken several measures to ensure that the activity will be increased in 2018: Faculty and students have been hired in short-term adjunct positions. However, we also expect the external portfolio to increase activity significantly in 2018, thus the overall activity will increase significantly.

List of products

Dissemination – external events

The role of CCSE

Topic	where, for whom	who	when
Centre for Computing in Science Education – Erfaring fra oppbygging av en fremragende utdanningssatsing	HiOA	Malthe-Sørenssen	17.01.2017
Bioscience, chemistry, pharmacy or life science?	Presentation for a delegation from Ethiopia	Mørken	25.01.2017
Centre for Computing in Science Education – Erfaring fra oppbygging av en fremragende utdanningssatsing	Juridisk Fakultet, UiO	Malthe-Sørenssen	13.02.2017
Reflections on mathematics and science education for the future	Presentation for a delegation from South Korea	Mørken	02.03.2017
Centre for Computing in Science Education	Korean University visit to UiO	Malthe-Sørenssen	02.03.2017
Centre for Computing in Science Education	Bulgarian Ministry of Education visit to UiO	Malthe-Sørenssen	07.03.2017
Centre for Computing in Science Education – Erfaring fra oppbygging av en fremragende utdanningssatsing	Faculty of Law, UiO	Malthe-Sørenssen	17.03.2017
Reflections on mathematics and science education for the future,	Presentation for a delegation from ENS – Lyon, France,	Mørken	24.03.2017
Centre for Computing in Science Education	ENS Lyon visit to UiO	Malthe-Sørenssen	24.03.2017
Centre for Computing in Science Education	Stellenbosch University visit to UiO	Malthe-Sørenssen	11.05.2017
Computing in Science Education	Norwegian Pharmaceutical Research School, Oslo	Malthe-Sørenssen	20.06.2017
Computing in Science Education	Presentation for delegation from Copenhagen University	Mørken	08.12.2017

Contributions to seminars, workshops and conferences

Topic	where, for whom	who	when
En (video)introduksjon til UiOs studietilbud i realfag og teknologi - utdanninger for framtidens arbeidsmarked,	Presentasjon for rådgivere i skolen	Mørken	09.03.2017
Kan informatikk sammen med matematikk bli morsomt?	Presentasjon på IT-camp for jenter på Institutt for informatikk,	Mørken	15.03.2017
The InterAct philosophy	iEarth workgroup, Department of Geoscience, University of Bergen	Mørken	
Centre for Computing in Science Education	MNT Conference, Soria Moria, Oslo	Malthe-Sørenssen	30.03.2017
Education and exchange	Presentation for SIU workgroup, SIU, Oslo	Mørken	05.04.2017
Computing in Science Education	University of Liverpool, UK	Malthe-Sørenssen	10.05.2017
Building science teacher identity through an integrated program of study	Presentation at Litteraturhuset, Oslo	Tellefsen and D. Jorde	12.05.2017
High performance computing in Nuclear Physics	Lecture at the *Advanced Computational Research Experience* at Michigan State University	Hjorth-Jensen	01.06.2017
Computing in Science Education	Stockholm University, Sweden	Malthe-Sørenssen	01.06.2017
Science teacher education at UiO	NFSUN conference, Trondheim	Tellefsen and D. Jorde	07.06.2017
InterAct at UiO: Good education is more than good lecures	iEarth workgroup, Department of Geoscience, University of Bergen	Mørken	08.06.2017
How to write good code	Lecture at the *Advanced Computational Research Experience* at Michigan State University	Hjorth-Jensen	24.06.2017
Developing a culture for teaching at MN, UiO	Institute for Microsystems, University College of Southern Norway	Mørken	09.08.2017
Science teacher education at UiO	ESERA conference, Dublin	Tellefsen and D. Jorde	21.08.2017
Computing in Science Education	Swedish e-Research Center visit to UiO	Malthe-Sørenssen	07.09.2017
Computing in Physics Education	Invited talk at the 103rd National congress of the Italian Physical Society, Trento	Hjorth-Jensen	11.09.2017-15.09.2017
Computing in the undergraduate mathematics curriculum?	Invited presentation at the annual meeting of the Norwegian Mathematical Council,	Mørken	27.09.2017

(Continued)			
Topic	where, for whom	who	when
En forskningsnær utdanning ved integrasjon av databeregninger og programmering	Fagdag for utdanning, NTNU	Malthe-Sørenssen	02.10.2017
Computing in Science Education,	Presentation at the conference in memory of Hans Petter Langtangen,	Mørken	24.10.2017-25.10.2017
Utdanningsutvikling på MN-fakultetet ved UiO,	Presentasjon for studieutvalget ved Norges miljø- og biovitenskapelige universitet,	Mørken	25.10.2017
Science teacher education at the MN-faculty, presentation	Helsinki (meeting with teacher educaters)	Tellefsen	27.11.2017
Computing in Science Education; how to integrate computing in Science courses across disciplines	Seminar at the University of Surrey, UK	Hjorth-Jensen	28.11.2017
Computing in Science Education (CSE)	Presentation at Syddanske Universitet, Odense, Denmark,	Mørken	07.12.2017

Meetings in the SFU family

Topic	where, for whom	who	when
Centre for Computing in Science Education	Nokut samling av SFUer	Malthe-Sørenssen	06.02.2017

Contributions to policy and the public debate

Topic	Where, for whom	Who	when
Center for Computing in Science Education - hvordan integrere programmering i utdanningen	NHOs kompetanseforum	Malthe-Sørenssen	10.01.2017
How to inspire girls to choose science?	Nordic conference on gender equality, Oslo	Ros	08.02.2017
Committee leader, White paper on the integration of computing in undergraduate physics at MSU	Michigan State University	Hjorth-Jensen	20.03.2017
Develop core elements for school subjects, Science	Group for core elements, Udir	Rose	01.06.2017-10.12.2017
Develop core elements for school subjects, Mathematics	Group for core elements, Udir	Mørken	01.06.2017-10.12.2017
Digitalisering av MNT-utdanning	UHR, Oslo	Malthe-Sørenssen	26.10.2017

Dissemination – internal events

CCSE seminar series

Title	Who	When
SDT and motivation for biology students	Lucas Jeno, bioCeed, UiB	01.06.2017
The role of practice learning in biology education	Torstein N. Hole, bioCeed, UiB	01.06.2017
Nanohub	Alejandro Strachan, Nanohub, Purdue University, USA	10.10.2017
Learning through gamification in physics	Gerd Kohlmeyer, Meyer-Briggs College, Michigan State University, USA	11.12.2017
Mathematics education research and the role of computing in mathematics education	Elise Lockwood, Oregon State University, USA	14.12.2017

CCSE educational development activities (policy and teaching)

Topic	Where, for whom	Who	When
Institute seminar	Department of Geoscience	Mørken, Tellefsen	06.01.2017
REAL education, seminar	Teachers at Faculty of Mathematics and Natural Sciences, UiO	Tellefsen	12.01.2017
Seminar on development of education	Department of Geoscience, UiOs	Tellefsen	26.01.2017
Educational development and InterAct	Seminar for Department Heads, MN Faculty, UiO	Tellefsen, Mørken	09.02.2017
Introduction to the film Hidden Figures	Science Library, Oslo	Tellefsen, Mørken	08.03.2017
Educational development and the InterAct processes	Department workshop at Sundvolden, Department of Bioscience, UiO	Tellefsen, Mørken	20.04.2017
Seminar on the InterAct process	Educational leaders (og programrådsledere)	Tellefsen, Mørken	26.04.2017
To talk your discipline	Seminar, Department of Physics, UiO	Tellefsen, Mørken	04.05.2017
Stimulating renewal of programs and education.	Seminar for Department Heads, Humanistic Faculty, UiO	Mørken	11.05.2017
Full-day education seminar	Ullevål, Department of Physics, UiO	Henriksen, Tellefsen	18.05.2017
Innovation in the PhD-education	Seminar for PhD supervisors, MN Faculty, UiO	Mørken	24.05.2017
Educational development and the InterAct processes	Strategy meeting, Faculty of Mathematics and Natural Sciences, Husøy	Tellefsen, Mørken	01.06.2017
Culture for quality in higher education: Systematic work to improve educational quality	National meeting for Deans of Studies in social sciences, UiO	Mørken	19.06.2017

(Continued)			
Topic	Where, for whom	Who	When
Computing in Science Education	Norwegian Pharmaceutical Research School, Oslo	Malthe-Sørenssen	20.06.2017
Workshop: Hands-on programming in pharmacy	Norwegian Pharmaceutical Research School and PharmaTox, Oslo	Malthe-Sørenssen	20.06.2017
REAL teaching, seminar	Teaching Assistants at Faculty of Mathematics and Natural Sciences, UiO	Tellefsen	20.09.2017
Centre for Computing in Science Education	Presentation at STUT-meeting for all educational leader at Faculty for Mathematics and Natural Sciences, UiO	Malthe-Sørenssen	26.09.2017
Developing a culture for teaching at MN, UiO	InterAct and ForVei seminar for UiO ambassadors, UiO	Mørken	26.09.2017
Hvordan kan CCSE bidra til kvalitet i utdanningen ved MN og UiO	Real utdanning, Fagdag for utdanning, UiO	Malthe-Sørenssen	10.10.2017
REAL education, seminar	Teachers at Faculty of Mathematics and Natural Sciences, UiO	Tellefsen	10.10.2017
Computing in Science Education	Fagdag for utdanning, Fysisk Institutt, UiO	Malthe-Sørenssen	12.10.2017
Physics teacher competence seminar	Department of Physics, UiO	Tellefsen	12.10.2017
REAL teaching, seminar	Teaching Assistants at Faculty of Mathematics and Natural Sciences, UiO	Tellefsen	10.11.2017
Educational development at MN, UiO	Seminar for heads of departments, Humanistic Faculty, UiO	Mørken	22.11.2017

Workshops and conferences at CCSE

Topic	Where	Attendance	When
Physics teacher competence and the culture for teaching and learning in physics departmets, Guets lecturers from Uppsala University	Department of Physics, UiO	20	10.10.2017
CCSE Internal Seminar	Lysebu, Oslo	15	03.11.2017-04.11.2017
Computing in Science Education Annual Christmas Seminar	CCSE, University of Oslo	90	12.12.2017

Visitors

Who	Topic	When
Lucas Jeno, bioCeed, UiB	Presentation on bioCeed survey	01.06.2017
Torstein Nilsen Hole, bioCeed, UiB	Presentation on bioCeed survey	01.06.2017
Alejandro Strachan, Nanohub, Purdue University, USA	Nanohub collaboration	10.10.2017-11.10.2017
Minister of Education	Visit to CCSE and BIOS1100	20.10.2017
Tor Odden, University of Wisconsin-Madison, USA	Visit to CCSE	03.11.2017-05.11.2017
Parliamentary group, Norwegian Labor Party	Visit to CCSE and BIOS1100	23.11.2017
Elise Lockwood, Oregon State University, USA	Visit to CCSE, collaboration on computing in math education	11.12.2017-15.12.2017
Gerd Kohlmeyer, Meyer-Briggs College, Michigan State University, USA	Visit to CCSE and talks	11.12.2017-13.12.2017

Publications

Scientifc publications

Anders Malthe-Sørensen, Ellen Karoline Henriksen, Morten Hjorth-Jensen, Knut Mørken, Hanne Sølna, Cathrine W. Tellefsen, *Centre for Computing in Science Education: Fornyelse av utdanning ved integrasjon av beregninger*, Nordic Journal of STEM Education, **1**, 1, 236-241, 2017.

Knut Mørken, Ragnhild Kobro Runde, Tone Skramstad, Det nasjonale kvalifikasjonsrammeverket og utdanningsutvikling, Nordic Journal of STEM Educations, **1**, 1, 31-35, 2017.

C. W. Tellefsen, Undervisningsformer i en akademisk kultur – Systematisk arbeid for dybdelæring og profesjonell kompetanse, Nordic Journal of STEM Education, **1**, 1, 189-193, 2017.

Shih-Yin Lin, John M Aiken, Daniel T Seaton, Scott S Douglas, Edwin F Greco, Brian D Thoms, Michael F Schatz, *Exploring physics students' engagement with online instructional videos in an introductory mechanics course*, Physical Review Physics Education Research, 13, 2, 020138, 2017.

Internal reports

Rapport fra pilotprosjekt biologi (report from KURT).

Rapport fra pilotprosjekt MAT1100 (report from KURT).

Rapport fra IN1000 (report from KURT).

Op-eds and articles in the media

Anders Malthe-Sørenssen, Sunniva Rose, Aslak Tveito, *Programmering bør inn i matematikkfaget*, Aftenposten, 30.10.2017

Books

Arnt Inge Vistnes, *Waves and Oscillations*, Textbook in Fys2130 – Waves and oscillations. Translated from Norwegian to English, 350 pages, 2017.

Simon Tennøe, Andreas Solbrå, Milad Mobarhan, Svenn-Arne Dragly, *Introduction to analysis and modeling in biology with Python*, Textbook in BIOS1100 – Introduction to computational modeling in bioscience, 400 pages, 2017.

Social media

Facebook: https://www.facebook.com/CentreForCSE/?ref=bookmarks

Web: http://www.mn.uio.no/ccse/

Blog: http://www.mn.uio.no/ccse/om/aktuelt/blogg/

Instagram: https://www.instagram.com/ccse.uio/

Student activities

Student activities – student development of learning material

Course and topic	Student	Teacher	When
Modelling and programming, High School course and book	Kristine Baluka Hein	Andreas Haraldsrud	20.06.2017-19.08.2017
JupyterHub and docOnce support	Kristian Gregorius Hustad		01.01.2017-31.12.2017
Introduction to economics	Sebastian Winther-Larsen	Anders Malthe-Sørenssen	20.06.2017-19.08.2017
BIOS1100 – Introduction to computational modeling in bioscience	Can Hicabi Tartanoglu, Dejana Mitrovic, Bernt Helen, Hallvard Heiberg	Lex Nederbragt	20.06.2017—19.08.2017
KJM1101 – Introduction to chemistry	Sverre Løyland, Eirill Stand Hauge	Karoline Fægri	20.06.2017-19.08.2017
MAT-IN1105 – Introduction to scientific programming, Geoscience	Tham Le	Karianne Lilleøren, Geir Stordal	20.06.2017-19.08.2017
Fys2130 – Oscillations and Waves	Sebastian Winther-Larsen	Arnt Inge Vistnes	20.06.2017-19.08.2017
Mek1100 – Introduction to mechanics and vector calculus	Valentyna Pysarieva	Karsten Trulsen	20.06.2017-19.08.2017
Mek3570 – Computational solid mechanics	Nithusha Tharmanathan	Kent-Andre Mardal	20.06.2017-19.08.2017

(Continued)			
Course and topic	Student	Teacher	When
BIOS1110 – Cell and molecular biology	Simen Russnes	Tom Andersen	20.06.2017-19.08.2017
BIOS1120 – Physiology	Stian Ingebrigtsen	Marianne Fyhn	20.06.2017-19.08.2017
BIOS1140 – Evolution and genetics	Alexandra Treimo	Tom Andersen	20.06.2017-19.08.2017
GEO2110 – Mineralogy	Jostein Brændshøi	Bernt Ertzmuller	20.06.2017-19.08.2017
AST2000 – Introduction to astrophysics	Jonas Fløde	Frode Hanssen	20.06.2017-19.08.2017

Student activities – student researchers

Theme	Students	Supervisors	When
Friction: Hierarchical surface structures	Daniel Heinsen, Erlend Lima	Malthe-Sørenssen, Sveinsson	01.01.2017-31.12.2017
Friction: Nano-asperities in water-wetter SiO_2	Anders Johansson, Cecilie Klarpås, Gabriel Cabrera	Malthe-Sørenssen, Hafreager, Sveinsson, Jamtveit	20.06.2017-19.08.2017
Earthquakes: Supershear rupture and impacts	Didrick Kruse, Erlend Aarskaug, Ivar Haugerud, Eline Andersen	Malthe-Sørenssen, Hafreager, Sveinsson, Jamtveit	20.06.2017-19.08.2017
Neuroscience: Effective methods for analysis of electrode and position data for grid cell studies	Halvard Sutterud, Camilla Lian, Håkon Flydal	Lepperud, Fyhn	20.06.2017-19.08.2017
Machine-learning methods for analysis of student use of video lectures	Robert Solli	Aiken, Caballero	01.11.2017-01.12.2017

UiO : Det matematisk-naturvitenskapelige fakultet

Senter for fremragende utdanning