MatRIC Centre for Research, Innovation and Coordination of Mathematics Teaching

UiA University of Agder Norway

# MatRIC Centre for Research, Innovation and Coordination of Mathematics Teaching

## Annual Report for 2019

### 1. Abstract

Highlights from 2019 include the development of student mathematics support and student engagement at UiA; MatRIC's sixth annual conference held in Bergen in mid-October, and international networking – the international research conference on teaching calculus in Kristiansand and substantial collaboration with the German Centre for Higher Mathematics Education, kdhm.

Included are brief accounts of MatRIC's successful actions planned and announced in the last annual report, including:

- Research fellows' and supervisors' workshop
- Workshop on creativity and mathematics
- Workshop on providing mathematics support (with khdm)
- International research conference on teaching and learning Calculus
- Teaching Induction course (with khdm)
- MatRIC's sixth annual conference
- Student Learning Assistant Camp

The report also includes brief accounts of collaboration with UiA's Centre for Learning and Teaching, and the Erasmus+ project PLATINUM led from UiA.

MatRIC continues to develop in accordance with the action plan agreed at the mid-term evaluation. MatRIC is more firmly embedded in the national arena of mathematics teaching and learning networks and contributes in substantive and meaningful ways to national organisations. The report further explains how dissemination remains an important part of MatRIC's work and lists the various channels and mechanisms and approaches used to communicate with a variety of stakeholders.

MatRIC's plans for 2020 are listed at the end. Of special note are plans for enhanced student engagement in MatRIC's decision making and activity. Also, an innovative course for teachers of mathematics teacher education programmes that has been design in collaboration with the National Centre for Mathematics Education, based at NTNU, and the Mathematics Education group at the University of Stavanger.

### 2. Results compared to the application and plans

We report MatRIC's sixth year of activity. MatRIC's plans have not changed in any significant way from the action plan agreed during the mid-term evaluation of 2017. Neither has there been any changes to MatRIC's strategy to achieve the goals and objectives set in the action plan. Nevertheless, each year of activity has a unique characteristic because the context within which MatRIC operates is fluid and MatRIC's actions each year have an impact that results in new opportunities and challenges in subsequent years. Additionally, MatRIC is a learning community and our engagement with learners and teachers leads us to reflect on how we might do things differently and better to move on towards MatRIC's vision:

*Students enjoying transformed and improved learning experiences of mathematics in higher education.*

## 2.1 Highlights

### MatRIC's achievements during 2019 to which we especially wish to draw attention.

#### *Within the University of Agder.*

MatRIC has focused on student engagement and students as partners in the educational process. The goals are *more students* engaged, *more engaged* students and *more effectively* engaged students.

MatRIC's Student Learning Assistant Programme has incorporated the university teaching and learning development centre (PULS), recently renamed Centre for Learning and Teaching (SLU). The collaboration with PULS/SLU has enabled MatRIC to extend the reach of the student learning assistant development activity across other faculties at UiA. MatRIC's camp for learning assistants in 2019 was the third such event and once again met in the week before the start of the first semester at a local holiday centre. In 2019 the event attracted 80 participants from across the university including a large number of student mentors who had been recruited to the First Year Study Environment (FYSE) initiative set up by the Engineering Department to support students in their first year. MatRIC's programme has also been developed as an outcome of the engagement of PULS/SLU to include mid- and end of semester meetings. Student Learning Assistant Development is now taking off in a meaningful way across the university, led by established and enduring structures within the university. We note also the presence of an observer from University of South-East Norway, who hopes to lead a similar initiative.

MatRIC employs student mathematics learning assistants to work in the Drop-in support and assist students in several courses – calculus in year one, mathematics for economics (pre-course and main module), and mathematics for engineering.

In 2020 MatRIC will continue to explore and develop ways to enhance student engagement. Following discussions within MatRIC's Management Board and a subsequent meeting with the Student members of the Board, it has been decided to engage two "Student Mentors" who will develop a liaison role between the student body, MatRIC's Management Board and MatRIC executive leadership. The intention is that the "Student Mentors" will enable MatRIC to improve and develop actions intended to promote student engagement and advise on how MatRIC might disseminate its work more effectively amongst the student body. It is hoped that at the end of 2020 it will be possible again to point to MatRIC's achievements in developing student engagement.

#### *Nationally*

In 2019 MatRIC's held its sixth Annual Conference. This time the Conference was held in Bergen (previous conferences have been held in Trondheim and Oslo, Gardermoen). The annual conference serves several purposes. The conference is the only national meeting point for university mathematics teachers and thus provides an important opportunity for networking amongst these teachers. MatRIC's conference now attracts broad international participation and thus it connects the Norwegian community with international partners. The conference is an important element of MatRIC's dissemination strategy, it is an opportunity to get MatRIC's actions known and motivate mathematics teachers in innovative improvements in university mathematics education. The conference also provides an opportunity to invite leading national and international speakers to stimulate engagement in mathematics teaching development. In 2019 The conference theme was "Making and communicating mathematical meaning" and keynote speakers were Kristin Flornes, Exectutive Vice-President (Technology) NORCE Norwegian Research Centre AS, and Chair of the Diku Board; Michael Dorff, President of the Mathematical Association of America (2019-2021), Professor of Mathematics Brigham Young University, Utah; and John Mason, Professor Emeritus from the Open University, Honorary Research Fellow University of Oxford, UK. The goal is to ensure that each conference has a special character, in 2019 it was to engage participants actively in mathematical activity and thinking.

MatRIC also facilitates Norwegian higher education mathematics teachers engagement in a larger international network by involving them in MatRIC's international outreach including collaboration with the German centre for higher mathematics education (khdm), the Mathematics Education Centre at the University of Loughborough, and supporting Norwegian participation in workshops and seminars arranged through the Erasmus+ project PLATINUM.

Also reported below are meetings with MatRIC's national Contact Group, which was formed in 2018 and leading the survey of teaching approaches in higher education, a collaboration with the Norwegian Mathematics Council (NMR). Significant evidence of MatRIC's contribution to national provision of mathematics education has been the leading role MatRIC has taken, at the request of "Universities Norway" (UHR) in the development of the mathematics component in the revised framework for engineering education, more can be read of these actions below.

### *Internationally*

At the international level MatRIC's collaboration with the German Centre for Higher Mathematics Education, khdm has developed significantly during 2019. The third cohort of MatRIC's Teaching Induction Course for Mathematics Teachers this time runs in collaboration with khdm, with sessions in 2019 Kristiansand and Oslo, Gardermoen, in 2020 Hannover and Trondheim. Previous courses have had rather small cohorts, the 2019 cohort has 19 participants, 10 of these from Norwegian institutions. The course draws on teaching expertise from the USA, Norway, UK and Germany, and international involvement will continue as resources permit, but the goal is to make the course sustainable with highly competent Norwegian university mathematics educators. Also, MatRIC collaborated with khdm, in the organisation of a seminar/workshop for mathematics support, this was held in June 2019 in Hannover. In addition to covering costs of some of the international contributors MatRIC covered costs of Norwegian participation.

A recent report of the European Society for Engineering Education (SEFI) Mathematics Working Group[1] draws attention especially to MatRIC, khdm and the Mathematics Education Centre at Loughborough University (another of MatRIC's collaborating partners) as playing "a major role in organising research and dissemination of research in conferences and networks" (page 3) concerning mathematics as a service subject.

MatRIC was also pleased with the outcome of the conference for mathematics education researchers focusing on teaching and learning calculus in school and beginning university studies. Forty leading international researchers presented papers at the conference, which provided an opportunity for the Norwegian university mathematics teaching community to connect with scholars at the cutting edge of research in this field. A link to proceedings of this conference is included in the publications list attached to this report.

## 2.2 Summary of activities/projects that have been conducted and the effects and results of these.

### Specific plans set for 2019

In the previous annual report, it was promised that MatRIC will continue to build on the successes achieved in 2018 by implementing a number of key events, brief reports of these follow.

**Research fellows and supervisors' workshop in May (guest presenters Professors Pat Thompson and Marilyn Carlson from Arizona State University).**

The PhD seminar was held 13 and 14 May. One full day was spent at Fevik Strand Hotel, and one full day at Frolands Verk, the place where Niels Henrik Abel spent the final days of his life. Professors Pat Thompson and Marilyn Carlsen from Arizona State University joined the event as guest speakers and reactors to PhD fellows presentations. The programme was led by Barbara Jaworski and included presentations by the PhD

[1] Alpers, B. (2020). *Mathematics as a Service Subject at the Tertiary Level: A State-of-the-Art Report for the Mathematics Interest Group*. Brussels: European Society for Engineering Education (SEFI)

fellows who joined the seminar. We were pleased to include PhD fellows from NTNU. One fellow from UiO was also due to join the seminar but had to withdraw at the last moment.

The University of Agder has made four PhD fellowships available to MatRIC. Additionally, some fellows accepted onto the Mathematics Education PhD programme have chosen topics aligned to MatRIC's objectives, these fellows have been adopted into MatRIC's research group, which is composed of 7 PhD fellows, 1 Post Doc Researcher, two Associate Professors and five Professors.

**Workshop on creativity and mathematics**

This was led by Professor Bharath Sriraman from University of Montana on June 3. There were 13 participants from 7 Norwegian higher education institutions. MatRIC offered to cover overnight accommodation in Kristiansand for those with long journeys.

**Workshop on providing mathematics support**

This collaboration with the German Centre for Higher Mathematics Education (khdm) was held in Hannover June 13-14. The workshop included guest speakers: Dr. Michael Grove, University of Birmingham UK; Dr. Ciarán Mac an Bhaird, Maynooth University, IRL; Professor Duncan Lawson, Coventry University UK). Details of the workshop can be found at https://www.matric.no/events/31 We were very pleased to learn that a Drop-in support centre has since been established at the University of South-East Norway.

MatRIC's Drop in support centres have continued to be open at least 20 hours each week throughout both semesters with a mathematics teacher available to help any student experiencing difficulty with mathematics.

**International research conference on teaching and learning Calculus.**

This four-day event took place on the UiA campus, Kristiansand 6-9 August, it was sponsored and supported by MatRIC. The initiative and proposal for the conference came from mathematics education researchers who are part of the community to which MatRIC seeks to reach out and engage in activity that will help to achieve MatRIC's objectives. Thus, although not directly inspired by MatRIC's management/leadership team it was an outcome of the network for teaching and learning mathematics that MatRIC has developed. The intention of the organisers was to have a research focused conference that considered the teaching and learning of calculus across the transition from school to university. Participation was dependent upon the acceptance of a research paper to be presented at the conference. MatRIC's sponsorship was conditional on mathematics teachers at UiA being invited to participate irrespective of whether they had a paper to present, and the final (dissemination/summary) day being open to higher education mathematics teachers throughout Norway, who were able to seek support from MatRIC towards their costs for participation. The conference attracted international participation by highly regarded researchers in the field and was successful in providing an opportunity for mathematics teachers based at Norwegian universities to connect with leading researchers. This was just one of several rich opportunities created or supported by MatRIC to stimulate higher education mathematics teachers to reflect on and develop their teaching and students' learning opportunities. Feedback by mathematics teachers about MatRIC events is invariably positive, but teachers are also required to be highly selective about where they will make space for such events because of heavy teaching loads and concurrent demands for research and publication. The calculus conference took place during vacation time but just before the start of the new semester and it was not an ideal time for teachers who were busy preparing for courses, which they would begin teaching the following week. Despite this there were several Norwegian participants who were highly satisfied and stimulated by their engagement.

**Teaching Induction course**

This is the third time the course has run. As noted above, on this occasion we are collaborating with (and providing substantial support) the German Centre for Higher Education Mathematics, khdm. There are 19 participants, ten from Norway (UiT, NTNU, HVL, UiS and UiA) and 9 from Germany. The first meeting took place on 10-11 September at UiA. The main contributors were Professor Tommy Dreyfus (Tel Aviv University) Barbara Jaworski and Frode Rønning. The evaluation of the two days reveals a high level of

satisfaction. The next meeting was 1 November (Norwegian and German participants met separately). Further sessions will be held in April in Hannover and June in Trondheim. The full programme can be found at http://www.matric.no/articles/130. Guest presenters at sessions to be held in the spring semester 2020 include Professor Chris Rasmussen (San Diego State University), Professor Emerita Lisa Lorentzen (NTNU), Professor Burkhard Alpers (Aalen University), Dr Michael Grove (Birmingham University, UK), Professor Chris Sangwin (Edinburgh University, UK).

The purpose of collaboration with the German Centre khdm is to enrich the experience of all participants, and to develop the course by learning from working with the other Centre. Such collaboration is expensive and unsustainable, but we take the opportunity of the resources currently available to establish the network, learn from each other and develop sustainable models of collaboration for the course based on modern communications technology.

**MatRIC's sixth annual conference**

There were over 80 participants attending who represented a very pleasing spread across Norwegian higher education institutions (11 institutions), and international participants (10 institutions represented from Europe and USA). About 70% of participants responded to the evaluation survey, they reported high levels of satisfaction with the conference and all parts of the programme, which is available at https://www.matric.no/events/32.

The next conference is being planned for November 5-6, 2020 again to be held in Bergen (we hope the same location). A programme committee has been set up.

**Student Learning Assistant Camp**

This took place at Skottevik Holiday Centre, 8-9 August. This year MatRIC collaborated with the UiA Centre for Learning and Teaching (SLU) and the first day included student teaching/learning assistants from across the university. There were about 80 participants on the combined first day, and about 50 on the second day that focused more sharply on teaching and learning mathematics. Collaboration with SLU is a strategic initiative of MatRIC, there are two main goals, first to extend the influence of MatRIC across the university, second to root MatRIC's actions in the university's educational structures as a means of ensuring sustainability beyond MatRIC's funding.

## Collaboration with other projects

MatRIC also benefited from the Erasmus+ PLATINUM Project led from the University of Agder. PLATINUM organised workshops on Inquiry Based Mathematics Education that were very closely aligned to MatRIC's goals, thus MatRIC resources were used to facilitate participation other Norwegian institutions (colleagues from NTNU, NMBU, UiT, UiS accepted the invitation). The PLATINUM project is also a channel for international dissemination. The synergy arising between the Norwegian Centre for Excellence, MatRIC, and the European project PLATINUM is worth investigating as possibly providing a model for the enrichment of both nationally and internationally focused teaching development programmes.

## Other MatRIC activity

In addition to the above specific events, MatRIC also fulfilled everything planned to build on other positive developments from 2018 (and earlier).

- Increasing the influence of MatRIC in the institutional structures of higher mathematics education in Norway (Universities Norway Subject group for Mathematics, Natural Sciences and Technology (UHR-MNT), Universities Norway Subject group for Economics and Administration (UHR-ØA), Norwegian Mathematics Council (NMR))
    - Leading mathematics curriculum development for revised national framework for engineering education. (UHR-MNT)
    - Preparation for hosting 2021 biennial Norwegian STEM education conference. (UHR-MNT)
    - Planning workshop for mathematics teachers on economics programmes. (UHR-ØA)

    - Leading development and implementation of national survey of teaching approaches (NMR)
    - Supporting development of digital assessment of mathematics (UHR & NMR)
- Securing even greater levels of engagement with colleagues at other institutions through the MatRIC Contact Group, which was introduced in 2018. There are about 20 members of the Contact Group with representatives from each of the major Norwegian higher education institutions. Where mathematics teaching is distributed over several widespread campuses there are Contacts located on separate campuses. The network of Norwegian higher education mathematics teachers, especially those working on service courses is one of the outcomes of MatRIC's activity. This network is of fundamental importance in terms of the dissemination of experience, ideas and knowledge of the transformation and improvement of students' learning of mathematics.
- Embedding the culture of student partnership and expanding the work of student learning assistants and peer support, in courses and the MatRIC Drop-in.
- Improving communication and sharing MatRIC's vision for transformed and improved learning experiences in mathematics. Measured over all MatRIC's activity – conferences, workshops, seminars, research – it is possible to point to the engagement of mathematics teachers from all the major centres of mathematics teaching in Norwegian Higher Education Institutions.
- Continuing to create and develop knowledge about higher mathematics education through the work of PhD fellows, MatRIC research awards, NMR-MatRIC survey of (active) learning approaches and researching developments in teaching and learning mathematics at UiA.
- Promoting R&D based education and student engagement, at UiA and nationally.
- Further developing MatRIC as a forum for sharing and exchange of ideas to improve higher mathematics education through the events listed above, and the introduction of a MatRIC server that is available through password protected log-in to mathematics teachers at other higher education institutions around Norway.
- Delegation visit to University of Toronto. MatRIC joined the UiA Rectorate and Deans in an institutional visit to U of T. The agenda was to learn more about learning centres such as the MatRICs Drop in.
- Open lecture (29 August) Associate Professor Kathrine Frey Frøslie held an inspiring talk about the importance of statistics for students at UiA
- Realfagsdagen (26 September) in collaboration with TEKNA. MatRIC invited Dr. Magnus Dehli Vigeland to talk about mathematics for high school students.

In light of the success of MatRIC's actions during 2018 and 2019 as we have focused on implementing the revised action plan agreed from the mid-term evaluation, we are satisfied that the current strategic direction is the right one and whilst minor adjustments in operational plans may be required we do not anticipate major changes at a strategic level. However, we do note that the leadership of MatRIC will change in the middle of 2020 and in preparation for that the Director designate will be meeting with MatRIC's Management and Advisory Boards in April to consider MatRIc's strategy, especially considering sustainability beyond the Phase Two period of funding.

## MatRIC and Teacher Education Programmes

MatRIC has been challenged over the years to find a place for MatRIC within mathematics teacher education that complements an already busy support network. During 2019 a major advance for MatRIC has been in collaboration with the National Centre for Mathematics Education (NSMO) based at NTNU in Trondheim and the Mathematics Education group at the University of Stavanger. MatRIC and NSMO have now developed a course for mathematics teacher educators, loosely based on MatRIC's mathematics teaching induction course. The new course differs in many respects, especially that the content is designed for the diverse needs of teachers taking up positions in mathematics teacher education. Other differences include the course being more extensive and spread over four semesters, further, it has been validated as an ECTS award bearing course (30 points) at NTNU. The first cohort will be recruited for the autumn semester 2020. MatRIC will provide financial resources to make the course viable for up to two pilot cohorts, after this it is hoped that the course will be self-sustaining.

The developmental process has included the use of a large advisory group to provide critical feedback on content and structure. The advisory group have expressed a great deal of support for the concept of the course noting that it will make an important contribution to the development of mathematics teacher education in Norway. In addition, as there are very few similar examples of such courses internationally, we hope to set Norway as a leader in the field.

## Activities/projects have had the desired results

The above report of MatRIC's many actions to support and develop teaching, learning and researching mathematics education in higher education reveals the comprehensive programme aligned to the objectives agreed in the action plan emerging from the mid-term evaluation. The first phase of MatRIC's existence resulted in the national and international networks that comprise MatRIC's communities and the human resources that ensure the success of MatRIC's activity.

Evaluation of MatRIC's actions is undertaken using anonymous on-line surveys and through conversation and representation in Management Board and other meetings. Feedback from students at the University of Agder and teachers from other Norwegian Higher Education Institutions – MatRIC's prime audiences reveals high levels of satisfaction with MatRIC's actions.

We continually monitor to expose evidence of the realisation of MatRIC's vision students enjoying transformed and improved learning experiences of mathematics. During 2019, it has been very rewarding to see the improved performance of students in the mathematics for economics course, thus confirming the innovations to the course reported in the previous annual report.

MatRIC grows and matures, and MatRIC's engagement with individuals enables those people to develop and progress in their professional engagement and careers. The lessons we learn from this are that MatRIC cannot stand still. We point to one of MatRIC's network coordinators being awarded "Excellent Teaching Practitioner" and in 2019 appointed Vice Rector (Education) at UiA. Another network coordinator, a mathematician, has been successful in securing Erasmus+ funding for mathematics teaching development projects. MatRIC has been highly influential in these personal and professional developments. However, the impact on the networks they coordinated is considerable. Nevertheless, their effort as network coordinators in earlier years have resulted in sustainability that is not dependent on MatRIC, and MatRIC is able to move on and develop fresh areas of activity, such as the focus on courses to develop student learning assistants and mathematics teacher professional development.

## Activities/projects that have not had the desired results and the lessons learned.

MatRIC has a competent and committed leader team that collaborates effectively to ensure that MatRIC actions are successful. In those areas where it is possible to exercise control, objectives are met. In those areas where it is not possible to control, such as participation in MatRIC actions, great effort is made to mitigate the threat, such as in the example cited, an effective marketing and dissemination strategy.

## MatRIC's effort to fulfil the action plan agreed at the mid-term evaluation.

The agreed action plan set out a realistic programme that was believed to be achievable with the human and material resources available. Despite the changes in human resources mentioned above, it has been possible for MatRIC to delver on all points of the plan, with one exception. So far MatRIC has not produced any so called "White Papers". It is hoped that as the MatRIC related PhD fellows begin to defend their theses the necessary evidence that will support this production will emerge.

## Dissemination

MatRIC's dissemination strategy has not changed. Four dissemination goals are set, dissemination for:

- Awareness
- Understanding
- Engagement/Action
- Change/Self-generating sustainable development

MatRIC recognizes several constituencies of stakeholders:

- Students
- Mathematics teachers
- Researchers
- Leaders and managers (Department, Faculty, Institution)
- Funders and policy makers
- Employers[2]

A substantial proportion of MatRIC's budget is used in different forms of dissemination including the production of printed and on-line materials as well as travelling to conferences and other meetings. Given that networking mathematics teachers is a key strategy of MatRIC's actions to achieve the objectives, physical presence in meetings is very important, and necessary travel is considered in the light of global sustainable development. During 2019 MatRIC has …

- Produced a summary printed version of the Annual report for distribution to leaders and policy makers.
- Revised video presentations to advertise MatRIC to students
- Increased student engagement in MatRIC activity
- Organised conferences, workshops and seminars to engage mathematics teachers and mathematics education researchers.
- Published Newsletters, placed material on the MatRIC website (www.matric.no) and used national e-mail lists to reach out to mathematics teachers.
- Promoted and met with MatRIC's Contact Group[3] on two occasions (at the UHR-MNT Conference in March and MatRIC's Conference in October).
- Been in attendance and presented MatRIC at national subject groups The Norwegian Mathematics Council (NMR), The Economy and Administration Subject Group (UHR-ØA), The Mathematics, Natural Sciences and Technology Subject Group (UHR-MNT), and collaborated with these groups –
    - NMR National survey of active learning approaches
    - UHR-ØA Planning a seminar for mathematics teachers serving economics programmes
    - UHR-MNT Planning 2021 MNT Conference to be jointly hosted by MatRIC. Convening and leading a group producing guidelines for mathematics in the new national framework for engineering education.
- Had a presence and presented research at conferences around the world.

## 3. Aims of the SFU initiative: R&D-based education, integrated models and student engagement

### Research and Development based education

MatRIC supports research that:

- Motivates, explores and informs teaching development,
- Contributes to course contents and students' educational experience

[2] It was reported last year that the plan to develop a course based on the USA "Preparation for Industrial Careers in Mathematics (PIC-Math)" project had been dropped due to lack of interest by employers. MatRIC's concentrated focus on the early semesters of mathematics teaching and learning in service courses means that MatRIC acts rather remotely from employment. Nevertheless, the future employment of graduates with mathematical competencies fit for the purposes of their employment remains an important consideration in MatRIC's programme.

[3] The formation of the Contact Group was reported last year. The group is composed of representatives from higher education institutions around Norway. The Group is an important element in the two-way lines of communication between MatRIC and mathematics teachers.

- Contributes to national and international understanding of the nature of teaching and learning mathematics in higher education.

We await with interest the findings from PhD fellows whose research projects are aligned with MatRIC's objectives for learning and teaching Mathematics. Already, some PhD fellows are publishing from their inquiries (See Fredriksen, Kanwal, Tetaj, and Zakariya in the attached publication list). The research pursued aims to go into depth to understand better the nature of students' learning in the context of teaching innovation. The Department of Mathematical Sciences at UiA appointed a post-doctoral researcher in 2019, his chosen field of inquiry is teaching and learning mathematics in higher education, thus he was welcomed into the MaRIC Community. MatRIC has funded two year's research leave for one Associate Professor in Mathematics Education, he is researching students' learning and meaning making in first year engineering classes.

During 2019 MatRIC has made an effort to balance the in-depth qualitative research by the appointment of an experienced statistician as researcher and a new PhD fellow who is undertaking quantitative research on large cohorts. We have negotiated with the Norwegian Data Protection Agency to gain permission to integrate teaching and learning analytics at individual student level. The General Data Protection Regulations introduced in 2018 impose strict requirements on eliciting students' consent to share data between different offices/functions within the university – even with the promise of complete anonymity before anything is seen by researchers. Briefly, we are trying to work through these obstacles and gain access to meaningful data that will enable us to make claims about the effect of MatRIC's actions on students' learning outcomes.

The survey of active learning approaches in university mathematics that MatRIC is conducting with The Norwegian Mathematics Council will stimulate a discussion about changes in practice amongst mathematics teachers and about the nature of teaching and learning mathematics. The discussion will be informed by other research from the USA, especially, that reveals the positive impact of active learning in mathematics, science and technology.

MatRIC encouraged participation and presentation at the MNT-Conference (Mathematics, Natural Sciences and Technology) that met in Tromsø at the end of March 2019. Altogether 12 mathematics teaching related papers were presented at the conference of which 7 were supported in various ways by MatRIC. As we look to the future, we recognise that the MNT conference will continue as an established forum for reporting research into teaching and learning mathematics in higher education, it is therefore part of MatRIC's strategy to promote this conference. As part of that strategy it is very good that MatRIC, with the Faculty of Engineering and Science at UiA will host the next meeting of the biennial conference in 2021.

### Integrated models and student engagement

MatRIC's main focus is the teaching and learning of mathematics as a service subject. Superficially this seems an ideal context for developing courses in which the mathematics is integrated within other courses the subject serves. This has been attempted within the electrical engineering course at UiA. However, there are issues that have made permanent change very difficult to achieve. These issues include the need to ensure coverage of a syllabus in mathematics, that may not serve the concurrent subject studies, but rather subject studies that will be followed in later semesters. There is also a financial issue where mathematics as a service subject often happens in large classes that combine students from several programmes. In this latter situation MatRIC has been concerned to find ways to motivate students' engagement by making the mathematics more relevant. There are also issues where the service mathematics and the programme served 'belong' to different faculties (as with mathematics for economics at UiA). Integrated models of teaching and learning are an ideal for which MatRIC can campaign, but MatRIC does not 'own' programmes or courses and MatRIC has a limited resource (financial and human) that are used to be effective in authentic sustainable situations.

Student engagement in their education is prioritised within MatRIC's actions and we point to the developments that were highlighted at the beginning of this report.

## 4. Plan for 2020

### MatRIC has established a regular programme of activity that will continue, this includes:

- Provision of Drop-in support
- Pre-Course in Mathematics for students joining the Economics programme
- Development and deployment of student learning assistants
- Annual Conference
- Motivating and supporting research into teaching and learning mathematics in higher education
- Engagement with national and international teaching and research communities
- Engagement with national subject groups: NMR, UHR-MNT, UHR-ØA
- Maintaining MatRIC's Contact Group

### In 2020 increased attention or innovative action is planned as follows:

**Mathematics for first year engineering students**. It is intended to take what has been learned from the successful innovation with mathematics for economics students and apply or adapt to improve engineering students' experience of learning mathematics.

**Course for Mathematics Teacher educators**. This new course has been described above. The implementation of the course will be strongly supported and carefully monitored.

**Workshop/seminar for mathematics teachers serving economics programmes**. This is a national development at programme level that follows MatRIC's engagement with the UHR-ØA subject group. The event will be nurtured carefully because the aim is to stimulate the development of a network of mathematics teachers working in Economics programmes of study.

**SEFI-MWG Conference**. MatRIC is pleased to host this European conference in Kristiansand in June. As reported above, SEFI-MWG acknowledges MatRIC as one of three major European organisations contributing to the development of mathematics teaching and learning as a service subject in Engineering. MatRIC's goal is to ensure a successful conference that cements Norway's place into this European network.

**Complete 3rd Cohort of Mathematics Teaching Induction Course**. The course will be evaluated, and plans made for a 4th cohort. There have been informal conversations about the possibility of incorporating the course into a developed UniPed course that includes modules on didactics. In this respect it would be necessary to modularise the MatRIC course. The advantage of this is that the didactics course would achieve a level of sustainability outside MatRIC.

**MatRIC-NMR Survey of Active Learning approaches**. The survey will be closed for responses at the end of February 2020. During 2020 work will be on-going in analysis and reporting results. The first full report will be at the NMR Annual Meeting in September.

**Student engagement and partnership**. MatRIC will engage students more actively in MatRIC's decision making and activity. Currently two positions for students are announced. The appointed students will form an effective channel of communication and liaison between the student body and MatRIC. Further, MatRIC's programme for student learning assistant development will be embedded more deeply into a university wide scheme that will be part of UiA's Centre for Learning and Teaching.

**PhD Fellows Seminar**. The seminars have been a useful part of MatRIC PhD fellows' programme. In 2020 we will seek to develop this programme and invite a wider range of PhD fellows researching mathematics education more widely. We recognise that researching teaching and learning in higher education is a specialised area within the field, but there is much to learn from the theoretical and methodological issues confronted by others researching mathematics education in a school context. 2020 is a full year of international conferences: RUME, INDRUM, NORMA, SEFI-MWG, ICME, PME[4] in addition to summer

[4] RUME: Research in Undergraduate Mathematics Education conference in Boston, USA February
INDRUM: International Network for Didactics Research in University Mathematics conference in Tunisa, March
NORMA: Nordic Research in Mathematics Education conference in Oslo, May

schools to which Norwegian PhD fellows are invited. It is necessary to consider, in discussion with PhD fellows, the total demand on their time before deciding whether and when a MatRIC PhD seminar should occur.

**Drop-in support**. The leaders of Drop-in support will make a study tour to learn from provision in the UK and Ireland (sigma network). It is an objective to demonstrate the effectiveness of Drop-in mathematics support at UiA so that students will be offered this service in all Norwegian Higher Education Institutions. To achieve this object the recruitment of a PhD fellow to research the local impact of the UiA Drop-in support will be made as soon as a fellowship and suitable candidate for the fellowship are available.

**Dissemination.** MatRIC will develop the dissemination actions listed above. Especially, within UiA we want to develop more effective ways of reaching the student body so that students will make better use of the mathematics learning support available.

## Conclusion

This report presents MatRIC as a dynamic and responsive Centre for Excellence in Mathematics for Higher Education. MatRIC, which is now deeply rooted in educational development at the University of Agder, strongly networked within a community of Norwegian higher education mathematics teachers and recognised internationally for making a significant contribution to mathematics teaching as a service subject. MatRIC's three pillars of student engagement in education, mathematics teaching development, and research and development-based mathematics education inspire actions, reported in the foregoing report, that are making an important contribution to the development of teaching and learning mathematics in higher education.

## Attachments to the report:

o Personnel

o Financial accounts (submitted to Diku separately)

o Publications

SEFI-MWG: European Society for Engineering Education-Mathematics Working Group conference in Kristiansand, June
ICME: International Congress of Mathematics Education in Shanghai, July
PME: International Group for the Psychology of Mathematics Education conference in Thailand, July.

# Attachments

## 1. Personnel

*For proportion of full-time position refer to Budget for 2020.*

| | |
|---|---|
| Simon Goodchild | Director |
| Thomas Gjesteland | Co-Director |
| Lillian Egelandsaa | Project Manager |
| Morten Brekke | Contact Group, Computer Aided Assessment, Video (Promoted to Vice Rector August 2019) |
| Per Henrik Hogstad | Simulation, visualization, programming (Retired Emeritus from March 2019) |
| Yuriy Rogovchenko | Mathematical modelling, Leader of Erasmus+ project PLATINUM |
| Linda G. Opheim | Mathematics Teacher Education (coordinator) |
| Barbara Jaworski | Research Coordinator |
| Svitlana Rogovchenko | Drop-in Leader (Grimstad) |
| Elna Svege | Drop-in Leader (Kristiansand) |
| Hans Kristian Nilsen | Researcher |
| Kirsten Bjørkestøl | Researcher |
| Farzad Radmehr | Post Doc. Research Fellow |
| Yannis Liakos | PhD fellow (Fellowship ended December 2018, still to defend dissertation) |
| Shaista Kanwal | PhD fellow |
| Helge Fredriksen | PhD fellow |
| Henrik Kjelsrud | PhD fellow |
| Floridona Tetaj | PhD fellow |
| Ida Landgärds | PhD fellow (Transferred to employed position during 2019) |
| Yusuf F Zakariya | PhD fellow |

***Administrative support***

| | |
|---|---|
| Elisabeth Rasmussen | Conferences and events |
| Ling Jiang | Travel, accommodation, contracts |
| Ninni Marie Hogstad | Conference web-site, proceedings, support. |
| Bendik Dyrli | ICT/MatRIC Server technical support |

## 2. Budget Commentary

*Accounts and Budget submitted separately.*

MatRIC receives 4 mill. NOK from KD distributed by NOKUT/Diku. An additional 4 mill. NOK is received received from the University of Agder (3 mill. From central allocation and 1 mill. From the Faculty of Engineering and Sciences). PhD fellowships devolved by UiA are additional to this cash income.

Conceptually the use of funds differs from that detailed in the accounts. MatRIC's budget is used in three conceptual areas: Centre costs, mainly for personnel, external costs supporting dissemination and events, and internal costs supporting MatRIC's actions within UiA.

- Centre costs are covered jointly by funds coming from KD (NOKUT/Diku) and funds from UiA.
- External costs are covered by the remainder of funds coming from KD (NOKUT/Diku).
- Internal costs are covered by the remainder of funds coming from UiA.

## 3. Publications

**Note:** some publications from earlier years are listed below because they have not been included in previous annual reports.

**Journal articles, books, chapters & published proceedings**


**Bjørkestøl, K., Borge, I. C., Goodchild, S., Nilsen, H.K**., & **Tonheim, O. H. M** (2019). Student-active learning in mathematics: Operationalisation of 'constructive alignment'. *Nordic Journal of STEM Education, 3*(1), 220-224.

**Bjørkestøl, K., & Nyberg, S.O.G** (2019). Bruk av podcasts i matematikk ved et universitet og analyse av eksamensresultat. *Nordic Journal of STEM Education, 3*(1), 116-120.

Borji, V., **Radmehr, F**., & Font, V. (2019). The Impact of Procedural and Conceptual Teaching on Students' Mathematical Performance over Time. *International Journal of Mathematical Education in Science and Technology,* https://doi.org/10.1080/0020739X.2019.1688404

Bosch, M., Chevallard, Y., García, F. J., & **Monaghan, J**. (Eds.) (2019). *Working with the Anthropological Theory of the Didactic in Mathematics Education: A Comprehensive Casebook*. Routledge.

Dreyfus, T., **Monaghan, J**. & Nardi, E. (2019). Introduction in Calculus in upper secondary and beginning university mathematics. *Proceedings of the conference Calculus in upper secondary and beginning university mathematics*, University of Agder, Norway. Available at https://matric-calculus.sciencesconf.org/

Dreyfus, T., **Monaghan, J**. & Nardi, E. (Eds.) (2019). Calculus in upper secondary and beginning university mathematics. *Proceedings of the conference Calculus in upper secondary and beginning university mathematics*, University of Agder, Norway. Available at https://matric-calculus.sciencesconf.org/

Drijvers, P.; **Monaghan, J**.; …, **Hadjerrouit, S**., et al. (2019). Transitions Toward Digital Resources: Change, Invariance, and Orchestration. In: Trouche, L., Gueudet, G., & Pepin, P. (ed.). *The 'Resource' Approach to Mathematics* Education (pp. 389-444). Advances in Mathematics Education. Springer, Berlin.

**Fredriksen, H**. & **Hadjerrouit, S**. (2020). Exploring engineering students' participation in flipped mathematics classroom: a discursive approach. *Nordic Studies in Mathematics Education*, 25 (1), 45–64.

**Fredriksen, H**. (2020). Exploring Realistic Mathematics Education in a Flipped Classroom Context at the Tertiary Level. *International Journal of Science and Mathematics Education*. doi:10.1007/s10763-020-10053-1

**Fredriksen, H**., & **Hadjerrouit, S**. (2019). An activity theory perspective on contradictions in flipped mathematics classrooms at the university level. *International Journal of Mathematical Education in Science and Technology*, 1-22. doi:10.1080/0020739X.2019.1591533

Fredriksen, H., & **Hadjerrouit, S**. (2019). An activity theory perspective on contradictions in flipped mathematics classrooms at the university level. *International Journal of Mathematical Education in Science and Technology* 2019, 1-11.

**Gjesteland, T**. & **Vos, P**. (2019) Affect and mathematical modeling assessment – A case study on students' experience of challenge and flow during a compulsory mathematical modeling task by engineering students. In S. Chamberlin (Ed.) and B. Sriraman (Ed.) Affect in Mathematical Modeling ISBN: 978-3-030-04431-2, Springer Publishing Company.

**Hadjerrouit, S**. (2019). Investigating the affordances and constraints of SimReal for mathematical learning: A case study in teacher education. *CSEDU 2019 - Proceedings of the 11th International Conference on Computer Supported Education,* Vol. 2. SciTePress 2019, pp. 27-37.

**Hansen, R**., **Herheim, R**. & **Lilland, I.E**. (2018). Teachers' mathematical discussions of the Body Mass Index formula. In E. Noren, H. Palmer & A. Cooke (Eds.), *Nordic Research in Mathematics Education. Papers of NORMA 17. The Eighth Nordic Conference on Mathematics Education. Skrifter från SMDF, Nr 12* (pp. 249-258*).* Göteborg: Svensk Förening för MatematikDidaktisk Forskning.

**Hadjerrouit, S**., & Gautestad, H.H. (2019). Evaluating the Usefulness of the Visualization Tool SimReal+ for Learning Mathematics: A Case Study at the Undergraduate Level. In D. Ifenthaler, P., Isaías, J. M., Spector, & PP. Stylianos (Ed.). *Learning Technologies for transforming Teaching, Learning and Assessment at Large Scale* (pp.71-89). Springer, Berlin.

Hernandez-Martinez, P., Thomas, S**., Viirman, O**. & **Rogovchenko, Y**. (2019). 'I'm still making dots for them': mathematics lecturers' views on their mathematical modelling practices. *International Journal of Mathematical Education in Science and Technology.* DOI: 10.1080/0020739X.2019.1668977

Heyd-Metzuyanim, E., Adler, J., Lavie, I., Nachlieli, T., Tabach, M., Robertson, S.-A., Graven, M., & **Viirman, O**. (2019). Research Forum: Rituals and explorations in mathematical teaching and learning. In M. Graven, H. Venkat, A. Essien, & P. Vale (Eds.), *Proceedings of the 43rd Conference of the International Group for the Psychology of Mathematics Education* (Vol. 1, pp. 137-164). Pretoria, South Africa: PME.

**Kacerja, S**. & **Herheim, R**. (2019, February). Mathematics teachers' critical colleagueship. In U. Jankvist, M. Van den Heuvel Panhuizen & M. Veldhuis (Eds.), *Proceedings of the Eleventh Congress of the European Society for Research in Mathematics Education* (pp. 3384-3391). Utrecht, NL: University of Utrecht.

**Kacerja, S**., **Rangnes, T. E**., **Herheim, R**., **Pohl, M**, **Lilland, I. E**., & **Hansen, R**. (2017). Stimulating critical mathematical discussions in teacher education: use of indices such as the BMI as entry points. *Nordisk matematikkdidaktikk, 22*(4), 43-59.

**Kanwal, S**. (2019). Exploring affordances of an online environment: a case-study of electronics engineering undergraduate students' activity in mathematics. *International Journal of Research in Undergraduate Mathematics Education.* https://doi.org/10.1007/s40753-019-00100-w.

Kolahdouz, F., **Radmehr, F**. & Alamolhodaei, H. (2019). Exploring students' proof comprehension of the Cauchy Generalized Mean Value Theorem. *Teaching Mathematics and its Applications: An International Journal of the IMA*, https://doi.org/10.1093/teamat/hrz016

**Meaney, T**., Trinick, T., & Fairhall, U. (2019). Statistical enquiry and cultural knowledge: Ocean settlement voyages. *Journal of Mathematics and Culture*, *13*(1), 80-99.

**Monaghan, J.** (2019). The place of limits in elementary calculus courses. Calculus in upper secondary and beginning university mathematics, 82. *Proceedings of the conference Calculus in upper secondary and beginning university mathematics*, University of Agder, Norway. Available at https://matric-calculus.sciencesconf.org/

**Nilsen, H.K.** (2019). First-year engineering students' reflections on integration and the Fundamental Theorem of Calculus*.* In J. Monaghan, E. Nardi and T. Dreyfus (Eds.) (2019), *Calculus in upper secondary and beginning university mathematics – Conference proceedings* (pp. 135-139). Kristiansand, Norway: MatRIC. Retrieved on the 21st of February 2020 from https://matric-calculus.sciencesconf.org/

**Nilsen, H.K.** (2019). *First-year university students' interpretation of praxeology when solving an integration task.* Presentation held at the 43rd Conference of the International Group for the Psychology of Mathematics Education (PME), Pretoria, South Africa.

**Nilsen, H.K.** (2019). First-year university students' interpretation of praxeology when solving an integration task*.* In M. Graven, H. Venkat, A. A. Essien and P. Vale (Eds.) (2019). *Proceedings of the 43rd Conference of the International Group for the Psychology of Mathematics Education* (Vol 3) (pp. 129-137). Pretoria, South Africa: PME.

***Rangnes, T., Herheim, R. & Kacerja, S****. (2018). In-service teachers' positioning when discussing the body mass index. In E. Noren, H. Palmer & A. Cooke (Eds.), Nordic Research in Mathematics Education. Papers of NORMA 17. The Eighth Nordic Conference on Mathematics Education. Skrifter från SMDF, Nr 12 (pp. 289-298). Göteborg: Svensk Förening för MatematikDidaktisk Forskning.*

**Rensaa, R. J**., **Hogstad, N. M**., & **Monaghan, J**. (2019). Themes within lecturers' views on the teaching of linear algebra. *International Journal of Mathematical Education in Science and Technology*. Retrieved from https://www.tandfonline.com/doi/pdf/10.1080/0020739X.2019.1668976?needAccess=true. doi:10.1080/0020739X.2019.1668976

**Rogovchenko, Y**., **Viirman, O**., & Treffert-Thomas, S., (2020). Joy of Mathematical Modelling: A Forgotten Perspective? In G. Stillman, G. Kaiser & C.E. Lampen, Mathematical Modelling Education and Sense-making. Springer (in press) ISBN:978-3-030-37672-7

**Tetaj, F**. & **Viirman, O**. (in press). A case study on mathematical routines in undergraduate biology students' group-work. To appear in *Proceedings of CERME11.*

**Viirman, O**. & Nardi, V. (2019). Negotiating different disciplinary discourses: Biology students' ritualized and exploratory participation in Mathematical Modelling activities. *Educational Studies in Mathematics, 101,* 233-252.

Voigt, M., **Fredriksen, H**., & Rasmussen, C. (2020). Leveraging the design heuristics of realistic mathematics education and culturally responsive pedagogy to create a richer flipped classroom calculus curriculum. *ZDM*. doi:10.1007/s11858-019-01124-x

**Zakariya, Y. F**. (2019). Study approaches in higher education mathematics: Investigating the statistical behaviour of an instrument translated into Norwegian. *Education Sciences*, *9*(3), 191. doi:10.3390/educsci9030191

**Zakariya, Y. F**., **Bjørkestøl, K**., **Nilsen, H. K**., **Goodchild, S**., & Lorås (2020). University students' learning approaches: an adaptation of the revised two-factor study process questionnaire to Norwegian. *Studies in Educational Evaluation, 64*, 1-10. doi:10.1016/j.stueduc.2019.100816

**Zakariya, Y. F**., **Goodchild, S**., **Bjørkestøl, K**., & **Nilsen, H. K**. (2019). Calculus self-efficacy inventory: Its development and relationship with approaches to learning. *Education Sciences, 9*(3), 1-14. doi:10.3390/educsci9030170

**Presentations**

**Bjørkestøl, K.** (2019). *The use of podcasts in mathematics by a university and the analysis of exam results from 3 years.* Presentation held at the Monday seminar, Department of Mathematics, Kristiansand, Norway.

**Bjørkestøl, K., Borge, I. C., Goodchild, S., Nilsen, H.K., & Tonheim, O. H. M** (2019). *Student-active learning in mathematics: Operationalisation of 'constructive alignment'.* Presentation held at the MNT conference, Tromsø, Norway.

**Bjørkestøl, K., Borge, I. C., Goodchild, S., Nilsen, H.K., & Tonheim, O. H. M** (2019). *Student-active learning in mathematics: Operationalisation of 'constructive alignment'.* Presentation held at the NMR annual meeting, Stavanger, Norway.

**Bjørkestøl, K., Goodchild, S., Nilsen, H.K.** (2019). *Developing a survey instrument to explore the incidence of active learning approaches in higher mathematics education.* Presentation held at the Monday seminar, Department of Mathematics, Kristiansand, Norway.

**Bjørkestøl, K., & Nyberg, S.O.G.** (2019). *Bruk av podcasts i matematikk ved et universitet og analyse av eksamensresultat.* Presentation held at the MNT conference, Tromsø, Norway.

**Brekke, M**. (2019, April 29-30). *Establishment of a new Norwegian STACK community within MatRIC.* Putting educational research into practice in HE Mathematics and Statistics teaching, ICMS – International Centre for Mathematical Sciences, Edinburgh, University of Edinburgh. https://www.icms.org.uk/perpstack.php

**Brekke, M**. (2019, February 21-22). *Student Active Learning in Mathematics and Statistic at University of Agder (UiA). How do we implement programming to our engineering students? Keynote by Morten Brekke from University of Agder and following panel discussion.* ASIM - FG Edu Fachgruppensitzung ASIM Workshop – Simulation of technical systems / Basics and methods of modelling and simulation, Braunschweig. https://www.asim-gi.org/publikationen/asim-fg-workshops/detail/tagungsband-asim-workshop-sts-gmms-2019

**Brekke, M**. (2019, January 3). *"Utfordringer med å nå de matematiske kompetansemål".* Workshop Nasjonale retningslinjer for ingeniørutdanning. Universitets og Høgskolerådet, Gardermoen.

**Brekke, M**. (2019, June 13-14) *Pre-university mathematics courses are not rocket science – they would be so much easier if they were!* MatRIC-khdm International Workshop on Support for Students in Mathematics in the First Year of University Studies. Leibniz University Hannover. https://www.matric.no/events/31

**Brekke, M**. (2019, March 28-29). *Utvikling og oversetting av selvrettende oppgaver fra STACK for å bedre studentenes læring i matematikk.* The Nordic Conference for STEM Recruitment, Tromsø, https://doi.org/10.5324/njsteme.v3i1.2992

**Brekke, M**. (2019, May 22). *Blended Learning in Calculus.* Webinar Pearson Education. https://docs.google.com/forms/d/e/1FAIpQLSfOwu0m9jGERjCbzzbRS4LQjz3H4cmLMm0IQYB6cfZxndWiFQ/viewfor

**Kacerja, S**. (2018, April). Bærekraftig utvikling i undervisning og forskning- det kritiske perspektivet i matematikkdidaktikk- indekser som et eksempel [Paper presentation]. Bærekraftig utvikling ved HVL-hvor står vi, hvor går vi?. Bergen, NO.

**Kacerja, S**. (2018, June). Indekser og kritisk matematikkdidaktikk. Halvdagsseminar for Argument prosjektet - samarbeid mellom UiB, HVL, Skolelaboratorien og Bergen Kommune. UiB, Bergen.

**Kacerja, S**. (2018, June). Teacher educators' critical colleagueship in developing mathematics teaching about the Body Mass Index. Paper presented at the NOMUS XVI seminar, Bergen.

**Kacerja, S**. (2018, March). Indices and critical mathematics education. Guest lecture for mathematics student teachers and staff. University of the Western Cape, South Africa.

**Kacerja, S**. (2019, March). Critical competence in mathematics with existing mathematical models, such as BMI. Guest lecture for in-service teachers of mathematics (CPD). LEDIMTALI, University of the Western Cape, South Africa, 05.04.2019.

**Kacerja, S**., **Rangnes, T. E**., & **Lilland, I. E**. (2018, March). Stimulating critical mathematical discussions in teacher education: examples from our work with indexes. Guest lecture for the staff of Faculty of Education, University of the Western Cape, South Africa.

**Larson, N**. (2019, March 28–29). *Comparative judgement as a learning activity* [Paper presentation]. MNT Conference 2019, Tromsø, Norway. https://doi.org/10.5324/njsteme.v3i1.2992

**Nilsen, H. K**. & **Gjesteland, T**. (2019, June 13-14) How do we get active students? Students enjoying transformed and improved learning experiences of mathematics in higher education. [Paper presentation] MatRIC-khdm International Workshop on Support for Students in Mathematics in the First Year of University Studies. Leibniz University Hannover, Germany.

**Nilsen, H.K**. (2018). *Students perception of integrals and their use of different learning resources.* Presentation held at the Monday seminar, Department of Mathematics, Kristiansand, Norway.

**Nilsen, H.K**. (2019). *First-year engineering students' reflections on the Fundamental Theorem of Calculus.* Presentation held the MatRIC conference on Calculus in Upper Secondary and Beginning University Mathematics, Kristiansand, Norway.

**Nilsen, H.K.** (2019). *First-year engineering students' reflections on integration and the Fundamental Theorem of Calculus.* Presentation held at the Monday seminar, Department of Mathematics, Kristiansand, Norway.

**Rangnes, T. E**., **Herheim, R.** & **Kacerja, S**. (2017, September). Læreres posisjonering når de diskuterer indekser og BMI [Paper presentation]. Etterutdanningskonferanse for lærerutdannarar i matematikk. UiS, NO.

**Rogovchenko, S.** (2019, February 13-14). Exploration routines in a Differential Equations course: students' work with non-standard problems. The 1st International Commognitive Workshop, Haifa, Israel. https://edu.technion.ac.il/wp-content/uploads/sites/35/2019/02/The-1st-International-Commognitive-Workshop_Program.pdf

**Rogovchenko, S.** (2019, July 21-26). Mathematical modelling tasks in an ODE course: a commognitive perspective. The 19th International Conference on the Teaching of Mathematical Modelling and Applications. Hong Kong, PR China. https://www.ictma19.org/daily-program-schedule

**Rogovchenko, Y.** (2019, July 21-26). Mathematical modelling activity with biology undergraduates. The 19th International Conference on the Teaching of Mathematical Modelling and Applications. Hong Kong, PR China. https://www.ictma19.org/daily-program-schedule