

# EXPLORING DIFFERENT FACULTY DEVELOPMENT MODELS THAT SUPPORT CDIO IMPLEMENTATION

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## ABSTRACT

This paper describes different models of faculty development in engineering from five higher education institutions that support CDIO implementation. It is interesting to see that although geographically dispersed, these institutions express a strong consensus that it is necessary for faculty to be trained in educational methods. The five models encompass many similar characteristics that are in line with a fundamentally sound faculty training programme. They all share the basic activities one expects to find within a faculty development facility. That said, each model has built its unique functioning structure which sets it apart, particularly in the nature of the programme, and the format delivery takes place. These differences are most likely related to national policies and legislations, as well as to cultural or historical reasons. The paper also discusses the pedagogical training and support given to faculty implementing CDIO.

## KEYWORDS

Faculty development models, pedagogical support, teaching skills

## INTRODUCTION

Many engineering programmes worldwide realise the importance for quality teaching and therefore allocate resources for training and support in pedagogy for their faculty members. This is usually done through the Faculty Development Centers (FDC) whose main activities consist of training new faculty members, supporting existing faculty, programmes or departments wishing to implement innovative pedagogies, and helping in the teaching evaluation process. Their goal is to prepare faculty by developing their teaching skills; mainly in course design and planning, teaching methods, use of information technology, student assessment, and evaluation of teaching.

Despite these common threads, we do come across some variations in these activities amongst institutions. Moreover, there are a variety of faculty development models, particularly in the format the delivery takes place. For instance, the most frequent differences

in the programmes are related to their nature (compulsory or elective), their structure (length, schedule), their format (individual meetings or group sessions), and their assessment requirements.

Because teaching effectiveness stands at the heart of student achievement and learning outcomes, it appears crucial to support initiatives aimed at developing useful academic skills. The spirit of this paper is to share information, ideas, and experiences that foster sound faculty development models, while addressing genuine concerns and challenges related to faculty development efforts. Hence, the aim of this paper is to help higher education institutions set up or improve activities of existing FDCs, by describing five faculty development models destined to promote excellence in teaching and learning, to support an assortment of programmes, and activities in order to enhance professional teaching skills.

All of the five faculty development models support CDIO implementation efforts. They come from distinct institutions: 1) Singapore Polytechnic (Singapore); 2) École Polytechnique Montreal (Canada); Queen's University of Belfast (Ireland); 4) Royal Institute of Technology Stockholm (Sweden); and 5) Massachusetts Institute of Technology (USA). Table 1 summarizes the commonalities and differences between the various models.

Table 1  
Comparison of the various faculty development models

Institution	Established	Nature/level	Structure	Format	Assessment requirements
SP	1982	Compulsory	12 month period in 3 parts	Group	Teaching portfolio
EPM	1977	Compulsory. Institution level	12 month period, one hour-long sessions every 2 weeks	Individual	None
QUB	1997	Compulsory for new staff only. Institution level	12 month period with 2 week long modules Full and half day sessions.	Group (about 70 people)	Written assignments, graded as a piece of Masters level work on a pass / fail basis only
KTH	2003	Requirement for eligibility as Senior Lecturer. State and institution level	10 weeks full time, divided in modules. The first module is scheduled over a semester with 14 half-day meetings about once a week.	Group (about 35 people)	Compulsory attendance in meetings, three assessment tasks required to pass the first course module.
MIT	1997	Elective	Workshops	Group	None

The first model describes the professional development support that the Educational Development Department provides to faculty in Singapore Polytechnic (SP). The professional development programmes in SP is guided by a learning roadmap that defines the teaching competencies that faculty need to develop to pursue a teaching career. New faculty, for example, attend a rigorous one year programme that focuses on the core competencies and essential underlying knowledge bases of teaching, and the personal dispositions related to highly effective teaching and training. Sharing of good practices by invited guests and innovative faculty is conducted at platforms like the monthly Educational Roundtable and Excellence in Education and Training Convention.

The second model describes the Faculty development center in École Polytechnique Montreal (EPM). Established in 1977, the center engages in a range of activities related to the support of teaching. Since 1984, EPM introduced a compulsory pedagogical training programme for all new faculty members. Therefore they must attend individual meetings with a pedagogical consultant that assists them in enhancing their teaching skills, improving courses, and resolving instructional problems. The Faculty development center also assists faculty with the preparation of promotion and tenure materials. For this purpose, EPM has adopted an integrated approach for instructor evaluation by implementing a campus policy.

The third model describes Queen's University of Belfast (QUB) Postgraduate Certificate in Higher Education Teaching (PGCHET). In this model, new faculty sign up for a course that leads to a postgraduate certificate in higher education teaching and is accredited by the UK Higher Education Academy. At QUB only new staff is required to pass the PGCHET. The objective is to enhance the quality of teaching provision across the university by helping faculty adopt best practices and become effective teachers and facilitators of learning.

The fourth model describes the package of courses offered by the Royal's Institute of Technology (KTH) Learning Lab. This package corresponds to the national requirement for newly appointed staff that must be trained in teaching and learning in higher education in order to be eligible for a position as Senior Lecturer. Several principles guide the TLHE courses.

The fifth model describes the Faculty Development efforts at the Massachusetts Institute of Technology (MIT). Various offices and initiatives have formed a widely spread network, providing a full range of services to the MIT community. There are Institute-level offices with the function of services, support and collaborations in the campus, and educational specialists on department-level who can provide specific disciplinary and pedagogical consultation. There is also other on-campus resource that the faculty can access and get support.

The following sections describe in more detail each of these five models. We then discuss possible implications for faculty development in engineering

## **1) PROFESSIONAL DEVELOPMENT AT SINGAPORE POLYTECHNIQUE**

“It could well be that faculty members of the twenty-first century university will find it necessary to set aside their roles as teachers and instead become designers of learning experiences, processes and environments. ... Faculty members will be less concerned with identifying and then transmitting intellectual content and more focused on inspiring, motivating, and managing an active learning process by students.” James J. Duderstadt. “A University for the 21st Century”, 2000 [1].

The professional development of faculty at Singapore Polytechnic (SP) is led by the Department of Educational Development (EDU). The department's mission is to enhance the quality of teaching and learning in SP. It provides expertise for the professional development of faculty and assists academic schools and departments in developing strategies to enhance the quality of teaching and learning.

The department's key functions include encouraging and leading educational innovations and initiatives, providing consultancy in the areas of curriculum, teaching, learning and assessment, applying educational research to enhance teaching and learning, promoting pedagogically sound applications of educational technology to teaching and learning, and providing services to support audio/video production and e-learning content creation.

### ***Professional Development Programmes***

The professional development programmes in the institution is guided by a Learning Roadmap. The Learning Roadmap (Appendix 1) describes the competencies faculty need to develop to pursue a teaching career at SP. It guides faculty in developing their annual Staff Development Plan (SDP) of which at least 20 hours would consist of learning- and teaching-related programmes. It has 2 main learning dimensions – Professional Knowledge and Practice, and Core and Leadership Competence. The Professional Knowledge and Practice dimension covers continued professional development in one's discipline as well as in teaching.

It has been clearly established that highly effective teachers not only have technical competencies in planning, delivering and assessing learning, but also excellent interpersonal skills and display behaviours that communicate genuine interest and concern for learning and learners. As it is impossible to cover all competences for teaching and learning, the Learning Roadmap focuses on the key competences that every lecturer needs to play the dual role of content matter expert and facilitator of knowledge.

The department offers a range of professional development workshops in the areas defined in the learning roadmap. These could be half day workshops or 45 min lunch time sessions and are offered throughout the year. Customised workshops are also conducted on request. The resources used in all workshops are available online for faculty to browse and use.

### ***Professional Development for New Academic Staff***

The Certificate in Teaching (Higher Education) Course is specially designed to provide quality training for faculty who are new to teaching. The programme focuses on the core competencies of teaching, the essential underlying knowledge bases and the personal dispositions related to highly effective teaching and training. It is aligned to SP's Learning Roadmap that faculty use to plan their professional development.

There are 4 core competences in the Certificate in Teaching (Higher Education) programme. They are Learning Design and Management, Assessment, Student Management, and Reflective Practice. The course extends over a 12 month period and consists of 3 parts and a teaching portfolio:

#### ***Part 1 – Induction Programme***

New faculty, when they are first appointed, have to attend a one week induction programme which equips them with some pedagogic skills like creative teaching, classroom management and facilitation skills before they begin teaching.

## ***Part 2 – Learning Design Project***

For part 2 of the CT course, faculty use a set of core principles of learning to design meaningful learning experiences that incorporate notebook activities. We suggest that the core principles that underpin good learning design in the face-to-face learning context are equally applicable to designing and managing learning in the online environment. Learning online does not change the way the human brain functions or the basic processes of learning. Clarke and Lyons (2005) [2] illustrate this fundamental point when they argue that:

The most robust instructional principles are those based on a model of human psychological learning processes....Any given instructional method will be effective or ineffective depending on the extent to which it supports or disrupts basic-learning psychological processes regardless of the delivery media. (p.594)

This perspective is reinforced in this one week project based programme where faculty are introduced to good practices of e-learning and a range of e-tools, and are tasked to design lessons with meaningful laptop activities based on the core principles of learning.

## ***Part 3 – Specialised Workshops***

Part 3 comprises of specialised workshops that help hone the competency of faculty in the 4 areas like active learning techniques, writing learning outcomes and designing open and closed assessments. Half a day every week is set aside for faculty to attend these workshops.

## ***Teaching Portfolio***

Faculties are also expected to apply their learning and work on a range of assignments which are submitted in a teaching portfolio. These assignments include producing lesson plans, learning resources, assessments, conducting an action research, observing an experienced faculty and a teaching practicum. The portfolio hence documents their journey on the course and their attainment of the competences spelt out in programme objectives.

The merits of the new structure, apart from those documented above, are the important motivational and rapport building between faculty developers and the new faculty. Common comments from faculty who have completed the course include “the course provided me with more ideas and also helped to make getting started on teaching easier” and “I realise that this is a new programme and I would like to say that it is a great idea to have such a programme right at the start of our teaching stint at SP”.

## ***Professional Development for New Initiatives***

- ***CDIO Implementation***

A special series of workshops for faculty implementing CDIO were also developed. In these workshops, an overview of CDIO, the CDIO syllabus, and the underpinning knowledge of CDIO skills like teamwork, communication skills, thinking and managing learning are shared. Faculty conduct a gap analysis, integrate selected CDIO skills into the curriculum, and design active learning activities and assessments for these skills.

In addition to these workshops, the EDU team also meet with a cross disciplinary CDIO implementation team once a week to discuss the curriculum and pedagogical approaches to adopt. A customised CDIO syllabus for SP was drawn up by the team which defined the learning outcomes for the CDIO skills appropriate for students at the polytechnic (Table 2).

The EDU team work closely with the CDIO implementers to revise or develop new syllabuses and to develop suitable assessments for the activities and skills integrated into the curriculum.

Table 2  
Example of learning outcomes for personal skills and attitudes

Personal skills and attitudes	Learning outcomes
Apply the thinking process	<ul style="list-style-type: none"> <li>• Use a range of critical thinking skills (e.g., analysis, comparison and contrast, inference and interpretation, and evaluation).</li> <li>• Identify the creative thinking process (e.g. Generating possibilities, incubation, illumination, etc.).</li> <li>• Use a range of creative thinking tools and techniques (e.g., brainstorming, mindmapping, triz).</li> <li>• Identify contradictory perspectives and underlying assumptions.</li> <li>• Reframe and take a range of different perspectives.</li> <li>• Use metacognition in monitoring the quality of personal thinking.</li> </ul>
Analyze factors that affect thinking	<ul style="list-style-type: none"> <li>• Identify barriers to effective thinking (e.g., traits, dispositions, working memory, perception, lack of information, etc).</li> <li>• Evaluate ways to reduce barriers to effective thinking.</li> <li>• Identify factors that promote effective thinking (motivation, openness, risk taking, exposure to varied knowledge bases and ideas, etc.).</li> </ul>
Manage learning	<ul style="list-style-type: none"> <li>• Identify one's own learning approach.</li> <li>• Identify approaches for self-improvement (e.g., lifelong learning, creating positive beliefs and psychological states, etc.).</li> <li>• Display key dispositions e.g., (initiative, perseverance, flexibility) in work projects).</li> <li>• Use a range of learning strategies and skills (e.g., goal setting, learning plans, organizing/summarizing information, receiving feedback, etc.).</li> <li>• Manage time and resources.</li> </ul>

Besides the syllabus, starter kits for Introduction to Engineering and Design Build were developed. These kits contain information on activities, processes and techniques that can be adopted. A website was also set up for sharing of resources developed.

A longitudinal programme evaluation is currently being carried out to study the impact of the changes made to the curriculum on students' learning, skills development and interest in engineering. The evaluation design includes blogs by a group of student co-participants, student questionnaires and focus group interviews with students and faculty.

- *Elearning Initiative*

SP's e-learning strategy is to embed e-learning into teaching and learning. It is intended that e-learning be developed as an integral part of learning and teaching while leveraging on the BlackBoard Learning Management System (LMS) and the notebook PC. It is about using technology within a campus-based course in ways that add value to the learning experience as well as support new modes of learning and teaching.

In 2008, an eLearning Project was initiated by EDU which aimed to put in place the following provisions:

1. Course websites that provide course-specific information such as syllabus, schedules, assessment criteria, etc, to assist students in completing the course and in understanding its objectives and procedures
2. Lessons designed with active learning activities using the notebook PC.
3. Recorded lectures to be made available for the students via Blackboard.

Pedagogical support was provided to course co-ordinators on a one-to-one basis. EDU staff helped faculty to integrate useful technological tools into their lesson designs, restructure the delivery of their programmes through course maps and provided useful resources that faculty can use to enhance the learning experience for their students. Sharing of appropriate e-tools to help deliver their content like wikis, blogs, Cmaps and voicethread were also conducted.

### ***Platforms for Sharing of Best Practices***

Best practices and new directions in education are shared at three platforms organised by the Educational Development Department. New and innovative ideas in the area of teaching and learning as well as interesting pedagogy are shared by invited guests or by the SP faculty themselves. These platforms also allow faculty to network with their counterparts from different schools and to build rapport with faculty developers.

- *A monthly Educational Roundtable*

The Educational Roundtable (ERT) is a popular lunch time talk that brings together experts from the educational field to share their thoughts on popular educational topics for faculty in SP. Held once a month, invited speakers have shared on a wide range of topics ranging from innovation in education to competency based education. Faculties get to identify and evaluate recent developments in professional practice and it usually concludes with lively discussion and debate.

- *A community of practice gathering held every semester*

To continue to build a sense of professional identity amongst the new faculty, they are invited to attend the Communities of Practice (COP) meeting which is held every semester. This is a platform where past and present CT participants gather to share teaching and learning ideas as well as listen to speakers from the field of education. Set in an informal environment, faculty share with each other teaching nuggets that their peers can then try and adopt in their own classrooms. More importantly, the COP allows EDU to continue to build professional relationships with the faculty who have graduated from the CT programme.

- *An annual in-house Excellence in Education and Training Convention (EETC).*

The EETC is a gathering of all academic faculty in the polytechnic to keep them abreast with developments in higher education. The theme of the convention is usually focused on an area that the polytechnic has selected as a strategic goal to be achieved. The convention also a platform to publicly honour the polytechnic's faculty who have excelled in their teaching and to provide faculty with the opportunity to showcase their innovations and research in teaching and learning.

It is essential that opportunities for professional development training and activities are provided to faculty to ensure the quality of the programmes and graduates from the polytechnic. However, while this need for upgrading of competencies and skills is regarded as important, there are often competing demands on faculty's time and priorities. Ensuring the professional knowledge and skills of faculty developers themselves to meet the changing demands of education is another challenge. In the area of engineering education, a collective

effort by the CDIO collaborators to share innovative ideas and approaches in teaching and learning amongst teaching faculty and faculty developers across institutions has certainly helped to engage and motivate faculty in SP to review and improve their curriculum and instructional practices.

## **2) ÉCOLE POLYTECHNIQUE MONTREAL – FACULTY DEVELOPMENT CENTER**

### ***Background***

École Polytechnique of Montreal (EPM) is the biggest French speaking engineering school in Canada. Founded in 1873, it has an enrolment of over 6000 students, 230 full-time faculty members, and more than 400 part-time instructors. Located on the same campus as the University of Montreal, EPM remains a completely autonomous institution, and offers 13 undergraduate four-year programmes, and 15 disciplines in graduate programmes, all exclusively in the field of engineering.

EPM is committed to providing quality teaching, and has recently launched an institution-wide initiative to renew all of its undergraduate programmes. The goal was to adapt the curriculum to the needs of the society and the labour market, and to introduce sound modern pedagogies that are more appealing to today's students. In 2004, each programme mobilized a team of faculty members whose responsibility was thinking and planning the entire process. Guidelines were somewhat loose, but each programme had to make room in their curriculum for at least one project-based course per year, and get every student to do an internship in industry during the third or fourth year of their programme. One year earlier, the department of mechanical engineering decided to undergo a similar reform by joining the CDIO initiative. Both these initiatives are driven by the same vision which is giving a more active role to students, and engaging them in the development of technical knowledge and reasoning as well as personal and professional skills and attributes. EPM, who was one of the first higher education institutions in Canada to establish a Faculty development center (FDC), didn't hesitate to call on its staff to support faculty in implementing these pedagogical initiatives.

The Faculty Development Center (*Bureau d'appui pédagogique*) in EPM was established in 1977, with an original goal of improving classrooms, supporting faculty in their mass production of overheads, offering individual consultations, and running workshops on various pedagogical aspects. Its mission has evolved over the years, and has now a more integrated approach to promoting faculty development. The FDC has a staff of five, the director (a specialist in evaluation and assessment), two specialists in integration of information and communication technologies (ICT), one specialist in higher education pedagogy, and one secretary. The FDC is seen as a service center dedicated to faculty, to departments, or to any other academic authority. With different fields of expertise, the educational consultants often collaborate to give the best possible service to faculty.

### ***Compulsory training programme for new faculty***

In Canada, although there are no State requirements for faculty members to have any formal training in pedagogy, most institutions offer optional support to faculty in their work as teachers. However, what is particular to EPM is that in 1984 it introduced a compulsory pedagogical training programme for all new faculty members. They receive individualized and confidential consultations on a variety of instructional issues, including course design, classroom performance, students' learning assessment, and reflection upon their practice. This individually tailored pedagogical programme runs one-hour-long face-to-face meetings; during the first year new faculties are hired. The meetings take usually place once every two weeks, but scheduling is convenient and very flexible, hence taking into consideration busier



than normal periods of the year for faculty (e.g. grant requests, midterms and end of semesters).

Faculty members are encouraged to engage in continuous improvement of teaching. Discussion topics include the teaching and learning process, classroom presentation skills and methods to enhance teaching and learning, interactions with students, providing and receiving student feedback, how to utilize effectively the latest developments in ICT to enrich course content, presentation and enhancing the student's educational experience, and other matters related to teaching.

### ***Reasons why the programme is appreciated***

New faculty members are usually very grateful for the opportunity they are given to develop their teaching skills in a participant-friendly environment. They also appreciate the hands-on approach which gives them the chance to work directly on their courses, and not just having to listen about pedagogy in a theoretical or philosophical manner. The intent is to share as many ready-to-implement ideas and activities, and to provide useful real examples taken from other faculty members. For example, when covering student assessment, faculty like to see what a grading rubric looks like, or how others have written their course objectives when presenting Bloom's taxonomy of educational objectives of the cognitive domain. The examples are updated regularly to reflect actual practices.

Another important reason new faculty members appreciate the programme is related to the fact that tenure is obtained after a four year probation period. During this period, every course they give must be evaluated. The course evaluation process at EPM is based on a questionnaire of student opinion. The twenty-two question evaluation form gives students the chance to comment anonymously about the course and how it was taught. The statements are grouped in four categories: course organization and communication, instructional skill, student outcomes, assignment, exams, and grading. There is also an open-ended comments and suggestions section. The results of the evaluation are not given to the instructor until final student grades have been submitted. Quantitative results are only given to the instructor and his or her dean. Written comments are seen only by the instructor. Because of the high-stakes nature of the final summative evaluation for new faculty members on probation, instructor evaluation is always associated to a feedback process. Every semester, results of course evaluation are transmitted to new faculty by the pedagogical consultants who write a brief comment, while inviting faculty with weaknesses to a meeting in order to analyse the situation and look for solutions for improvement. The consultant also helps to put the evaluation results in perspective and to present a comprehensive portrait of the new faculty member by exposing his or her strengths and emphasizing growth and improvement. This will also help the head of the department to make final decisions concerning instructor retention. In Canada, the possibility to obtain feedback is quite rare in universities. Generally, departments only send faculty their evaluation results, and hope teaching will automatically improve.

### ***Policy for faculty evaluation***

EPM has adopted an integrated approach for instructor evaluation by implementing a campus policy. The first policy was introduced in 1986 and its purpose was to establish common grounds for evaluation across the departments by building a standardised questionnaire. The policy was written in collaboration with the FDC's pedagogical consultants. The policy applies to the final summative evaluation process for new faculty members who have yet to obtain tenure, as well as for the promotion of tenured faculty.

Ten years after the adoption of the first policy of evaluation, a committee was asked to revise it and widen its scope. In 1997, the second policy is introduced and does not only cover

course evaluation, but also looks to promote quality teaching, and seeks to foster an environment where teaching is rewarded and recognized. The second policy allows EPM to emphasise the integrated approach of faculty evaluation and to set some conditions. This set of conditions are multiple and diverse, but essential to help carry forward its mission to promote the value of teaching. Therefore, before thinking of evaluating faculty, it is important to support faculty in professional development in teaching. It is also important to make sure the process of evaluation is valid, and feedback mechanisms as well as adequate help are available. Tangible actions for the recognition and an increase in the value of teaching are necessary in order to engage faculty members in continuous improvement of teaching. Appropriate examples of such actions can be providing resources like teaching grants, and awarding promotions that value teaching as well as research.

Furthermore, genuine support from university administrators is an essential condition to the success of any policy concerning excellence in teaching. The FDC must be able to count on the support of the establishment's leaders, and on a constant institutional will in the successive administrations. Indeed, if a president or a vice-chancellor is needed to give the initial impulse, his or hers successors must also be convinced of the need for continuing the work. Evidently, the constant commitment of faculty is another crucial condition for success. Faculty must recognize the importance of teaching, and get actively involved in its promotion.

Finally, all actions must be structured, and decent policies should guide the actions. It is also necessary to envisage a certain time to set up the components of the system, in EPM's case the process has taken 30 years. That can appear long, but it is necessary to respect the rhythm of the establishment in its capacity for change, and the process of acceptance and implementation of the proposed measures. It is also necessary to take into account the people, the faculty and the students, who work on the various committees. In addition, a major crisis, like the global financial crisis happening now for example, can occur and slow down any initiatives or developments.

### **3) QUEEN'S UNIVERSITY OF BELFAST – POSTGRADUATE CERTIFICATE IN HIGHER EDUCATION TEACHING (PGCHET)**

Established in 1997, and coinciding with the publication of the Dearing Report [3] which recommended the introduction of formal qualifications for all teaching staff in UK universities, the Queen's University Belfast (QUB) PGCHET course leads to a postgraduate certificate in higher education teaching and is accredited by the UK Higher Education Academy. At QUB it is jointly delivered by the School of Education and the Centre for Educational Development, part of the university's Academic & Student Affairs Directorate which works with staff, students and employers to enhance learning, teaching and assessment within the University. Academic staff on probation are given priority for places on the course. Successful completion of the PGCHET is a condition for passing out of the probationary period for new academics. While Dearing recommended such qualifications for all staff it is not as yet a mandatory requirement in the UK and each university currently set their own policy in this regard. At QUB only new staff are required to pass the PGCHET.

The PGCHET has been designed primarily for recently appointed lecturers and teaching fellows with limited experience of teaching in higher education. It aims to help participants develop their knowledge and skills in teaching and learning and to encourage them to reflect on their professional practice. The course runs over a 12 month period with 2 week long modules scheduled outside teaching weeks supplemented by several full and half day sessions throughout the year. The course is generic in content and each cohort comprises up to 70 students drawn from various Schools of the university. The objective is to enhance the quality of teaching provision across the university by helping staff adopt best practice and become effective teachers and facilitators of learning.

Assessment is by a number of written assignments with a strong focus on reflection of teaching practice and a requirement to reference pedagogic literature. In 2008/9 the assignments were:

- A teaching journal and portfolio
- An analysis of assessment procedures
- An action research project investigating an issue in student learning
- Conducting a reciprocal peer observation of teaching with a colleague

Each assignment is graded as a piece of Masters level work on a pass / fail basis only. In either case detailed feedback from all assessors (minimum of 2) is provided. Unsatisfactory work may be altered and resubmitted for subsequent reassessment. Students are required to pass all 4 assignments within 2 years of enrolling on the course to be awarded a certificate.

#### 4) THE ROYAL INSTITUTE OF TECHNOLOGY, STOCKHOLM, SWEDEN

To be eligible for a position as Senior Lecturer in Sweden one must be educated in *teaching and learning in higher education* (in Swedish literally *higher education pedagogy*). This requirement is stated in the Higher Education Ordinance, (Chapter 4, Section 7) and applies to all HE institutions since 2003:

“A person shall be qualified for appointment as senior lecturer [...] if he or she

1. has completed a doctorate [...],
2. has taken a course in teaching and learning in higher education [...], and
3. has demonstrated teaching skills.”

Lecturers can also be hired under the condition to take the courses within two years.

An agreement was made in 2005 by all Swedish universities to recognise each other's courses. To make this possible, a common set of intended learning outcomes was agreed, together with the decision that such training should correspond to 10 weeks full time study.

At the Royal Institute of Technology (KTH), a package of courses corresponding to the national requirement is offered by the KTH Learning Lab. See Figure 1.

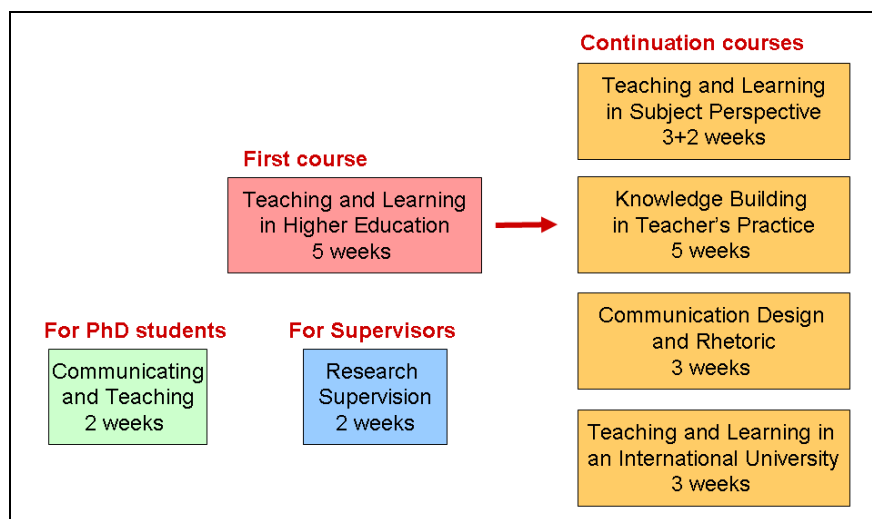


Figure 1. Course package offered at the KTH Learning Lab

Participants start with the five-week course Teaching and Learning in Higher Education (TLHE), after which they can select any of the continuation courses to fill up the course portfolio to the required 10 weeks. Many teachers opt to include the Research Supervision course in their package. Younger teachers may also have taken a basic teaching course while they were PhD students and this can be part of their package. In the following, the TLHE course is described more closely.

### **THE COURSE 'TEACHING AND LEARNING IN HIGHER EDUCATION'**

Since 2004, the TLHE course has been taken by more than 350 teaching staff, with an additional 100 people currently in pipeline. The course corresponds to 5 weeks full time, scheduled over a semester with 14 half-day meetings about once a week. Between meetings there is literature to read and a written assignment to prepare for the meeting. In addition, there are three larger assessment tasks required to pass the course. The first half of the course, called Course Design, is a practical exercise where the participant develops a course in which he/she teaches. The goal is to be able to make conscious and informed course design choices, driven by a student learning perspective. Course Design is assessed based on documentation of the 'makeover course'. The second part, called Reflective Practice, aims to deepen the learning perspective through further application of it to areas such as course evaluation, student diversity, one's own contribution to the organization etc. Assessment is based on transcribing and analyzing interviews with two students and a teaching philosophy statement.

Below some principles that have been guiding the development and running of the TLHE course are discussed.

#### ***It started as a spin-off from the CDIO implementation of KTH.***

Within the CDIO implementation process at KTH (from 2001) a series of workshops were developed for teachers who were responsible for courses in the first CDIO programme. These workshops contained the essentials of course development (designing intended learning outcomes, learning activities, and assessment) and this later became the backbone of the TLHE course. One could say that the TLHE course is *what we wished every teacher should have been able to do* when we were developing our first CDIO program. The CDIO experience was a strong platform for developing the TLHE course, we had developed and validated an engineering-flavoured approach to course development, we had data from KTH and other partner institutions that we could use as an empirical base, and we had established legitimacy and built trust relationships with many faculty.

#### ***It should have an engineering education flavour and a functional approach.***

Engineering faculty should be able to identify with the course content, and recognise their own kinds of subjects, students, teaching and assessment methods, the most common problems, and how these problems can be addressed in ways that works here – and within existing resources. When we read about phenomena and concepts in the literature, this is complemented with student quotes illustrating how these phenomena can be recognised when they appear in our context, as demonstrated in [4]. Faculty who have previously taken the TLHE course are invited back to show how their specific interventions have worked. We use their examples as case studies to analyze and learn from, and their appearance also helps affirm the local credibility and legitimacy of the course content. The applicability of the course content has been key to the success of the course. A typical quote: *"I had expected a great deal of "philosophic" reasoning that would be hard to apply in practice. Instead, the theory of the course backed up a large toolbox of concrete teaching methods and strategies. I am struck by the substance of the course."*

### ***Change is built in.***

Participants are encouraged to change their teaching practice already while taking this course, it is not something they are expected to do "later". Several of the written assignments in the TLHE course are documents that they have use for, e. g. they create the documents necessary to launch the makeover course in its new format. This helps participants reach all the way and implement the change. This increases their benefit, as they are acquiring the formally required merit, and at the same time improving their teaching. One participant put it: *"I think it is a very good idea to make [the work in the course] something that a (good) teacher would have to do anyway. It makes you very motivated to do it well, and it is encouraging to work on something that is going to be useful, not just for assessment of the course."* This is also a way to increase the benefit for the university. 350 teaching staff who have taken the course equals 350 courses that had a makeover.

### ***It is necessary to win acceptance by faculty.***

Since the TLHE course is in practice compulsory for new faculty it was necessary to establish a positive image around the course, otherwise resistance would be strong. A comment from a previous course participant: *"Overall it is very good course. Actually it is one of the best courses I ever attended. I was more or less forced to attend this course since it is required for KTH teachers. But it turns out as an enjoyable venture."* The fact that the course takes five weeks full time is a particular challenge – just think about adding five weeks on top of all other commitments. One message to participants is that the course is serious and takes time. A typical comment: *"The course takes time. It is not 'free' credits."* But the other message is that their effort will pay back in their teaching, because they will be able to teach more effectively and cope with their teaching better. Many previous participants testify to this: *"Well invested time.";* *"I must say that it is so much more fun to go to work and meet the students now that I've worked on the course design, than previously when I taught more 'quick and dirty'.";* *"You get incredible inspiration and ideas on how to develop your own courses. Little tactics and interventions with enormous leverage."*

### ***It is intended to enable and strategically drive educational development.***

The results of this faculty competence development can be seen not only on the level of the individual course or faculty member. When a critical mass of teachers in a division or department share the framework (set of concepts, models, strategies and tools) acquired in the course, it will affect the educational climate of that department. We are starting to see such signs. Also, many alumni of the course sit in the governing bodies of the university – another area where they can apply this competence. It is just a matter of time (say a decade) before a majority of the faculty will have this competence.

To conclude, KTH has used the mandatory national requirement as an opportunity for creating a mechanism for strategic educational development. One of the reasons we could do this was the experience of CDIO implementation, which turned out as a useful starting point.

## **5) FACULTY DEVELOPMENT AT THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY**

With the mission to "advance knowledge and educate students in science, technology, and other areas of scholarship that will best serve the nation and the world in the 21st century" (<http://web.mit.edu/facts/mission.html>), MIT has always put teaching and research as the primary purpose. To achieve this purpose, the MIT faculty plays a very important role. As of October 2008, the Institute has 1,009 faculty members (<http://web.mit.edu/facts/faculty.html>).

They instruct undergraduate and graduate students, and engage in research. The Institute provides them not only the best resources to conduct teaching and research, but also the opportunities to develop themselves, as teacher, advisor, administrator or researcher.

Faculty development in the MIT community is a very comprehensive effort. Various offices and initiatives have formed a widely spread network, providing a full range of services to the MIT community. There are Institute-level offices with the function of services, support and collaborations in the campus, and educational specialists on department level, who can provide specific disciplinary and pedagogical consultation. There is also other on-campus resource that the faculty can access and get support.

### ***1. Institute-level Offices***

The Office of the Dean for Undergraduate Education (DUE) sits at the core to provide systematical and institute-level faculty development resources to the MIT community. Three offices under the supervision of DUE – the Teaching and Learning Laboratory (TLL), the Office of Faculty Support and the Office of Educational Innovation and Technology (OEIT) – set their missions on support and develop faculty in a wide range of educational activities. Each of these offices has their own focus on faculty development: the TLL on teaching and learning research, training and consultation; the Office of Faculty Support mainly on undergraduate curriculum development and faculty government support; and the Office of Educational Innovation and Technology mostly on the innovative technology development and dissemination.

#### ***Teaching and Learning Laboratory***

MIT established the TLL in 1997, with the goal “to strengthen ongoing educational efforts at MIT and develop innovations in pedagogy and technology” (<http://web.mit.edu/tll/about-tll/index.html>). The Laboratory has three interrelated functions: instructional support, research and assessment. They support one another and allow TLL to provide a full range of services to the MIT community.

The programmes and services TLL provides include consultations, workshops, orientations and courses. Faculty members from the community could improve teaching and instruction skills through workshops and courses; they could consult the staff from TLL about their syllabus design, teaching and assessment method; they could find teaching materials from TLL’s library and website. New faculty of the community could also participate in a New Faculty Teaching Orientation at the beginning of the fall semester. The orientation is designed to help them think strategically about teaching, learn more about active learning and interactive teaching.

The TLL employs 7 staff and has 5 associate groups with over 15 experts and specialists from both inside and outside of campus. Their disciplinary backgrounds include educational psychology, educational technology, sociology, history, communications, management, science and engineering. Therefore, they could provide comprehensive services and consultation to the educational activities in MIT, especially in science and engineering education.

#### ***Office of Faculty Support***

The Office of Faculty Support has its mission to help the faculty development and support faculty governance. Their services emphasize on undergraduate education and support the committees on Undergraduate Education. The Office is responsible for the distribution of several funds for education improvement. Faculty can apply for resources from these funds to initiate innovative educational projects. The Office also manages the Student Subject

Evaluation process. The process gets feedback and evaluation of the course and instructor from the students, which can help Faculty improve their teaching. With the effort of 9 staff, the Office has built a communication bridge among faculty, staff, the five Schools and the central administration.

### ***Office of Educational Innovation and Technology***

The OEIT aims to promote the development and dissemination of innovative uses of technology in teaching and learning. It assists faculty in “locating, building and integrating technologies that support a wide range of pedagogical models” (<http://web.mit.edu/oeit/learn/index.html>). The Educational Technology Consultants support the educational technology needs of MIT's academic departments and faculty. They can help find technologies to support instruction in specific disciplines, identify possible resources, participate in select projects, and help with long-term educational technology planning. Faculty consultation includes pedagogical uses of technology on instructional design, educational assessment, project support and so on. The OEIT employs 18 staff and gives a solid technology support to faculty members on teaching and research.

### ***II. Department-level Support***

Some of the departments in MIT employ their own educational specialist to instruct education activities and help to establish the department-level faculty support. Compared with the staff from institute-level offices, these department-level specialists can provide more discipline-oriented services for the faculty. They have a more concrete idea on the curriculum of the programmes in the department and know better of the requirements of each course. Faculty members can get professional suggestions on designing, teaching and assessment.

The Department of Aeronautics and Astronautics, which adopts CDIO as the framework of curricular planning and outcome-based assessment, is one of the examples. There are two educational specialists in the Department of Aeronautics and Astronautics, both having a Ph.D. Degree in education. Their job includes course design and development, curriculum design, instructional and assessment materials design and development and individual consultation. Each academic year, they collect a memo document from each instructor of the course and compare the outcome of the course with the 12 CDIO Standards. The result of the analysis is given to the department and faculty and helps them improve their teaching. The specialists are also responsible for designing workshops and special projects on different topics in engineering education and helping faculty in the Department.

### ***III. On-campus Resources***

The Institute employs about 11,500 individuals in 2008 as research, library, and administrative staff, as well as many others who directly or indirectly support the teaching and research purpose. This number makes the staff/faculty ratio in MIT reach 11/1, which gives a solid foundation and good support to faculty activities.

The website Faculty Resources (<http://web.mit.edu/faculty/>) integrates most of the online resources related to faculty life in the MIT community. Faculty could find link lists on Advising and Teaching, Benefits and Services, Governance, Relocating, Research and so on. It provides a convenient way to search information and get help in the campus. There's also a periodic Faculty Newsletter to keep the faculty informed of the important events in campus.

## CONCLUSION

The aim of this paper is to describe the efforts of five higher education institutions to adequately train their faculty for teaching and help them facilitate learning. These institutions have developed and successfully sustained a training programme process that effectively encompasses the basic skills and knowledge that contribute to teaching excellence. This process is facilitated by faculty development centres, education departments or a concerted effort between these two entities. Each institution has developed its own faculty development model and is engaged in enhancing the quality of teaching and learning. Although models vary from one institution to another, their objectives are usually very similar. All in all, their purpose is to provide programmes and resources designed to promote teaching methods that are consistent with the research on how people learn, present opportunities for faculties to reflect on their work, to encourage pedagogical innovations and initiatives, to offer consultancy in the areas of curriculum, teaching, learning and assessment, to enhance teaching and learning, and to promote pedagogically sound applications of educational technology to teaching and learning.

While five models is quite short of a representative sample, the comparison of these faculty development models does allow making certain interesting observations. First and foremost, the perpetuity of any faculty development model strongly depends on the institution's support and the administrators' faith that this is the right thing to do. This is a very important condition to consider before thinking of offering such a service. If the administration is unwilling to allocate resources, it is very probable that such an enterprise will not function.

Second, thriving models show clear evidence of a continuing improvement approach, and apparent necessity for collaboration among specialists. This highlights the fact that teaching is a complex skill that requires the people involved work in a very serious and well structured matter to ensure that faculty feel they are well prepared with respect to required knowledge and skills they will apply during their career. The average 12 month length of the programmes, their often compulsory nature, and the sometimes heavy assessment requirements testifies of the seriousness of the process.

Third, all faculty development models described in this paper provide sound instructional design services to assist new faculty members in enhancing their teaching skills, deepen their understanding of the learning process, and improving courses.

Finally, one transcendent wish of all the models is to create a stimulating learning environment, to help faculty achieve their academic goals, and to learn with the experience and expertise of their colleagues.

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Helene Leong-Wee has been in the education service for the past 20 years. She was a teacher and senior curriculum specialist in the Ministry of Education (Singapore) involved in the development and introduction of the teaching of critical and creative thinking skills in schools in Singapore. She has conducted numerous workshops on promoting critical and creative thinking, and creative problem solving for teachers and students.

She is currently the Deputy Director of the Educational Development Department at Singapore Polytechnic. As Deputy Director, she oversees the professional development programmes as well as the implementation of new initiatives adopted by the polytechnic. As such, she is actively involved in assisting engineering schools in their implementation of CDIO. This includes rewriting existing syllabuses as well as designing new syllabuses to integrate personal and interpersonal, and design build skills. Besides staff development, she is also an external assessor for the Ministry of Education (Singapore)'s School Excellence Model and an Academic Quality Councillor in Singapore Polytechnic.

Mark Nivan Singh is currently the co-ordinator for the Certificate in Teaching (Higher Education) competency based course in Singapore Polytechnic where lecturers are mentored in their journey to be more effective lecturers. He conducts workshops in the area of Effective Lesson Designs, Creative Teaching, Assessing Learning and also in the area of Facilitation Skills. Mark has also developed course content on the area of Classroom Management and also for blended learning in the area of assessment for SP's lecturers.

Over the past 8 years, Mark has been extensively involved in training, development of professional development activities for teachers and also partnering teaching professionals in a variety of educational contexts. Mark was responsible for writing the entire Literature course content for his school when he was teaching and this also included designing authentic and performance based assessment for his students. Mark has also worked with various schools in the area of *Multiple Intelligences* conducting workshops for these schools when he was at the Ministry of Education Staff Training Branch.

J. Paul Hermon is a Teaching Fellow in the School of Mechanical and Aerospace Engineering at Queen's University Belfast. He holds a MEng Degree in Mechanical and Manufacturing Engineering (QUB 1987) and is Program Director for the Product Design and Development degree pathway. He has a Postgraduate Certificate in Higher Education Teaching (PGCHET) and is a Fellow of the Higher Education Academy.

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**Learning Roadmap for Staff of Singapore Polytechnic (Academic)**

<b>Learning Dimensions</b>				
<b>Professional Knowledge and Practice</b>				
<b>Subject Knowledge</b>		<b>Learning Design Management</b>	<b>Assessment</b>	<b>Student Management</b>
Discipline Knowledge	CDIO skills+	The range of decisions and knowledge bases (e.g. Principles of Learning, Pedagogic Content Knowledge) involved in the planning, preparation and delivery of learning.	The processes, methods and procedures used to assess and promote desired learning outcomes.	The methods and activities that enhance the students' cognitive, affective and moral development.
The technical knowledge and skills that lecturers must acquire.	The relevant CDIO-skills that lecturers must acquire.			
<ul style="list-style-type: none"> <li>• Mastery of Subject Discipline</li> </ul>	<ul style="list-style-type: none"> <li>• Mastery of Skills</li> </ul>	<ul style="list-style-type: none"> <li>• Science of Learning</li> <li>• Lesson Design</li> <li>• Problem/Project Based Learning</li> <li>• Learning Resource Development and Use</li> <li>• Creative Teaching</li> <li>• Facilitation</li> <li>• E-learning pedagogy</li> <li>• Active Learning</li> </ul>	<ul style="list-style-type: none"> <li>• Principles of Assessment</li> <li>• Assessing Learner performance</li> <li>• Online Assessment</li> <li>• Authentic assessment</li> </ul>	<ul style="list-style-type: none"> <li>• Classroom Management</li> <li>• Pastoral Care</li> <li>• Counselling</li> </ul>

[+ These CDIO skills refer to the 13 CDIO skills in Parts 2, 3 and 4 of the CDIO Syllabus. The actual training will vary depending on the areas for which your school/department is developing]