



Continuing Education and Training of Academic (Teaching) Staff and (Teaching) Change Agents for Engineering Education: Concept and Program for Developing Teaching and Improving Learning at University (name)

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for Engineering Education:
Concept and Program for
Developing Teaching and Improving Learning
at Technische Universität Berlin/Germany**

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Abstract

Technische Universität Berlin (TU Berlin) is a traditional research university and one of the largest technical universities in Germany. Currently, about 30,000 students are enrolled with admissions of more than 5,000 new students per year in various bachelor's and master's programs and in PhD studies, primarily in engineering and architecture, mathematics, and natural sciences, fewer in humanities, social sciences, and economics. The teaching staff comprises only about 300 full-time professors, about 20 junior professors, few full-time and part-time lecturers, but nearly 2,500 research and teaching assistants.

Current challenges for teaching and learning are caused by recent structural and curricular changes of the undergraduate and graduate programs, focusing more on the achievement of competence-oriented learning outcomes than on the delivery of content. This contradicts with partly traditional learning environments, in particular big classes with 1,000 or more students in introductory STEM-lectures. New teaching/learning arrangements are needed to increase student engagement, promote independent and active learning and raise student success rates.

How can the teaching staff be motivated and qualified to create and implement this environment and establish an innovative and interactive teaching/learning culture? The approach of TU Berlin is twofold:

first, to train the academic teaching staff individually to develop their pedagogical competences theoretically and practically with respect to interactive teaching and learning methods; and

second as a new approach, to hire and train additional teaching "change agents" who are supposed to develop innovative teaching projects and to disseminate good practices in teaching and learning enhancement among faculty and their fellow teaching staff.

This paper describes both the curriculum to qualify academic teaching staff and a model curriculum to qualify those in the new staff category, who are charged to function as "change agents." Experiences are discussed and a desirable profile of competences is outlined. The organizational structure of this paper covers "Introduction and Background," describing teaching at German universities and TU Berlin, "Questions and Overviews," highlighting the European Bologna-process and the research basis and framework for our continuing education program for teaching. The central chapter, "Program and Methods," focuses on general aspects of the target groups of regular academic teaching staff including additional offers, and teaching change agents. "Chances and Challenges" highlights quality assurance of the program and evaluation instruments. "Results and Recommendations" name the professional certificate and future assessment by interviews as well as a short list of the most successful training efforts for new teachers and some transferable elements for the adaption of our concept to other existing programs. Finally, "Conclusion and Outlook" names first effects, the future focus and expected outcomes.

Introduction and Background

In comparison to the USA, the faculty structure and composition of the teaching staff at German research universities have different roles and responsibilities, recruitment requirements, career levels, and designations for teaching staff. In the organization and delivery of the necessary teaching and student assessment provisions, relatively few tenured full professors are supported by comparatively few teaching staff members and external part-time lecturers, but by a huge number of so-called “assistants.” These assistants usually are young graduates with a master’s degree, hired shortly after their graduation. Professors and assistants are required to perform research and to teach. This is a result of the traditional and highly appreciated German “Einheit von Forschung und Lehre” (the unity of research and teaching), intended to guarantee the most up-to-date delivery of content using methodological approaches at the forefront of research and practice. In the environment of a research university, professors and assistants tend to focus more on research than on teaching. In addition to teaching, assistants are supposed to finish a PhD degree and contribute to the research of the department, institute, or work of a related professor. Comparing the German system to the American one, the main difference is that German teaching assistants are engaged with their PhD studies (thesis) as contribution to department research, in addition to the requirement of teaching 4 hours weekly. One problem lies in the contracts of the young assistants, which are mostly limited to only 5 years. Recruited on the basis of their excellence in a specific discipline or subject area, assistants usually do not possess a pedagogic qualification or prior teaching experience. It therefore requires positive efforts to train them to be effective pedagogues. Learning to teach is not part of undergraduate or graduate engineering programs. Instead, students may have availed themselves of elective pedagogical training opportunities, or they may base their approaches to teaching on their own experiences working as a student tutor or their own learning experiences. Primarily, however, competency as an instructor has to be acquired through continuing education. In addition to training on the job and learning by doing and imitating, German universities offer various continuing education programs to qualify young teaching staff and newly recruited professors or junior-professors. Sometimes these are compulsory, but most are voluntary.

The teaching staff at TU Berlin comprises, in addition to approximately 300 full-time professors who teach 9 hours per week, nearly 2,500 research and teaching assistants, working under 5 year contracts. In addition to working on their doctoral thesis, these researchers and instructors are required to teach at least 4 hours per week. The target group for improved teaching and learning processes are mainly students in engineering studies and STEM-courses. The organizational frame and structure for the pedagogical continuing education program for the academic staff of TU Berlin is the Centre for Scientific Continuing Education and Cooperation. Since 1995, it has offered a modularized program of courses for regular academic teaching staff on a voluntary basis. In addition, and as a new approach, the Centre for Scientific Continuing Education and Cooperation began two years ago to provide a tailor-made program to qualify teaching change agents, who are hired specifically to implement and disseminate innovative teaching and learning arrangements in crucial subject areas. As preparation for this specific role, the “change agents” are required as part of their contracts to participate in the pedagogical and didactic training program.

The “change agent” as a new category of teaching staff with instructional qualifications are perceived as key success factors of the Project TU wimiplus which is one of the projects – funded by the German Federal Ministry of Education and Research – to provide better study

conditions and to improve the quality of teaching and learning at TU Berlin. They develop and implement innovative teaching concepts for their own subject-specific teaching. An additional task is to provide counseling and workshops about good teaching practice in their fields to colleagues.

Questions and Overview

What kind of “change” is targeted? Which processes of change are to be initiated? The European Bologna process started 15 years ago with the so-called “Bologna Declaration”. Meanwhile 48 European countries are signatories of this process which aims at a common “European Higher Education Area” (EHEA) with comparable degrees and degree levels, a common credit system, agreed quality standards and a mutually recognized system of quality assurance. Instead of very diverse structures of Higher Education in Europe, the common reference is now - like in the USA - a consecutive system of three levels and respective programs of study for Bachelor, Master and PhD-degrees. For many European countries including Germany this was a tremendous challenge as their universities had to reshape their 5 to 6 year programs leading directly to a master degree level by implementing an additional exit level and a Bachelor type of degree after 3 to 4 years of study.

In addition to the structural changes, a common “Qualifications Framework of the European Area of Higher Education” was adopted in 2005¹. This Framework defines qualitative level indicators to enhance quality and facilitate comparability. Based on the so called “Dublin Descriptors”, developed in 2003, five categories of learning outcomes and graduate attributes are named: Knowledge and understanding, Applying knowledge and understanding, Making judgements, Communication, Lifelong learning skills. They are specified for the three degree levels. As they are generic, they need to be detailed for particular disciplines or programs. The orientation on threshold levels of graduate attributes also promoted a “Shift from Teaching to Learning”. The focus on learning outcomes and the need to provide evidence that required outcomes are achieved resulted in significant changes of curricula and of teaching and learning environments. The emphasis now is less on the delivery of content than on creating specific student learning outcomes through the appropriate organization of learning arrangements.

Engineering education in addition is challenged by requirements to adapt to new demands of employers and society, fast changes of science and technology and the need to attract students and to increase the retention and success rates. Therefore, addressing the issue of how to enhance teaching and learning and how to contribute to higher study success rates raises the question: Are there special teaching and learning processes for future engineers? A basic assumption is that innovation in engineering education needs to emphasize problem-based and project-oriented, example-based, interdisciplinary as well as team-oriented or participant-centered learning approaches. In our efforts to train teaching staff, we focus on activating teaching methods, active learning processes, and collaborative learning. We face this challenge by adopting good practices from the corresponding literature² as well as developing our own good practices³ for our continuing education program. The enhancement of study quality in accordance with the “shift from teaching to learning” demands modern approaches to teaching and learning and implies a focus on active learning. Consequently, demands on the competencies of individual teacher and the curricular necessities emerge as challenges to continuing education.

Meanwhile, most universities accept “scholarship of teaching and learning” as a professional concept for academic teaching staff and for responsible professors, even if acceptance is still

in its early phases. In addition to a professional specialization in a subject area, the concept also requires pedagogic competences and involvement in education research. Therefore, the professionalization of the teaching role is promoted. Especially for engineering graduates who pursue an academic career, teaching is an essential area of their professional life and should be a central topic in the professional field of their continuing education efforts.

To qualify all teaching staff in all phases of their teaching careers, the TU Berlin enlarged the offerings and processes for preparing teaching staff for scientific and educational training purposes and service. The development of the new curriculum and therewith the learning outcomes for desirable teaching competences are largely based on the research basis, analysis, and the frame provided by the German Association for Teaching in Higher Education (dghd) as part of accreditation procedures. Accordingly, elements of a recommended curriculum include competences for analyzing learning situations and learning processes; planning for studies, study sequences and study modules; planning and “staging” of learning situations; teaching and facilitation of learning; consultation on study goals, study strategies, study planning; consultation on learning strategies, learning tasks, learning problems, working, examinations, and evaluation.

Desirable attributes for continuing education offerings for teaching in higher education are described with the following organizing principles and subjects of recent discussion: reflexivity, reform orientation, participant orientation, problem and activity orientation, focus on learning, variety of methods, internationalization, scholarships of teaching, consistency, sustainability and transfer.

By means of a Delphi survey of German-speaking experts on teaching in higher education, a demand-oriented, sustainable model of didactical competences for teaching in higher education has been developed. For teaching, the following ranking of the 10 most important competences has been compiled: knowledge of (didactic) methods, professional knowledge, supporting independence, self reflection, enthusiasm, competence orientation, communication skills, participant orientation, concept competence, use of methods and change of perspectives. The model also describes competences for processing examinations and academic self-administration.⁴

Program and Methods

The competence development of teaching staff at TU Berlin starts with a curriculum for the qualification of academic teaching staff in general and focuses on different types of support for new teachers. It contains educational theories, active learning methods and teaching instruments as a basic pedagogy for new engineering faculty members. The basic and specialized courses, which are offered within the accredited program for teaching in higher education, are listed according to general aspects of teaching, activating teaching and teacher-oriented methods, as well as examination and evaluation issues. Structuring the program according to “activating teaching methods” and “teacher-oriented methods” permits the course issues to be organized methodically and with regards to contents according to practical teaching settings in projects and lectures. The underlying principles of continuing education offerings are oriented towards managing classroom and (learning) group activities and concentrating on innovative “classroom” techniques.

To promote the Bologna reforms to enhance student learning, it has been helpful to provide different course contents and curricula for the competence profiles of academic teachers on the one hand and change agents on the other. While the training of general teaching

competences includes innovative teaching methods and normal changes to teaching processes, change agents undergo targeted preparation to implement clearly specified changes to courses, labs, and other teaching and learning environments. The content of the training for change agents is based on the existing accredited program for teaching and learning and complemented by tailor-made offers to support individual and curricular needs. The continuing education efforts are used for teachers at different career phases at TU Berlin:

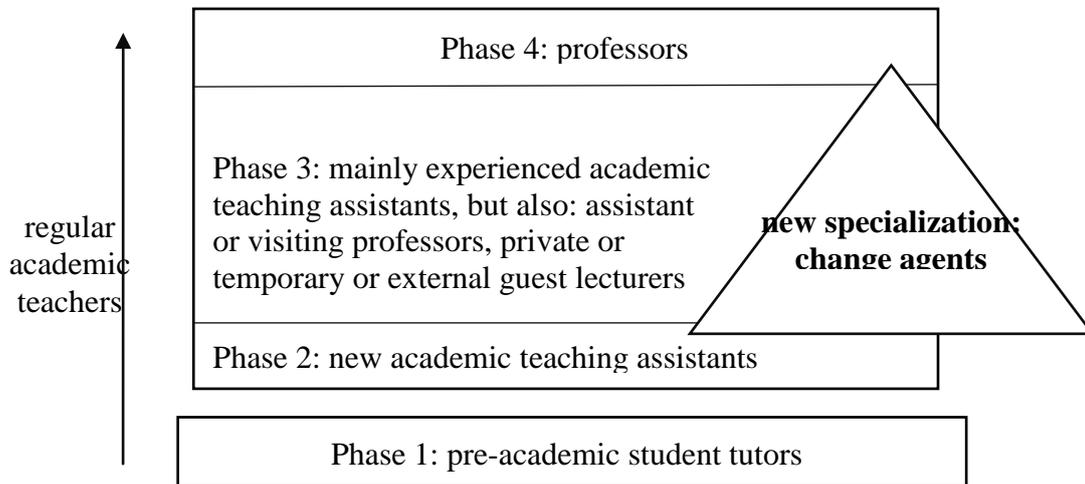


Fig. 1. Model of change agents within regular teaching staff

The following sections concentrate first on the program for regular teaching staff, in particular the assistants, and second on the program for teaching change agents focusing on learning and qualification goals, profile of competences and tasks, and continuing education program.

1) Regular academic teaching staff⁵

Learning and training for scientific teaching staff of the continuing education program as a target group is oriented towards activation and motivation, fostering exemplary learning and reduction of learning materials, is oriented towards problems and holistic concepts, includes special teaching methods for engineering subjects, is interdisciplinary and intercultural, supports the change of perspectives and follows the sandwich principle (change of active and passive learning phases). It also includes video-supported feedback.

Central intentions for a profile of teaching staff – besides technical or engineering expertise – are conceptual and planning activities, interdisciplinary activity, intercultural competence and a didactic attitude as role model, mentor, trainer respectively lecturer or teacher.

The individual training curriculum consists of three levels of qualification:

1. Level: Introductory course “Teaching for University’s Best”⁵

New academic teachers are the target group. Active participation in the introductory course is required for successful training (total: 60 hours). Topics cover basic methods and contents to improve the quality of teaching in higher education: criteria for good teaching, planning and performance of a seminar or lecture, aspects of teaching design, use of media, micro teaching setting, presentation and video-supported feedback, difficult situations, tests and exams. The participants are motivated to visit the lectures of colleagues to promote the exchange of

experiences, and reflection on and consequences for their own teaching. This is a face-to-face course with theoretical topics and talks as well as comprising a number of single tasks and working or learning in small groups. It provides written materials for course learning and for later individual study. We offer the possibility for the group to meet virtually in an online forum to exchange experiences and to continue with subjects according to participants' needs.

2. Level: Training program "Quality enhancement for teaching at university"

We expect active participation at least five teaching modules which the individual may select (total minimum: 100 hours). The fully modularized package for advanced continuing education consists of 18 teaching modules (eight basic modules and ten advanced modules), each of which lasts from one to three days. Spread over a period of five years, the workload is 265 contact hours plus an average of 20% of time spent on independent learning. Basics include: planning and designing teaching and learning, promotion of learning in lectures and large groups, project work and project-based learning in higher education, basics of how students learn, traditional media in teaching and learning, new media in teaching for beginners, evaluation of teaching in higher education, and competence-oriented assessment, grading, and examination. Advanced topics are: communication and group dynamics for teaching staff, resolving difficulties to ensure successful teaching, enhancing key competences by games, gender in teaching and learning, intercultural communication in teaching and learning, planning a presentation or lecture for an English-speaking audience, presentation techniques, learning techniques and organization of scientific work, moderation in teaching and learning, working with problem based-learning, and management of the learning process.

3. Level: Documentation and reflection of teaching experience

Active participation in the workshop "teaching portfolio – concept and teaching philosophy" is expected along with the written development of an individual teaching portfolio in German or English on teaching activities, including two coaching sessions and final talk (total: 50 hours). This instrument is suitable for implementing a quality assurance through self-reflection; to develop, describe, and evaluate an own teaching project; to initiate expert and peer observations of the teaching lesson, peer consulting, and peer tandems.

Additional offers

Parallel courses and other offerings are recommended: a lecture series on academic teaching methods offers regular open access to information on latest the developments in the discussion about good teaching in higher education. National and European experts are invited to talk about their perspectives and share experiences about their professional background on teaching matters. This is completed by informal monthly meetings for counseling, consultation hours, and a telephone hotline for teaching questions.

Especially for teaching professors, we have established individual coaching packages and expert observation of lectures with personal feedback as new measures.

The supportive offers include a wide range of written material for deepening self-studies, a book series on good teaching practice^{3,6}, and an online forum for experience exchange.

A desirable composition of competences associated with our teaching profile is fundamentally similar for all regular teaching staff, but in some respects broader for change agents as will be outlined in the following section.

2) Teaching change agents⁷

The unique qualification of the change agents demands a selection of academic teaching staff that shows a strong affinity towards teaching and dissemination tasks, as well as good project management skills. This new special personnel profile and expansion of the roles of regular academic teaching staff requires a focused preparation for these tasks and takes place in two fields: change agents learn and work in a project-team (along with other faculty) and in a teaching project with students. Outlining the desirable profile of competences, the roles of innovative teaching change agents could be...

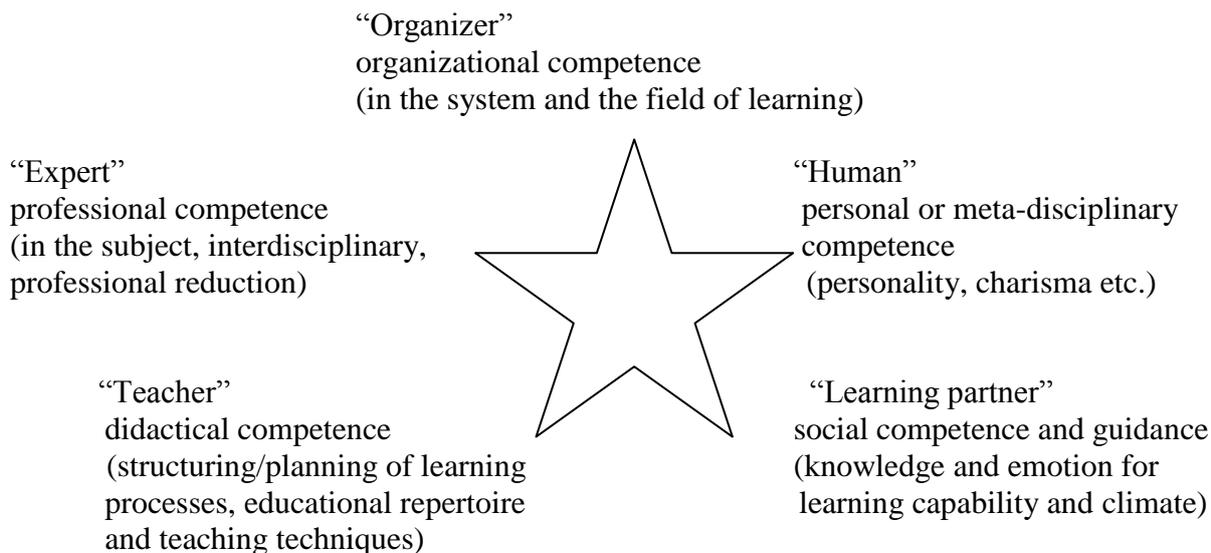


Fig. 2. Competences for (teaching) change agents⁸

To define what a change agent is, it is helpful to see what their main job is. They have different roles and multiple tasks, especially in the process of qualifying students and teaching colleagues. Their main job is a supportive function: to establish new teaching and learning situations and to disseminate innovative didactic interventions.

Change agents' tasks are ...

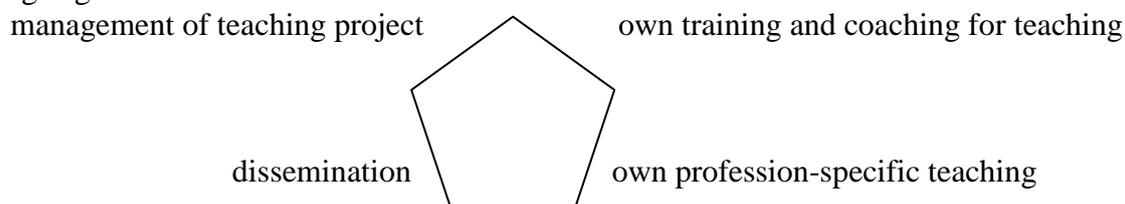


Fig. 3. Roles of (teaching) change agents⁶

How much training do they have? The change agents' role and how they prepare in their qualification process to act as consultants and disseminators to their teaching colleagues is listed in the following survey:

Table 1. Roles, tasks and training for (teaching) change agents

Roles and tasks	Corresponding training
Teaching: own profession-specific teaching in the engineering study subject	courses in the regular continuing education program
Training: teaching in higher education and professional comprehensive counseling and supervision for the development of professional competences	ensured by: workshop on counseling competences, single and group coaching, regular topical meetings, including subject-specific teaching, lecture series on teaching in higher education
Project: development of innovative teaching curricula	a team-building kick off-event and a training module for project management skills and didactic concepts of curricula for teaching projects ⁹
Dissemination: good teaching practice in (didactical) training at least twice each year (most frequent example: teaching staff conference). These activities aim at training peers within the faculty, preparation of the whole team for examinations, colleagues within the project.	continuous training, workshops and coaching for disseminators on teaching in higher education, for knowledge sharing and self-study, a maintained interactive internal online forum on teaching in higher education is available.

The following table describes a model curriculum draft for the qualification of a change agent's profile. It is derived from the draft of the recent exemplary curriculum we have offered to the first group of change agents. It has been developed in cooperation with the participants' demands and curricular needs and the trainers' teaching purposes.

Table 2. Model curriculum for (teaching) change agents

Time	Continuing education	Tailor-made offers	Support program
1 st semester	introductory course	kick-off workshop	coaching, peer observation of teaching, project jour fixe (implementation, to be continued in the following semesters)
2 nd semester	brain-friendly learning, activating teaching methods, project work and problem-based learning	planning workshop for teaching projects	workshop for reports
	imparting knowledge and presentation techniques in lectures	development of a dissemination workshop	workshop for writing: attractive advertising of innovative course offers
	classical and digital media in the teaching process	digital media: participatory tools	online forum for exchange of experiences and self-study
	assessment and grading	workshop: grading papers and tests	lectures on examination techniques
3 rd semester	moderation of learning groups	workshop: reflecting dissemination work	the student generation today: their goals and possibilities
	managing difficult teaching and learning situations	workshop: active methods for diverse classrooms	lecture on learners' diversity
	feedback and quality management	evaluation: activity-oriented questionnaire	preparation of self-evaluation and reflection: teaching portfolio
	research based teaching and learning	workshop: inverted classroom techniques	workshop: fund-raising for teaching projects
4 th semester	development of key competences	results of teaching projects and dissemination activities	workshop: networking for lecturers
	studying technique and work organization	planning of future strategies	knowledge management workshop: handing over the baton

Semester 1 starts with the introductory course for teaching activities and the kick-off workshop for the project members. At the same time, the permanent supporting events like coaching, peer observation of teaching and project jour fixe are implemented.

Semester 2 concentrates on the two main lines of teaching, following results of findings on brain-friendly learning: activating teaching methods, project work and problem-based learning, as well as imparting knowledge, and presentation techniques in lectures and large classes. The basic aspects and methods of the change agents' teaching projects and their disseminating tasks are planned and prepared. This is framed by techniques for the use of classical and digital media as well as the application of assessment and grading. The consolidation is reached by tailor-made individual offers. A report and material for promotion are developed.

Semester 3 is focused on moderation and difficult situations in learning groups as well as diverse students' characteristics. The link between research and teaching is addressed. With regard to quality management, the teaching projects and dissemination workshops are evaluated and modified where necessary. Furthermore, self-evaluation of teaching key competences with a written teaching-portfolio is fostered.

During semester 4, networking and handing over the baton are initiated. Preparations for the implementation of the teaching project start. This and planning future strategies (also based on former fund-raising activities) will be the main challenge for all change agents. This model curriculum is finalised after four semesters teaching and qualifying as a change agent. It is followed and supplemented by individual and team coaching, didactic monitoring of the teaching projects, jour fixe- and networking meetings as well as tailor-made offers according to individual demands.

Chances and Challenges

The above described model curriculum for change agents has been developed on the basis of evaluation, theoretical considerations, and discussions with the change agents and responsible experts as a consequence of the experience derived from the pilot project. The reach of the program is the creation of a new special profile within the structure of academic teaching staff.

Quality is assured by the evaluation of all didactic measures: lectures, projects, workshops, and coaching. Findings and evaluation results of continuing education courses are documented in yearly reports. Quality assurance underlies the accreditation process in five-year intervals.

The methods of assessment of the effectiveness of this program are the following quality measures. The evaluation instruments include all phases: before, during and after the training, view both perspectives: of participants and trainers, focus on topics: satisfaction and assessment of learning goals und activities, choose trainers: by recommendations, assessment, teaching portfolios, drafts, detailed programs, include thorough documentation: teaching portfolios, learning materials for participants, results of evaluation in reports, accreditation.

A questionnaire for the recruitment processes is used in interviews with job applicants at Tu Berlin to reflect on prior teaching experience and teaching concepts. The application procedure for full professors contains as a compulsory element a written teaching portfolio based on recommended guidelines and provision of a compilation of teaching materials and former continuing education measures.

Results and Recommendations

For the regular academic teaching staff, we offer a professional certificate with a performance record on all three levels. We certify that the following requirements have been fulfilled during the participant-focused program: at least 80% active attendance in a minimum of 5 modules (respectively 10 days), video-supported didactically prepared individual presentations, moderation of group discussions and presentations of findings from group work, self-determined learning with individual preparation and post-processing and specialization, peer observation of teaching, critically written documentation and self-reflection of past and current teaching experience. Successfully completed means that the requirements listed above have been fulfilled satisfactorily.

The teaching change agents can acquire a certificate based on their active participation in all continuing education courses. Additionally, we will certify the individually acquired competence profile gained in tailor-made courses as described in Tables 1 and 2 and the development and written documentation of the teaching project and their fulfilled dissemination tasks.

Recommendations for future assessment could be interviews with those who have acquired our certificates for teaching staff or for change agents. Objectives could be to reflect both the integrated vision and general overview on the alumni's learning process within the continuing education program and the individual improvement of teaching competences. This could provide a holistic view on the learners' development and the learning outcomes as well as help to further develop the systematic program, support individual learning, and future professional perspectives.

A short list of the most successful training efforts we have identified as being most effective for preparing new teachers to teach (in addition to learning by doing and learning by imitating), includes active learning of teachers in learning groups, peer observation of teaching, oral and written reflection of own teaching, interdisciplinary exchange of teaching experience, application of scientific results for teaching purposes, comparison of different teaching philosophies, video-supported feedback to individual teaching performance. Our teacher trainings focus on transfer of contents into daily teaching. All theoretical and methodical issues are practiced and exercised in the training courses, the experiences are reflected and support for successful transfer, and application is provided. Learning contracts include learning goals and change purposes of course participants.

Some transferable elements for adaptability of our concept to other existing programs or schools are a clear task-oriented description for the change agents' profile in the profession-specific area, an integration of this position into departmental structures and professional networks with other change agents, a permanent support and assessment of the change agents by tailor-made and general didactic continuing education, the development and evaluation of teaching projects in the change agents' and the departments' professional teaching field. This model curriculum for change agents can provide orientation. Depending on existing continuing education offers for teacher training at other universities, an adaption might be necessary.

Conclusion and Outlook

After two years a final conclusion is not possible. The current group of change agents will first foreseeable reach their qualification goal and certificate in a year. The evaluation⁸ of the success of changes to studying, inspired by the innovative teaching projects, shows as a first effect an improved success rate and an increase of students' progress in the innovative teaching and learning situation in some lectures. One future focus will be to pay more attention to the range of students' activities and how these activities can be fostered systematically. Another option is to build up informal and formal support structures for the daily work and quality management of the teaching staff. The potential future work and perspective will extend at least until 2016 (end of project phase I) and 2020 (estimated end of project phase II). Expected outcomes that will result from this work are a model curriculum for teaching change agents, experiences with disseminating specific didactic approaches and innovative good teaching practice within the faculty. This also implies an improvement of study success rates and better teaching and learning processes in engineering studies for both academic teaching staff and students. Hence, we describe the creation of a new, special personnel category within the structure of academic teaching staff. One open question is how the change agents individually can use the competences acquired during the continuing education and practical work with the teaching project and dissemination tasks. However, the implementation of the necessary change also requires organizational and curricular development in addition to staff development. This presents an issue to consider in the future.

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