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Realising A Centre For Educational Development: Experiences, Challenges, Lessons Learnt, And Future Ambitions

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REALISING A CENTRE FOR EDUCATIONAL DEVELOPMENT: EXPERIENCES, CHALLENGES, LESSONS LEARNT, AND FUTURE AMBITIONS

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ABSTRACT

In order to develop high-quality engineering education with a focus on students' learning, academic staff must themselves develop new skills, with a lifelong learning perspective to their own teaching. This requires coordination and support. For this purpose, three faculties at our university decided to jointly fund a *Centre for Science and Engineering Education Development*. Among the aims were to boost educational quality, strengthen educational competence among academic staff, and build educational quality culture on the institutional level. The faculties also recognized a need to establish a stronger and more focused didactic perspective for the university's programme STEM portfolio, beyond and in addition to the general pedagogical training already offered by the university. The centre's main responsibility has been to provide various forms of training of and teaching for academic staff and educational leaders, thus indirectly affecting also students' learning experiences. Strategic advice on educational change, dissemination of

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results, and strengthening of international and national collaborations, networks, and arenas, have been important additional tasks. This paper reflects upon the centre's activities, strategies, impact, experiences, and challenges from the start-up until today. We identify lessons learnt and propose advice for others planning similar centra. Among the topics covered are capacity and recruitment challenges, coping with diverse faculty cultures, and the need for a shared vision in which to anchor activities and resource usage. We will also describe a recent upscaling of the Centre's mandate, responsibilities, and capacity, designed to support a major ongoing educational reform in the STEM programmes at our university.

1 BACKGROUND AND EARLY HISTORY

In 2016, three faculties at NTNU decided to jointly finance a *Centre for Science and Engineering Education Development* (acronym SEED). Education(al) development has been variously defined as "*helping colleges and universities function effectively as teaching and learning communities*" (Felten et al. 2017), actions "*aimed at enhancing teaching*" (Amundsen and Wilson 2012), and a "*key lever for ensuring institutional quality and supporting institutional change*" (Sorcinelli et al. 2005). The ambitions for SEED have, over its lifetime, included all these aspects.

The original initiative addressed a need for support of pedagogical development based on *Scholarship of Teaching and Learning* (SoTL) (Hutchings and Shulman 1999), both for the teaching-learning environments carrying out the educational work, and in support of educational strategies. It was decided that SEED should span the three faculties offering most of the engineering education, thereby including also departments for mathematics, computer science, and the natural sciences. SEED consisted initially of one person in a 50% position, with extensive experience and background from engineering educations. This person was given a nominal leadership of SEED, answering to a governing body of vice-deans of education.

The most important activities during the initial two years were to support educators and teaching-learning environments that asked for help, primarily with developing Learning Outcome Descriptions, both for courses, and for programmes. At the same time SEED established a network of contacts both on the national and international level, and in 2016 it facilitated the university's joining in the *International CDIO Initiative*. The CDIO standards and syllabus subsequently came to provide an important conceptual framework for SEED's activities (Crawley et al. 2014). Increasingly the university also came to be represented and active at arenas such as the Norwegian biennial conference for STEM education, a biennial Development Conference for Engineering Educations in Sweden, and the annual SEFI conferences. Furthermore, SEED provided advice on two successful applications for national *Centres for Excellent Education*, and contributed to development reports serving NTNU's *Executive Committee for Engineering Education*.

It soon became clear that more manpower was needed to realise SEED's potential and achieve the desired impact. When NTNU merged with three regional university colleges in 2016, an opportunity arose to engage co-workers, and in early 2017 SEED established a close collaboration with one of these colleges' ongoing 'Teaching Excellence' projects. Two new employees with research and educational

development expertise joined SEED. They contributed, among other things, with the following activities which were integrated into SEED's portfolio: Development and evaluation of interactive learning spaces, response technology in teaching and assessment, and the development of educational competence among academic staff through empirical peer guidance.

2 ACTIVITIES 2016 – 2022

A main contribution from SEED in its first seven years of existence has been to provide various forms of training of and teaching for employees, indirectly affecting also students' learning experiences. One particularly successful example of this, which became a key part of SEED's portfolio after 2017, is the *empirical peer guidance* for teaching faculty. The peer guidance programme was inspired by the REAP (Reassigning Assessment Practices) project (University of Strathclyde, n.d.) (Nicol and Draper 2009), as well as research literature which clearly demonstrates that with support, educators can transform research findings into new and effective practices (Thompson and William 2008). Educators were divided into teams and introduced to a theoretical framework that supported their understanding of their own teaching practice. Reflection and observations were important tools, as SEED guided an individual feedback process for the educators involved. The activity addressed both educator awareness and approaches to designing teaching-learning activities and assessment choices. The establishment of teams through peer guidance worked well, and several educators have made contact for further guidance and advice afterwards. Spin-off courses have also been run in the use of student response systems, advice on possible changes to formative assessment, use of electronic whiteboards, help with research on own practice, etc.

Furthermore, SEED focused on course and programme design, with particular emphasis on establishing relevant Learning Outcome Descriptions, designing appropriate teaching-learning activities, and addressing assessment formats. In fact, the most commonly asked-for support from academics has been about writing learning outcome descriptions, choosing and developing appropriate teaching-learning activities, and assessment. It is more than 10 years since the *European Qualifications Framework for lifelong learning* (EQF) (European Union, n.d.) was adopted in Norway. However, the use of learning outcome descriptions was rolled out nationally simply as a decree to be followed, without motivation, instruction or training, resulting in a widespread copy-paste (Sørskår 2015, Flobakk-Sitter and Fossum 2022) approach to writing learning outcome descriptions. A recent national evaluation of the national adoption of the EQF framework also indicates that it has had little impact on changing quality development work or extant teaching-learning and assessment practices (Flobakk-Sitter and Fossum 2022). Explaining, discussing, and improving the use of the national EQF framework, together with the idea of constructive alignment (Biggs and Tang 2011), has therefore been a mainstay of SEED's activity since its establishment. But while getting traction with the individuals who chose to attend SEED's workshops has been successful, establishing a *systemic change* in attitudes and support in the university routines still proved elusive. Few existing strategies were identified for systemic follow-up.

SEED's biggest impact in this phase may be the changes made in selected courses as a result of the centre's support on developing and updating teaching-learning activities, e.g., through the peer evaluation programme. However, SEED's support activities were also aligned with the establishment of parallel ongoing programmes and processes, both institutionally and nationally. Perhaps the most important example is that when a national programme for recognizing *Centres for Excellent Education* (CREs) was established*,* the university responded by establishing corresponding incentives and development projects both on the university-wide and on the faculty level. These local activities aimed to support the development of environments that could grow to become future national CREs. SEED has been an active advisor on many CRE proposals*,* as well as on grant proposals from other relevant national and international funding institutions. Two CREs have so far been granted to NTNU. A second important example was the national initiative on *establishing systems for recognition of pedagogical merits*, partly in line with the conceptual framework developed by *The Career Framework for University Teaching* (Career Framework for Teaching 2022), but also based on experiences with such merit systems from neighbouring countries. Here, it was helpful that one of SEED's team members was centrally placed in the establishment of merit systems on the national level. Today NTNU has recognized close to 40 *excellent teaching practitioners* according to this system, with SEED having given important guidance both on the institutional and individual level during the development phase.

The development of interactive *learning spaces* has been another ongoing initiative from NTNUs leadership and property division. SEED has been an active and close collaborator throughout its existence, starting with advice on the design of such spaces. SEED has provided training and support to educators who want to change their teaching practice, by introducing a more active learning approach and using spaces that are designed for this purpose. At the same time, we have conducted several evaluations of the impact of such spaces built on experiences of both students and educators. Our insights from these evaluations have led to participation in several development projects concerning learning spaces at the university, in particular under the umbrella of NTNU's long-term campus development project.

Another important focus has been on establishing NTNU in national, European, and international networks for engineering education research and development. Significant time and effort was spent on informing about SoTL at large, and about the CDIO framework in particular. SEED has thus been instrumental in supporting a growing interest in engineering education research, providing support both in identifying research questions, choosing methodologies, and disseminating results, nationally as well as internationally. NTNU's presence and impact in international networks has profited from SEED's activities and international engagement. As mentioned earlier SEED was the driving force for engaging with the CDIO network, and has had considerable impact on NTNU's increased SEFI participation.

3 CHALLENGES 2016 - 2022

The challenges SEED experienced during the period 2016-2022 may be of general interest. We will first describe the education portfolio challenges identified by SEED,

and subsequently challenges experienced by the centre itself regarding its work capacity, operational efficiency, and overall impact.

After a while it became clear that the conditions for quality development of the university's STEM education programmes were lackluster in several aspects: A general lack of knowledge about the design and development of teaching and learning practices in line with progress made over the last quarter century in university pedagogics and didactics; a systemic lack of dialogue between departments providing courses and programme managers with responsibility for programme development; and a lack of awareness of how administrative routines should be designed to support rather than hinder educational development.

While this may seem very critical, it should not be taken to mean that the attained learning outcomes of the graduates was in a bad state. Decades of adapting to existing conventions of primarily lecture-driven teaching with written final exams, excellent student recruitment, and a culture supporting engineering projects, made up for most of the shortcomings. The graduates have been highly competent, as witnessed by their strong popularity and reputation in industry and society at large.

The major challenge was, and remains, to transform the educational design of the university into *agile processes that can be continually developed and improved upon*. The established system has evolved to update the scientific and technical contents of the educational programmes in a proper way. However, it faces considerable challenges if the graduates are to develop a broader set of professional competences that includes creativity, communication, collaboration, reflection, and negotiation skills covering both digital transformation and sustainability, providing the basis for competence profiles needed to face the 21st century's challenges.

The challenges related to the establishment, development, and impact of *SEED itself* have mainly been related to the governance model, challenges pertaining to long-term commitment of faculty resources, diversity of faculty cultures, capacity reduction due to people leaving, and the lack of an overarching vision for the science and engineering education at our university. The latter challenge could in fact be seen as a root cause of many of the other challenges. SEED's original incarnation provided support for development of educators, courses and sometimes study programmes, and the centre personnel provided valuable advice on both strategy, systemic development, peer coaching, learning spaces, and infrastructure. However, without a clear governance model based on a shared strategic vision, the very freedom awarded to SEED meant that internal prioritization between these activities was hard to do. Many possible activities in practice competed with each other on equal terms, without the clear priorization that could have resulted from a more clearly formulated vision on which to base governance. The diversity in faculty cultures and varying attitudes to changes in pedagogical approaches (or even the need for change) also affected how different teaching environments responded to offers of support from SEED. Such offers were sometimes interpreted as just extra work in an already busy work schedule. This situation was to undergo a significant change with the university-level development project *Technology Education of the Future*, which provided both a vision, an updated conceptual framework, and an ambition level that created a concrete need to develop an up-scaled 'SEED 2.0'.

4 THE 'TECHNOLOGY EDUCATION OF THE FUTURE' REFORM: A FRAMEWORK FOR FUTURE ACTIVITIES

The recent upscaling of SEED's mandate, responsibilities, and capacity is designed to support NTNU's ongoing educational reform of its engineering, technology, and science programme portfolio. Through an institutional development project, "Technology Education of the Future" 2019 - 2022, a holistic conceptual framework was developed for re-design of the NTNU's educational programme portfolio in technology and engineering. This project delivered its final report in January 2022 – a roadmap focusing on the concrete steps NTNU should take in order to implement the project's developed vision. The roadmap outlined 12 Main Actions (MAs) within five quality areas, plus an overarching 'umbrella action' to enable the MAs. For each MA, *Prioritised Measures* (PMs) were described (Øien and Bodsberg 2022).

One of the recommended MAs was to *'Facilitate and support educational competence development'*, and one of the central PMs proposed under this MA was to *strengthen the university's existing Centre of Science and Engineering Education Development*. The idea was to further strengthen SEED's capacity for educational competence development and project implementation support, and to develop and establish the centre as a hub able to join together didactic resources and other support functions from different sections of the university, both local and common. A strengthened and long-term funded SEED could support the project implementation on everything from study programme design and learning outcome descriptions to pedagogical support for individual educators, and act as an operational "right hand" for the university's *executive management committees for engineering and technology studies* in their work on further quality development. Furthermore, SEED could provide practical and strategic support for faculty leadership and department heads in the project implementation process.

While these tasks were present already in the original ambitions for SEED, the 'Technology Education of the Future' framework implies significantly raised ambitions, complexity, and scope, plus a clear strategic direction and a raised bar for strategic commitment from the university. Four faculties participating in the 'Technology Education of the Future' project therefore decided to co-fund a doubling of SEED's man-year capacity from 2023. The centre now consists of a Director (60 %), an Educational Development Expert (100 %, two Educational Developers (50 % + 20 %), and a Coordinator and Advisor (50 %).

The upscaled SEED's activities are currently under planning and will commence in earnest from Fall 2023. The Spring Semester 2023 has been mainly used for

- ensuring continuity in activities that were already ongoing and/or committed to before the recent upscaling of SEED,
- developing an overarching vision: '*SEED shall be a central, highly competent, and active contributor to the development of the university's study programme portfolio within technology, science, and economic-administrative subjects, towards internationally outstanding educational quality and reputation*',
- developing clear criteria for prioritization between potentially competing activities, based on the needs for support and development that are seen to be the most

important or urgent from the funding faculties' side, and tentative long- and short-term aims formulated for SEED's future activities,
- aligning and coordinating SEED's efforts with those of other learning support and educational competence development functions at NTNU,
- identifying specific resource persons and educational experts who may be recruited to SEED in part-time positions,

We have identified a need to support STEM-specific didactical competence development for both newly appointed and experienced subject educators. It is particularly important to develop competence in facilitating comprehensive competences in STEM subjects, and to show how a programme-driven approach to curriculum development, teaching, and assessment can be implemented in practice. This will complement and deepen the university's general programme of basic educational competence for all newly recruited faculty provided today. We have also concluded that all university staff involved in education will need some kind of further education supporting *STEM-specific educational competence development*. SEED can contribute here as well, by offering competence development modules in specific areas such as, e.g., the integration of sustainability competence in curricula, an increased degree of calculation-orientated mathematics, strengthening innovation competence, and appropriate forms of assessment and teaching. Key SEED personnel also have a high expertise in developing, assessing, and recognizing pedagogical merits, and can contribute with support for development and documentation of such merits for academic staff.

Summarizing the above points, we have identified the following themes as particularly important to prioritize going forward:
- Support for study programme (re-)design according to the design principles advocated by the *Technology Education of the Future* project, starting from the project's established graduate competence profiles
- Interpretation of and implementation advice on results and recommendations from the project at large
- Offering didactic competence development modules and courses, on specific topics such as, e.g., active learning and constructive alignment, tailored to a range of specific target groups. These include PhD students, newly hired faculty, study programme managers, course responsibles, and, importantly, educational leaders on the department and faculty level.

Furthermore, we see it as vitally important to support an *increased discoursive pressure* about education. By this we mean strengthening and firmly establishing the ongoing dialogue among all university staff about all aspects of education - its outcome, contents, and design. This includes facilitating new arenas and fora which strengthen the university discourse on education development, motivating faculty to participate actively in relevant international and national networks for educational development, providing advice on innovative assessment practices, and on proposals for funding of educational development projects.

A central precondition for all of the above to work is that SEED communicates its services and competence proactively and professionally to the target groups, and stays visible and in demand on all levels from the local to the international. A strategic communication plan is being developed to support this aim.

5 CONCLUSIONS AND LESSONS LEARNT

This paper has described and reflected upon the strategies, impact, experiences, and challenges of NTNU's Centre of Science and Engineering Education Development (SEED) from its start-up until today. We have identified lessons learnt and proposed advice for others considering to establish similar centra. Among the topics covered have been capacity and recruitment challenges, coping with diversity in faculty cultures, and the need for a shared vision.

From 2023, the "Technology Education of the Future" project provides SEED with an shared overarching vision and a common framework for all participating faculties. The project implementation has also been enshrined among the explicit aims for the university in its development agreement with the funding ministry, making it an institutional priority. This has already had positive effects in terms of capacity, visibility, and impact. Important and positive as this capacity increase is, it must be emphasized that it is still crucially important that all the university's educators understand and acknowledge that they are also part of the change and development. A centre like SEED cannot just come in and "eliminate the problems" - if sustainable and lasting change is going to happen, the educators and educational leaders must themselves take ownership and have an active role in developing a quality culture.

Based on our experiences and reflections we conclude that if a centre such as SEED is to have the desired impact, the following factors are particularly pertinent:

- The faculties involved need to have a common understanding and vision, from the leadership on down, of what their engineering programme portfolio and closely related education programmes should achieve, and what the centre's mandate and responsibilities are towards this achievement.
- The centre needs to be closely aligned and in continuous dialogue with the pedagogical development strategies of the governing faculties.
- Based on these two conditions, the centre must strategically plan and prioritize its resources, and develop its own capacity and competence, to provide strategic advice and solid support for education-related competence development among all staff categories involved in education activities. All the while it needs to communicate actively to make itself visible, relevant, and in demand.
- The university needs to develop its systemic and administrative routines to actively support educational quality development, and the centre needs to provide advice in this work. This is in line with (Havnes and Stensaker 2015): '*the educational development centre is on its way to be transformed from a merely technical activity focusing on how individuals become good teachers, into having a broader focus in which the organisation, frameworks and infrastructure surrounding the teaching and learning experience is addressed.*'

A number of challenges are still involved in achieving the above, which SEED is working systematically on. This includes, e.g., how support on the various prioritized themes should be designed, and which demands the various activities will have on SEED's resource and staffing needs. The last bullet point above may be challenging both with respect to identifying the most relevant routines, and with respect to unintended collateral changes which may occur should the routines be changed. Changes are also complicated by legal aspects and financial constraints.

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