# AC 2008-1643: A REVIEW OF PROFESSIONAL QUALIFICATION, DEVELOPMENT, AND RECOGNITION OF FACULTY TEACHING IN HIGHER EDUCATION AROUND THE WORLD

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# A Review of Professional Qualification, Development, and Recognition of Faculty Teaching in Higher Education around the World


## Abstract

Recent discussion within the engineering education community has included how to document progressive skills in scholarly teaching and whether a philosophy of engineering education can improve the practice of engineering education. As these types of discussions move forward, it will be helpful to provide some context as to how these ideas might formally manifest themselves. This paper provides a global overview of models for faculty development and recognition in teaching in higher education.

Few would disagree with the idea that educating the next generation of leaders in both academia and industry is at the heart of what higher education is all about. However, in the US, while many faculty are dedicated to becoming outstanding educators, the general assumption is that holding a PhD in a core technical area is sufficient to be qualified as an academic educator. This no longer holds true (and maybe never did). In order to address this issue, a number of models have been proposed and/or implemented in other parts of the world (Europe, Australia, Asia). These models seek to provide both professional qualification and recognition for educators working in higher education. Accordingly, the research question addressed in this paper is: what models for professional development and recognition in higher education have been explored or implemented around the world? The approaches used to address this question are: conversations with leaders in engineering education, participation in conference discussions on this topic, and a literature survey.

As a result of these efforts, this paper first reports an overview of existing model types. Major differences in the types of models are explained in terms of duration, incorporation with promotion and tenure, and what components of educational practice are included in the model. Next, the various characteristics of individual models are documented in terms of content and practicum components, contexts for implementation, and how the models work within their various contexts. Finally, due to the inherently political and emotional nature of considering the use of these models with the US, a brief reflection on experiences and lessons learned from these models is presented as relevant to US higher education.


## 1. Introduction

Few would disagree with the idea that educating the next generation of leaders in both academia and industry is at the heart of what higher education is all about. As such, teaching and learning environments which support this goal are imperative for success. However, in the US, while many faculty are dedicated to becoming outstanding educators, the general assumption is that holding a PhD in a core technical area is sufficient to be qualified as a college or university educator. Unfortunately, the evidence for this automatic link between research skills and teaching skills is weak at best [1]. The idea that a teaching and research nexus naturally exists within higher education today no longer holds true (and maybe never did). Therefore, actions that support faculty development in the area of teaching will be needed in order to move forward in creating the types of teaching and learning environments which will best equip our students to lead into the future.

Any discussion of US higher education faculty development in teaching on a large scale will require basic frameworks to support and guide activities. Towards this end, the US engineering education community has recently presented and sought input about two important ideas which could have significant impact on the future of engineering education. These are (1) how to document progressive skills in scholarly teaching[2, 3] and (2) whether a philosophy of engineering education can improve the practice of engineering education[4, 5].

As these discussions continue, it will be helpful to provide some context as to how these ideas might formally manifest themselves. This paper specifically addresses the first topic above by providing a global overview of models for faculty development and recognition in teaching in higher education.

A number of models have been proposed and/or implemented in other parts of the world with discussion centered in Europe, Australia, and Asia. Though the details vary, these models all seek to provide some form of professional qualification and recognition attained through formal means for educators working in higher education. Accordingly, the research question addressed in this paper is: what models for professional development and recognition in higher education have been explored or implemented around the world?

The approaches used to address this question are reflected in the following organizational structure for the paper: first, a literature survey of materials relating to professional qualification and recognition for teaching in higher education is presented. This consists of an overview comparing and contrasting existing models around the world followed by more detailed descriptions of several models. Next, a reflection on US activities is presented which builds on knowledge gained from conversations with leaders in engineering education and participation in recent discussions within the engineering education community on this topic.

Ultimately, the authors agree with Cropley[6] that "the issue of compulsory accreditation of university teaching carries with it a range of political, social, and financial consequences". As such, the international aspect of this paper is important. Cultural differences will have an effect on solutions and implementations. There remains work to be done in uncovering the opportunities and challenges regarding potential implementation of aspects of these models in the US, and in clearly identifying critical elements that will be required for success in any endeavor attempting to bring formal faculty development activities leading to teaching qualification and recognition in higher education.

## 2. Overview of Existing Models around the World

Around the world, several programs to support professional qualification, development and/or recognition for those teaching in Higher Education are known. They vary considerably in scope, administration and reputation. However, the literature in this area is incomplete so some of the information provided here is based on personal experience and informal conference and workshop discussions.

An analysis of existing models reveals the following programmatic elements to guide comparison:

- Who is the governing association or body for the professional development program?
  These may be state entities, national or international societies, associations or academies, institutions, etc.
- Who is responsible for professional development program enforcement?
  Enforcement may occur through accrediting agencies, state agencies, institutions, associations or academies, etc.
- How is the professional development program implemented at the national level?
  The program may be nation wide, international, or locally controlled.
- How is the professional development program implemented at the local level?
  Internal or external personnel may coordinate, deliver, and document professional development activities. Mentors may or may not be used or required.
- How is the professional development program included in accreditation?
  Accreditation may require teaching certification for all or some faculty, documentation of professional development activities, or other teaching related items.
- Is participation compulsory or voluntarily?
  Participation requirements vary widely.
- Who is/are the target group(s)?
  While some countries focus on professional development for junior faculty, others address all those teaching in technical, engineering-related domains.
- What is the professional development program duration?
  There may be multiple sequential levels of professional development activities and/or achievement, and programs vary from short courses to continuous development.
- What is the professional development program content?
  Cultural expectations regarding teaching and learning can heavily influence the content of the professional development activities.
- How are qualifications recognized and/or rewarded?
  Relationships between tenure/promotion and professional development vary from non-existent to tightly coupled.

Clearly criteria, standards, and policy regarding professional qualification for teaching in higher education are unique to each nation's needs, interests, and cultural expectations. Initial training of university teachers has been established in every university in the United Kingdom, Norway and Sri Lanka and, as alluded to before, is becoming increasingly common in many other countries[7]. From beginning as small in scale, low in credibility and poorly supported, substantial training of 120-500 hours duration is now well embedded in many institutions across multiple nations, is often compulsory and is sometimes linked to probation or tenure. Major programs include a coherent series of meetings and various learning activities spread over a period of 4-18 months, usually with elements of both formative and summative assessment. Many of these programs are so-called postgraduate certificate courses subject to formal academic approval and quality assurance, which in addition lead to nationwide professional registration.

Significant progress with regard to professional qualification, development, and recognition of engineering educators has been made in the UK[8-12]. Every new tenure-track hire has to participate in and successfully complete a compulsory 30 credit hour accredited training program in Teaching and Learning in Higher Education to pass probation and earn tenure. Successful completion also leads to certification and professional registration, and hence nationwide recognition based on common standards.

While the UK system mainly targets those teaching at university level, within the European Union the focus is on all those involved with teaching technical, engineering-related subjects. The International Society of Engineering Education (IGIP)[13] at their headquarters in Austria have created a training program open to all "teaching teachers". Participation is voluntarily and often used as a means of continuous professional development to support career development. Successful completion of their program leads to professional registration as ING-PAED IGPP (International Professional Engineering Educator).

IGIP, together with SEFI, the European Society of Engineering Education[14] (the equivalent of ASEE in the US) represent the largest network of higher education engineering institutions and of individuals involved in engineering education in Europe. It promotes information exchange about current developments in the field of engineering education between teachers, researchers and students in the various European countries.

While both the British and the Austrian/International programs are accredited, other countries have just embarked on the avenue of professional educational training. In Australia, for example, a number of efforts have been initiated at the federal level to ostensibly track and improve teaching quality. However, some claim these efforts are based on criteria that do not have the strength to make real changes in the quality of teaching occurring in engineering[6]. However, there are individual institutions whose engineering programs have made first moves towards more formal requirements regarding teaching quality[15].

As yet, little is known about corresponding developments in Asia. Sources from Japan report on the development of a ranking scheme that links salary of faculty to practical experience of an educator in their chosen field[16].

### *2.1 United Kingdom: Postgraduate Certificate in Teaching and Learning in Higher Education*

In the UK, the governing body for the so-called *Postgraduate Certificate in Teaching and Learning* programs is the Higher Education Academy[12]. It is an independent organization that supports Higher Education institutions with strategies for the development of research and evaluation to improve the learning experience of students. The Higher Education Academy was founded in May 2004 from a merger of the Institute for Learning and Teaching in Higher Education (ILTHE), the Learning and Teaching Support Network (LTSN), and the TQEF National Co-ordination Team (NCT). The Higher Education Academy is funded by grants from four Higher Education funding bodies in the UK (HEFCE, SFC, HEFCW and DELNI), subscriptions from Higher Education institutions, and grant/contract income for organized initiatives. It is owned by the representative bodies of the Higher Education sector - Universities UK and GuildHE (formerly known as the Standing Conference of Principals). Subject specific learning and teaching issues are supported by 24 subject centers which focus on specific disciplines and are based in Higher Education institutions throughout the UK. The Academy is governed by a Board whose members are drawn mainly from institutional leaders and senior academics. There is also an advisory Council made up of Subject Centre representatives and Registered Practitioners. Day to day management of the Academy is undertaken by the Senior Executive Group (SEG).

The Higher Education Academy certifies individuals and the programs through which they are prepared for teaching in Higher Education. While the process is generic across disciplines, it does recognize discipline-specific paths. In the following, an overview of the UK's holistic approach to enhancing faculty development is presented using the program at Durham University as a case study.

### *2.1.1 Rationale, entry qualifications and recognition*

The *Postgraduate Certificate (PGCert) in Learning and Teaching in Higher Education* as delivered at Durham University, UK, between 2003 and 2005 is primarily designed for newly appointed full time academic teaching faculty. The program was developed in response to the requirements outlined in a UK Government's White Paper "The Future of Higher Education" (The Secretary of State for Education and Skills, 2003)[17] regarding the expectation that all new teaching faculty at higher education (HE) institutions would obtain a teaching qualification in accordance with nationally recognized professional standards. Successful completion of this program is part of the compulsory criteria to pass a three-year probationary period and earn tenure. In addition, the PGCert is considered suitable for established academics as part of their ongoing professional development (Baume, 2003)[18]. On successful completion, participants are eligible for certification and professional registration through the UK Higher Education Academy.

The Durham PGCert is based around reflection on a participant's teaching practice in higher education. In order to achieve the programs learning outcomes, participants have to experience breadth and depth to their Higher Education teaching experience for at least the duration of the program. This has to include: teaching, learner support, design and planning of learning and teaching activities, assessment and/or giving feedback, and the development of effective learning environments. It is assumed that all participants have earned at least a bachelors or masters degree. The following paragraphs will give an overview of this program as described in the original course handbook and module guides prepared by Durham University's Centre for Learning, Teaching and Research in Higher Education (CLTRHE, 2003-2005)[8-11].

### *2.1.2 Program aims and learning outcomes*

Program aims are:

- To provide an initial orientation to the learning and teaching issues that course participants will encounter in their professional teaching role (at the University of Durham) within the context of their discipline.
- To provide course participants with a learning environment which they can reflect on, and further develop, their professional teaching role and values expressed by the UK professional teaching bodies, namely The Institute for Learning and Teaching in Higher Education (ILTH) and the Staff and Educational Development Association (SEDA).
- To develop in participants an understanding of the factors that influence student learning, and an awareness of the implications that this has for a constructively aligned student-centered approach to teaching.
- To develop an appreciation of the potential role of e-learning within their practice.
- To instill in participants a reflective and innovative approach to their practice that they will take with them throughout their teaching careers.
- To enhance the conceptually underpinned professional teaching practice and the student learning experience (at the University of Durham).

Learning outcomes are:
On successful completion of the program participants will:

- Demonstrate knowledge and critical understanding of concepts embedded in the research literature on learning and teaching that are used to differentiate between qualitatively contrasting forms of learning and teaching engagement (for example, deep and surface level learning, study orchestration, conceptual dissonance, contrasting patterns of motivation, intention and self regulation, teacher-centered and student-centered teaching).
- Be able to demonstrate the professional HE teaching competencies and values expressed and required by ILTHE and SEDA.
- Be able to describe, interpret, evaluate, and reflect on their teaching practice in a theoretically coherent manner.

### *2.1.3 Structure of the program*

The program moves through three stages of professional development for university teaching: foundations, scholarship and reflection, respectively, in three compulsory modules although these themes are also integrated within each module. An overview is given in Table 1. Further details on individual module aims, learning outcomes, structures and content can be found in (Schaefer, 2007)[19].

| **Module:** | **Foundations of Learning & Teaching** | **The Scholarship of Learning & Teaching** | **Reflection on Learning & teaching: Portfolio** |
|---|---|---|---|
| **Credits (UCU)** | 15 | 15 | 30 |
| **Content** | This module offers an introductory framework for understanding the theory and practice of learning and teaching in HE, whilst also providing | Course members are taken beyond an initial reflection on their teaching practice, towards a deeper understanding of variation in student learning engagement, and of the | The development of a learning & teaching portfolio allows for the overall synthesis of research, theory and reflective practice. It provides an emphasis on the development of |

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| | support in the development of practical skills associated with teaching and learner support. These generic issues will be considered within the context of the particular learning and teaching context of the University of Durham. | philosophy of constructive alignment. This in turn provides the theoretical underpinning for participants to conduct research into how their students learn and an assessment of the implications of this for their own teaching. | reflective practice, underpinned by theoretical understanding and serves as an expression and justification of course participants' professional teaching knowledge and values. As such the module provides a structured process whereby course participants will reflect on and document their own practice and values in teaching and the support of learning in HE. This process will lead them to an espousal and justification of their own mental model of learning and teaching in HE. |
| **Delivery** | An initial 2 day block of workshops will establish the overall framework. Participants will then be established in peer learning groups in Durham's virtual learning environment duo. In parallel, course participants will be provided with optional opportunities for more practically oriented faculty development sessions, including those offered by Durham's ITS (Information technology Service). A half-day formative assessment event will be scheduled around 8 weeks after the initial workshops. The module is offered twice a year: one beginning in September, and one beginning in April/May. | A series of Wednesday afternoon workshops and seminars, led by institutional, national and international researchers in the field. | The module will commence with a workshop session introducing participants to the role, purpose and expected content of the portfolio, together with modules of reflection. A limited number of plenary workshops will be staged periodically throughout the module, but the portfolio building process will primarily be led by the course participants with the support of their departmental mentors, their peers, and the program team. Participants will be encouraged to use on-line discussion groups to share and discuss their emerging models of learning and teaching. Alongside this, experience gained through course participants' day to day professional teaching practice, and reflection on this, will form the major part of learning on the module. |
| **Assessment** | Drawing from peer discussion, formative feedback and from further independent reading course participants will submit a 2,500 word report for summative assessment in which they evaluate aspects of their teaching practice, with a requirement that this reflects at least two of the first four of the ILTHE's 'learning and teaching activities'. | The assignment for this module is research based. Course participants interview three of their own students as a means of constructing their own appreciation of variation in student learning within their own discipline context. An interview protocol is formatively assessed. Summative assessment is through a 2,500 word written report. | Formative assessment will be made up of at least two teaching observations (normally to be conducted by departmental peers). Summative assessment is through a reflective overview (maximum 5,000 words) and a portfolio of supporting evidence. |

Table 1: PGCert Module Overview: Content, Delivery and Assessment

At major universities, programs like that in Durham are usually implemented through their local centers of teaching and learning. These centers provide training to participants from all schools/departments. These schools/departments then usually provide discipline-specific mentoring to junior faculty going through the program.

While the professional development programs need to go through accreditation, they have not yet been included in accreditation of subject-specific engineering programs. However, more and more schools are seeking to increase their number of professionally trained educators in order to improve the quality of the education they provide as well as to visibly increase their professional competence to attract more funding from educational bodies. Another interesting development is that almost all UK Higher Education institutions now require a professional teaching qualification as essential criteria to be met when hiring new faculty.

## *2.2 Austria/Switzerland: International Society for Engineering Education – ING-PAED IGIP*

The International Society for Engineering Education (IGIP)[13] was founded in 1972 at the University of Klagenfurt, Austria . It created *ING-PAED IGEP*, an international register of qualified engineering educators who have gone through a curriculum which has been approved by IGIP and guarantees minimum standards in technical expertise along with a well-balanced competence profile for engineering educators. Those registered are designated as International Engineering Educators and can use the title *ING-PAED IGIP*. Registration is monitored through IGIP's national monitoring committee headquarters in Switzerland.

The society also serves as an accrediting body for training centers producing International Engineering Educators, whose teaching matter must conform to IGIP's curriculum for engineering pedagogy. From 1972 until today, IGIP has members in 72 countries and has consultative status with UNESCO and UNIDO. Participation in the *ING-PAED IGIP* program is voluntarily. It is an international program that can be completed by participants across the world. It is used mainly as a means of continued professional development for both recent graduates as well as experienced, more senior persons who are involved with teaching in a technical discipline.

### *2.2.1 Entry qualifications*

Eligible to participate in the *ING-PAED IGIP* program are all technical teachers who are:

- engineers according to IGIP principles and have studied according to the
- IGIP curriculum studies at accredited institutes
- plus have one year of teaching experience.

### *2.2.2 Curriculum overview and recognition*

IGIP has established a curriculum for engineering pedagogy which is used in several countries. This curriculum is a modular system which consists of core modules (8 Credit Points), theory modules (4 Credit Points) and practice modules (8 Credit Points). The core modules include theoretical and practical engineering pedagogy as well as laboratory methodology. The theory modules include psychology, sociology, ethics, and intercultural competencies. The practice modules consists of oral communication skills, scientific writing, working with projects, media, e-learning, and computer aided technologies and an elective module from additional topics.

The basic curriculum comprises of a minimum of 204 sessions covering the following subjects:

- Engineering education (36 sessions)
- Engineering education practice (36 sessions)
- Educational technology (at least 12 sessions)
- Laboratory didactics (at least 12 sessions)
- Comprehensible text creation (at least 16 sessions)
- Rhetoric (at least 12 sessions)
- Communication and discussion training (at least 32 sessions)
- Selected principles of psychology (at least 16 sessions)

- Selected principles of sociology (at least 8 sessions)
- Principles of biological development (at least 8 sessions)
- Other subjects (at least 16 sessions)

IGIP promotes their curriculum by stating that "Both the Register and the title "ING-PAED IGIP" will generally improve the position, role and responsibility of engineering educators in society."

### *2.3 European Society for Engineering Education (SEFI)*

The European Society for Engineering Education[14] is the leading organization for engineering education in Europe and is commonly known as SEFI, an acronym for its French name, Société Européenne pour la Formation des Ingénieurs. SEFI was founded in Brussels, Belgium in 1973 and has 196 institutional members in 38 countries. It promotes information exchange about current developments in the field of engineering education between teachers, researchers and students in the various European countries. Additionally, it facilitates cooperation between higher engineering education institutions and promotes cooperation with industry. It also acts as a link between its members and other collaborating scientific and international bodies such as its European sister organization IGIP, the American Society for Engineering Education, and the Board of European Students of Technology.

The objectives of SEFI are achieved through the activities of thematic working groups (curriculum development, continuing education and lifelong learning, physics, mathematics, women in engineering, ethics, information and communication technologies) and through the organization of Annual Conferences. The *European Journal of Engineering Education* published by Taylor and Francis is the official journal of SEFI. Together with IGIP both societies represent the largest network of higher engineering institutions and of individuals involved in engineering education in Europe.

### *2.4 Australia: UNESCO International Center for Engineering Education (UICEE)*

The UNESCO International Centre for Engineering Education (UICEE)[20] is based in the Faculty of Engineering at Monash University, Melbourne, Australia, and began its operation on 1 January 1994. The Centre operates under the Directorship of Prof. Zenon J. Pudlowski. Prof. Harold P. Sjursen, Associate Provost, Polytechnic University, Brooklyn, New York, USA, is Chairman of the UICEE Academic Advisory Committee (AAC). The Deputy Chairmen of the AAC come from high ranking academic positions the current members are from Poland, Russia, and India.

The mission of the UICEE was developed in accordance with the principle of global solidarity. The key objective in the Centre's operation is the sharing of knowledge and expertise on engineering education through its role as an information broker. The Centre has persistently carried out a wide range of activities in engineering and technology education in order to assist developing countries and countries in social, political and economic transition to improve and advance their education systems. As an advocate and facilitator of the sharing of knowledge, the

UICEE espouses the solidarity of humankind and aspires through its work to achieve genuine and lasting peace.

### *2.4.1 General discussion in Australia*

Cropley[6] offers that a number of efforts have been initiated at the federal level to "establish a range of quality issues in recent years", but goes on to state that these efforts have resulted in criteria that do not have the strength to make real changes in the quality of teaching occurring in engineering. He also points out that accreditation for Australian programs in engineering is purely voluntary. In contrast to these approaches, Cropley calls for a national compulsory accreditation scheme that requires a formal qualification in teaching. Although this type of move does not appear to be on the current national agenda, there are individual institutions whose engineering programs have made moves towards more significant requirements in teaching quality for their engineering programs. One such program[15] began implementation in 2004 at Curtin University of Technology where a Teaching Quality Improvement Process (TQIP) was created within a framework aimed at creating greater accountability regarding teaching. In this process each department is required to clearly and formally demonstrate their teaching effectiveness and identify areas for improvement.

### ***2.5 Japan***

In Japan, the current discussion on Engineering Education with regard to professional development appears to be driven by three aspects: salary, practical experience and societal status[16]. Many engineering teachers are not satisfied with their salaries and initiated a process of professional certification leading to salary structures based on the rank of certification. The rank of certification mainly depends on whether or not a teacher has practical professional experience in his chosen field of expertise. More recently, there has been a call for engineering teachers to gain more societal recognition by improving their international contacts, language ability, and ability to communicate internationally, which may also affect the ranks of certification.

## 3. Activities in the US

At the national level in the United States, the National Academy of Engineering (NAE)[21] supports a Committee on Engineering Education which is currently studying the issue of how to identify and enhance the use of quality metrics for

> "assessing the "instructional scholarship" of higher education faculty and provide a set of recommendations about how such metrics could be augmented, combined or modified in a way that leads to greater use and acceptance of such a metric among engineering faculty. The outcome of the process will be the development a framework by which to explore the development and implementation of metrics for instructional scholarship within the discipline of engineering"[21].

This report is in progress and should become available after July 2008.

In contrast to the direction of work by the NAE, recent discussion with ABET leaders[22] indicates little desire to bring any kind of teaching certification or assessment of teaching quality into the assessment process. The feeling within the ABET community appears to be that outcomes assessment should sufficiently address issues of teaching quality. This approach, however, does not take into account the potential to address student learning (and thus learning outcomes achieved) that might be possible if faculty in higher education were required to actively develop teaching skills towards achieving some level of officially recognized training/proficiency. Nor does this approach support any shift in faculty reward systems towards valuing teaching more as suggested through the broadened definition of scholarship presented in Boyer's seminal work[23].

Finally, 2005 saw significant discussion among many influential members of the engineering education community. These discussion stretched across the American Society for Engineering Education Conference[2] and Frontiers in Education Conference[3].

The first of these involved a working session with the purpose of addressing the following two questions: (1) How should we structure a reward system for teaching? and (2) How can we reach beyond the choir? Results from these discussions indicated the importance of validity in peer evaluation and whether external evaluators should be considered, the necessity of multiple modes for evaluating teaching, and the need for valued rewards and reward systems which genuinely recognize the importance of teaching.

This discussion was followed a few months later by a panel discussion organized by Norman Fortenberry. In this session Eli Fromm led a discussion addressing the question of whether or not there is a realistic means of adapting some components of models such as those in the UK to the US engineering education community in order to establish some sort of credentialing system. Discussion included the idea of a "faculty guild" which might define core competencies in engineering education that could be nationally comparative, or standardized, across all disciplines and institutional types.

Finally, it should be noted that three programs granting degrees in engineering education have been formed recently and that, at the community college level, at least one very large school has implemented a college-wide requirement for teaching scholarship. The engineering education degree granting programs are located at Purdue University[24], Virginia Tech[25], and Utah State University[26], while Florida Community College at Jacksonville now has a college-wide requirement for teaching scholarship[27]. The formation of these programs and requirements may well be very influential in future expectations regarding the teaching of engineering within higher education in the US.

## 4. Lessons Learned

Gibbs and Coffey[7] investigated the effectiveness of university teachers' training involving 20 universities in 8 countries. In their study they showed evidence of a positive impact on teachers and on students' ratings of their teachers, when compared with a control group (that did not change or got worse over the same period). A group of teachers in training and their students were studied at the start of their training and one year later. A control group of new teachers (who had received no training) and their students were studied in the same way. Evidence was reported for changes over time relating to three measures: (i) student ratings of their teachers; (ii) the extent to which teachers described themselves as teacher-focused and/or student-focused in their approach to teaching; and (iii) the extent to which these teachers' students took a surface approach and/or a deep approach to learning.

In a detailed study of a training program designed explicitly to change teachers' conceptions of teaching, Ho et al.[28]demonstrated the following chain of influence: training goals and training processes → teachers' approaches to the teaching and learning environment → their students' approaches to learning. This is important since conceptions of education (and misconceptions as well) tend to drive educational approaches which in turn influence how students study and, ultimately, what types of learning outcomes are achieved.

Based on both statistical evidence (such as that alluded to in the studies above) as well as a substantial amount of informal and anecdotal evidence, the success of professional development programs in the educational sector has encouraged more and more countries across the world to begin to implement various types of programs. There is also a growing demand for professional certification and registration in the educational sector. Long-term, this might have a significant impact on faculty recruitment, promotion and tenure, salary development, and from an institutional perspective accreditation and fund raising. While these statements appear to hold true in general, there does not appear to be any single "best option" to be implemented within the US in the short term considering the current cultural and societal context.

## 5. Closing

In this paper, an overview of models of professional qualification, development and recognition for those teaching in Higher Education selected from across the world was presented. It has become apparent that many countries have realized the benefits and value that professionally qualified educators may add to their institutions, education of their future leaders in engineering and science, and hence society in general. Furthermore, there is evidence showing the positive impact of such programs. As such, even more countries, including the US, have at least joined the discussion.

As far the US educational sector is concerned, the introduction of professional development programs for faculty as well as professional certification and registration are still a highly controversial socio-political topic. For the time being, the question is "How do we proceed from here"? Based on the review summarized in this paper, a potential roadmap and a set of recommendations for addressing professional qualification, development and recognition within the US context are being developed. A brief outlook is presented below.

### *5.1 Opportunities and Challenges in Professional Education-related Faculty Development in the US*

It is highly reputable and even mandatory to participate in many professional activities (such as qualifying on examinations, consulting, appraising, surveying, etc.) to be registered as a Professional Engineer (P.E.). This provides some reasonable guarantee of quality in the engineering work that certified P.E.s do. However, there is no such system regarding teaching qualifications in higher education in the United States.

In Utschig and Schaefer[29] opportunities and challenges relating to the concept of implementing a formal education-related faculty development program on a large scale are outlined through an exploration of the following questions: What would be the benefits of a formal educational professional qualification to US higher education institutions, their faculty and students, industry, and society as a whole? How can resources be synergistically integrated to support such an effort? What are the major challenges or barriers present that must be overcome in order to create such a system?

In response to these questions, the authors are developing a concept map to explore how faculty professional development in education could support and enhance the entire higher education community revolving around teaching and learning. They have also begun to summarize, within the US context, the pros and cons of a number of programs worldwide, and, finally, explore resources needed to establish such programs. Utilizing and reflecting upon the literature, major issues considered include the roles of various members in the higher education engineering community, the relationships between educational research, engineering faculty, and student learning outcomes, the various monetary support structures related to engineering education, and the implication of different models for reward structures related to teaching and learning.

### *5.2 Critical Elements for Future Programs Seeking to Establish Excellence in Engineering Education through Professional Qualification of Faculty Teaching in Higher Education*

Nationally, the engineering education community has advanced over the past several decades to a point where sufficient resources, knowledge, and expertise are available not only to meet the needs of but also to dramatically impact the performance expectations of faculty, students, employers, and institutions of higher education. Within this context, a professional qualification for educators could potentially be highly beneficial to the US higher education system.

In Utschig and Schaefer[30] three critical elements needed for any successful US program seeking to establish excellence in engineering education through professional qualification of faculty teaching in higher education are presented. Specifically, the following questions are addressed: Who could be sponsoring societies? How could communities of professional practice be built? What levels of qualification standards are feasible and appropriate? What are the minimum standards to be met (institutional, statewide and/or nationwide)? What are the potential elements of technical content of such programs? How could such programs actually be implemented in practice? Specifically, building on concepts well grounded in the literature, this work addresses the questions above within the context of three critical elements for future programs seeking to formally recognize excellence in engineering education.

1. Programs should evolve and be supported by a *nationally respected society or academy*.
2. Programs should be supported by *qualifying criteria or standards at several levels* of expertise with clear criteria at each level and should include both practicum and training components.
3. Programs should accommodate *flexibility in implementation.*

When developing any professional development program to support and recognize teaching excellence (whether in the US or elsewhere), carefully considering these critical elements will aid in producing measurable improvements in student learning outcomes and help foster vital and robust communities of practice within engineering education.

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