Centre for Excellence in Education

Excited

Centre for Excellent IT Education

Annual report 2017

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NORD University

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1. Abstract

Excited is organized in five main projects: P1, **Informed Decision**, concerning IT activities for secondary school, P2 **Projects of Becoming** addressing mainly the first-year experience at university, P3 **Learning through Construction** looking into learning activities where students develop artefacts, P4 **Sharing and Diversity** mainly considering cross-campus teaching and the establishment of a community of practice among Norwegian IT educators, and P5 **Career Readiness** looking at industry-involvement in our degree programs and the employability of our candidates.

Excited' s main tool for involving teachers outside the centre core team has been mini-projects where teachers could apply for money to improve their courses. As for engaging students in the centre, this has mainly been done by meetings with reference groups, employment of student assistants to work part-time in Excited, having some students at summer jobs to develop digital learning resources, and involving students in Excited-related research, the latter mainly on the Master thesis level.

Recruiting personnel, especially PhD and postdoctoral fellows, has taken more time than stipulated in the application, thus we have also spent less money than planned, and to some extent produced less results than we might have done if all positions had been filled more quickly. Nevertheless, Excited has achieved interesting results in all five projects, creating a good foundation for the next year, when activities may be further boosted by hiring more people.

The report presents the results achieved so far, and the future plans, with a detailed breakdown on each of the five mentioned projects. For the benefit of the casual reader, who might not have time to read through all the detailed information in the rest of this report, we provide below a list of "highlights" or examples of achievements, without necessarily claiming that these are *the* most important activities or outcomes of Excited in 2017:

- establishing an understanding of the state-of-practice in IT education for pre-university youth in Norway, leading to four papers in peer-reviewed conferences (for details see Task 1.1 in section 2).
- trying out a particular learning intervention called "Informatikk Arbeidsdag" for the first-year students of the Bachelor Informatics degree program in Trondheim, combining learning assistance across all the four courses they were taking in the Autumn semester 2017 with a weekly social gathering (for details see Task 2.3).
- having two student-developed games in the game competition at ECGBL 2017, and getting 100 student app ideas for educational improvement out of the course TDT4140, also analysed in one national and one international conference paper (for details see Task 3.4).
- studying four different cases of cross-campus learning, ranging from project courses to more traditional lecture courses (for details see Task 4.2).
- investigating the employability of candidates from the Bachelor in IT Networks Administration (for details see Task 5.1).
- initiating several activities to address gender balance issues in IT studies. At Nord, one has seen the establishment of a girl network, a collaboration with NHO, and an international collaboration project. At the NTNU having female students develop instructional videos for novice Python programmers. Having female students make these videos was considered a good idea from a role-model perspective since instructional programming videos otherwise available on YouTube tend to be made by men.

- research about student dropout and retention has led to three international publications, one at the EDUCON conference, and two in journals (Education and IT; ACM TOCE), see publication list for details.

The rest of this report is structured as follows: Section 2 presents the results so far and explains the main deviation from plans. Section 3 explain how Excited is aligned with the objectives for the SFU instrument, in the form of direct responses to some questions explicitly asked by NOKUT. Section 4 then presents plans for the future, mainly focusing on 2018, but also explaining how this fits in to the centre's longer-term objectives. Both for section 2 and 4, the presentation is detailed according to the five main projects of Excited. Finally, appendices show details about the economy and personnel, as well as lists of publications, dissemination and student theses related to Excited.

2. Results compared to the application and plans

Excited has had a good start and achieved interesting results in all the five projects P1-P5 listed in the application and the plan submitted a year ago. Details about the results from each project is provided in subsections for each project (2.1-2.5) below. The results of the centre have been communicated in various ways in 2017, from peer-reviewed scientific publications in national and international outlets, via presentations at conferences and seminars, to interviews and digital learning material on YouTube. The output in 2017 is 25 peer-reviewed papers and 21 other registered dissemination activities, cf. publication list in Appendix 3.

In addition to some learning interventions that have been tried out, engagement of students in the centre has mainly been done in three ways: (1) meetings with student reference groups to discuss objectives and plans, (2) employment of students in summer jobs and teaching assistant positions, and (3) involvement of students in centre-related research, mostly via Masters theses (14). A list of Master theses and other student works is attached.

The centre’s main approach for engaging teachers outside the core team has been so-called “mini-projects”, where a faculty member (or several in collaboration) can apply for a small sum of money (typical amount 50 KNOK). The idea is to help the faculty member(s) try out educational interventions, and money can be used e.g. for hiring extra assistance, buying the faculty member off some other tasks, or establish necessary infrastructure. There have been two rounds of calls for such mini-projects, one in the Spring, one in the Autumn. The two first rounds taken together, 26 mini-projects have been granted, whereof about half are completed. The list below gives a quick summary of the mini-projects granted so far, clustered according to some recurring themes:

- Supporting computing activities for pre-university students, two projects: (i) Approach to teaching coding for youngsters (McCallum, Gjøvik); (ii) Start-up of youth coding clubs in Ålesund (Tomren, Ålesund)
- Support for freshmen-related and gender-balance initiatives, four projects: (i) Improved group organization at start-up weeks (Munkvold, Steinkjer); (ii) Improving the first-year experience with team-building and motivational e-portfolio (Pedersen, Gjøvik); (iii) Professional network for female students (Sigurdardottir, Steinkjer); (iv) Experience-transfer from “old” students to freshmen (Skundberg, Trondheim)

- Tool support for feedback and assessment, 3 projects: (i) Expert system for assessment of students (Hameed, Ålesund); (ii) Automated feedback on code for novice programmers (Trætteberg, Trondheim); (iii)Tool for peer-assessment (conditional, first encouraged to get money from another funding scheme) (Skundberg, Trondheim)
- Project-based learning and tighter work-life connection, five projects: (i) Social innovation events w EiT village in collaboration with SOCRATIC EU project (Jaccheri, Trondheim), (ii) Workshop on Project Management for students (Strand, Trondheim); (iii) Research on effects of TA's in Learning Through Construction courses (Curda, Steinkjer); (iv) Work-life connection for game development students (Munkvold, Steinkjer); (v) Reshaping a Software Engineering course according to GameLab principles (Strazdins, Ålesund). This latter mini-project is a good example of spread of best practice between campuses / universities, as an already well-established way of doing realistic team projects at Nord@Steinkjer got transferred to NTNU@Ålesund as people from the two campuses met and discussed experiences in the context of Excited.
- Developing new exercise modules in courses, six projects: (i) Infrastructure for interactive lectures interleaved with lab in Programming Languages course (Nytrø, Trondheim); (ii) Infrastructure setup for IoT programming exercises (Osen, Ålesund); (iii) Equipment for IoT exercises in Advanced Software Engineering (Li, Trondheim); (iv) Learning resources related to drones (Sund, Steinkjer); (v) Distributed simulation framework for more industry-realistic exercises (Wang, Ålesund); (vi) Hardware in the loop, building and programming a valve simulator (Osen, Ålesund)
- Involving students in course material development, two projects: (i) Student-created wiki-based compendium (Strazdins, Ålesund); (ii) Multimedia textbook in Image Analysis course, w/ student contributions (Lindseth, Trondheim)
- Developing video and similar distance learning resources, three projects: (i) Videos and other resources for distance / inter-campus learning of Parallel Programming (Elster, Trondheim); (ii) Instructional videos for using office tools (Hjelle, Trondheim); (iii) Using 360-degree images in online GIS courses (Holand, Steinkjer)

All in all, there has been mini-projects at every campus involved in Excited, and related to all the five main projects in Excited.

During 2017, Excited has had two Steering Committee meetings (May and October), and one meeting of the international Advisory Board (December). The latter meeting was done by Skype, as we did not manage to find a time slot in 2017 when all members could come to Trondheim (from Sweden, Denmark, Germany and the USA). We got a lot of useful input both from Steering Committee and Advisory Board meetings.

The key deviations from previous plans are related to the fact that it has taken more time to fill positions than expected beforehand. So far, we have employed an administrative coordinator and 2 PhD fellows, while the remaining 3 PhD fellowships and one postdoctoral fellowship are currently in process after a second round of announcement. Our current aim is to achieve a formal decision on whom to offer these remaining positions in the meeting of the IE Faculty's employment committee on March 5. Delayed hiring means that we have spent considerably less money than planned at this point in time, and to some extent produced less results than we might have if all the above-mentioned positions had been filled in mid-2017. In the projects that did not get a PhD fellow yet,

the bulk of the work has had to be done by that project's leader, helped by master students and teaching assistants. The lack of a dedicated administrative resource for the first 9 months of 2017 has also caused the Excited web site to be less developed than we want it to be.

Nevertheless, Excited has managed to produce interesting results in all the five projects, as will be detailed below, and given that we manage to increase our personnel with the necessary employments in 2018, we think we are in a good position with a many interesting activities to build upon. Too little money spent in 2017 means that we can spend more money in later years and thus boost our activities further.

The following five subsections will present the 2017 results of the projects P1-P5 in Excited. These projects are led by Monica Divitini (P1), Trond Aalberg (P2), Line Kolås (P3), Rune Hjelsvold (P4), Birgit R. Krogstie (P5).

P1: Informed Decisions

In 2017, P1 has actively worked to ground the upcoming work in the local, national, and international context, aiming at engaging with local communities of practice and increasing awareness about the project. Document analysis, stakeholder's interviews, questionnaires to teachers supported the mapping of P1 landscape, with multiple actors trying to compensate the limitations of the formal education system with a number of informal activities. To be successful P1 needs to find its role in the existing community of practice and gain trust among the actors, explaining the strong focus on dissemination for 2017.

In addition to the mapping and networking activities, research in P1 started to define and evaluate innovative educational interventions for pupils in secondary schools.

Below we present the main results organized around the main tasks identified for 2017. The main focus for 2017 has been on T1.1, understanding state of practice, and T1.3, dissemination

T1.1 – Understanding state of practice

Within this task we have performed document analysis, stakeholder's interviews, questionnaires to teachers.

More details about the studies are available in the following publications:

- Mavroudi, A., Divitini, M., Giannakos, M., & Jaccheri, L. (2017). Local communities of computing education in Norway. In *IEEE Global Engineering Education Conference, EDUCON*. https://doi.org/10.1109/EDUCON.2017.7943095
- Mavroudi Anna, & Divitini Monica. (2017). A Case of Career Consultancy in STEM for Youths. Proceedings of EC-TEL2017. LNCS 10474. Springer. pp. 571-575
- Serussi Sarah & Divitini Monica (to appear). GIRLS AND COMPUTING IN LOWER SECONDARY EDUCATION- The surprisingly unsurprising results of a Norwegian exploratory study. Proceedings of UDIT2017.
- Mavroudi Anna, & Divitini Monica (to appear) Beliefs and perceptions about enabling factors of computer science teachers in Norway. Proceedings of CSERC2017. ACM Press.

T1.2 – Studies of pre-university IT activities.

Some interventions have been conducted in 2017 thanks to the cooperation with external projects. Examples include:

- TILES workshop (http://tilestoolkit.io/), creative workshop for IoT design. The workshop has been conducted in two schools (one lower and one upper secondary school) and in the context of informal activities at the university with students 12-18y old. The data is currently under analysis and expected to be published in 2018.
- Privacy workshop, creative workshop for design of games to promote awareness about sharing of data online, in cooperation with ALerT IKT+ Project-Phase1. The workshop has been piloted in the context of informal activities at the university with students 12-18y old. An additional intervention is planned before the end of 2017 with two classes of an upper secondary school. The data is currently under analysis and expected to be published in 2018.

T1.3 – Dissemination, Dissemination and establishment of P1 cooperation network.

Dissemination activities conducted in 2017 as part of T1.3 include:

- In Ålesund, NTNU, in collaboration with Tekna Ålesund and the Norwegian Data Society of North West, has conducted five Kodeklubben events with between 50 and 120 children as participants each time during February to April 2017.

- Established cooperation with Lær Kidsa Kode (https://kidsakoder.no), the largest Norwegian organization for promoting computing in K-12. This cooperation has already resulted in:

- co-organization of the Lær Kidsa Kode (LKK) teacher conference in Trondheim, https://kidsakoder.no/konferanser/trondheim2017/, attended by more than 70 people, mainly teachers and teacher students. At the conference, we have presented relevant Excited activities. LKK has already expressed their interest to run the conference again in 2018.
- a task proposed by Lærkidsakode for NTNU students, course it2901 (15 ETCS), 7 students at NTNU-Gløshaugen.

- Established cooperation with European project Horizon2020, Umi-Sci-Ed, see http://umi-sci-ed.eu/news/excited-for-umi-a-new-norwegian-center-for-excellence-in-it-education/ - In this context we have also signed an Erasmus+ agreement with Hellenic Open University, to promote exchange with the project coordinator.

- Course for teachers (7,5 credits) on programming, Autumn 2017 (IDI Trondheim), 8 participants finished the course

- IDI-Gjøvik organized a summer course on game development (partly supported as mini-project)

- IDC2018, ACM conference on Interaction Design and Children, together with FabLearn2018, to be organized in Trondheim in 2018.

- Setting up cooperation with Gjøvik VGS for different interventions, 2 already in 2017 (see T1.2)

- Prof. Divitini has been appointed as IDI representative in the advisory board of LUR program, with Prof. Giannakos as deputy. We expect that this will improve the cooperation with this very relevant group of students

- In Nord University:

- Meeting with Steinkjer videregående skole (Medie-fag, Elektro-fag)
- Nord girl Network - Network coordinated by and for female students.
- Jenter og teknologi - Collaboration with NHO on the project "Girls and technology".
- Nord Plus project "Girls just wanna have fun-damental IT skills" - Pre-project with University of Reykjavik, Iceland and Aalborg University, Denmark and a variety of relevant stakeholders. Goal: To empower young girls in the field of information technology, and to increase the gender balance in IT studies.

International special sessions relevant for Excited-P1 include:

- **workshop at IDC2017**: Divitini, M., Giannakos, M. N., Mora, S., Papavlasopoulou, S., & Iversen, O. S. (2017). Make2Learn with IoT: Engaging children into joyful design and Making of interactive connected objects. In *IDC 2017 - Proceedings of the 2017 ACM Conference on Interaction Design and Children*. https://doi.org/10.1145/3078072.3081312
- **Special session at EDUCON2017**: Mavroudi, A., Economides, A. A., Fragkou, O., Nikou, S. A., Divitini, M., Giannakos, M., & Kameas, A. (2017). Motivating students with Mobiles, Ubiquitous applications and the Internet of Things for STEM (MUMI4STEM). In *IEEE Global Engineering Education Conference, EDUCON*. https://doi.org/10.1109/EDUCON.2017.7942820
- **Special issue of Entertainment Computing**: Giannakos, M. N., Divitini, M., & Sejer Iversen, O. (2017). Introduction for the Special issue on "Maker technologies to foster engagement and creativity in learning." *Entertainment Computing*, *18*. https://doi.org/10.1016/j.entcom.2016.11.001

T1.4 – Monitoring of impact

This task has not been in focus since it was necessary to identify the baseline before monitoring is possible. The results of T1.1 will allow to start the monitoring in 2018.

P2: Projects of Becoming

In 2017, the activities in P2 has been in planning and initiating activities directly related to students' learning environment as well as initiate and plan for research. The project has been successful in recruiting a PhD-student with very relevant master in Natural Science Teaching. The topics of the project are challenging to research, and this year we have been able to explore research methods that may give results. Through the dedicated PhD we have a good resource for interesting research in the coming years.
A main activity in the fall has been the introduction of a learning intervention, the concept of student working day. A day dedicated to social learning in a specific study program (Informatikk arbeidsdag).

Although the project may look trivial, it represents a solution for how to organize learning activates that is different from how this is currently organized at the large universities in Norway.

T2.1 – Understanding challenges for IT-engagement, motivation to study, learning habits among freshmen.

- Survey developed and conducted Spring 2017
- Interviews with first-year students performed Autumn 2017 (about their experiences with the start of their university studies)

T2.2 – Methods for evaluating participation, motivation and engagement

- Integrated in research plan for PhD student
- Measures identified for our evaluation plan

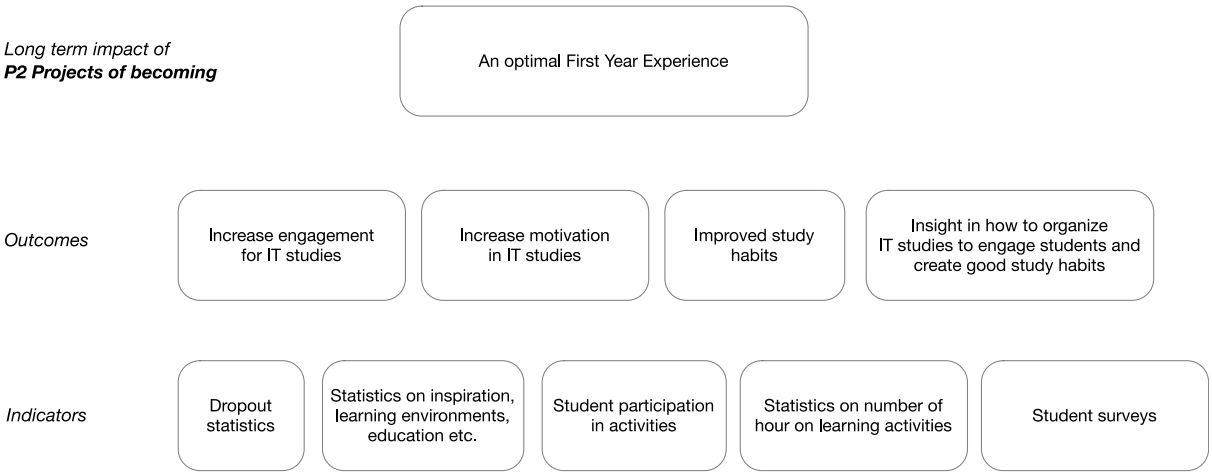
T2.3 – Activities and projects for first year students

- LAOS teaching assistant training (Spring and Fall). LAOS is a training scheme offered for students two take TA jobs, consisting of some general pedagogic advice and some discipline specific sessions (e.g., how to help students in programming labs, but without just spoiling the solution)
- Nord University: Summer job: Development of NordHunt game - gamification of the study start-up.
- QueMe app to manage queues for TA support
- "Informatikk arbeidsdag" (Informatics work-day). This was an intervention tried out for the first semester students in the degree program Bachelor Informatics (having approx. 150 students). On Fridays, they had no scheduled lectures, so two rooms were booked where the students could come and work and get qualified help from TAs related to all the four courses they were taking during that semester. The idea was to achieve a social classroom feeling for these students, who otherwise would not have a classroom and only attend big auditorium lectures together with other students - as well as to encourage them to come to campus and work on Fridays, when many of them might otherwise just have slacked at home due to the lack of scheduled activities.

T2.4– Management and dissemination

- Setting up projects
- Presentation of "Informatikk arbeidsdag" at the UDIT conference

The long-term objectives and indicators for P2 are shown in the figure below:



P3: Learning through Construction

In 2017 much effort has been put into collecting baseline data about spaces and setups for "learning through construction" (LtC) courses, as well as trying out new LtC ideas in classrooms through mini-projects. The LtC courses were identified, and rigid structured interviews where performed with the teachers of the spring LtC courses. We are currently doing the same data collection among teachers of the 2017 fall courses.

One of the largest LtC courses were under particular study; TDT4140 - a software engineering course (7,5 ECTS) with 413 students, collaborating in 104 teams working on a mandatory development project. The 2017 task was to develop a concept for an educational app. The team products were published in a book and at a final event. The student projects were analysed, and a survey focusing on the students' experiences and academic emotions were conducted, analysed and published.

An overview on quantitative measures (grades and throughput) for spring semester LtC courses is made. The fall courses will be added when grades are ready.

The mini-projects allow teachers across all Excited campuses to experiment with new ideas, methods, tools etc. Some examples are 1) G. Curda studied the use of peer experts as TAs in the classrooms, as some students have special interest, skills and knowledge that other students could learn from, 2) Jaccheri designed, executed and evaluated a hackathon on social innovation skills, and 3) Sund's students create 3D models based on mobile phone and drone camera images.

For P3 the results for 2017 are as follows:

T3.1 – Understanding the impact of different spaces for “learning through construction”

- Data collection: Survey / interviews among teachers

T3.2 – Understanding the impact of different setups for “learning through construction”

- Data collection: Survey / interviews among teachers

T3.3 – Integration of “learning through construction” into study programs

- Report on activities with “learning through construction” at NTNU and Nord University.
- Report on quantitative measures (grades and through-put) from NTNU and Nord University.

- Student summer jobs:
    - Ålesund: Hardware in the loop, building and programming a valve simulator.
    - Steinkjer: FMOD introduction

T3.4 – Dissemination

- Initial dissemination plan for 2017
- Mini-projects applications (spring and fall semester)
- Munkvold, R. (2017). Game Lab – A practical learning approach for game development. Proceedings of European Conference for Games-based learning (ECGBL) 2017.
- Kolås, L., Munkvold, R. and Nygård, S. A. (manuscript submitted for publication). Learning through construction in IT courses. Proceedings of UDIT conference.
- Kolås, L. and Munkvold, R. (manuscript submitted for publication). Learning through construction – A roller coaster ride of academic emotions? Computer Science Education Research Conference (CSERC) 2017. ACM Publications.
- 2 student games in the ECGBL 2017 game competition:
    - Wild Quest. Developed by Bjørn Vidar Dahle, Astradur Isak Larusson, Tarald Østby, Millie Spouse and Sunna Sol Sigurdardottir (SPO students at Nord University).
    - Math Temple. Devloped by Aleksander Johannsson, Tom Knudsen, Sigurdur Tomas Arnason, Kim Eriksen, Stephane Andre Olim Ehrhardt, Matthew Anderson and Thomas Bøkseth (SPO students at Nord University).
- Event at Nord University Oct 26th 2017: Testing student games. 25 external persons.
- Presentation "Learning through construction" at "Fagdagen 2017 for lærere i videregående skole I Nordland fylkeskommune" Nov 17th 2017.

T3.5 - Administration

- Setting up the core team
- Hiring student assistants, students for summer jobs and PhD scholar
- Framework for impact evaluation of P3

P4: Sharing and Diversity

In 2017, one of the main activities in P4 has been in studying cross-campus activities with the aim of identifying main barriers and obstacles that hamper cross-campus offerings. Four different cases of cross-campus teaching were examined revealing technical and cultural problems that lecturers and students face when learning activities are spread across multiple campuses. The lessons learned in these case studies can be used to reduce the obstacles and lower the threshold for offering cross-campus activities.

The other main activity for P4 has been on supporting and extending a community of practice for IT educators. A community of practice meeting for IT educators at NTNU was held in Ålesund in May. P4

initiated the creation of a special practice session at the NIK/UDIT conference that took place in Oslo in November encouraging experience sharing among IT educators nationally.

For P4 the results for 2017 are as follows:

T4.1 – Sharing

- IT educators from the NTNU campuses in Gjøvik, Trondheim, and Ålesund participated in a community of practice meeting in Ålesund in May. Topics that were discussed included digital exams, cross-campus teaching, student-active learning, and automated questionnaires and grading.

- Three scientific papers originating from Excited were presented at UDIT - the Norwegian conference for education and pedagogics in IT disciplines, in Oslo, November 2017. Seven members of Excited participated in the conference and in the scientific discussions. Excited suggested the creation of a new practice session at the conference with the aim of having longer discussions on IT education practices within the UDIT community.

T4.2 – Cross-campus learning

- Excited has been studying four different cases of cross-campus learning; one case on distributed Experts in Teamwork, two cases of courses taught at the Gløshaugen campus in Trondheim where groups of students in Gjøvik have attended, and one case of a course taught at the Gjøvik campus where a group of students in Trondheim attended. The experiences from the cases are being documented in a report.
- Excited has collaborated with the Faculty on Architecture and Design on infrastructure for various types of teaching configurations ranging from streaming of lectures held in large lecture halls to distributed small-group collaboration. We are currently working on a joint proposal for establishing physical installations of some of these configurations in Trondheim and Gjøvik.

T4.3 – MOOC-style distance learning

- Not been prioritized in 2017.

T4.4 – Techniques and tools for capturing progress and for providing automatic feedback for self-reflection and -evaluation

- Not been prioritized in 2017, except for some mini-projects looking at automated feedback tools, and two student summer jobs making one-liner programming exercises with automated feedback in Blackboard.

P5: Career Readiness

In 2017, activity in P5 has focused on investigating and building an understanding of current practices and challenges with respect to students' employability and the use of industry networks among faculty and students.

T5.1 Industry Relevance

- Study on employability among employers of candidates from Bachelor in IT Networks Administration (9 interviews). *Findings particularly on the significance of supporting students' interest in the field and the mutual benefit of extra-curricular and curricular student activity.* Dissemination: Research paper accepted to an international conference.

T5.2 Industry contact networks and web portals + T5.3 Guest lectures and industry involvement in course development and QA

- Current challenges and practices of using industry networks in IT education at NTNU and Nord; teaching staff and student perspectives
    - In-depth focus groups with teaching staff at 3 different campuses. *Findings particularly on the use of personal vs. institutionalized networks; the latter needed but with the support of the former.* Dissemination: Research paper published at the Norwegian Conference on Didactics in IT Education (UDIT) 2017.
    - Focus groups with students (from student organizations) at 2 campuses. *Early findings on the complementary role of student organizations w.r.t. university-industry collaboration.*
- Survey among all permanent teaching staff on the use of guest lectures and how it relates to other use of industry networks. Data collected November 2017. *Early findings: Several different reasons why staff do not arrange guest lectures or see them as relevant*
- Nord University: &Action - international media festival

T5.4 Project based learning

- Not prioritized in 2017. Resource employed (for Dec2017-May2018) to investigate practices in use of industry networks as customers of student projects at ID and suggest ways to digitize and establish common practices.

T5.5 Career readiness as experienced by the students

- Focus groups with students at 2 campuses (same as mentioned under T5.2/5.3). *Early findings on perceived employability among students at IDI as well as student organizations' significant activity and strong interest in managing their own industry networks.*
- Nord University: 2-day workshop for 2nd year students on self promotion / pitching with external evaluators.

3. Aims of the SFU initiative

This section provides response to the questions explicitly posed by NOKUT.

Q: How does the centre work with student-active learning methods in connection with R&D-based education and/or education based on artistic developmental work?

A: Excited is using student-active learning methods in all the 19 degree programs that are in the scope of the centre, in particular projects and practical exercises, involving teachers who themselves are active researchers in the topics in question.

Q: How does the centre develop and enhance this?

A: Excited is working along several paths to develop and enhance the usage of student-active learning methods. One focus has been to map our current offering of "learning through construction" activities, another to support the establishment of new and more exciting forms of such activities, providing technically up to date exercise infrastructures. Yet another effort is to try to make traditionally passive learning experiences more active, such as using interaction technology in lectures, and involving students in developing their own course material.

Q: What is the added value of R&D-based education when it comes to learning outcomes and relevance?

A: R&D-basis helps ensure that the curriculum is up to date, and is relevant for the job market that the students are going to meet when they graduate. Given the rapid changes expected in the job market in years to come, it is indeed hard to know what knowledge and skills will be needed in the job market some decades ahead. Our students, who graduate in IT – the technology enabling many of the expected changes - may have an advantage compared to candidates in many other disciplines. Still, it is evident that even IT experts will have challenges to stay relevant throughout their careers. Involving the students more in research is thus increasingly important, as research competencies may help them to update their knowledge more quickly whenever this is needed.

Q: How does the centre operate structurally to develop R&D-based education and student engagement?

A: Excited aims to develop R&D-based education further by involving teachers in a Community of Practice, encouraging more discussions about education, and more empirical research about the learning that takes place. After the merger into the new and bigger NTNU, the department (IDI) has also become more diverse, with some influx of university teachers who have little research time. Excited wants to contribute to these teachers' possibility to increase their research, for instance through a more empirical approach to their own teaching practices. Student engagement has been addressed by several mechanisms: employing a number of students in part-time jobs as assistants in the centre, having meetings with (non-employed) student representatives in reference groups in various campuses, announcing mini-projects for students, and including educational improvement as a case in project courses, as well as a topic for many Master theses.

Q: How has the centre's development and enhancement of integrated models affected the students' learning outcomes?

A: As a funded entity, the centre has existed only for a year, so it is too early to make significant claims about increased learning outcomes caused by the centre as such. However, if looking at the centre not just as the funded entity but as the university departments that originated the application, these have for a long time used an approach where industry is involved in teaching activities (e.g., as customers for student projects, guest lecturers, etc.) Also, the work of the student associations is key to the connection

between students and employers, and awareness of different kinds of jobs that the studies may lead to are believed to be key for the students' motivation.

4. Plan for 2018

For the centre as a whole, the main actions for 2018 are as follows:

- Fill the positions that we did not manage to fill in 2017. Even with these positions filled, the revised budget indicates that we have room for spending more money, though should anyway spend it wisely, in a way that can boost our activities and yield high quality results. We are considering several options, such as hiring senior personnel in adjunct positions or buying more senior personnel off other tasks, hiring dedicated support for popular dissemination, hiring more PhD/postdoc man-years, more student assistants, and putting more money into mini-projects for students and teachers, as well as the community of practice. In acquiring personnel, it is important to have a good mixture of junior and senior personnel.
- Finalize a communication strategy for the centre, improve the web page based on this, as well as consider other means of communication (e.g., social media)
- Detail the Theory of Change evaluation framework further
- Intensify student involvement by more frequent meetings with student reference groups to discuss needs and interventions. We are also likely to spend more money on hiring students part-time, especially as teaching assistants, as we need to spend more money, and this has shown to be a valuable resource.
- Continue with mini-projects as the main approach to motivating teachers outside the core team to get involved in centre activities. However, the ideal ambition would be to involve more teachers than there could be mini-project money for. Hence, Excited should also try to inspire teachers to place course improvement activities that are not extra funded in an Excited context, or help them acquire other funds outside Excited for such improvements where relevant.
- In addition to mini-projects for teachers, also initiate student-driven mini-projects. We have received 75 KNOK earmarked for this from NOKUT, but plan to spend additional money on it given enough good applications.
- Establish closer dialogue with the boards of degree programs that are within the scope of Excited. This because interventions in courses, either via mini-projects or other means, will have limited effect if some important obstacles to improvement instead lie in the structures of degree programs. I.e., improvement will require buy-in both from teachers and degree program management.
- Establish a closer collaboration with the enterprise network KID and the national organization of IT companies, Abelia. Excited has already participated in two meetings with KID in January 2018, especially discussing possibilities for piloting industry internships for students, ideally in a way that could give study credits.
- Perform a baseline questionnaire survey in the Spring. Questions may be partly inspired by a similar baseline survey that the 3 year older centre BioCeed did Spring 2015, however some changes will be needed because of a difference in discipline (IT vs. biology), stakeholders (e.g., also including secondary education as a key stakeholder for P1), and due to the fact

that Excited has already performed some surveys, so we must take care not to ask superfluous questions or overburden the same set of respondents with several surveys close in time.
- Look more thoroughly into possibilities for collaboration with the other SFU's in Norway - as well as similar centres for IT Education in other countries. Excited will also collaborate with the IPIT project (which IDI/NTNU recently got funding for through the INTPART programme of the Norwegian Research Council), this project implies collaboration with universities in the USA (Georgia Tech) and China (Tsinghua U. and Nanjing U.)

As in 2017, most of the work in Excited in 2018 will also be in the five projects, the plans for these are given below.

P1: Informed Decisions

For 2018 the main focus will be on T1.2, studies of IT activities, and T1.4, monitoring. At the same time, activities connected to the other tasks will also continue.

In addition, based on input from the Advisory Board, P1 will start the planning of more systematic activities to understand teacher training and identify possible interventions. Activities for teachers have already taken place in 2017, mainly the conference co-organized with Lærkidsakode and a course in programming. In 2018 we will put more emphasis on this type of activities.

T1.1 – Understanding state of practice

Activities in 2018 will aim at:

- Consolidating the overview built in 2017
- Understanding teacher training and identify possible
- Setting up comparative international studies, especially with countries that have a stronger tradition in IT education.

T1.2 – Studies of pre-university IT activities.

- Consolidation of the studies conducted in 2018
- Setting up of studies connected to activities already established in 2017 by the centre, e.g. the coding clubs in Ålesund, by NTNU, e.g. Kodeløypa, or actors in the network that was established in 2017.
- Definition of state-of-technology educational scenarios
- Definition of evaluation tools to be used to collect data, to be shared within the community of practice when consolidated
- Developing empirical knowledge about activity for K-12 IT education

T1.3 – Dissemination, Dissemination and establishment of P1 cooperation network.

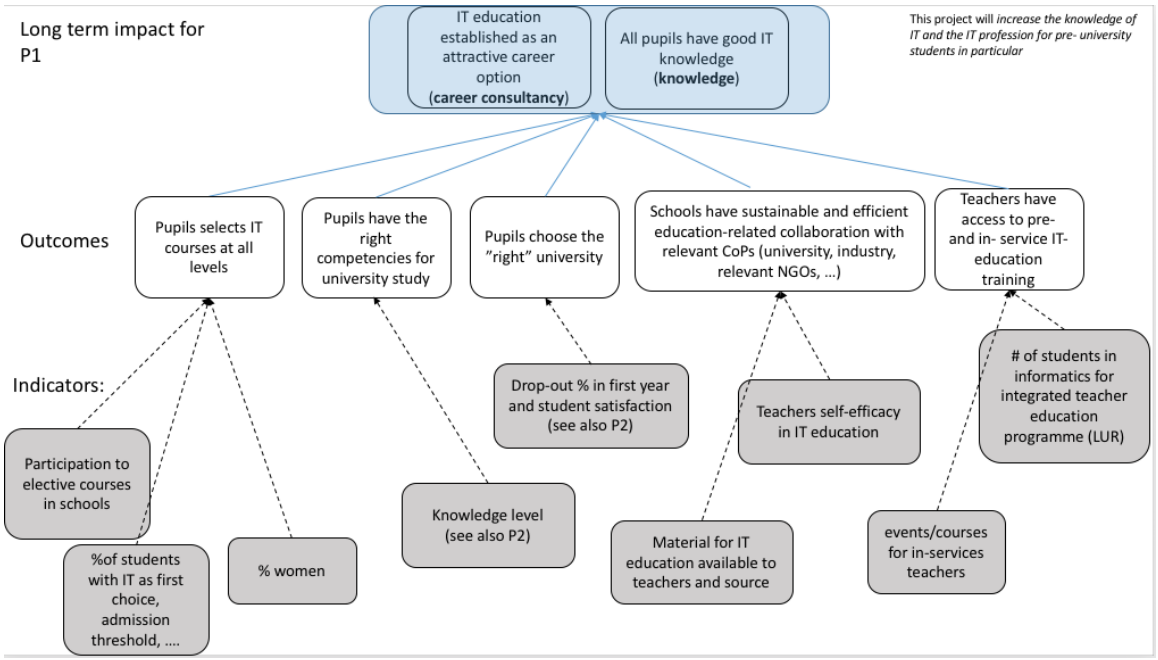
- Continue and extend the networking activities built in 2017, with the aim of moving from awareness about Excited to active engagement

- IDC2018 and FabLearn2018, international conferences organized in Trondheim. Proceedings will be published by ACM for both conferences.
- Publications in international venues

T1.4 – Monitoring of impact

- Complete ToC framework and setting up of data collection

The long-term impact, outcomes and indicators for P1 are shown in the illustration below.



P2: Projects of Becoming

For P2 the plans for 2018 are to continue with the activities we have initiated and to identify and support new activities. For research, we plan to do systematic studies and contribute towards a research-based understanding of the first-year experience in IT studies. It is particularly important for the project to create a working network for the study programs. Due to the restructuring of NTNU, there are many new persons engaged as study program leaders and impact of P2 is relaying on good collaboration with these leaders.

T2.1 – Understanding challenges for IT-engagement, motivation to study, learning habits

- Continue survey developed and conducted spring 2017
- Survey national and international practice for first year in IT education

T2.2 – Methods for evaluating participation, motivation and engagement

- Systematic Literature Review on how learning effect is measured in educational development projects

- Systematic study on how the first year of IT-studies are organized in different national programs (we will later have an international perspective) and the conditions and effects of different study plan choices and structures.

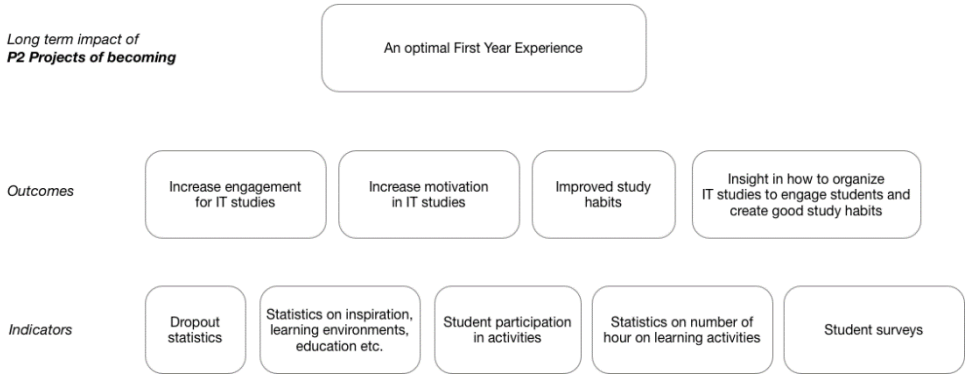
T2.3 – Activities and projects for first year students

- LAOS teaching assistant training.
- Encourage and support projects initiated by teachers (mini-projects)
- Promote and support QueMe app in spring courses and other projects that can contribute to better support for students studying
- Project on response technology to engage students in the large classes they typically have in the first year (particularly large programs at NTNU)
- Will work to establish the idea of "arbeidsdag" for more programs and promote the need to support this in the study scheduling tools

T2.4– Management and dissemination

- Hiring and organizing student assistants to support the activities in the project
- Support and manage projects targeting first year students
- Improve networking within the participating institutions and externally
    - Workshop with Program chairs to establish good relationship between Excited program chairs and program managers (in particular with the newly appointed program chairs at NTNU).
    - Participate at relevant conferences and improve the connections with related projects internationally

Long term impact, outcome and indicators for P2 is illustrated below:



P3: Learning through Construction

The main focus in 2018 will be to identify factors of innovative learning spaces for LtC and to study learning materials and theory approaches used in LtC courses. We will continue the studies on student products in LtC courses and a PhD project will initiate work on LtC's influence on student identity development. Another focus will be to map LtC courses with low throughput.

Some mini-projects are in progress, for example 1) Strazdins is reshaping a Software Engineering course according to GameLab principles, 2) Haddow is looking into automatic evaluations of student code in programming courses, and 3) Li is introducing hardware devices for developing IoT (Internet of Things) applications in a software engineering course. In 2018 we have a goal of sharing experiences among teachers based on experiences from mini-projects, and work to get new mini-projects on innovative ideas.

For P3 the plans for 2018 are as follows:

T3.1 Understanding the impact of different spaces for "learning through construction"

- Identifying factors of innovative learning spaces for LtC in IT courses at NTNU and Nord University.

T3.2 – Understanding the impact of different setups for "learning through construction".

- Learning materials in LtC – identifying best practice and share experiences
- Theory approaches in LtC – identifying best practice and share experiences
- Student products in LtC – Data collection
- LtC's influence on student identity development and student engagement - Data collection.
- Makerspace (events)
- Share experiences from last year's mini-projects.

T3.3 – Integration of "learning through construction" into study programs

- Mapping LtC courses with low throughput
- Report on quantitative measures (grades and through-put)

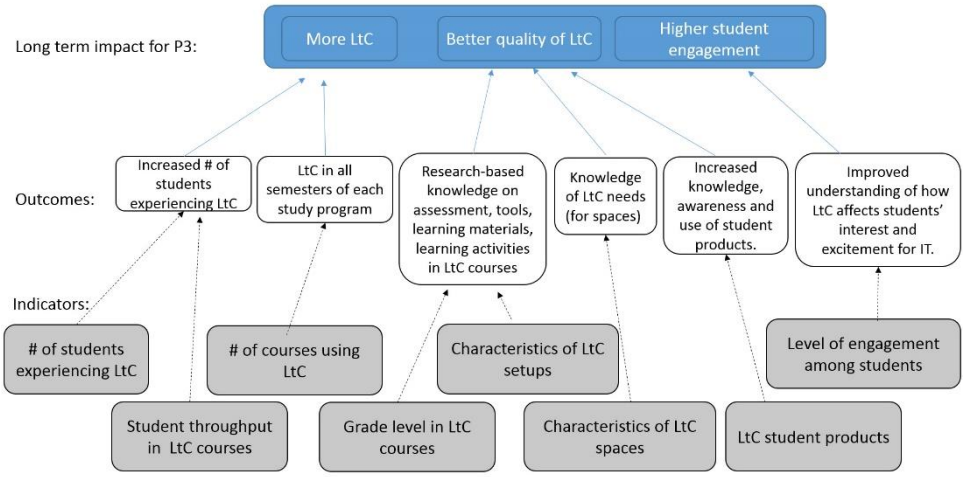
T3.4 – Dissemination

- Mini-project proposals
- P3 Dissemination summative report for 2018
- Scientific articles
- Events: e.g. Makerspaces

T3.5 - Administration

- Hiring student assistants / summer jobs / PhD scholar
- Report on P3 2nd year of activities and impact

The long-term impact, outcomes and indicators for P3 are shown in the illustration below.



P4: Sharing and Diversity

The main focus for P4 in 2018 will be to continue building up and supporting communities of practice and to participate in creating infrastructure and assistance for educators who will be offering cross-campus courses and learning activities. We will also start exploring tools and technologies for monitoring student progress and for supporting student self-evaluation and self-reflection.

For P4 the plans for 2018 are as follows:

T4.1 – Sharing

- Identify best practice for sharing; share experiences
- Study sharing in smaller "communities" - e.g., groups of teachers teaching the same courses but at different campuses

T4.2 – Cross-campus learning

- Identify best practice for cross-campus teaching; share experiences
- Identify and contribute to the creation of infrastructure for cross-campus teaching

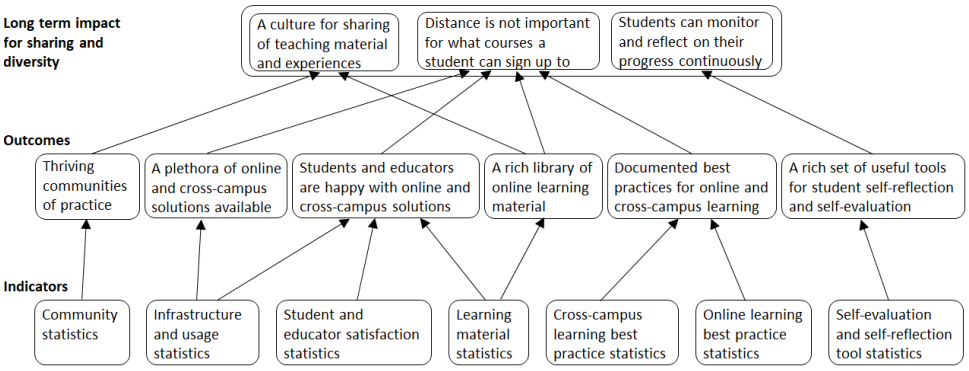
T4.3 – MOOC-style distance learning

- Identify best practice for the production of learning objects; share experiences
- Identify best practice for activating students and for achieving in social interaction in MOOC-style distance learning; share experiences
- Identify and contribute to infrastructure for creation and sharing of learning objects

T4.4 – Techniques and tools for capturing progress and for providing automatic feedback for self-reflection and -evaluation

- Investigate state of the art techniques and tools for capturing progress, self-reflection, and self-evaluation
- Involve students in the development of new ideas for such techniques and tools.

The long-term impact, outcomes and indicators for P4 are shown in the following diagram:



P5: Career Readiness

In 2018, focus will be on continuing the investigations of current practices/challenges started in 2017, broadening the scope with respect to campuses, study programs and types of stakeholders. Especially, we will work on employability (T5.1) and the use of industry networks with respect to student projects with external customers (T5.2) and guest lectures (T5.2).

T5.1 - Industry relevance

- Employability of Master students in informatics/computer science: A study based on interviews with employers. Data collected by teaching assistants.
- Employability of Bachelor students from the Informatics study programme; Study conducted by PhD student interviewing employers; data collection to be finalized June 2018
- Employability with regard to summer jobs; survey among students (conducted by teaching assistants). Will also contribute towards T5.5 Career readiness as experienced by the student.

T5.2 - Industry contact networks and web portals

- We will continue the recently started investigation of practices/challenges in the use of industry networks as customers of student projects at IDI. The goal is to find effective ways to digitize and establish common practices across all the IDI campuses, with relevance for other institutions also. This is to result in a report by end of May2018.
- Contribute to implementing new solutions (in collaboration with the department management), starting autumn 2018.

T5.3 - Guest lectures and industry involvement in course development and QA

- Analyse the collected data (from teaching staff and students) about guest lectures and propose actions for facilitating use of guest lectures at the Excited campuses and more generally

T5.4 - Project based learning

- The issue of access to relevant customers/cases will be addressed through the activities described for T5.2

T5.5 - Career readiness as experienced by the student

- Master project on use of e-portfolios in an IT bachelor program; focus on helping students document and reflect on own learning and employability. Thesis to be submitted summer 2018.

The long-term impact, outcomes and indicators for P5 are shown in the following diagram: