

Skjemainformasjon

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Host

Information about host institution and center

Name of centre	Centre for Research, Innovation and Coordination of Mathematics Teaching: MatRIC
Host institution	University of Agder
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About the centre

About the centre

Is the centre already established at the time of application

No

Describe briefly the plans for establishing the centre (maximum 1500 characters)

The Centre will lead innovation and research in university mathematics teaching and learning within the programmes of other subjects e.g. engineering, natural sciences, economics and teacher education (user programmes - UPs). The Centre will engage in networking university mathematics teachers with teachers in the UPs and employers of graduates from the UPs. The Centre will coordinate and sponsor research activity that enables sharing, dissemination and knowledge growth of good and innovative practice. The Centre will have four interrelated workpackages (WPs): networking, research, teaching innovation using modern technologies, and dissemination. Actions, contributing to one or more WPs include: annual conference, creation of web-based resources, innovative combined digital/video simulation packages, modeling workshops, publications, and study visits. The Centre will be established within the Faculty of Engineering and Science, with national and international collaborators. Mathematics teachers within the Faculty are developing integrated digital and video technologies for teaching through simulations, and are using web-based teaching approaches. A well-established research group in mathematics education runs masters and doctoral programmes, and collaborates in many international research projects. Research and teaching are integrated activities, and dissertation research at masters and doctoral levels is conducted into teaching and learning at all levels.

Describe briefly the aims and current as well as planned activities of the centre (maximum 1500 characters)

MatRIC aims to create and support networks that enable sharing and development of the use of video, digital and web-based technologies in teaching, learning and assessing mathematics. MatRIC will initiate and disseminate research into teaching, learning and assessing mathematics to understand and evaluate innovation in practice. MatRIC will bring together mathematics educators, scientists, engineers, and others in cross-disciplinary teams to produce workplace simulations and realistic tasks for mathematical modeling.

Mathematics teachers at the University of Agder use digital technology in teaching, net-based assessment, and computer based simulations to incorporate video lessons, video streaming, video and interactive simulations, exercises and applications. Post-graduate research focuses on these uses.

MatRIC will develop a web-site as a resource bank; establish an annual conference for teachers and users of mathematics to share, learn and develop innovations, organize workshops, and support individuals to visit international centres of excellence. MatRIC will support activity to review exiting research, inquire into innovations, and proposals for new studies. MatRIC will develop simulations of workplace situations in which mathematics is applied, and workshops for learning and applying mathematical modeling. MatRIC will create a journal for sharing innovations in teaching, and promote dissemination of research and innovation through existing journals and conferences.

Application Document

Application Document

Upload application document

[profile_MatRIC_Centre
description.pdf](#)

Timeline and budget

Timeline and budget

Upload planned timeline and the activities to be conducted

[timeline_MatRIC_Timeline.pdf](#)

Upload plan for financial resource acquisition

[financial_MatRIC_Financial
resource_acquisition.pdf](#)

Upload budget

[budget_MatRIC_Budget.pdf](#)

Attachments

Attachments

- Letter_of_intent.pdf
- Curriculum_vitae.pdf
- References.pdf
- Cost_plan.pdf
- Milestones.pdf
- budget_MatRIC_Budget.pdf
- financial_MatRIC_Financial resource acquisition.pdf
- timeline_MatRIC_Timeline.pdf
- profile_MatRIC_Centre description.pdf

Comments

Comments to the application form (maximum 1500 characters)

I hope all the documents and attachments are up-loaded correctly. I thought I had done it, but then I was required to re-load. I suspect some documents are now up-loaded twice, or possibly the final attachments have not been uploaded.

Information about responsible leaders of the University of Agder and other key persons.

Tor A Agedal, Director of University of Agder

Marit Aamot Nilsen, Vice Rector for Education

For work on the application, mainly:

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

1. PROFILE AND VISION

The proposed Centre for Research, Innovation and Coordination of Mathematics Teaching (MatRIC) will focus on mathematics teaching and learning within the study programmes of other subjects such as engineering, natural sciences, economics and teacher education. MatRIC will:

- Create, lead and support networks that enable sharing and development of effective use of video, digital and web-based technologies in teaching, learning and assessing mathematics.
- Initiate, support and disseminate research into teaching, learning and assessing mathematics to identify, understand and evaluate effective innovation in practice.
- Bring together mathematics educators, scientists, engineers, computer scientists and economists in cross-disciplinary teams to produce workplace simulations and realistic tasks for mathematical modeling.

Vision: *The Centre will lead innovation, research and excellence in mathematics teaching and learning within higher education 'user programmes'.*

This vision will be achieved through:

- i. Networking mathematics teachers and users (engineers, scientists, economists, teachers, etc.).
- ii. Coordinating research into innovation in teaching, learning and assessing mathematics.
- iii. Developing teaching resources that simulate applications of mathematics in the workplace and a student laboratory for developing competencies in mathematical modeling.
- iv. Disseminating research, innovation and excellence in mathematics teaching.

MatRIC will address a national priority area set out in the Norwegian strategy for science and technology (Ministry of Education and Research, 2010). Mathematics is a requirement in the Norwegian national frameworks for the education of engineers, economists and teachers, and is an indispensable element of studies in natural sciences and health care. However, national and international tests reveal disappointing levels of performance of Norwegian students as they transfer from school to higher education. The Norwegian Mathematics Council's test of basic skills exposes severe weaknesses in students' fluency and reliability in elementary mathematical procedures as they embark on studies in economics, engineering, and teaching (Nortvedt, 2012). Also, the TIMSS-Advanced Study revealed Norwegian upper secondary students' performance in mathematics to be below the international average (Grønmo, Onstad, & Pedersen, 2010).

Context: Mathematics education at the University of Agder (UiA) is provided within the Faculty of Engineering and Science, and is mostly concentrated within the Department of Mathematical Sciences (hereafter referred to as the 'Faculty' and 'Department' respectively). Mathematics education at UiA is organized in two 'genres': (1) in mathematics courses and (2) in

courses and research on mathematics education. In the first genre mathematics is taught within degree programmes in engineering, natural sciences, economics and finance, and teacher education to the extent that 30% of the Faculty's 'production' (i.e. students x ECTS points) consists of mathematics education. The Department has also worked with colleagues in Healthcare to improve the performance of students in the compulsory course in medical calculations (Leland & Tollisen, 2009; Omland, 2008). In the second genre, the Department has well-established masters and doctoral programmes in mathematics education (114 masters and 13 PhDs completed), and a large internationally recognized research group in mathematics education. Research focuses on teaching and learning mathematics at all levels from pre-school to university. Mathematics education research at UiA has a substantial record of collaboration (local, national and international) and innovation stretching back over several decades. Over the last five years, national and international collaborations have included several large research projects funded, for example, by the Research Council of Norway (RCN) and NordForsk.¹

At UiA the integrated community of mathematicians, mathematics education researchers, mathematics teacher educators, and scholars from disciplines and professions that use mathematics reflects the priority given to achieving high quality teaching and learning in mathematics. Mathematics teaching at UiA is based on several fundamental principles: Learning is a social and interpersonal activity and the consequent effectiveness of group work, collaboration, peer-tutoring, and teacher-student engagement. Personal control over learning is achieved through active engagement, inquiry, reflection, and students' willingness to be challenged. Teaching and learning are dynamic social processes that can be developed through innovation, the use of modern technologies and critical implementation of research findings. The following examples illustrate the extent and integration of mathematics, teaching, mathematics education research and innovation.

Mathematics teachers at UiA have developed the use of digital technology in teaching (e.g. Fuglestad, 2009), net-based assessment, and computer based simulations to incorporate video lessons, video streaming, video simulations, interactive simulations, exercises and applications (e.g. Brekke, & Hogstad, P.H., 2006, 2010). Research at masters and PhD levels, supervised by mathematicians and mathematics education researchers, focuses on these developments (e.g. Hogstad, N.M. 2012; Raen n.d.), and using the products in school (e.g. Curri, 2012). Mathematics teaching developmental research projects funded by RCN have generated knowledge and experience about incorporating 'inquiry' in teaching and in learning mathematics (cf. footnote #1). This knowledge is now being applied in innovative ways in the mathematics teacher education programme (Berg & Grevholm, 2012). The masters' programme in mathematics education

¹ Information about research projects in mathematics education and publications can be found at: http://www.uia.no/no/portaler/om_universitetet/teknologi_og_realfag/forskning/institutt_for_matematiske_fag

incorporates students' research in addition to their dissertation work. For many years the masters' research course included classroom based inquiry, but for the last three years this has evolved to integrate inquiry into teaching and learning in school, university and (industrial) enterprises (Cestari, 2011a,b,c; Cestari & Vos, 2013). Master students and PhD fellows focus on teaching and learning mathematics at all levels. In addition to those mentioned above, recent masters' researches inquire into teaching and learning mathematics in programmes for economics (Eilertsen, 2008, Rømteland, n.d.), health care, (Omland, 2008) and teacher education (Storebø, n.d.). Recent doctoral research includes studies into engineering students' use of their mathematics textbook (Randahl, 2012), and didactical issues of learning algebra in inquiry-based group work in teacher education (Måsøval, 2011).

The application of technology is aimed at supporting students' learning and enabling more efficient and effective use of teacher time. Mathematics teachers are supported by UiA's efforts to develop the use of digital technologies in teaching and learning in the university's developmental programmes such as "Learning Arena 2020" (LA2020)² and "The Digital University" (investment in each of these to date: 6,5 and 10 million NOK respectively). Funding has been secured by mathematics teachers within the Faculty to develop a 'teaching studio' for the production of video episodes that will reduce dependency on technician support. A two day seminar is planned for June 2013, to develop the science, technology, engineering and mathematics (STEM) teaching/research agenda within the Faculty and with colleagues from other Norwegian institutions.

The mathematics education group is well-connected to a wide international network of scholars and researchers and regularly invites highly regarded researchers to present their work in seminars and spend time at UiA within the university's guest stipend scheme.³ Events with international guests are open and advertised nationally.

2. QUALITY IN ESTABLISHED EDUCATIONAL ACTIVITIES

MatRIC will build on excellence recognized in the external evaluations of UiA programmes carried out by the Norwegian Agency for Quality Assurance in Education (NOKUT, 2006, 2008, 2010 & 2011); and The Research Council of Norway (RCN, 2012).

2.1 Summary of basis for claiming excellence in mathematics teacher education at UiA.

The Committee appreciates that Agder University gives importance to the quality of teaching in mathematics (RCN, 2012, p. 23)

Evaluations of UiA's programmes, a recent survey of UiA graduates, and national data provide consistent evidence of the quality of mathematics education at UiA. MatRIC will be founded on

² See http://www.uia.no/no/div/prosjekt/la2020/om_la2020 (In Norwegian).

³ For the seminar programme see: http://www.uia.no/no/portaler/om_universitetet/teknologi_og_realfag/-matematiske_fag/--seminarer_og_foredrag

established quality in teaching, research, innovation and students' experience in mathematics.

2.2 Result factors: Student flow, graduation rates, quality assurance, external evaluations, etc.

The Norwegian 'state of higher education' report for 2012 observes "*Among the universities Agder and Stavanger have the highest completion rates ...*" (Ministry of Education and Research, 2012, p. 45, author's translation). This observation is consistent with the report of the national evaluation of engineering education (NOKUT, 2008), which noted that UiA is one of the larger institutions of engineering education and has "*good progression rates compared with other engineering institutions, with monitoring among many good features*" (p. 287 author's translation). The NOKUT evaluation of engineering education also reported "*additional teaching resources have been provided for mathematics ... failure rates have reduced from 36% to 19%*" (pp. 291, 292 author's translation). Special effort to improve students' progress has also been made in other programmes, for example, a mathematics course for economics students was restructured so that students could select a track that suited their needs best (Eilertsen, 2008).

Progression rates data published by the Norwegian Social Sciences Data Service (NSD, 2013) reveal that UiA lies above the average for Norwegian Universities. The data also reveals that progression rates in programmes within UiA that have a compulsory mathematics component provided by the Faculty are above the UiA average. Progression rates for courses with a compulsory mathematics component (i.e. engineering, natural sciences, economics and teacher education) at UiA over the last five years range from 83% to 93,5%.

Quality Assurance system and internal evaluations: In 2010 NOKUT evaluated the quality assurance systems at UiA and found the quality assurance system to be satisfactory:

The system is known throughout the (university's) operation ... It is evident that through the system, the university obtains the knowledge which is necessary to evaluate the quality of education. The committee has in the documentation seen good analyses and discussions that give the foundation for improvement in education (NOKUT, 2011, p. 5 & p.11).

Mid-way and terminal course and programme evaluations provide evidence of a dynamic cycle of improvement. Students' evaluations of their experiences are considered in Study Programme Advisory Committee and contribute to annual course, programme, Department and Faculty reports. Thus students' satisfaction with their experiences and their suggestions for improvement are well documented within the system. Nevertheless, the basis of excellence rests on the close relationship between students and teachers, which facilitates *continuous* feedback, adjustment and improvement.

Reports from alumni - Graduate Survey 2010: The survey of graduates from years 2007, 2008 and 2009 (Rambøll, 2010) although not focusing directly on mathematics courses, reveals that about 75% of graduates were satisfied with the education they received at UiA. Mathematics is a significant component of the basic analytical skills that students need in their studies and thus it is

relevant to note from the report: “*The results show that it is the basic academic skills of analysis ... that graduates evaluate most positively*” (Rambøll, 2010, para. 9.9, author’s translation).

2.3 Process factors: teaching, working methods and assessment

The Committee will emphasise that the institution also has specific strong subject didactics milieus which succeed in dissemination of research and have good and relevant research and development projects linked to compulsory school, where teaching practice supervisors and students participate. Especially, this applies to mathematics (NOKUT, 2006, p. 13).

Teaching and assessment: Students meet a variety of teaching approaches ranging from more traditional style lectures through to innovative digital-simulations and collaborative problem-solving in small groups. Approaches to teaching and learning support students’ development as independent learner-inquirers who contribute to, and learn from, their participation in an active learning community. Assessment approaches are chosen to suit the learning objectives and students’ learning needs. These include: traditional examinations, oral presentations, reports from individual and group activity, observation in work place settings, and interactive web-based approaches through which students are provided with immediate feedback and targeted support.

Integration of research and development in teaching:

The research base and orientation of the teaching is more evident than in many other institutions (NOKUT, 2006, p. 19).

Students are introduced to and engaged in research in bachelor and masters courses, examples are included above (Section 1). Students are invited to research seminars, and *all* masters and PhD students present their research in the same seminar series as international visitors. Research, as systematic inquiry, and evidence permeate teaching and learning at all levels. The University has developed a large international research group in mathematics education (described below in Section 2.4), which is engaged in many directions of research activity in mathematics education. This facilitates the dynamic synergy between research and teaching, described briefly in Section 1. Opportunities are taken for masters and doctoral students to research innovative practice within mathematics teaching at UiA. Additionally they can engage in developmental research to apply innovations which they have experienced at UiA. Reciprocally, researchers both enrich teaching from their own research agenda as well as designing new, innovative courses at all levels.

2.4 Input factors: Academic resources, staff competence and leadership.

Academic resources: MatRIC will be located within the Department of Mathematical Sciences.

The university college’s⁴ leadership reports that to a large extent international resources are brought in for teaching and supervision in the doctoral programmes for specific milieu, especially mathematics education (NOKUT, 2006, p. 13).

⁴ UiA was awarded the ‘University’ title in 2007, it was formerly Agder University College.

These ‘international resources’⁵ combine with the strong national resource in mathematics education. The Department comprises 26 permanent teaching staff⁶ including mathematicians and statisticians, mathematics education researchers, mathematics teacher educators, and informatics and ICT educators. Mathematicians and mathematics teachers are also employed within other departments in the Faculty (about 10). Teachers from different fields within mathematics collaborate closely, especially through joint supervision of dissertation work (at masters and doctoral levels) and the moderation of students’ assessment. Mathematics courses and students at all levels benefit from the integration of academics and researchers in different fields.

The Committee notes also that in specific subjects there is a clear focus on subject didactics.

Mathematics and Norwegian are outstanding in this respect (NOKUT, 2006, p. 14).

Teachers within the Department are experienced in higher education and schools, they are highly and appropriately qualified (18/26 with PhD), many with a PhD in mathematics education (9), and most are actively engaged in research within their own field (average 36% of assigned work is research and development⁷). The Department emphasizes the importance of the didactical competencies and knowledge of academics, for example, in 2010 the appointment of a professor of mathematics included a demonstration lecture which was required to focus on teaching. Teachers serve on national and international committees representing the subject at a variety of levels.⁸

3. POTENTIAL FOR INNOVATION AND DISSEMINATION

MatRIC will support effective mathematics teaching and learning that results in:

- Motivated students, who enjoy mathematics and appreciate the relevance of mathematics.
- Students who understand fundamental mathematical ideas so that they can apply relevant mathematics to resolve non-routine problem situations.
- Students who have strategic knowledge and awareness of mathematics that enables effective problem solving and self-regulation.
- Students who have procedural fluency and reliability in routine operations and calculations.
- Students who possess competencies in mathematical modeling and the application of mathematics in the problems encountered in the work place and applied research situations.

3.1 Strategic plan for development and innovation: rationale and description

MatRIC will have four interdependent work packages (WP) focusing on networking (WP1),

⁵ Scholars from Algeria, Brazil, France, Germany, Sweden, the Netherlands, UK and Ukraine

⁶ Not counting PhD fellows.

⁷ Based on R&D allocation together with project work, doctoral supervision, and research leave. This is low because UiA is funded on the model used for the university colleges.

⁸ Carlsen, M. - Faggrupperepresentant for matematikk i FLU - member of the subject group of kindergarten teacher education representing mathematics.

Fuglestad, A. B. – Board member - Norwegian Mathematics Council.

- International Commission on Mathematics Instruction (ICMI) representative for Norway.

research (WP2), innovation (WP3) and dissemination (WP4).

WP1: Networking mathematics teachers and user groups. One main concern addressed by MatRIC is the coordination of innovative effort invested in teaching mathematics. MatRIC seeks to connect teachers to facilitate exchange of ideas and experience.

Objectives: Stimulate, share and coordinate good, innovative practice and experience and enhance teaching through collaboration and exemplary practice. Bring together mathematics teachers with specialist teachers and specialists from the workplace within engineering, science etc. which focus on specific applications of mathematics and learners needs (Special Interest Groups – SIGs).

Task 1.1: MatRIC will develop a web-site as a ‘virtual competence centre’. The web-site will be MatRICs resources bank and notice board. MatRIC will work to establish links to the MatRIC web-site from universities, research institutes etc.

Task 1.2: MatRIC will establish an annual conference that will bring together teachers of mathematics and user disciplines to present exemplary cases of innovative approaches in teaching mathematics from other countries and within Norway. The conferences will facilitate the formation of SIGs (WP3) – initially one for each study programme - and dissemination (WP4).

Task 1.3: MatRIC will organize regional workshops that will serve an outreach function, to connect teachers of mathematics and user subjects into the Centre’s network, and make the activities of the Centre known (WP3 & 4).

Task 1.4: MatRIC will support visits to international centres of excellence in teaching mathematics and provide opportunities (in all WPs) to share the knowledge gained through publication and action.

Competence: The Mathematics Education Research Group has established collaborative research projects with other institutions. Members of the Group have organized national and international conferences. Teachers within the Department and Faculty are connected into national and international professional networks.

WP2: Research: Evaluation of innovation of teaching and learning. Another main concern of MatRIC is the knowledge base that supports mathematics teachers experimenting with, or exploring the use of video, digital, web-based and other technologies.

Objectives: Enable the replication of innovation leading to the coordination and validation of knowledge gains and eliminate ‘blind’ repetition that occurs due to inadequate means of sharing. Support the development of a research-informed knowledge base in the use of innovative approaches in teaching and learning, and share this with teachers and users of mathematics.

Task 2.1: MatRIC will survey sources of research evidence related to innovation in teaching, learning and assessing mathematics at university, and make this available on the Centre web-site.

Task 2.2: MatRIC will survey current efforts to improve the teaching, learning and assessment

especially in the use of video, digital and web-based technology to establish a data base of practical information, insights and contacts for others interested in introducing similar innovations.

Task 2.3: MatRIC will support research effort by providing small grants ('seed money') to enable pilot studies and the development of proposals for external funds to support research and innovation in teaching.

Competence: The Mathematics Education Research Group is already engaged in this research field, including masters and PhD students' research. The network established by MatRIC will enable the development of this research activity and the distribution of the knowledge accumulated.

WP3: Student modeling laboratory and workplace simulations. This WP is the core component of MatRIC as a centre of innovative practice. MatRIC will establish a network (WP1) and a research base (WP2) that can be exploited to develop innovative approaches to teaching and learning mathematics through the collaboration of teachers and users in SIGs (WP1).

Objectives: Improve students' enjoyment and motivation in mathematics. Develop students' competencies in mathematical modeling in situations related to their 'user' programmes. Develop students' awareness of how mathematics is applied in the workplace and thus motivate their engagement in mathematics. Contribute to students' understanding of the mathematics as a subject where abstract relationships are related to 'concrete' objects of the application. Develop competencies in group work, collaboration, sharing responsibility, and communication skills. Reinforce the need for accuracy and self-monitoring when using mathematics in real contexts.

Task 3.1: MatRIC will support SIGs to develop workplace simulations in which video, digital and web-based resources are used to create contexts in which students apply their knowledge of mathematics to the real world problems and challenges of the work place and research laboratory.

Task 3.2: MatRIC will support SIGs to create "Student laboratory" workshops in which students learn mathematical modeling 'in-vitro' through specially structured and focused tasks, and then apply their learned competencies 'in-vivo' as they are required to create mathematical models of 'real-world' contexts, related to their programmes of study.

Competence: This WP builds on the integrated community of mathematics teachers, mathematicians, scientists, engineers, computer scientists within UiA, and institutions and Centres (national and international) with which MatRIC will collaborate. Mathematics teachers within the Faculty have a national reputation for the integrated use of video and digital simulations (cited above, cf. attached cv-s). Tasks within WP3 are framed within the principles of mathematics teaching outlined in Section 1.

WP4: Dissemination of knowledge. MatRIC will communicate the knowledge gained through the other WPs through the annual conference (Task 1.2), and regional workshops/seminars (Task 1.3).

Objectives: Make the activities and outcomes of the Centre known to all 'stakeholders' and

stimulate collaboration in innovation and research in teaching and learning mathematics (WP1).

Task 4.1 MatRIC will produce a Newsletter each half year and make this available through the MatRIC web-site (Task 1.1). The Newsletter will be aimed at teachers, user groups, policy makers, students and other stake holders of innovation in teaching and learning.

Task 4.2 MatRIC will establish a professional journal for university mathematics teachers to share their experiences and insights from innovation. Papers in this journal will provide a 'launch pad' for developing articles for publication in international peer-reviewed scientific journals. MatRIC will also support presentation of results from WP2 and WP3 at national and international conferences.

Competence: Mathematics teachers and mathematics education researchers within the Faculty have extensive experience in publishing in professional and scientific journals and conferences, and dissemination of research outcomes in 'popular media'.

4. ORGANISATIONAL PLAN

4.1 Organisation

A Centre Management Board (CMB) will have responsibility for budget, oversight, policy and strategy of MatRIC. The Board will be chaired by a Vice-Rector (assistant vice-chancellor, or substitute) with members representing teachers and students from mathematics and user subjects and external members from other universities and employers. MatRIC's leader will be a member of CMB. The Centre Executive (CE) comprising the Centre Leader and administrator will have responsibility for ensuring MatRIC's policies and work packages are carried out. CE will provide CMB with monthly progress reports. An International Advisory Board (IAB) will be appointed to provide CMB with advice and evaluations of MatRIC's policies, strategies and implementation. IAB will comprise international authorities in mathematics education for engineers, scientists, economists, health workers and teachers. IAB will meet once each year, during the annual MatRIC conferences (Task 1.2), IAB will also receive the monthly reports from CE and have direct lines of communication with CE and CMB. Tasks in Work packages WP1 and WP4 will be carried out directly from the MatRIC-CE. Tasks in Work Packages WP2 and WP3 will be devolved to coordinators and groups, for which CE will have responsibility for monitoring and ensuring efficiency and effectiveness.

4.2 Centre management

MatRIC will be led by a Professor who is employed by UiA on a 100% permanent contract. MatRIC will account for 50% of the leader's workload. The person identified to lead MatRIC has extensive international experience in teaching mathematics, leadership, consultancy and research. A Centre Administrator will be appointed on a 100% contract. Coordinators to carry out the tasks for WP2 and WP3 will be appointed from SIGs (WP1). Coordinators will lead the tasks in WP2 and WP3, and will report to the Centre Leader.

4.3 Impact of MatRIC

MatRIC will directly address the challenges for higher education set out in the national strategy for mathematics and science (Ministry of Education and Research, 2010). MatRIC's research into innovations in teaching and opening up new opportunities for innovation, coordination of effort and dissemination of knowledge will raise significantly the quality of teaching mathematics and improve students' learning experiences. MatRIC will contribute towards improved recruitment to occupations in mathematics, science and technology, and better progression and completion rates in programmes that require a significant level of mathematical maturity as a foundation competence.

Additionality: Many are exploring the use of video and web-based technologies to teach, learn and assess mathematics. Much of the effort is uncoordinated and under-researched; consequently there is a lot of repetition and little progress in the systematic accumulation of knowledge about effective and efficient approaches to teaching and learning with these technologies. MatRIC will fill this gap by combining networking (WP1), research (WP2) and dissemination (WP4). The network will also create opportunities to establish groups of mathematics teachers and users that will work on design of simulations and modeling tasks that focus on specific applications of mathematics (WP3).

5. COLLABORATIVE PARTNERS

MatRIC will collaborate with and learn from the experience of the award winning Mathematics Learning Support Centre (of Excellence) at Loughborough⁹ (contacts: Director Dr. Carol Robinson, & Professor Barbara Jaworski). MatRIC will also seek links with the UK National Centre of Excellence in Teaching Mathematics, until recently directed by Professor Celia Hoyles. Prof. Hoyles has recently been elected President of the Institute of Mathematics and Its Applications (2014-2016). Also, MatRIC will collaborate with the Science Education and Communication research programme at Delft University of Technology (contact: Director Prof. Marc de Vries). Leaders of these international centres will be invited to participate on the IAB.

Within Norway, the proposers of MatRIC have agreed to collaborate (independent of the award of Centre status) with colleagues at the Norwegian University of Technology and Science (a letter of intent is attached) and The Norwegian University of Life Sciences (UMB). Professor Frode Rønning, NTNU, and a representative from UMB will contribute to the management of MatRIC. Mathematics Educators at UiA and Norwegian Centre for Mathematics Education (NSMO) have been collaborating for several years in the development of courses. MatRIC will work with NSMO to exploit the synergy between the two Centres. MatRIC will seek to collaborate with other Norwegian Centres of Excellence, recognition of the potential for mutual benefit exists between the proposers of MatRIC and the leaders of ProTed.

⁹ See: <http://mlsc.lboro.ac.uk/>

Centre for Innovation, Research and Coordination of Mathematics Teaching: MaTric
University of Agder

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Centre for Research, Innovation and Coordination of Mathematics Teaching: MatRIC
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Milestones

Year/Quarter	
2014/0	Centre Management Board (CMB) has first meeting, Centre Leader confirmed in position, Centre Administrator appointed (CE), International Advisory Board set up (IAB)
2014/1	Contract agreed to set up Centre web-site. Centre Leader visits international centre – fact-finding. Coordinators for WP 2 and WP 3 appointed. Conference programme committee set up. Groups to develop simulations and modeling workshops (pilot round) set up.
2014/2	Centre mailing list functional and first Centre Newsletter distributed. First announcement of conference. Tasks 3.1 and 3.2 (pilot round) active. Group coordinator makes international study visit. Editorial board for MatRIC journal created, invitations for contributions to the journal – examples of innovative teaching and learning practices in mathematics for engineers, scientists, etc.
2014/3	First regional workshop. Groups preparing simulations and modeling workshops present their work and visions for innovation. Conference programme published, and invitations distributed. Invitation to form Special Interest Groups to be supported in 2015 sent out. Web-site commissioning. Group coordinator international study visit.
2014/4	Conference. Second issue of Newsletter. Groups working on tasks 3.1 and 3.2 report to CMB and in the conference. Web-site opened. Identification of coordinators for WP2 and WP3 for 2015. First meeting of the International Advisory Board (to coincide with the conference). Programme committee for second conference set up, first announcement of second conference. Group coordinator international study visit. First reviews of research and innovative activity published on MatRIC web-site.
Summary of 2014	MatRIC established, including web-site and mailing list. Two products – simulation and modeling workshop created, national conference, regional workshop and two issues of the MatRIC newsletter. Four study visits to learn excellence in other countries. Editorial board for journal set up. Initial research review completed and published on the MatRIC web-site.
2015/1	Internal evaluation of the first year of MatRIC’s activities and impact. Four Special Interest Groups set up to create new simulations and modeling workshops (it will be possible for existing groups to continue being supported by MatRIC). Second regional workshop.
2015/2	Third issue of the newsletter. Conference programme published, invitations sent. Third regional workshop.
2015/3	2 nd MatRIC conference. Groups working on tasks 3.1 and 3.2 report at the conference and to CMB. Meeting of IAB. Invitation to form Special Interest Groups to be supported in 2016 sent out.
2015/4	Fourth issue of newsletter. First issue of MatRIC journal. Fourth regional workshop. Identification of coordinators for WP2 and WP3 for 2016.
Summary of 2015	Four new simulation or modeling workshops created. MatRIC journal launched, two issues of MatRIC newsletter. Annual conference. Three MatRIC regional workshops. Four international visits by Centre Leader and others related to the Centre’s work packages.

2016-2018	MatRIC routine, each year MatRIC will support the production of: National conference (and meeting of IAB) Two regional workshops to showcase the work of simulation and modeling special interest groups (Task3.1 and Task 3.2) 4 international visits 4 special interest groups Two issues of the MatRIC newsletter One issue of the MatRIC journal. One evaluation of the activities and impact of MatRIC, in 2017 this will be conducted by NOKUT, and in 2018 MatRIC will appoint external consultant(s) who can advise on the way forward.
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Centre for Research, Innovation and Coordination of Mathematics Teaching: MatRIC
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	Time Line															
	2014			2015			2016			2017			2018			
Centre Management Board (CMB)	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
International Advisory Board (IAB)	2	2	1	2	1	2	0	2	2	1	0	2	1	2	0	2
Centre Executive (CE)				1			1								1	
Mailing list	Continuous															
Construction	Construction				Maintenance and up-dating				A							
Evaluation					A								B			C
Work Package 1	Networking															
Task 1.1	Web-site				Maintenance and up-dating											
Task 1.2	Conference		1				1				1				1	
Task 1.3	Workshops		1			1	1	1		1	1	1		1	1	1
Task 1.4	Visits to other Centres	1	1	1		1	1	1		1	1	1		1	1	1
Work Package 2	Research															
Task 2.1	Survey of research	Construction			Maintenance and up-dating											
Task 2.2	Survey of activity	Construction			Maintenance and up-dating											
Task 2.3	Research support	Continuous														
Work Package 3	Innovation															
Task 3.1	Simulations	1				2				2				2		
Task 3.2	Modelling workshops	1				2				2				2		
Work Package 4	Dissemination															
Task 4.1	Newsletter	1	1			1	1	1		1	1	1		1	1	1
Task 4.2a	Journal							1				1				1
Task 4.2b	Conferences				According to national and international conference schedules											
Work Packages 1-3	International visitors	1	1	1		1	1	1		1	1	1		1	1	1
	Applications for ext. Fund.				Continuous, as opportunities arise											

Key:

2 Indicates '2' events in this period.

2----- Indicates the number of groups supported during the period through which ----- extends

A Evaluation of Centre's activities and impact (internal)

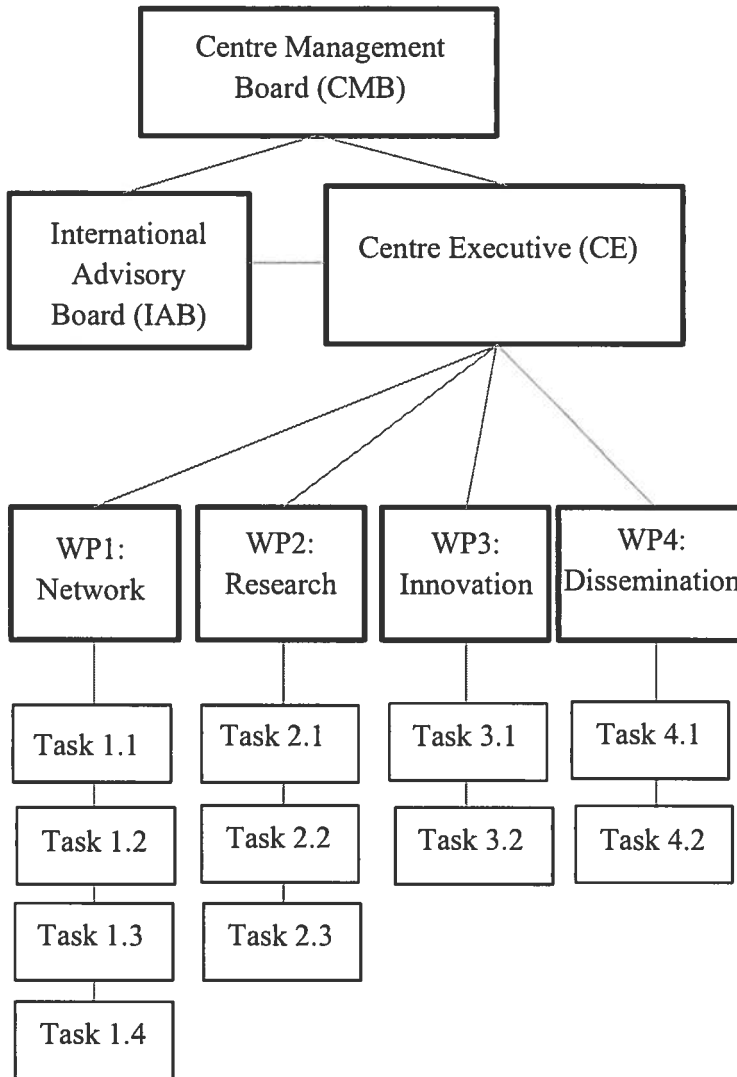
B Evaluation of Centre's activities and impact (NOKUT)

C Evaluation of Centre's activities and impact (external)

Centre for Research, Innovation and Coordination of Mathematics Teaching: MatRIC
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Cost Plan

MatRIC will entail costs to run the Centre and to implement the work packages and associated tasks.



Costs (Numbers in parentheses a cross-referenced to the budget)

- (1) CMB Travel and subsistence for external members.
- (2) IAB Travel & subsistence – one visit each year.
- (3) Honoraria to IAB members
- (4) Centre Leader (CE)
- (5) Centre Administrator (CE)
- (6) Centre Costs – travel & subsistence for Centre business (CE)
- (7) Travel & subsistence for invited guests. (WP1-3)
- (8) Web-site development & maintenance (T1.1)
- (9) Annual national conference (T1.2)
- (10) Regional workshops (T1.3)
- (11) International study visits (T1.4)
- (12) Research coordinator (WP2)
- (13) Researcher time (T2.1, T2.2)
- (14) Pilot studies, proposal preparation support (T2.3)
- (15) SIG coordinators (T3.1 & T3.2)
- (16) SIG Travel & subsistence costs (T 3.1 &3.2)
- (17) Technical support for SIGs (WP3)
- (18) Printing and distribution costs (T4.1 & T 4.2))
- (19) Travel & expenses for conferences (T4.2)

Explanatory notes.

The Centre Management Board (CMB) will meet seven times in the first year and five time per year thereafter. External members of CMB will have travel costs, and when necessary, overnight accommodation. There will also be costs related to refreshments during meetings.

Members of the **International Advisory Board (IAB)** will receive a small honorarium for their services to MatRIC. Most communication between IAB, CMB and CE will be via e-mail or similar.

Members of IAB will be invited to the annual conference, in which it is hoped they will take an active part; this will provide an opportunity for face to face meetings of IAB, CMB and CE. Costs entailed include travel accommodation and subsistence for IAB members when they attend the conference.

The **Centre Executive (CE)** will comprise a Centre Leader (50% position within the Centre) and a Centre Administrator (100% position). Direct costs cover the salaries. CE will have direct responsibility for the tasks in work packages WP1 and WP4, in addition to coordinating the work of the Centre and monitoring and oversight of the tasks in WP2 and WP3. Centre running costs to cover attendance at meetings related to MatRICs operation and activities. The Centre will also take responsibility for coordinating international guests who will contribute to tasks in work packages WPs1-4.

Costs entailed in WP1 will be Task 1.1: setting up and maintaining the MatRIC web-site, Task 1.2: organizing the annual conference, Task 1.3: organizing regional (outreach) workshops and Task 1.4: supporting study visits to international Centres of Excellence in teaching and mathematics. It is intended that for the first two years of operation MatRIC will cover all the costs of those attending the annual conference, this will be reduced in later years as the conference becomes recognized as an important event in teachers' calendars. SIG coordinators and groups will be the principal presenters at the regional (outreach) workshops. Contributions from invited international guests will also be included in these events.

Printing costs shown for WP4 will be held as low as possible. The main means of distribution of MatRIC publications within the MatRIC network will be via e-mail and the MatRIC web-site and 'social media'. Small numbers of printed materials will be produced to present MatRIC and its activities to an audience outside the MatRIC network.

MatRIC will support **coordinators for WP2 and WP3**. One coordinator for WP2 and four for WP3. These will normally be one year 20% 'secondments' to MatRIC. In WP2 the coordinator's role will be research oriented, and in WP3 the coordinators will be used to initiate the collaboration within SIGs and take responsibility for the production of teaching learning materials. It is thus intended to create at least four new SIGs each year.

Other costs relating to the operation of SIGs include technical support, travel and subsistence. Additional funding from internal and external sources will be sought to cover the work of SIGs. The work of SIGs will be directly related to the teaching and educational responsibilities of the members and thus some time will come from regular research and development allowance.

Not shown in the above cost plan are masters and PhD students whose research will directly contribute to MatRIC. These students will be supported from within their programmes, MatRIC will be offering additional research/fieldwork opportunities. Their engagement will be coordinated through the Centre Executive.

**Centre for Research, Innovation and Coordination of Mathematics Teaching: MatRIC
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Plan for financial resource acquisition

MatRIC will be established with combined funds from NOKUT (66,6%) and UiA (33,3%). MatRIC will submit bids for funding from local, national and international sources, as opportunities arise.

Participants in special interest group working to develop simulations and mathematical modeling workshops will contribute from the allocation of research and development time in their regular work.

The research of MatRIC (working package 2, tasks 2,2 and 2,3) will be augmented by master students and doctoral fellows on the mathematics education programmes.

Basic funding – the base line for the proposed budget:

NOKUT: 3 000 000 NOK per year

University of Agder (1) – assured contribution: 1 500 000 NOK per year

Sources of additional funding will be sought to support individuals and collaborating ‘special interest groups’ to develop their ideas and projects. MatRIC will provide groups with support to develop proposals when it is not available from other sources.

University of Agder (2) – income from competitive bids from internal sources (e.g. DDU); Guest stipend scheme, etc.

Collaborating institutions.

NordForsk: (e.g. Researcher networks)

Research Council of Norway: (e.g. Utdanning2020/PRAKUT programme)

European Union:

Private sector:

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Curriculum Vitae

CV's included with the proposal are compiled in this document in the following order.

Professor Simon Goodchild, (proposed leader of MatRIC)	page 2
Assistant Lecturer Morten Brekke	page 12
Professor Anne Berit Fuglestad	page 10
Professor Pauline Vos	page 14
Professor Yuriy V. Rogovchenko	page 16

Curriculum Vitae

Name: SIMON GOODCHILD

Title/Position: Professor in Mathematics Education

Department: Mathematics Sciences, Faculty of Engineering and Science, UiA

Education: 1971: BSc(Hons) University of Wales: Pure Mathematics & Education.
1972: Post Graduate Certificate in Education University of Wales. Mathematics & Adult Education.
1987: MSc(Distinction) University of London: Mathematical, Statistical & Computing Education.
1997: PhD. University of Exeter. Dissertation title: An Exploratory Study of Year Ten Students' Goals in the Mathematics Classroom.

Research: Mathematics teaching development, classroom based studies. Development of theories of teaching mathematics. Students learning.

Employment: 2007-on: Professor in Mathematics Education, University of Agder.
Spokesperson for Mathematics Education Research Group
2004-2007: Associate Professor in Mathematics Education, Agder University College.
1988-2004: Senior Lecturer in Mathematics and Mathematics Education. The College of St Mark and St John, Plymouth. From 2001 Head of Mathematics; from 2003 Head of Undergraduate Secondary Initial Teacher Training Programmes.
1975-1988: Teacher of Mathematics (grades 7-13) Clacton County High School, Clacton on Sea, UK. (1981) Head of Mathematics Department; (1985) Senior Teacher (curriculum/timetable).
1972-1975: Teacher of Mathematics, Robert Blake School, Malawi.

International Consultancies:

2011- Member of the scientific advisory board for teacher education at Stockholm University.
2008 Institutional evaluation for Aga Khan University, Institute for Educational Development, Pakistan.
2005 Mathematics-English language trainer-training materials development for Government of Malaysia/British Council.
1998-2000 Teaching development support in Swaziland (DfID funded project).
1997 Mpumalanga Primary Schools Initiative, South Africa, mid-project consultancy for British Development Division Southern Africa, UK DfID
1996 Primary Mathematics Project, South Africa, project evaluation UK Department for International Development (DfID).

Teaching: Forty years of teaching experience. First 16 years teaching mathematics in school grades 7 to 13. This followed by teaching mathematics to undergraduate students on secondary mathematics teacher education programmes. At the University of Agder teaching and supervision on the masters and PhD in mathematics education programmes focusing on theories of teaching and learning mathematics, and research methodology.

I aim to make my approach student centered, I seek students' active engagement in their learning through problem solving and modeling. Especially in teaching mathematics I am enthusiastic to introduce new technology for exploring the subject. In all situations I am exploring alternative ways, using technology, to engage students in active and collaborative learning.

Examination of PhD and MPhil. & Masters research degrees for University of Nottingham, University of Exeter, Loughborough University, University of Oslo, University of Tromsø, University of Agder.

Evaluation Committees: for, Professor: Oslo & Stockholm Universities, Professor II Stockholm University. Associate professor and post-doctoral positions: University of Tromsø, & Linnaeus University Växjö.

Projects: 2007 -2010 (c. 40%) in RCN funded Teaching Better Mathematics (PraksisFoU program).
2004-2007 Researcher (80%) in The Research Council of Norway (RCN) funded: Learning Communities in Mathematics (KUL program).

Editorial activity: Associate Editor: Mathematics Enthusiast

Editorial Board: Mathematics Thinking and Learning, Didactica Mathematicae.

Member of the Advisory Board for Information Age Publishing series International Sourcebooks in Mathematics and Science Education. See:

<http://infoagepub.com/series/International-Sourcebooks-in-Mathematics-and-Science-Education>

Reviewer for: Educational Studies in Mathematics; Journal of Mathematics Teacher Education; Mathematics Thinking and Learning, NOMAD Nordic Studies in Mathematics education; ZDM; and conferences: PME, NORMA, MADIF, CERME.

Guest editor with B. Sriraman: ZDM 2012, Volume 44, issue 5. New Perspectives on the Didactic Triangle: Teacher-Student-Content.

Selected publications:

1. Journals

Goodchild, S. (2013). Reporting classroom research: A moral dilemma. In B. Grevholm, P. S. Hundeland, K. Juter, K. Kislenko and P. E. Persson (Eds.), *Nordic research in didactics of mathematics: past, present and future*, (pp.199-219). Cappelen Damm Akademisk.

- Goodchild, S. (2013). Enactivist Theories. In: Lerman S. (Ed.), *Encyclopedia of Mathematics Education: SpringerReference* (www.springerreference.com). Springer-Verlag Berlin Heidelberg, 0. DOI: 10.1007/SpringerReference_327537 2013-01-17 01:45:00 UTC
- Goodchild, S., & Sriraman, B. (2012). Revisiting the didactic triangle: from the particular to the general. *ZDM* 44: 581-585. DOI : 10.1007/s11858-012-0449-3.
- Berg, C. V., Fuglestad, A. B., Goodchild, S., & Sriraman, B. (2012). Mediated action in teachers' discussions about mathematics tasks. *ZDM* 44: 677-689. DOI : 10.1007/s11858-012-0423-0.
- Gebremichael, A. T., Goodchild, S., & Nygaard, O. (2011). Students' perceptions about the relevance of mathematics in an Ethiopian preparatory school. In M. Pytlak, E. Swoboda & T. Rowland (Eds.), *CERME 7: Proceedings of the Seventh Congress of the European Society for Research in Mathematics Education*. European Society for Research in Mathematics Education, pp.1430-1439.
- Goodchild, S. (2011). Using different sociocultural perspectives in mathematics teaching development research. In M. Pytlak, E. Swoboda & T. Rowland (Eds.), *CERME 7: Proceedings of the Seventh Congress of the European Society for Research in Mathematics Education*. European Society for Research in Mathematics Education, pp. 2421-2430.
- Jaworski, B., Goodchild, S., Eriksen, S., & Daland, E. (2011). Mediating mathematics teaching development and pupils' mathematics learning: The life cycle of a task. In O. Zaslavsky, & P. Sullivan (Eds.), *Constructing knowledge for teaching secondary mathematics: Tasks to enhance prospective and practicing teacher learning*, (pp. 143-160). Norwell, MA: Springer.
- Breiteig, T., & Goodchild, S. (2010). The development of mathematics education as a research field in Norway. In B. Sriraman, C. Bergsten, S. Goodchild, G. Palsdottir, B. Dahl, & L. Haapasalo (Eds.), *The first sourcebook on Nordic research in mathematics education: Norway, Sweden, Iceland, Denmark and contributions from Finland*, (pp. 11-33). Charlotte, NC: Information Age Publishing.
- Fuglestad, A. B. & Goodchild, S. (2010). Mathematics learning and teaching development. In M.F.Pinto & T. F. Kawasaki (Eds.), *Proceedings of the 34th Conference of the International Group for the Psychology of Mathematics Education* Vol. 3 (pp. 1-8). Belo Horizonte, Brazil: PME.
- Goodchild, S. (2010). Norwegian research in mathematics education: Introduction to the Norwegian section of the Sourcebook of Nordic Research in Mathematics Education. In B. Sriraman, C. Bergsten, S. Goodchild, G. Palsdottir, B. Dahl, & L. Haapasalo (Eds.), *The first sourcebook on Nordic research in mathematics education: Norway, Sweden, Iceland, Denmark and contributions from Finland*, (pp. 3-9). Charlotte, NC: Information Age Publishing.
- Goodchild, S., & Grønmo, L. S. (2010). The future of mathematics education research in Norway: Some indicators. In B. Sriraman, C. Bergsten, S. Goodchild, G. Palsdottir, B. Dahl, & L. Haapasalo (Eds.), *The first sourcebook on Nordic research in mathematics education: Norway, Sweden, Iceland, Denmark and contributions from Finland*, (pp. 259-266). Charlotte, NC: Information Age Publishing.
- Espeland, H., Goodchild, S., & Grevholm, B. (2009). Challenges faced by those working towards a co-learning agreement. In C. Winslow (Ed.), *Nordic research in mathematics education* (pp. 81-88). Rotterdam, Holland: Sense Publishers.
- Goodchild, S. (2009). Classroom research: Impact and long term effect versus justice, liberation and empowerment? In P. Ernest, B. Greer, & B. Sriraman (Eds.), *Critical issues in mathematics education* (pp. 217-235). Charlotte, NC: Information Age Publishing. Also as the text of invited

keynote lecture in: L. Burman, O. Björkqvist, & A.-S. Røj-Lindberg (Eds.), *Long-term research in the didactics of mathematics and science* (pp. 9-25). Vasa: Åbo Akademi 2011.

Goodchild, S. (2009). Listen to your supervisor! In B. Sriraman, & S. Goodchild (Eds.), *Relatively and Philosophically Earnest: Festschrift in honor of Paul Ernest's 65th Birthday* (pp. 9-17). Charlotte, NC: Information Age Publishers.

Goodchild, S. & Daland, E. (2009). Teaching development through discussion: a cultural-historical activity theory perspective. In C. Winslow (Ed.), *Nordic research in mathematics education* (pp. 151-158). Rotterdam, Holland: Sense Publishers.

Goodchild, S. & Grevholm, B. (2009). An exploratory study of mathematics test results: What is the gender effect? *International Journal of Science and Mathematics Education* 7: 161-182.

Jørgensen, K. O. & Goodchild, S. (2009). Utvikling av unge elevers relasjonelle forståelse i matematikk. In J. Fauskanger, & R. Mosvold (Eds.), *Å regne i alle fag* (pp. 100-115). Oslo: Universitetsforlaget.

Fuglestad, A. B., & Goodchild, S. (2008). Affordances of inquiry: the case of one teacher. In O. Figueras, J. L. Cortina, S. Alatorre, T. Rojano, & A. Sepúlveda (Eds.), *Proceedings of the joint meeting of PME 32 and PME-NA XXX* (pp. 3-49-3-56). Mexico: Cinvestav - UMSNH.

Goodchild, S. (2008). An activity theory perspective of didacticians' learning within a mathematics teaching development research project. In D. Pitta-Pantazi & G. Philippou (Eds.), *Proceedings of the Fifth Congress of the European Society for Research in Mathematics Education* (pp. 1678-1687). Larnaca, Cyprus: Department of Education, University of Cyprus.

Goodchild, S. (2008). A quest for 'good' research. In B. Jaworski & T. Wood (Eds.), *International Handbook on Mathematics Teacher Education: Vol. 4. The Mathematics Teacher Educator as a Developing Professional: Individuals, teams, communities and networks* (pp. 201-220). Rotterdam, Holland: Sense Publishers.

Ruthven, K., & Goodchild, S. (2008). Linking researching with teaching: Towards synergy of scholarly and craft knowledge. In L. D. English (Ed.), *Handbook of international research in mathematics education* (pp. 561-588). New York: Routledge.

Fuglestad, A. B., Goodchild, S., & Jaworski, B. (2007). Utvikling av inquiry community for å forbedre undervisning og læring i matematikk: Didaktere og lærere arbeider sammen. In M. B. Postholm (Ed.), *"Forsk med!" Lærere og forskere i læringsarbeid* (pp. 34-73). Oslo. N.W. Damm & Søn A/S.

Goodchild, S. (2007). Inside the Outside: Seeking evidence of didacticians' learning by expansion. In B. Jaworski, A. B. Fuglestad, R. Bjuland, T. Breiteig, S. Goodchild, & B. Grevholm (Eds.), *Læringsfellesskap i matematikk/Learning Communities in Mathematics* (pp. 189-203). Bergen, Norway: Caspar forlag.

Goodchild, S. (2007). Students' goals in mathematics classroom activity. In C. Bergsten, B. Grevholm, H. S. Måsøval, & F. Rønning (Eds.), *Relating practice and research in mathematics education. Proceedings of Norma05, Fourth Nordic Conference on Mathematics Education*. (pp. 27-49). Trondheim: Tapir Akademisk Forlag.

Goodchild, S., Jaworski, B., & Måsøval, H. (2007). Classroom research - analysis transcript data. In C. Bergsten, B. Grevholm, H. S. Måsøval, & F. Rønning (Eds.), *Relating practice and research in mathematics education. Proceedings of Norma05, Fourth Nordic Conference on Mathematics Education*. (pp. 133-147). Trondheim: Tapir Akademisk Forlag.

Grevholm, B., & Goodchild, S. (2007). Achievement in mathematics in Norway from a gender perspective. In G. Brandell, B. Grevholm, B. Melander, C. Rudälv, & B.-M. Stocke (Eds.), *Kvinnor och matematik. Konferens den 13-15 juni 2005*, (pp. 65-80). Umeå: Umeå universitet.

Jaworski, B. & Goodchild, S. (2006). Inquiry community in an activity theory frame, in J. Navotná, H. Moraová, M. Krátká and N. Stehliková (eds.), *Proceedings of the 30th Conference of the International Group for the Psychology of Mathematics Education, Vol. 3* (pp. 353-360). Charles University in Prague, Prague.

Goodchild, S. & Jaworski, B. (2005). Using contradictions in a teaching and learning development project In H. L. Chick & J. L. Vincent (Eds.), *Proceedings of the 29th Conference of the International Group for the Psychology of Mathematics Education, Vol. 3* (pp. 41-48). Melbourne, Australia: University of Melbourne.

Goodchild, S. (2002). Exploring students' goals in classroom activity. In S. Goodchild and L. English (Eds.), *Classroom research in mathematics education: A critical examination of methodology* (pp. 39-65). Westport CT, Praeger.

Colyn, W. & Goodchild, S. (2001). Challenges facing overseas aid-funded in-service teacher education and school development projects in Southern Africa. In D. Meerkotter, A. Fataar, O. L. Fuglestad & S. Lillejord (Eds.), *Learning from each other: School development and social transformation in South Africa* (pp. 127-147) Cape Town, South Africa, WYvern.

Goodchild, S. (1999). Pedagogy and the role of context in the development of an instrumental disposition towards mathematics. In O. Zaslavsky (Ed.), *Proceedings of the 23rd Conference of the International Group for the Psychology of Mathematics Education, Vol. 3* (pp. 33-40). Haifa, Israel: Israel Institute of Technology.

Goodchild, S. (1998). Students' goals in the mathematics classroom part 1: Background and research context. In M. Ogunniyi (Ed.), *The Pursuit of Excellence in Science and Mathematics Education Seminar Series 2* (pp. 52-61). Cape Town, South Africa: University of the Western Cape.

Goodchild, S. (1998). Students' goals in the mathematics classroom part 2: Interpretation and discussion. In M. Ogunniyi (Ed.), *The Pursuit of Excellence in Science and Mathematics Education Seminar Series 2* (pp. 71-82). Cape Town South, Africa: University of the Western Cape.

Goodchild, S. (1997). Issues raised by a Saussurian analysis of classroom activity. *Philosophy of Mathematics Education Journal* 10, 88-91.

Goodchild, S. (1996). Learner empowerment through problem solving. *Mathematics Education Review* 7, 8-16.

Goodchild, S. (1995). Rationales, purposes and metaconcepts in mathematical activity, in D. A. Almeida, & P. Ernest (Eds.), *Teaching and the Nature of Mathematics Perspectives* 53. (pp. 66-79). Exeter, UK: The University of Exeter,

Goodchild, S. (1995). Seven dimensions of learning - A tool for the analysis of mathematical activity in the classroom. In L. Meira & D. Carraher (Eds.), *Proceedings of the 19th Conference of the International Group for the Psychology of Mathematics Education Vol. 3* (pp. 113-120). Recife, Brazil: Universidade Federal de Pernambuco.

Goodchild, S. (1992). Active learning, reflection and interpretation. *Mathematics Education Review Vol 1*. 24-29.

Goodchild, S. (1988/1994). 3rd form secondary pupils' understanding of average. *Teaching Statistics* 10. 77-81. (Reprinted in D. Green (Ed.), *Teaching Statistics at its Best* (pp. 28-30). Sheffield, The Statistics Trust.

2. Other scientific articles

Fuglestad, A. B., & Goodchild, S. (2011). Mediators of mathematics in task-based discussions between teachers. In *Proceedings of the 35th Conference of the International Group for the*

Psychology of Mathematics Education. Ankara: International Group for the Psychology of mathematics education pp. 1-299.

Fuglestad, A. B., Borgersen, H. E., Daland, E., Goodchild, S., & Jaworski, B. (2007). KUL matematikk - glimt fra en konferanse. *Tangenten : tidsskrift for matematikk i grunnskolen*, 16.(3), 28-33.

Goodchild, S. & Jørgensen, K. O. (2007). Å utvikle barns forståelse av matematikk. *Tangenten : tidsskrift for matematikk i grunnskolen*, 16 (1), 35-40

Goodchild, S. (1997). Student's rationality in classroom mathematics activity: observations and theoretical aspects. In C. Kirfel, (Ed), *Rapport for NOMUS II Seminaret, Bergen 6-9 Mars 1997*. (pp. 6-29). Høgskolen I Bergen, Landås, Norway.

Goodchild, S. (1994). Pupils' metaconcepts in learning mathematics. *Proceedings of the Joint conference held at Northampton Moat House Hotel 14th May 1994*. (pp. 31-35) . Northampton. UK: British Society for Research into Learning Mathematics/Association of Mathematics Education Tutors.

Goodchild, S. (1994). Pupils' goals and teachers' objectives in a year ten mathematics classroom. In J. Pedro da Ponte & J. F. Matos (Eds.), *Proceedings of the Eighteenth International Conference for the Psychology of Mathematics Education. Vol. 1*. (p. 98) Lisbon, Portugal: University of Lisbon.

Goodchild, S. (1993). Blind activity. *Proceedings of the day conference Saturday 22 November 1993* (pp. 36-41). Manchester, UK. British Society for Research into Learning Mathematics.

Goodchild, S. (1992). Interpretation. *Mathematics Teaching*. 138, 33-35.

Goodchild, S. (1990). Dissecting a square. *Micromath* 6(2), 40-42

Goodchild, S. (1990). Angles. *Mathematics Teaching*. 132, 9-10.

Goodchild, S. (1987). Descent into the signified. *Proceedings of the Day Conference at University of London Institute of Education 7th November 1987* (pp. 5-7). London: British Society for Research into Learning Mathematics.

3. Monographs

Goodchild, S. (2001). *Students' goals: A case study of activity in a mathematics classroom*. Bergen: Caspar Forlag.

The above was reviewed by:

Keitel, C. (2004). *Journal of Mathematics Teacher Education*, 7, 269-277.

Teppo, A. (2003). *Mathematical Thinking and Learning*, 5(4), 307-310.

4. Anthologies

Goodchild, S. & Sriraman, B. (Guest Eds.), (2012) New perspectives on the didactic triangle: Teacher-student-content. Special issue of ZDM: The International Journal on Mathematics Education vol. 44 number 5.

Sriraman, B., Bergsten, C., Goodchild, S., Palsdóttir, G., Dahl, B., & Haapasalo, L. (Eds.), (2010). *The first sourcebook on Nordic research in mathematics education: Norway, Sweden, Iceland, Denmark and contributions from Finland*. Charlotte, NC: Information Age Publishing.

Sriraman, B. & Goodchild, S. (Eds.), (2009). *Relatively and philosophically Ernest: Festschrift in honor of Paul Ernest's 65th birthday*. Charlotte, NC: Information Age Publishing. (Selected and reprinted in *Philosophia mathematica* 2011).

The above was reviewed by:

Rowlands, S. (2011). *Science and Education*, 20, 543-555.

Jaworski, B., Fuglestad, A. B., Bjuland, R., Breiteig, T., Goodchild, S., & Grevholm, B. (Eds.), (2007). *Læringsfellesskap i matematikk/Learning Communities in Mathematics*. Bergen, Norway: Caspar forlag.

Goodchild, S & English, L. (Eds.), (2002). *Classroom research in mathematics education: A critical examination of methodology*. Westport CT, Praeger.

5. Other scientific work

Goodchild, S., & Grevholm, B. (2011). Epistemology and mathematics education research. University of Agder Symposium on Epistemology and research design; 2011-09-14

Goodchild, S. (2011). Students' tasks in learning and teaching mathematics Matte/NO-biennette, Stockholm, Sweden (repeat of 2010 lecture at Matematikbennalen)

Goodchild, S. (2010). Students' tasks in learning and teaching mathematics. Matematikbennalen, Stockholm, Sweden.

Fuglestad, A. B., & Goodchild, S. (2009). Inquiry in the development of Mathematics Teaching. Symposium presentation at AERA annual meeting: Disciplined Inquiry: Education Research in the Circle of Knowledge; 2009-04-13-17.

Goodchild, S., & Revheim, M. (2008). Introducing interactive technology into an upper secondary mathematics teacher's practice. *PPU serien* 2008 (32) pp. 39-40.

Goodchild, S. (2007). Methodology for research in an inquiry community. Fagdidaktikk mellom skole og lærerutdanning (Nordisk konferanse, Høgskolen I Oslo); 2007-05-14-16.

Goodchild, S. (2006). Action-Research: a professional approach to more effective practice. Matematikbiennalen Malmö, 2006-01-26-27.

Goodchild, S. (2006). Planning for action-research in our own classrooms. Matematikbiennalen Malmö; 2006-01-26-27.

Goodchild, S. (2006). Classroom Research. Invited lecture at Nordic Graduate School for Mathematics Education, Summer School June 2006.

Goodchild, S. (2001). Qualitative research methods. Invited lecture at In-service Conference for Teacher Educators in Mathematics, Ulvik, Norway.

Goodchild, S. (1998). Review of mechanics in Action for Window, computer software produced by University of Sheffield, School of Mathematics and Statistics. *Maths & Stats Vol 9(3)*.

Goodchild, S. (1997). Review of English, L. D. and Halford G. S. (1995). Mathematics Education: Models and Processes LEA. *British Journal of Educational Psychology Vol 67(3)*.

Invited lectures

2011 Matte/NO-biennette, Stockholm, Sweden. Title: Students' tasks in learning and teaching mathematics (repeat of 2010 lecture at Matematikbennalen)

2010 Matematikbennalen, Stockholm, Sweden. Title: Students' tasks in learning and teaching mathematics.

2006 Matemaattisten ja luonnontieteiden opetuksen tutkimuspäivät in Vaasa. Title: Classroom research: Impact and long term effect versus justice, liberation and empowerment?

2005 Kvinnor och matematik 6 (with Barbro Grevholm), Umeå, Sweden. Title: Achievement in mathematics in Norway from a gender perspective.

2005 NORMA05 Fourth Nordic Conference on Mathematics Education in Trondheim, Norway. Title: Students' goals in mathematics classroom activity.

2006 Matematikbiennalen in Malmö, Sweden. Title: Action-Research: A professional approach to more effective practice.

2001 In-service Conference for Teacher Educators in Mathematics, Ulvik, Norway. Title: Qualitative research methods.

1997 NOMUS II Seminaret, Bergen, Norway. Title: Student's rationality in classroom mathematics activity.

Curriculum Vitae

Name: Anne Berit Fuglestad

Title/Position: Professor

Department: Mathematical Sciences, Faculty of Engineering and Science, UiA

Education: Bachelor: mathematics, physics, chemistry. Later: Pedagogy, Informatics (ICT).

Masters: Pure mathematics, University of Bergen, 1971

Doctoral: PhD thesis: *Computers and the understanding mathematics. A study of teaching decimal numbers.* University of Nottingham, UK, 1996

Teaching qualification: secondary school & university level, mathematics and ICT

Research: Mathematics classroom research, teachers' competence development and the use of ICT in mathematics teaching. Methodological basis: qualitative studies, developmental and design research, collaborative actions with teachers, case study.

Employment: (1991 - today) University of Agder, professor in mathematics education, (associate professor from 1997, docent from 2002, professor from 2011)

(1972 - 1991) Hamar College of Education (teacher education,) Assistant professor,

(1964 - 1965) Varhaug school, teacher, grades 4 – 8, several subjects.

Visiting positions: University of Melbourne, Australia, study/research visit 4 weeks, 2003.

Concordia college, Minnesota, to study the use of ICT in mathematics teaching, 5 weeks, autumn 1983. UK, study visits to schools, support centres and universities, development of ICT in mathematics teaching, 6 weeks 1980.

Teaching: Mathematics for teacher education, ICT for teachers, including general technology, didactics of digital technology in teaching mathematics, and research.

Development of courses for technology in mathematics teaching 30 + 30 ECTS (on medium and masters level), and leading development of new course 15 ECTS for Practice teachers (supervisors course) for teacher students' school practice.

In my teaching I emphasize an inquiry approach in various forms, investigations and problem solving intending to stimulate understanding not just rote learning.

Supervision of 11 masters students and 9 PhD students (2 completed)

Projects: ICT and mathematics learning (2004-2007) Funded by The Research Council of Norway (RCN) (Project leader)

Learning Communities in Mathematics, (2004 – 2007) funded by RCN (participant)

Teaching Better Mathematics (2007- 2010) funded by RCN and The Competence Developmental fund of Southern Norway (SKF), collaboration with the schools

project Learning Better Mathematics (13 schools and kindergarten) funded mainly

by SKF. (Project leader) Teaching development and research were combined.

Central ideas: work in learning communities and inquiry approach to teaching.

Review activity: Reviewer for 4 international and 4 Norwegian journals, and several conferences.

Selected publications:

Journals

Berg, C. V., Fuglestad, A. B., Goodchild, S., & Sriraman, B. (2012). Mediated action in teachers' discussions about mathematics tasks. *ZDM The International Journal of Mathematics Education, 44*, 677-689

Carlsen, M. & Fuglestad, A. B. (2010). Læringsfellesskap og inquiry for matematikkundervisning. [Learning communities and inquiry for mathematics teaching] *FOU i praksis, 4* (3), s 39-60

Fuglestad, A. B. (2013). Mediation of a teacher's development of spreadsheets as an instrument to support pupils' inquiry in mathematics. *International journal of technology in mathematics education, 20*, 9-14.

Fuglestad, A. B. (2009). ICT for Inquiry in Mathematics: A Developmental Research Approach. *Journal of Computers in Mathematics and Science Teaching, 191-202.*

Jaworski, B. & Fuglestad, A. B. (2010). Developing mathematics teaching through inquiry: A response to Skovsmose and Säljö. *Nordic Studies in Mathematics Education 15*, 101-118

Books/chapters

Fuglestad, A. B. (2012). Teachers reflecting on inquiry in mathematics. In Guðný Helga Gunnarsdóttir, Freyja Hreinsdóttir, Markku Hannula, Eva Jablonka, Uffe Thomas Jankvist, Andreas Ryve, Paola Valero, & Kjersti Wæge (Eds.), *Proceedings of Norma 11. The sixth Nordic Conference on Mathematics Education* (pp. 247-256). Reykjavik: University of Iceland Pre.

Fuglestad, A. B. (2010). Inquiry into mathematics teaching with ICT. In B.Sriraman, C. Bergsten, S. Goodchild, G. Palsdottir, B. Dahl, & L. Haapsalo (Eds.), *The First Sourcebook on Nordic Research in Mathematics Education* (pp. 91-108). Charlotte: Information Age Publishing Inc.

Fuglestad, A. B., Healy, L., Kynigos, C., & Monaghan, J. (2010). Working with teachers: context and culture (ICMI study 17). In C.Hoyles & J.-B. Lagrange (Eds.), *Mathematics Education and Technology - Rethinking the Terrain* (pp. 293-310). New York: Springer.

Fuglestad, A. B. (2007). IKT som støtte for "inquiry" i matematikkundervisningen (pp. 27-38). and IKT-verktøy i løsning av matematikkoppgaver. (pp. 275-280) [ICT as support for mathematics teaching, and ICT tools in solutions of mathematical tasks.] In B.Jaworski, A. B. Fuglestad, R. Bjuland, S. Goodchild, & B. Grevholm (Eds.), *Læringsfellesskap i matematikk - Learning Communities in Mathematics* Bergen: Caspar Forlag.

Curriculum Vitae

Name: Morten Brekke

Title/Position: Assistant Professor

Department: Faculty of Engineering and Science, UiA

Education: Cand. Scient in Theoretical astrophysics

Research: Use of ICT in education, eLearning.

Employment: (1993-): Assistant Professor UiA

(1997) Teacher at Agderforskning (Mathematics)

(1994) Teacher at Risør VGS (Mathematics and Science)

(1993) Teacher at Aftenskolen (Physics, Chemistry)

Visiting positions: None

Awards: “Best Paper Award” at the London International Conference on Education (LICE-2009), November 9-12, 2009, London, UK (www.liceducation.org). Tittel: Effects of bringing computer technology in physics and mathematics into the classroom.

Teaching: Mathematics and Physics with special interest in use of ICT in education. Simulations, videos, e-Assessments and e-Learning.

Projects: Project leader for parAbel (2001 – 2009). A large national project, Interactive Mathematics and Physics at high school level.
LA2020 project (2010-2011) Early testing of eExams in Calculus at University level.

Editorial activity: Program Committee of the IADIS International Conference on International Higher Education 2012 (IHE 2012).

Selected publications:

Populærvitenskapelige arbeider og formidling

Brekke, M. (2013). Early testing of e-Exam. Using MyMathlab for conducting e-Exam in Mathematics at University of Agder. eLearning Discovery Workshop, hosted by Pearson education at Gardermoen, 06.05.2013.

Brekke, M. (2013). Videostreaming av forelesninger og e-Eksamen i Matematikk.. MNT-SAK-prosjekt, overgang i matematikk fra VGS til høyere utdanning. Universitets og Høgskolerådet, Gardermoen 06.05.2013.

- Brekke, M. (2013). Praktisk bruk av MyMathlab i Matematikk til underveis- og sluttevaluering. Seminar om e-lærings verktøy fra Pearson Education. Høgskolen i Narvik, Narvik 25.04.2013.
- Brekke, M. (2013). Realfagskurs på Nett og bruk av videoforelesninger. Seminar om e-lærings verktøy fra Pearson Education. Høgskolen i Narvik, Narvik 25.04.2013.
- Brekke, M. (2013). Videostreaming av forelesninger i matematikk på ingeniørutdanningen ved UiA. Nasjonal fagmiljøsamling for maskiningeniørutdanningene. Universitets og Høgskolerådet, Gardermoen 19.04.2013.
- Brekke, M. (2013). Digital eksamen i Calculus med MyLabsPlus. Fagmøte i matematikk og fysikk med Pearson Education. Høgskolen i Buskerud, Kongsberg 13.04.2013.
- Brekke, M. (2013). "Elektronisk eksamen i realfag for større grupper". NVU-konferansen 2012 - Læring i skyen(e)? Universitetet i Agder, Grimstad 17-18.04.2013.
- Brekke, M. (2011). Foredrag på Fagmøte i matematikk 4.-5. oktober 2011, Gardermoen. Tittel: «Samarbeid og implementering av rammeplanen»
[http://www.hioa.no/Mediabiblioteket/node_52/Hva-skjer-filer/Program-fagmoete-matematikk-04-05-2011/\(language\)/nor-NO](http://www.hioa.no/Mediabiblioteket/node_52/Hva-skjer-filer/Program-fagmoete-matematikk-04-05-2011/(language)/nor-NO)
- Brekke, M. (2011). Presentasjon på konferansen IKT med tanke på framtida, . 5. mai 2011. UiA, Kristiansand. Tittel: e-Eksamen i teknologiske fag.
http://www.uia.no/no/div/prosjekt/la2020/konferanser/ikt_med_tanke_paa_framtida
- Brekke, M. (2010). Paper sammen med Per Henrik Hogstad til International Journal for Digital Society, Vol.1, Issue 1, 2010. Tittel: New teaching methods – Using computer technology in physics mathematics and computer science.
- Brekke, M. (2009). Presentasjon på konferansen IKT og læring fram mot 2020, 8. desember 2009. UiA, Kristiansand. parAbel.
http://www.uia.no/no/div/prosjekt/la2020/ikt_og_laering_mot_2020
- Brekke, M. (2009). Foredrag og paper til London International Conference on Education (LICE-2009), November 9-12, 2009, London, UK (www.liceducation.org). Tittel:Effects of bringing computer technology in physics and mathematics into the classroom. ISBN: 978-0-9564263-0-7 Paperet fikk "Best Paper Award"
http://www.uia.no/no/portaler/aktuelt/nyhetsarkivet/best_paper_award_for_computer-fysikk

Curriculum Vitae

Name: F.P. (Pauline) Vos

Title/Position: Professor

Department: Mathematical Sciences, Faculty of Engineering and Science, UiA

Education: BSc (Mathematics), MSc (Mathematics)

PhD (title of dissertation: Like an Ocean Liner Changing Course; the Grade 8 Mathematics Curriculum in the Netherlands, 1995-2000)

Teaching qualifications: Mathematics, SMART board training certificate

Research: Education and Popularization of Mathematics

Employment: (2013- present) UiA – Professor

(2008-2013): University of Amsterdam, The Netherlands – Assistant Professor

(2004-2008): University of Groningen, The Netherlands – Lecturer

(2002-2004): University Eduardo Mondlane, Mozambique – Assistant Professor

Visiting positions: 2009 guest professor Universidade Federal de Salvador and Universidade Estadual Feira de Santana (Brasil)

2004 guest researcher: Human Sciences Research Council (South Africa)

Awards: ‘Web Byte of the Month’ by NCTM (National Council for Teachers of Mathematics), December 2001.

‘Most-cited article’ for “Algebra proficiencies of grade 8 students: did they improve or not?”, awarded by the editor of Euclides, November 2007.

Teaching: Mathematics Education (for teachers, for researchers), Mathematics (Linear Algebra, Discrete Mathematics, Geometry), Research Methods in the Social Sciences. My teaching approach: engagement, interactivity, variation (in representations, in tasks), serving differences in talents. Special interests: use of ICT; use of authentic contexts (in mathematical modeling).

Projects: Teaching development: I have designed several courses: Use of ICT in the Mathematics Classroom (for pre-service teachers), a fully digitalized module ‘Logic’; mathematics excursions for secondary school students to the university (informal learning through hands-on experiences).

Research: 2011 Ministry of Education, The Hague: Research project “e-learning and Mathematics”. € 88 000.

Editorial activity: Editor (Tijdschrift voor Didactiek der Betawetenschappen)

Reviewer (9)

Selected publications:

Journals - especially those related to the SFU proposal

Schaap, S., Vos, P., Ellermeijer, A.L., & Goedhart, M.J. (2011). De vertaalslag van een probleemsituatie naar een wiskundige formule – een studie naar vraagstellingen en leerlingprestaties op het centraal examen [The translation from a problem situation to a mathematical formula – a study on question format and student achievement]. *TD-β, Tijdschrift voor Didactiek der Bètawetenschappen*, 28(1&2), 3-19.

Vos, P. (2009). Pearson's correlation between three variables; using students' basic knowledge of geometry for a statistical exercise. *International Journal for Mathematical Education in Science and Technology*, 40(4), 533-541.

Vos, P. (1996). Teaching TRIG with Cabri. *MicroMath*, 13(2), 26-30.

Books/chapters - especially those related to the SFU proposal

Vos, P. (2011). What is 'Authentic' in the Teaching and Learning of Mathematical Modelling? In G. Kaiser, et al (Eds.), *Trends in Teaching and Learning of Mathematical Modelling* (pp 713-722). New York: Springer.

Medhiyev, R. & Vos, P. (2010). ICT (Information Communication Technologies) in mathematics education: Exploring students' learning experiences when using a Dynamic geometry Software (DGS) tool in geometry class. Saarbrücken, Germany: Lambert Academic Publishing.

Vos, P. (2007). Assessment of Applied Mathematics and Modelling: using a Laboratory-like Environment. In W. Blum, et al. (Eds.), *Applications and Modelling in Mathematics Education; New ICMI Studies Series no. 10* (pp. 441-448). New York: Springer.

Presentations - (conferences/seminars) –

Vos, P. (2011). Modelling and task formats: do we include mechanistic, reproductive modelling into modelling? Paper presented at the Working Group on Mathematical Modelling and Applications at the 7th Conference on European Research in Mathematics Education (CERME-7), Rzeszów, Poland.

Vos, P. (2011). Design principles for digital modules for Advanced Mathematics that cater for both procedural fluency and conceptual understanding. Conference on E-Learning and Mathematics, Eindhoven University of Technology.

Vos, P. (2009). E-learning in Advanced Mathematics. Keynote address at National Day for Advanced Mathematics. Utrecht, 5 June.

Laar, B. van de & Vos, P. (2006). Online assessment of academic proficiencies: results from a pretest at the University of Groningen. National Day Academic Skills, University of Groningen, The Netherlands, 1 June 2006.

Curriculum Vitae

Name: Yuriy V. Rogovchenko

Title/Position: Professor of Mathematics

Department: Mathematics Sciences, Faculty of Engineering and Science, UiA

Education: MS in Mathematics (High Honors) from Taras Shevchenko National University of Kyiv awarded on June 20, 1983. Thesis “Trajectories on a Torus”.

Ph.D. in Differential Equations from the Institute of Mathematics, National Academy of Sciences of the Ukraine, awarded on June 2, 1987. Thesis “Periodic Solutions of Weakly Nonlinear Partial Differential Equations with Impulse Action and their Stability”.

Qualification of a Senior Staff Member (Associate Professor) awarded by the National Attestation Board on June 25, 1998.

Research: Qualitative theory of ordinary, functional, and impulsive differential equations, perturbation methods, mathematical modeling in biology and economics.

Employment: 2012-: Professor of Mathematics, Department of Mathematical Sciences, UiA.

2010-13: Professor of Mathematical Analysis, Department of Mathematics and Mathematical Statistics, Umeå University, Sweden.

2007-09: Professor of Mathematics, 2006-07: Associate Professor, Department of Mathematics and Physics, University of Kalmar, Sweden.

2003-08: Professor, 1998-2003: Associate Professor, 1997-98: Assistant Professor, Department of Mathematics, Eastern Mediterranean University, North Cyprus.

1996-2000: Senior Staff Member, 1990-96: Staff Member, 1986-90: Junior Staff Member, 1983: Research Engineer, Department of Mathematical Physics and Nonlinear Oscillations, Institute of Mathematics, Kyiv, Ukraine.

Visiting positions: Aug-Sep 2004, Visiting Professor, University of Kalmar, Sweden. Jan-Feb 2004, Jan-Feb 2003, Feb-Mar 2002, Feb-Mar 2001, Jul-Aug 1999: Senior Guest Scientist, the Abdus Salam International Center for Theoretical Physics, Trieste, Italy. Aug-Sep 2003: Research in Pairs, Mathematisches Forschungsinstitut Oberwolfach, Oberwolfach-Walke, Germany. Aug 2003: Visiting Professor, Weierstrass Institute for Applied Mathematics and Stochastics, Berlin, Germany. Feb 2000: Visiting Professor, Middle East Technical University, Ankara, Turkey. Jul-Aug 1997: Visiting Professor, University of Amiens, France. Apr-Jul 1997, Sep 1995-Aug 1996, Apr 1994-Jun 1995: Visiting Scholar, Department of Mathematics, University of Florence, Italy. Sep-Nov 1992: Visiting Professor, University of Bologna, Italy

Awards: Regular Associate of the Abdus Salam International Centre for Theoretical Physics, Jan 2004-Dec 2011.

1994-95 and 1995-96: Research fellowships for foreign mathematicians awarded by CNR, Italian National Research Council. 1997: CNR-NATO Guest Fellowship.

Distinguished reviewer of Zentralblatt MATH (Aug 2009). Certificate of Recognition 2010 from the President and CEO of FIZ Karlsruhe Sabine Brünger-Weilandt and the President of the European Mathematical Society Ari Laptev.

Teaching: Taught a variety of courses at undergraduate, graduate and advanced post-graduate level ranging from Calculus and Linear Algebra to Applied Transforms, Theory of Ordinary and Partial Differential Equations, Asymptotic Behavior of Global Solutions to Initial Value Problems.

Projects: Initiator and coordinator of the INTAS Grant 96-0915 “Qualitative properties of impulsive differential equations with applications to control theory and mathematical biology” (1997-99).

Member of the work group “Complex networks and nonlinear production models for economic geography” under the COST Action IS1104 (2012-15).

Editorial activity: Editorial board membership: International Journal of Differential Equations, Discrete Dynamics in Nature and Society, Abstract and Applied Analysis, ISRN Mathematical Analysis (Hindawi Publishing Corporation), Journal of Applied & Computational Mathematics (OMICS Publishing Group). Lead Guest Editor for 2 and Guest Editor for 5 Special Issues (Hindawi, Springer). Referee for 60 journals including 37 indexed by Web of Science®.

Selected publications:

1. Dynamics of a single species in a fluctuating environment under periodic yield harvesting, *J. Appl. Math.* 2013, Art. ID 167671, 12 pp. (with M. Hasanbulli and S.P. Rogovchenko).
2. Effect of periodic environmental fluctuations on the Pearl-Verhulst model, *Chaos, Solutions & Fractals* 39 (2009), 1169-1181 (with S.P. Rogovchenko).
3. Comparison results for systems of impulse parabolic equations with applications to population dynamics, *Nonlinear Anal.* 28 (1997), 263-277 (with M. Kirane).
4. Nonlinear impulse evolution systems and applications to population models, *J. Math. Anal. Appl.* 207 (1997), 300-315.
5. Impulsive evolution systems: main results and new trends, *Dynam. Contin. Discrete Impuls. Systems*, 3 (1997), 57-88.

Letter of Intent for collaboration between:
The Norwegian University of Science and Technology (NTNU)
and University of Agder (UiA)

May 7, 2013

Introduction

The project "Multimedia based learning environments for quality and flexibility" at The Faculty of Social Sciences and Technology Management, Norwegian University of Science and Technology (NTNU) and the project "Research, innovation and coordination of mathematics teaching" at the Faculty of Engineering and Science, University of Agder (UiA) recognize the opportunity and are open for collaboration and establishing a partnership in STEM (Science, Technology, Engineering and Mathematics) education.

- UiA/NTNU has been informed about the SFU proposal submitted by NTNU/UiA.
- Proposers at NTNU and UiA recognize essential differences between the proposals, the proposed centres are complementary addressing different aspects and challenges in teaching mathematics and natural sciences in user group programmes.
- If NTNU is successful in the proposal then UiA intends to collaboration with the Centre at NTNU.
- If UiA is successful in the proposal then NTNU intends to collaboration with the Centre at UiA.
- If both proposals are successful we recognize that there is great opportunity for synergy between the two Centres and the two Centres will establish structures that will facilitate collaboration and complementarity.
- If neither proposal is successful we will continue to seek collaboration based on the limited funding available.

Desired Outcome

To develop and maintain an effective NTNU - UiA collaborative partnership that pools developed material, research results and human resources, allowing successful communication, research and education.

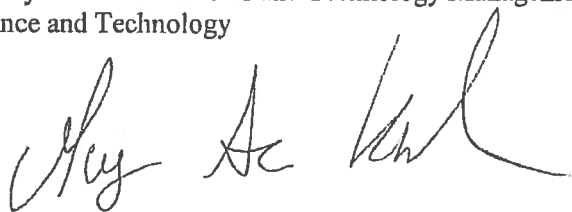
Summary

The NTNU - UiA partnership will effectively enhance STEM education at a national and international scale.



Dean,

Faculty of Social Sciences and Technology Management, Norwegian University of
Science and Technology



Dean,

Faculty of Engineering and Science, University of Agder

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

Supplementary documentation requested by the NOKUT Evaluation Panel.

1. Project Plan. *(Extending the Centre description and time-line in first submission).*

MatRIC will:

- Create, lead and support networks that enable sharing and development of effective use of video, digital and web-based technologies in teaching, learning and assessing mathematics.
- Initiate, support and disseminate research into teaching, learning and assessing mathematics to identify, understand and evaluate effective innovation in practice.
- Bring together mathematics educators, scientists, engineers, computer scientists and economists in cross-disciplinary teams to produce workplace simulations and authentic tasks for mathematical modelling.

Vision: *The Centre will lead innovation, research and excellence in mathematics teaching and learning within higher education ‘user programmes’.*

This vision will be achieved through:

- i. Networking mathematics teachers and users (engineers, scientists, economists, teachers, etc.).
- ii. Coordinating research into innovation in teaching, learning and assessing mathematics.
- iii. Developing teaching resources that simulate applications of mathematics in the workplace and a student laboratory for developing competencies in mathematical modelling.
- iv. Disseminating research, innovation and excellence in mathematics teaching.

Realisation of MatRIC rests on four interconnected functions: 1.1 Management and administration; 1.2. Creation and maintenance of a national (and international) profile and presence; 1.3. Research and innovation; 1.4. Dissemination. Each function is outlined below, with milestones and deliverables.

1.1 Management and administration. MatRIC will have 3 organs with responsibility for the management and development of the Centre – A Management Board (CMB), An Executive (CE), An International Advisory Board (IAB).

The Centre Management Board (CMB) will be led by a Vice Rector of the University of Agder. Other members will include: Centre Leader, Dean of UiA Faculty of Engineering and Science, UiA teachers of Mathematics and user subjects, Student representatives, External members (Norwegian University of Science and Technology, Norwegian University of the Life Sciences).

CMB will be responsible for monitoring, policy, direction, reporting to NOKUT.

The Centre Executive (CE) will comprise the Centre Leader (50% position, Prof. S. Goodchild employed 100% at UiA), and a Centre Administrator (100% position, to be appointed).

CE will be responsible for leadership, administration, management of funds, implementing

CMB policy, regular reporting to CMB and IAB, collection and archiving of MatRIC records, products and data, maintenance of the Centre calendar, external communications and relations, facilitation of Centre activities (work packages), leading/supporting applications for external funding (Regional, national, European) to further the Centre's research and innovation.

The **International Advisory Board (IAB)** will include international and Norwegian individuals with extensive knowledge and experience of teaching and learning mathematics and user subjects in universities, leadership of Centres of Excellence, employer and professional organizations.

The IAB will be called on for advice and suggestions about policy and direction, and making judgments about the quality of the Centre's activities.

MatRIC's research and innovation workpackages will be undertaken by individuals and teams at UiA and other higher education institutions. *Initially* teams at UiA and NTNU will lead innovation in designing products for supporting teaching and learning. Initially researching educational outcomes of the innovative products will be led by the Mathematics Education Group at UiA. As MatRIC becomes established as a national resource, the aim is to bring teachers and researchers from other HE institutions into the Centre's activities, and to connect and support, innovation and research in mathematics teaching for user groups nationally.

Key milestones: Centre Leader confirmed in position by Faculty of Engineering and Science, UiA, and CMB established November 2013, first meeting December 2013. IAB established by the end of 2013.

Announcement of Centre Administrator position will be made December 2013, the post will be filled as quickly as possible. Temporary administrative assistance will be available until the Administrator position is filled. The Faculty of Engineering and Science, UiA will manage the appointment process within current university policies and practices and national regulations.

Deliverables: CE monthly reports to CMB and IAB. Effectiveness of activities 1.2-1.4 below.

1.2 Creation and maintenance of a national (and international) profile and presence. This will be achieved through the MatRIC web-site, e-mail, etc., a 'Start-up' seminar, and dissemination.

Key milestones: CE will call for tenders for the web-design November 2013. Centre web-site will be open autumn 2014. A temporary web-site will be established within the existing 'home pages' of UiA.

A Start-up seminar to explain the Centre plan and encourage participation in Centre activities will be held January 2014. The seminar will include exemplar activities and open discussion about the Centre's national contribution. Invited participants will include: Deans of Faculties of mathematics and user subjects and other stakeholders – professional and employer organizations.

MatRIC e-mail list including all interested in the work of the Centre will be created within the

first quarter 2014, social networking channels will be opened. A document archive will be created.

Deliverables: Centre web-site and communication channels; ‘Start-up’ seminar.

1.3 Research and innovation. These are described in the Centre Description as work packages 2 and 3. MatRIC will commission and publish a review of literature related to innovation and research in teaching mathematics to user groups at higher education, especially focusing on the use of video and emerging technologies. MatRIC will also carry out a survey of Norwegian (and Nordic) innovation and research within the interests of the Centre’s network and facilitate communication between groups and individuals. MatRIC will also support the development of innovative simulation and modelling workshops in authentic contexts (e.g. in mechatronics, communications, health science, economics and finance, etc.) for teaching and learning mathematics.

Key milestones: Selection of researchers to conduct review and surveys (first quarter 2014), publication of results by December 2014. Establishment of working groups focused on innovation and research (1st quarter 2014). In year 1, researchers and teachers at UiA and NTNU will form the nucleus of these groups, wider national engagement will follow as MatRIC becomes known.

Negotiation of workplans of group coordinators. Creation of MatRIC calendars, agreements about administration, organization, activity, production goals and reporting. In addition to innovation, production and research, working groups will also develop workshops to disseminate their output.

Deliverables: Review of literature (12/2014). Survey of Nordic innovation & research (12/2014). First simulation workshop (12/2014); First modelling workshop (12/2014). Goal: to produce 4 new workshops each subsequent year, focusing on applications of mathematics in different contexts (engineering, finance and economics, health).

1.4 Dissemination. (more detail is included below, response to request for supplementary documentation point 3). Dissemination will be pursued by: communications network (web-site, e-mail, etc.); MatRIC publications (Newsletter, Journal); Meetings (MatRIC workshops & annual MatRIC conferences); papers in international journals, presentations at national and international conferences; visits to international centres of excellence of teaching and learning in mathematics, engineering, economics, etc.

Key milestones: MatRIC conference – programme committee set up (01/2014), first conference (12/2014). MatRIC Journal – Editorial board established (04/2014), first issue (11/2015).

Deliverables: MatRIC conference (12/2014, thereafter annually); MatRIC Journal (11/2015, thereafter annually – or more frequently if submissions demand); MatRIC Newsletter published two times each year: (June and December). Workshops will be organized at universities or university colleges around the country (normally two events each year).

2. Monitoring and measures of success.

Monitoring and evaluation

The Centre Executive will provide the Centre Management Board and International Advisory Board with monthly reports of activity mapped against the milestones and intended deliverables.

Qualitative feedback from individuals (teachers and students) who engage in Centre sponsored events will be collected, including reports of changes in practice arising from teachers' and students' participation in MatRIC activities. The Centre will use a web-based questionnaire (addressed to all stakeholders) to explore experiences, personal judgments, and suggestions.

Quantitative data of participation in the Centre will be collected: E.g. number of visits to the Centre web-site, participation in activities (innovation groups, workshops, conferences), visits to international centres, international visitors to MatRIC events.

MatRIC will seek and support case studies and vignettes of effective innovation in teaching and learning mathematics to user groups.

CE will prepare and CMB will publish an annual report of MatRIC activities and an analysis of the qualitative and quantitative data described above. IAB will be invited to make judgments about the quality of the Centre's activities and make suggestions for development and improvement. In the first quarters of 2015 and 2016 a small group from the IAB will be asked to prepare an evaluation of MatRIC for CMB. In 2017 NOKUT will undertake an evaluation. In 2018 the Centre will seek an external evaluation of the first five years.

Overall measures of success.

- Students' and teachers' reports of the impact and value of MatRIC's products, the usefulness of the Centre's network, and satisfaction with the Centre's organization and activities.
- Development of a research culture in mathematics teaching and teaching development.
- Development of teachers' research and inquiry in mathematics teaching in higher education.
- Nationwide engagement of university and university college teachers of mathematics and user subjects in MatRIC's network.
- Productions of simulations of mathematics and modelling workshops with mathematics applied in a broad range of authentic contexts. The goal is to produce resources and workshops that address mathematics in engineering; economics and finance; natural sciences; health; etc. (18 in the first five years).
- Implementation of the Centre plan and achievement of the milestones and deliverables.
- Generation of additional funding from regional, national and international sources to extend the Centre's programme of innovation and research.
- National (and international) reach of MatRIC Newsletter and Journal.
- Participation in and sustainability of the MatRIC conference.

3. Dissemination strategy

MatRIC will adopt a strategy in which dissemination evolves through three nested phases (Promotion, Profile and Product dissemination) in which both purpose and reach develop. Each successive phase builds on and incorporates earlier phase(s). In the 'Promotion Phase', which will coincide with the first year of MatRIC, dissemination will concentrate on making the Centre known and growing the network, regionally, nationally and internationally. Developing the network will continue as MatRIC enters the 'Profile Phase', in which attention broadens to develop the Centre's profile and making the Centre's resources – and resources of other groups and institutions associated with the Centre – known throughout the Centre's network. This second phase will extend through the second year of MatRIC and into the third year. MatRIC will aim to develop an international profile from the outset, especially through visits into the Centre and from the Centre to international centres of excellence (e.g Centre for Mathematics Education at Loughborough). However, as MatRIC enters the 'Product Dissemination Phase', it is anticipated that the resources of MatRIC, and the research base of MatRIC will both attract and deserve international attention, and the phase of product dissemination will commence.

MatRIC will use existing means and media for dissemination such as professional and scientific journals, conferences and interest groups, local and regional seminars and meetings, and national and international networks. In addition MatRIC will create and develop additional means to make the Centre known and disseminate the Centre's products, resources and output. These additional means include: MatRIC web-site, e-mail, (& other social networking); MatRIC Newsletter, and MatRIC Journal; MatRIC workshops, and MatRIC conference; and the Special Interest Groups developing modelling and simulation workshops based in authentic contexts. The MatRIC Newsletter will be produced by the Centre Executive, it will be in English so that the work of MatRIC can be followed internationally. The MatRIC Journal will provide a stepping-stone for university teachers in the MatRIC network to publish their work at an intermediate level within the Nordic community in the process of developing papers for existing international journals. MatRIC Journal will accept papers, following peer review, in English and Scandinavian languages.

Local dissemination, within the university. There exists an active seminar programme in mathematics education research. It will be natural to extend this to include MatRIC activities. The University of Agder (UiA) occupies two campuses separated by about 50 km. MatRIC will facilitate seminars at both campuses to embrace university mathematics teaching within all user groups (Engineering, Science, Economics, Health Care, Teacher Education). MatRIC will be active to promote its work and potential within the university by creating opportunities to explain the activities within regularly held Department and Faculty meetings (across the university), explore new possibilities and encourage participation within the MatRIC network. MatRIC will also take

advantage of the opportunities to extend its reach within the university through the university's Educational Development Centre by offering courses in innovative teaching with video and emergent technology.

Regional dissemination. MatRIC will work with mathematics and other subject specialists to develop links with users of advanced mathematics, mathematical modelling and simulation. MatRIC will seek collaboration with specialists in (engineering enterprises, hospital and health care, research institutes, finance industry, etc.) – to develop modelling and simulation applications of mathematics in authentic contexts. *An aim will be to explore ways in which MatRIC can develop resources that will better motivate and prepare students in their studies and future careers.*

MatRIC workshops will be held at the University of Agder and other universities/university colleges. Workshops will aim to have a regional as well as local impact and potential user groups from enterprises relevant to the workshops will be invited to participate. MatRIC will exploit the synergy that exists between engineers, scientists and academics etc. for educational (and professional) development. The participation of people from enterprises, businesses and research institutions will enhance the Centre's activities and open up new opportunities to develop authentic simulations and modelling opportunities.

There already exists within the region an 'MNT Forum' (Mathematics, Natural Sciences, Technology) that brings together university teachers and upper secondary school teachers, and representatives from the local authority and local businesses and industries. The meetings and visits of the Forum are used to develop regional awareness of cutting edge applications of science and technology. MatRIC will contribute to the MNT Forum and use the Forum to disseminate the work of the Centre, to 'show case' Centre products and to develop links with outside organizations.

National dissemination. Promoting the Centre and developing national participation in the network will have a high priority from the outset. The national network, identified as work package 1, is crucial to the success and impact of MatRIC. MatRIC will organize a 'Start-up' Seminar to explain the foundation and goals of MatRIC and further explore opportunities for collaboration. Deans of Faculties where teachers will benefit from being in the MatRIC network will be invited (or send a substitute). Other national stakeholders will also be invited.

MatRIC will also seek, through personal contact and visits, to develop links with other national centres of excellence in both education and research. These links will be important, to inform about the activities of MatRIC, to engage others in the MatRIC network, and to learn from good practice.

The annual MatRIC Conference, MatRIC Newsletter and MatRIC Journal will create opportunities for national dissemination. International guest speakers will be invited to the conference, and react to papers published in the journal. It is hoped that the conference and

publications will also attract international participation, especially from the Nordic countries.

International dissemination. MatRIC will seek associate membership of the European Society for Engineering Education (SEFI, <http://www.sefi.be/>) and benefit from the existing SEFI network.

The front pages and much of the MatRIC web-site will be in English to encourage international attention, although contributors to the web-site and journal will be able to write in a Scandinavian language if preferred (brief English summaries of Scandinavian text will be included).

MatRIC will support members of the network to visit international centres, to learn from good practice and make contact with others working on similar teaching and learning projects. MatRIC will also support visits of leading international teachers and scholars to share in MatRIC activities.

MatRIC will use the opportunities of international conferences to disseminate the activities and output of the Centre. Specialist conferences in engineering education, economics education etc. will be used. Research and evaluation of teaching resources developed through MatRIC will also be submitted to international journals.

<p>Conferences (there are numerous, some examples are listed):</p> <p>European Distance E-learning Network (EDEN)</p> <p>Int. Symposium on Problem Based Education</p> <p>European Society for Engineering Education (SEFI) Conference (& SEFI Mathematics Working Group: http://sefi.htw-aalen.de/)</p> <p>Int. Group for the Psychology of Mathematics Education</p> <p>Congress of European Researchers in Mathematics Education</p> <p>Nordic Researchers Mathematics Education Conference</p> <p>Int. Conference on Technology in Mathematics Teaching</p> <p>Int. Society for Design and Development in Education</p>	<p>Journals (there are numerous, some examples are listed):</p> <p>Int. Journal for Technology in Education</p> <p>Int. Review of Economics Education</p> <p>The Journal of Economic Education</p> <p>Int. Journal of Engineering education</p> <p>Int. Journal of Mathematics Education in Science and Technology</p> <p>Int. Journal of Science and Mathematics Education Studies in Higher education</p> <p>Teaching Mathematics and its Applications</p> <p>Int. Journal of Electrical Engineering Education</p> <p>Computers and Education</p> <p>British Journal of Educational Technology</p> <p>Engineering Science and Education Journal</p> <p>European Journal of Engineering Education</p>
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4. Collaboration with NTNU.

MatRIC will have a national profile that facilitates networking, collaboration and dissemination of innovation and research in teaching and learning mathematics within user programmes. In Norway, The Norwegian University of Science and Technology (NTNU) is the leading technological university and is investing heavily in developing and researching approaches using multimedia based technology in teaching and learning mathematics and other subjects. Teachers and developers at NTNU are creating high quality educational videos on specific subject topics and researching the factors that impact upon the videos' effectiveness in teaching and learning. There is considerable complementarity and some duplication of effort in mathematics teaching through video at NTNU and UiA, and thus scope for collaboration and synergy. MatRIC will be keen to support the national networking of teachers with NTNU and other universities and university colleges and the dissemination of teaching products and research into the use of these multimedia products.

MatRIC will provide the context and release resources for collaboration between mathematics teachers at UiA and NTNU, and because of the critical mass they produce others will want to participate. Innovative teachers of mathematics, science and engineering, and researchers in mathematics education at UiA and NTNU are seeking opportunities to collaborate to form the nuclei of several interest groups focusing on producing and researching the effectiveness of a diversity of resources for teaching, learning and applying mathematics with emergent technology.

- MatRIC will support the development of a special interest group that focuses on the innovation and research in using multimedia technology in teaching and learning mathematics. MatRIC will contribute towards travel and subsistence of teachers engaged in and wishing to develop similar teaching products from other institutions to meet and collaborate with the NTNU team.
- At UiA and NTNU mathematics teachers have experience of working with computer simulations of mathematical concepts to support teaching and learning, and there has been some exchange of ideas. The existence of productive divergent thinking between the UiA and NTNU groups will result in creative engagement and both groups are looking forward to the opportunities for collaboration in this development that will be opened up by MatRIC.
- MatRIC will support research, complementary to that already proposed and pursued by teachers and developers at NTNU into the use and effectiveness of multimedia based technology in teaching and learning mathematics.
- MatRIC will provide opportunities for the dissemination of innovative products and research evidence within the Norwegian community (MatRIC Newsletter, MatRIC Journal, links from the MatRIC web-site).
- NTNU will be represented on MatRIC Management Board. (Professor Frode Rønning, Professor of Mathematics and Mathematics Education at NTNU).

Professor Berit Johanne Kjeldstad, Pro-Rector (Pro Vice Chancellor) at NTNU, with special responsibilities for educational matters writes as follows: "I fully support the initiative taken to establish collaboration between NTNU and the University of Agder in the proposal to establish an SFU based on the MatRIC project. The responsible unit at NTNU to follow up the project will be the Faculty of Information Technology, Mathematics and Electrical Engineering represented by the Department of Mathematical Sciences."

Through networking and other means MatRIC will seek to support and disseminate innovation and research in teaching mathematics to engineers, economists, scientists etc. that are being carried out in all Norwegian institutions of higher education. MatRIC will only seek acknowledgement when the Centre has provided substantial support, it will not claim ownership of products. It will be the aim of MatRIC to recognize and promote innovation and research and direct to expertise and centres of innovation and research in teaching mathematics for the benefit of teachers and students in Norway, Scandinavia and internationally. Intellectual property rights will remain with the authors and originators of research and developments, but a condition of receiving Centre support will be that products supported by the Centre will be freely available.

5. Evidence of existing expertise in innovation and research in using digital and video simulation packages.

Examples of web-sites

Per Henrik Hogstad

<http://grimstad.uia.no/perhh/phh/> (web site in Norwegian)

Cornelia Brodahl

<http://home.uia.no/cornelib>

Examples of publications:

Brekke, M. (2013). Early testing of e-exams in calculus at university level. *Proceedings of the European Distance and E-Learning Network Annual Conference, "The Joy of Learning: Enhancing Learning Experience - Improving Learning Quality"*. Oslo, 12-15 June,

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Brekke, M. & Hogstad, P. H. (2010). New teaching methods - Using computer technology in physics, mathematics and computer science. *International Journal for Digital Society*, Vol. 1. 1 pp.17-24. <http://www.infonomics-society.org/IJDS/Contents%20Page%20Volume%201%20Issue%201.pdf>

Brock, S. & Brodahl, C. (2013). A Tale of Two Cultures: Cross Cultural Comparison in Learning

the Prezi Presentation Software Tool in the US and Norway. *Journal of Information Technology Education: Research*, 12(1), 95-119.

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- Vos, P. (2011). Design principles for digital modules for Advanced Mathematics that cater for both procedural fluency and conceptual understanding. *Conference on E-Learning and Mathematics*, Eindhoven University of Technology.
- Vos, P. (2010). Designing e-learning for Advanced Mathematics; Emphasis on Procedural and Conceptual Knowledge. *Invited Lecture. Masters course Research in Mathematics Education*, University of Utrecht, 24 September.
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- Vos, P. (2007). Assessment of Applied Mathematics and Modelling: using a Laboratory-like Environment. In W. Blum, et al. (Eds.), *Applications and Modelling in Mathematics Education; New ICMI Studies Series no. 10* (pp. 441-448). New York: Springer.