COMPARISON OF HIRING AND PROMOTION CRITERIA LINKED TO TEACHING, EDUCATIONAL DEVELOPMENT AND PROFESSIONAL ENGINEERING SKILLS

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ABSTRACT

Within the higher education system, criteria for promotion based on research quality and contribution are well established and widely accepted. For teaching, on the other hand, such criteria have generally not been developed and implemented to the same degree. This poses a challenge for the implementation of the Conceive-Design-Implement-Operate (CDIO) standards 9 and 10, which deal with the enhancement of faculty CDIO skills and faculty teaching skills. To be able to implement these standards successfully, universities need to have in place effective ways of evaluating teaching contribution and professional engineering experience. To support the implementation of CDIO standards 9 and 10, excellence in teaching and progressive educational development based on engineering experience must be acknowledged and rewarded.

This paper compares hiring and promotion policies and criteria for the evaluation of teaching contribution and educational development in four selected universities in Europe and North America. Conclusions are drawn with regard to the CDIO standards 9 and 10 and perspectives for future development of such criteria discussed.

KEYWORDS

Academic promotion criteria, hiring policies, educational development, teaching skills, professional engineering experience.

INTRODUCTION

One of the key ideas of the Conceive-Design-Implement-Operate (CDIO) approach to engineering education is to integrate engineering skills with disciplinary and technical knowledge throughout engineering programs [1]. This must mean an approach to higher education that recognizes and places value on factors such as teachers' professional

engineering experience and their development of innovative methods to improve the quality of engineering education and student skills. If these factors are not visible in an institution's hiring and promotion criteria, and thus not visibly recognized and rewarded, e.g. for tenured professorship, it is likely to be an obstacle to a coherent and sustainable implementation of the CDIO principles [2]. Motivating faculty to put the required emphasis on teaching and progressive educational development, as recommended by the CDIO framework, seems to be a generally recognised problem among research universities. In spite of most universities having established some criteria for teaching as part of their hiring and promotion criteria, there generally seems to be an imbalance in the relative value of research and teaching, where teaching tends to be valued secondary to research [3, 4, 5]. From a teacher and faculty perspective, self-efficacy and self-esteem can be impacted by this potential lack of recognition. This, in turn, can affect motivation and may lead to a weaker commitment to teaching by individual faculty members, which is likely to have a negative influence on the quality of educational programs.

The CDIO standards 9 and 10 deal with the enhancement of faculty skills that are relevant for enhancing the quality of education and the students´ learning experience.

The CDIO standard 9 deals with the enhancement of faculty CDIO skills, i.e. engineering knowledge and skills. For successful implementation of this standard, it would seem necessary for universities to have in place effective ways of evaluating professional engineering experience. Examples of actions that can enhance faculty competence are professional leave to work in industry, partnerships with industry colleagues in student projects, professional development experiences at the university, and inclusion of engineering practice as a criterion for hiring and promotion [6]. Rewarding excellence in professional engineering practice and educational development that is based on linking disciplinary knowledge to engineering practice is considered likely to motivate faculty.

The CDIO standard 10 deals with the enhancement of faculty teaching skills. Successful implementation of this standard can be seen to be contingent upon universities having in place effective ways of evaluating teaching contribution. Examples of actions that can enhance faculty competence in providing integrated learning experiences and using active experiential learning methods are faculty development programs, forums for sharing ideas and best practices, and emphasis on effective teaching skills in the hiring and promotion process [7]. Rewarding teaching contribution and the development of progressive teaching methods in a coherent and fair way is considered likely to motivate faculty.

In this paper, a review of hiring and promotion procedures and criteria at four educational institutions is presented, in order to shed a light on how teaching contribution, professional engineering experience and educational responsibilities can better be taken into account when evaluating academic performance, especially with regard to the objectives of CDIO standards 9 and 10. The aim is to identify similarities and differences between the selected universities, to pinpoint which factors the universities focus on in their hiring and promotion criteria, and finally to compare and open a venue for discussion. This paper is structured as follows: first it gives a brief account of previous research on the subject, although this is not intended to give a comprehensive literature overview in this field. This is followed by a description of the research methods and the universities involved. The main findings are then assimilated in a table and described, followed by discussion and recommendations.

PREVIOUS RESEARCH

In the context of faculty development for CDIO implementation, Kristina Edström has argued that educational development is generally insufficiently represented in the organization of universities and is often not seen as being made up of activities that build a carrier in

academia [8]. She has also suggested that since universities of technology are generally organizations where the main emphasis is on the science of engineering, the practice of engineering tends to be less represented and thereby harder to implement into academic programs and courses [8].

In a study by Adams published in 2003, an attempt was made to develop a quantitative procedure "for assessing the scholarly, teaching, and service accomplishments of faculty members being reviewed for promotion and tenure", called the Academic Assessment Index (AAI) [9]. The general objective of the study was "to determine if there is a level of standardization or uniformity in the ways in which administrators tend to regard various criteria of accomplishment in the assessments of faculty for academic rewards". In other words, to find out "what counts", as norms of advancement [9]. Based on a literature review and consultation with a number of stakeholders, Adams presented eleven criteria. Out of these, three deal with teaching: (i) teaching awards or nominations, (ii) favorable written student teaching evaluations, and (iii) developing and managing an online course in his/her discipline. Adams then performed a national survey in the US and on the basis of responses of 109 university and college administrators was able to establish that the criteria related to teaching ranked generally lower than research-related criteria.

This domination of research over teaching can also be read from a research report published in 2009 on reward and recognition of teaching in higher education in universities in the UK [4]. The general conclusion presented in the report is that "teaching in UK higher education is still perceived to be valued and rewarded too little, both in formal personnel processes and in the dominant culture of institutions". The study also reveals that while a high proportion of staff think that teaching should be an important factor in promotion, only a minority think that it is considered important in practice. Also the study pinpoints the critical importance of formal institutional reward systems in this respect, such as promotion processes. The authors conclude that it is "important to devise systems at local levels which are based on rigorous criteria that are not inconsistent with the ways research performance is assessed". They furthermore suggest sharing good practice in promotions and appointments procedures, both to enable the development of suitable criteria (both general and discipline-specific) and to learn from their application in practice.

In 2009, Hardré & Cox studied faculty performance evaluation standards and review processes of 62 academic departments in 23 research universities in 13 US states [5]. They found that these standards generally differed between universities. However, most research universities specified research as primary, teaching as comparable or secondary and service as a tertiary role. Hardré & Cox emphasise that the "ideal or consummate faculty member at the research university is excellent at both research and teaching". But they also acknowledge that it is unclear how excellence in these areas is defined and what message candidates for promotion and tenure get from faculty performance standards. They also emphasise that faculty work is complex, ill defined and varied, and therefore the task of evaluating it is difficult. They advise against trying to develop a one-size-fits-all formula or template for evaluating faculty work. Instead they emphasise that faculty performance standards need to be developed with explicit attention to the values of the institution and discipline in question.

The final point mentioned above in Hardré & Cox's conclusion corresponds well with the findings of a study performed by Malmqvist, Gunnarsson & Vigild in 2008 in three universities in Denmark and Sweden, all participants in the CDIO network [11]. Their study involved interviews with faculty members. One of their key findings was that the faculty members interviewed assessed proficiency in professional skills being of high importance in their working situation. In particular this applied to skills in teaching project-based courses and being able to relate one's research to the industrial context.

In a report commissioned by the National Academy of Engineering in the US to identify and assess options for evaluating "scholarly teaching", the authors strongly recommend that universities develop multidimensional metrics, "a thoughtfully designed and broadly agreed-upon method of evaluating teaching effectiveness" [10]. They suggest such an evaluation of teaching to include both formative feedback to assist individual improvement and summative evaluation to measure progress toward institutional goals on which personnel decision such as promotion and tenure can be based. A key factor for a successful system is that faculty and administrators have significant input into the design of the evaluation system and that the system is linked to mechanisms for continuous improvement (quality assurance). Institutions/deans are encouraged to "take the lead in developing and gaining widespread acceptance of metrics for evaluating teaching effectiveness in engineering". Any evaluation system is predicated on a set of values. A set of desirable conditions must be defined and then measurements are made to determine whether those conditions are met. The problem lies in reaching a consensus on a definition of what constitutes excellence in teaching. The authors state the following five basic skills as necessary for effective teaching: (i) content expertise, (ii) instructional design, (iii) instructional delivery, (iv) instructional assessment, and (v) course management. They introduce a system by which these skills are quantitatively rated by four different groups: (a) students, (b) peers, (c) supervisor/department head, and (d) the evaluee. Noteworthy is that these different groups are given different proportional weight for the evaluation of the different skills. For example, for the category content expertise, the student group does not have a say.

In a study by Roxå and Bergström, it is suggested that mandatory student evaluations of teaching may counteract innovation and development in teaching [12]. Students' opinions are said to matter to teachers and that they often experience stress and anxiety related to the students' evaluations of teaching. The fear of not being a "good teacher" in the eyes of the students and the threat of being stigmatized as a "bad teacher" may result in teachers tending to play safe and teach in a "normal" way, rather than aspiring to try something new.

This brief literature survey conducted as part of our study has thus established that educational development and engineering practice seem to be insufficiently represented in the organization of universities, even though faculty members at CDIO universities consider proficiency in professional skills of high importance. Also, this sample of literature gives clear evidence to the well known claim that teaching comes second to research in academic carriers, but at the same time the literature shows that academic staff feels that teaching should be considered more important in promotion. Many of the studies point towards the importance of institutional frameworks and institutional culture as a means of improving this, there amongst formal hiring/promotion criteria. The studies also remind us that faculty work is complex and the task of evaluating it is difficult as can e.g. be seen from the example of student evaluations, discussed by Roxå and Bergström.

METHODS

Hiring and promotion standards and criteria, as well as relevant rules and regulations, were collected from four universities and compared. In some cases the standards and criteria also apply to annual or other regular reviews of the performance of academic staff. The universities are: (i) Chalmers University of Technology in Sweden (Chalmers), (ii) École Polytechnique de Montréal in Canada (EPM), (iii) Reykjavik University in Iceland (RU), and (iv) Telecom Bretagne in France (TB).

These universities were chosen with the aim of presenting a broad comparison of universities involved as members in the CDIO network. They all have a strategy that emphasizes the importance of teaching and educational development, and are therefore seen as likely to be putting an emphasis on teaching contribution in their hiring and promotion criteria. Some also

emphasize the importance of teachers' professional engineering experience. They represent a spectrum from large and long established institutions to younger and smaller institutions that may be seen as more dynamic and adaptable to new approaches. Some of these universities have adopted the CDIO approach generally throughout their institution and academic programs, while others have primarily focused on one or more of their disciplines and academic programs.

For this paper, the formal written rules on indicators and criteria applied in hiring and promotion processes were reviewed and a comparison table developed, where all indicators and criteria dealing with teaching or educational responsibilities directly or indirectly relevant to CDIO standards 9 and 10 were listed. Only university-wide rules were considered, and not rules that may have been introduced within individual schools or departments within the universities. Three aspects were documented, that is:

- First, the indicators mentioned in hiring/promotion rules that are taken into account, e.g. teaching skills or teaching experience. In other words, the forms of accomplishments related to teaching that are considered as evidence of performance.
- Secondly, the criteria (qualitative or quantitative) that are presented as to how candidates are judged, e.g. if a candidate should be active in …, or have shown significant effort in … etc.
- And thirdly, the type of documentation or evidence that is required to demonstrate the candidate's experience or qualifications, e.g. self-report (curriculum vitae based on teaching experience), student evaluation or pedagogical training.

This study deals with the criteria that are officially documented and accessible at the chosen universities. It does however not analyze how this matches with the universities' practice. A summary of the key indicators and criteria applied and evidence required from candidates in the hiring and promotion procedures of the selected universities is compiled in Table 1, which is followed by a discussion and recommendations. The study also included a search for literature on the topic. Based on the authors' literature review, relatively little seems to have been done on this subject in recent years.

RESULTS

In this study, standards and criteria for evaluation of teaching contribution in hiring and promotion of academic staff were collected and analyzed from four universities, all members of the CDIO network. In Table 1, a summary of the main findings is presented [13, 14, 15, 16, 17, 18, 19, 20].

The first column of the table lists key categories or items that deal with teaching contribution in hiring/promotion processes. The second column lists what criteria the universities apply to evaluate individual's contribution and skills with regard to each category or item. The last column lists what type of evidence or documentation the applicant is required to submit, on which the evaluation for hiring/promotion will be based. The evidence discussed in the last column of the table is grouped into four types; that is (i) evidence provided in the form of written documentation submitted by the applicant (*self-report, curriculum vitae*); (ii) evidence in the form of some sort of *observation*, most often through student course evaluation, but possibly also by peers through some sort of peer assessment; (iii) evidence through recognition by received *teaching awards or prizes*; and (iv) evidence of formal *pedagogical training*.

The information in Table 1 refers to all four universities, unless where it is specified to relate to specific universities out of the four in the sample. The table does not give a comprehensive overview over all items and criteria related to teaching in the hiring and promotion processes at the four universities. Instead it is intended to give an overview over

those aspects of teaching that are most directly related to CDIO standards 9 and 10 and how they are treated in hiring and promotion processes at these universities.

Table 1. Summary of standards and criteria for evaluating
teaching contribution in the four universities.

Items for evaluation	Criteria for evaluation	Forms of evidence for evaluation
Teaching experience	The evaluation shall focus on the individual's contribution to teaching at university level. For hiring new faculty, teaching experience at university level is generally required. This can range from requiring minimal teaching experience to having much more extensive teaching experience and having assumed a leading role in teaching, depending on the academic title in question.	**Self-report:** The applicant is required to submit information in the form of a CV or on the basis of a special form for promotion evaluations. There, teaching experience shall be documented, including listing all teaching assignments, e.g. courses taught.
Teaching & pedagogical vision	No explicit criteria is stated regarding this item, apart from that TB acknowledges if the applicant's approach is aligned with the institution's teaching strategy.	**Self-report:** The applicant is required to submit a statement about his/her objectives related to teaching and personal pedagogical ideas.
Teaching skills	Chalmers has explicit criteria related to this item. There, pedagogical expertise is required for all academic positions, shown e.g. through the ability to generate commitment and interest and motivate students in their learning. EPM and RU both state that applicants have to show evidence of good teaching skills and have shown innovation and creativity in teaching methods and the teaching endeavour as a whole, depending on the academic title in question. EPM requires new faculty to undergo formal pedagogical training under the supervision of a pedagogical expert for a total of about 50 hours. Similarly Chalmers requires associate professors to have 15 ECTS or equivalent in pedagogy for higher education.	**Self-report:** Chalmers requires applicants to submit information/reflections on various aspects that relate to teaching skills. RU and TB also touch on particular aspects. **Observation:** All the universities refer to results from course evaluations conducted by students. None of them does however seem to put much weight on peer assessment. **Pedagogical training:** All the universities require applicants to submit information on pedagogical training that the applicant has undergone. **Teaching awards/prizes:** All the universities, apart from TB, ask the applicant to state teaching awards received.
Creation of teaching material	EPM and RU state development of new teaching material as a criterion for evaluation. Here, both qualitative and quantitative aspects can be considered, i.e. the quality of teaching material developed and the number of books, syllabi, web sites, etc.	**Self-report:** All the universities ask applicants to report on their development of new teaching material. This can e.g. include new courses taught or fundamentally altered syllabi.

Professional engineering experience	At EPM and TB, professional engineering experience is encouraged through sabbatical leaves in the industry. Chalmers explicitly states that other experiences and abilities than scientific and pedagogical should be evaluated for hiring/promotion (not linked to specific academic level). This may include the ability to cooperate, skillful leadership, experience of industrial development work and proven ability to innovate. These qualifications must be well documented to facilitate assessment. At Chalmers and RU the title "Professor of the Practice" can be awarded to individuals who are business leaders in a specific field, have attained recognition for having made an impact in the field, and who have demonstrated undisputable teaching abilities at university level. At EPM, the transmission of industrial experience in teaching is favorably considered.	**Self-report:** RU asks applicants to list professional experience gained outside of university. The applicant is also asked to reflect on how his/her courses connect students to business, industry, the community and/or the profession.
Personal and interpersonal skills	Chalmers and RU both address this somewhat in their criteria. Chalmers refers to ability in networking and co-operation and leadership qualities, but does not state how these are evaluated. RU states that individual's endeavours to encourage independent and scholarly work methods among his/her students shall be considered.	**Self-report:** Not addressed explicitly, apart from that in the promotion process at RU, the applicant is asked about interdisciplinary teaching projects that he/she is responsible for.
Product and system building skills	Not explicitly stated in hiring/promotion criteria.	Not explicitly stated.

Teaching experience

All four universities in the sample take account of the applicant's teaching experience for the hiring/promotion process. For that purpose the applicant is required to submit a record over his/her teaching contribution, listing all teaching assignments (e.g. courses taught) and explaining the scope and variety of his/her teaching experience. At EPM for example, candidates for faculty positions could be asked to present to the selection committee a sample short course on a specific subject related to the expertise targeted by the position description.

All the universities have similarly stated general, qualitative criteria about what teaching experience is required for the different academic titles/positions. None of the universities has however developed quantitative criteria to evaluate this item, but some of them have nevertheless other specified criteria relating to this aspect. For example, TB requires that one member of a review committee established for the evaluation of a candidate for promotion to associate professor or professor, to be an external professor internationally recognized for expertise in pedagogy [19].

Teaching/pedagogical vision

All the universities mention in their hiring/promotion rules that an applicant is required or expected to hand in a statement, describing his/her objectives related to teaching for the coming year/s and his/her personal pedagogical ideas. It is however, not clear how the universities generally evaluate this evidence, apart from maybe TB, which explicitly states that they acknowledge if the individual's contribution to the design of courses and delivery of

courses is well aligned with the institutions teaching strategy [19]. This would especially be relevant regarding how individual contribution is aligned with the CDIO approach.

Teaching skills

CDIO standard 10 recommends emphasis to be put on effective teaching skills in performance reviews and hiring, and that competence in teaching, learning and assessment methods can for example be provided by self-reports from applicants or by observation [7].

In this category, the four universities both state different criteria to evaluate the applicants' teaching skills and apply different forms of evidence. The most advanced set of criteria for evaluation can probably be seen at Chalmers. There, the rules describe explicitly how pedagogical expertise is evaluated:

> *"Pedagogical expertise should be shown through one's own teaching and the ability to generate commitment and interest in the subject, to organise knowledge in well-structured and highly esteemed courses, to motivate students in their learning, and to communicate with students and other teachers. The abilities to hold a comprehensive view and to engage in renewal are valuable assets. Pedagogical expertise is founded on sound and extensive knowledge of the subject in question and a reflective attitude both towards one's own pedagogical work and student learning. Links with research in the subject are also important in relation to pedagogical expertise. ..."* [13] *(art. 4.2.2)*

Furthermore, two of the four universities (Chalmers and EPM) require their academic staff to have undergone (or undergo in the first years of term) formal pedagogical training.

The four universities ask for evidence on the applicants' teaching skills in the form of self-reports, student course evaluation, information on pedagogical training and information on teaching awards received. In spite of these diverse forms of evidence the applicant is asked to provide, it is only to a limited degree clear from the formal rules and framework, how this evidence is being evaluated in the hiring/promotion process. The strongest commitment though may be claimed to be evident at Chalmers. There, for example, an academic title of a "Professor with pedagogical expertise" is defined. Applicants for this position need to have more pedagogical expertise, for example to have exceptional and very well documented pedagogical expertise in undergraduate and/or graduate education, have external publications on pedagogical work and participated actively in a pedagogical networks [13].

Creation of teaching material

Even though all the universities require applicants to submit information on their contribution regarding the development of new teaching material, there does not seem to be a great emphasis on this aspect when it comes to formal criteria for evaluation of candidates. This seems to be true for all four universities except where the quality of new teaching material may have led to a prestigious recognition or an award.

Professional engineering experience

CDIO standard 9 deals with the enhancement of faculty CDIO skills, i.e. engineering knowledge and skills. For that purpose, CDIO standard 9 recommends the inclusion of engineering practice as a criterion for hiring and promotion [6].

The four universities in the sample approach this aspect in different ways. RU and TB do not have explicit evaluation criteria related to this for conventional academic positions, but nevertheless require applicants to submit relevant information. Chalmers and RU furthermore define a special title of Professor of the Practice, for those who have attained recognition for

their impact as professional engineers, as well as having demonstrated undisputable teaching abilities at university level. At EPM and TB, professional engineering experience is encouraged through sabbatical leaves in the industry for scientific researchers. The role of faculty in encouraging participation of industrial representatives in capstone engineering projects is strongly appreciated in CDIO-oriented programs at EPM. Chalmers goes furthest in responding to the above-mentioned recommendation of CDIO standard 9, and states explicitly that other experiences and abilities than scientific and pedagogical should be evaluated for hiring/promotion. This can apply to all levels of academic positions and may include the ability to cooperate, skillful leadership, experience of industrial development work and proven ability to innovate [13]. The Chalmers hiring/promotion rules state that these qualifications must be well documented to facilitate assessment.

Personal and interpersonal skills

CDIO standard 9 recommends competence in personal and interpersonal skills to be demonstrated through self-reports by candidates and observation and that universities should accept professional development in these skills in its evaluation for hiring/promotion [6]. This aspect of teaching seems to have gained relatively little attention in the hiring/promotion frameworks of the four universities. Personal and interpersonal skills may of course be implicit in some of the criteria and documentation discussed above under e.g. *teaching skills.* It must however raise questions about how much emphasis is really being put on these skills, if they do not explicitly appear in hiring/promotion criteria. RU and especially Chalmers address these types of skills somewhat, but the other two universities do not.

Product and system building skills

CDIO standard 9 approaches product and system building skills in the same manner as personal and interpersonal skills above. This aspect seems to be even more poorly addressed in the four universities' hiring/promotion rules and frameworks. It is not explicitly mentioned although it may perhaps partly be dealt with under *professional engineering experience* above.

DISCUSSION

Historically, evaluation of academic performance in hiring or promotion procedures has focused on three aspects: (i) teaching, (ii) research, and (iii) service to the community. At the same time, it is generally recognized that research is the one out of these three that has gained the most attention, although this varies somewhat from one university to the next.

It is also generally to be expected that the infrastructure of review and incentives for hiring and promotion within academia has to reflect the strategic position of a university, to be able to support the operations of the university in the direction that the university wants to be heading towards. In the case of universities engaged in the CDIO network, the institutions are explicitly emphasizing a particular pedagogic approach to engineering education. It is therefore to be expected that this will be represented in their hiring and promotion frameworks. This could also be promoted by accreditation and ranking bodies putting more emphasis on such criteria i.e. teaching, educational development and engineering practice skills.

Through this study of the formal rules and procedures for hiring and promotion of academic staff, this paper has attempted to pinpoint what criteria and approaches are being applied to value and reward teaching contribution, especially in relation to the principles stated in CDIO standards 9 and 10. In the self-evaluation process for the positioning of CDIO member

institutions with regard to the level of compliance with the standards, it should be possible to evaluate the progress in the implementation of standards 9 and 10.

The study shows that the four universities, which all apply the CDIO ideology to engineering education, approach the evaluation of academic performance somewhat differently. There seems generally to be room for more attention to the weight between, on the one hand the requirements for material to be submitted by candidates, and on the other hand having defined criteria for the evaluation of the submitted information. In most cases, candidates are asked to submit a great deal of information without it being obvious whether, or how, the submitted information will be evaluated. This corresponds with Hardré & Cox's study of American universities, which showed that universities were generally much clearer on the sources of documentation for faculty evaluation than they were on the criteria by which they judge the evidence provided by candidates [5]. It is to be expected that candidates for promotion or tenure would generally be eager for promotion committees to base their decisions on clear criteria and even more quantitative parameters. The lack of such criteria can increase the level of uncertainty and frustration amongst faculty.

Regarding the evaluation of teaching, the hiring/promotion criteria of the four universities do not provide metrics or milestones that can be quantitatively compared. Typical criteria for a professor would be "the pedagogical expertise required in undergraduate and graduate education should be of good quality and well documented" [13], or a similar qualitative description. It would be interesting to define parameters for a quantitative rating scale based on CDIO standards. Emphasis on the values defined in CDIO standards 9 and 10 could for example be incorporated into the parameters on which evaluation of each of the five basic skills described in the NAE study [10] are based.

Furthermore, there seems to be room for developing more varied approaches with regard to evidence provided, as the current systems seem to relay almost exclusively on the candidate's own record and student course evaluations. It is interesting to notice that course evaluations seem to be an important source of evidence regarding teaching skills in all the universities. This may raise some questions in the context of promoting teaching and learning quality. On the one hand, this emphasis may direct teachers towards holding on to existing courses which do historically receive good student ratings, at the cost of putting less emphasis on course development and course design [12]. Also, it is generally recognised among academics that student evaluation can only give a partial insight into the quality of teaching, and therefore needs to be supplemented with other forms of evidence regarding teaching and pedagogical engineering skills in promotion procedures.

Overall, hiring/promotion criteria should be flexible enough and determined with a view to favoring adaptability to new challenges and innovation in education. The challenge facing higher educational institutions regarding hiring and promotion issues is not only the definition of appropriate quality criteria, but also the design of objective and reliable procedures aiming at fairly determining whether these criteria have actually been fulfilled.

This comparison can only be seen as a step towards gaining better understanding of how hiring/promotion frameworks can be developed in such a way that teaching excellence and the CDIO principles may become real and important considerations for hiring and promotion of academics in universities that teach engineering. Education and research are the two pillars on which universities are founded. Judging from this study, the authors feel that too little emphasis is placed on teaching skills and educational development in the hiring/promotion criteria. Furthermore, the study shows that even less emphasis seems to be placed on practical professional skills. Finally, and maybe most importantly, judging from this sample of only four universities, there is work to be done in specifically addressing the principles of CDIO standards 9 and 10 more directly in hiring/promotion frameworks. Given

the importance of teaching as one of the primary roles of universities, this must be of great concern and a call for action.

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