

“Good Teaching Practice” at DTU Systems Biology - Sustaining quality in teaching and learning

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ABSTRACT

Success in developing teaching and learning in engineering education in general, as well as in a CDIO context, depends on continuous development of teaching competences among faculty members. Thus, it is essential to develop systems that promote understanding of how teaching and assessment can support student learning within disciplinary knowledge as well as development of professional skills. Development and maintenance of high quality teaching and learning furthermore requires that teachers have the ability to reflect critically on their teaching activities and understand its impact on the students' learning process. To succeed in reaching these goals, development of teaching competences and knowledge in the fields of teaching and learning must be combined with continuous possibilities to reflect on teaching practise in a structured way. Development of successful teaching also requires that faculty members are inspired and encouraged to try new ways and methods in teaching, and gaining an extended understanding in how students learning can be efficiently supported.

In this paper we describe a novel initiative, a concept of Good Teaching Practice, that has been developed through a process involving faculty at the department of Systems Biology at the Technical University of Denmark. The GTP initiative addresses important factors for effective teaching and enhancement of student learning. On the surface GTP is structured as an online tool, which makes six statements about important factors that support student learning that the teachers at the department are supposed to consider. This is coupled to a wiki-based web resource for sharing good examples from teaching practice among faculty. By formulating a teaching and learning profile at the department level the importance of teaching for the department are emphasized and at the same time, the wiki-based resource for sharing teaching experience shows that teaching is a shared responsibility among the entire faculty. On the website, the theoretical framework underlying GTP provides a shorthand introduction to the important prerequisites for students learning and provides definitions that provide the faculty members with a common language to use in discussions of teaching and learning. The GTP concept addresses standard 10 in the CDIO context which focuses on the enhancement of the development of teaching and learning at department level and provides the teachers with tools to conduct teaching proficiently.

KEYWORDS

Teaching and learning development, teaching competences, enhancement of quality in engineering education

INTRODUCTION

At the Technical University of Denmark several activities has been initiated at the university level in order to support the teaching and learning development at the university. LearningLab DTU, the central unit for development of teaching and learning, run a compulsory teacher training program for all new faculty. They also give seminars and short courses on teaching matters and are involved in the development of e-learning tools and participate extensively in evaluation of courses and educations. Those activities provide DTU with a good frame to 1) develop teaching methods to enhance learning, 2) to enhance the understanding among DTU faculty of the prerequisites of student learning and 3) develop teaching competences at the university.

Even if all the necessary prerequisites for faculty members to develop their teaching competencies and to understand the important factors in student learning are available at a university, it is still a challenge to secure conversion of the theoretical knowledge into teaching practice. High quality in teaching requires that this transmission is actually taking place to support student learning efficiently, to motivate the students in their performance and to support retention. This has been one of the main challenges in Higher Education in the past decades [1].

The most important objective during teacher training is to ensure the creation of a loop of quality enhancement where teachers implement adequate teaching methods for support of the intended learning outcomes, and assesses the students in accordance with these [2]. Constantly the teachers should take student evaluation into account and conduct self evaluation in order to develop their courses and teaching.

A development like the introduction of the GTP concept depends on many factors at the organisational level and its development depends on support from administrative structures and incitements [3]. The importance of teaching and learning to the department may be communicated to the faculty, and the organisational culture may or may not be supportive to new initiatives in teaching and assessment methods. In the supportive environment initiatives may be encouraged and praised, while alternatively in the non-supportive environment the same initiatives may be regarded as waste of time. The view on course evaluations is interconnected with this attitude. Evaluations may be seen as a tool for improvements or alternatively as a necessary control mechanism. The latter view could result in the conservation of the teachers' approaches to teaching and learning as it becomes important to act on safe ground instead of try out new methods. A solid base for quality enhancement of student learning can only arise in a working environment where teaching and learning are openly discussed and regarded as important aspects of the faculty profession, and in which the teacher should continue to improve their abilities to create a successful learning environment. This fruitful dialogue among faculty members about teaching and learning within special disciplinary subjects is one of the most important prerequisite for ensuring and sustaining quality in engineering educations [4].

These prerequisites are addressed in the CDIO-initiative in Standard number 10, "Enhancement of Faculty Teaching Competence". Standard 10 stresses that "if faculty members are expected to teach in new ways, as described in Standards 7, 8 and 11, they need opportunities to develop and improve these competencies" [5]. Examples of actions that enhance faculty competence such as "support for faculty participation in university and external faculty development programs, forums for sharing ideas and best practices, and emphasis in performance reviews and hiring on effective teaching methods" are described [5].

Department of Systems Biology at DTU consider teaching as one of the most important activities, and has a long tradition of encouraging developments in this field. To further improve the student learning environment a decision was made to invite the entire faculty to take part in the development of the departments teaching and learning. One of the initiatives was to meet a number of issues commonly addressed in the course evaluations. This development was primarily aimed at taking the step from teachers simply attending courses and taking teacher training programs to create a culture at the department where the knowledge each teacher possesses could be used for a general and common development of the teaching and learning at the department.

An essential part of the project was to provide the faculty members with a tool to encourage deep learning among the students and the knowledge to create a good learning environment in the courses and educations at the department. The project was also aimed at creating possibilities for a dialogue among faculty where teaching and learning was the subject. Development of a community of practice and the sharing of good teaching practice in order to fulfil those aims has previously been described by Wenger (E Wenger). The result of the current project is the concept of "Good Teaching Practice", abbreviated as GTP. GTP is a web based tool with six standards that was found to be important for faculty members in their teaching practice. The web based GTP also contains short explanations of why those standards are important, and a wiki-based resource where teachers can upload and share examples from their teaching practice.

This paper describes the development of the GTP concept and the implications and ideas behind it. Some experiences from the short time after its implementation will also be addressed.

The problem addressed is how to ensure and sustain quality in teaching and learning in an engineering education with focus on student learning, coupled to motivation and development of faculty skills in this area. Many of the activities during the development of the GTP concept are found in CDIO Standard 10. This paper will examine some of these activities in relation to the process in developing the GTP concept and their benefits to the department of Systems Biology at DTU.

PREREQUISITES FOR A SUSTAINABLE TEACHING AND LEARNING DEVELOPMENT

In CDIO standard 10 enhancement of faculty teaching competence are dependent on the following prerequisites

- Majority of faculty with competence in teaching, learning, and assessment methods, demonstrated, for example, by observation and self-report.
- University's acceptance of effective teaching in its faculty evaluation and hiring policies and practices
- Commitment of resources for faculty development in these skills [5]

Those statements clearly indicate that teaching and learning development need to be framed at the organisation level but also need to be supported by a general acceptance that quality in teaching is prioritized high enough to motivate a busy university teacher to improve in this field.

Motivation is the key factor if any busy professionals should chose to use time on changing the way they act and think. Naturally, this is also one of the central prerequisites for involving university teachers in developing teaching and learning [6]. In teaching and learning development at universities there are special factors, based upon the university context which has an impact on the motivation of faculty members. The priorities of a faculty member at a university need to be balanced between many tasks. Boyer analyzed the role of university faculties and pointed out that a number of tasks are important in the post modern society, for the education of highly qualified professionals. Different tasks are needed to produce knowledge and research of high standards, to contribute to innovations and to ensure that this knowledge is used and spread, and all tasks have to be performed in a scholarly way [7]. Many complex tasks are thus required of the universities and their faculty, and here engineering educations receive special attention from society because engineers and engineering knowledge is considered to play a central role in meeting new challenges today and in the future. In many reports evaluating engineering educations, e.g., Sheppard et. al [8], these issues are addressed. The special awareness and attention required from teachers in engineering educations is addressed in the CDIO initiative [5]. In the first phases of the faculty-driven GTP project at DTU Systems Biology both motivation and prioritizing of high quality teaching among other duties at the department level were recognized as extremely important. Ownership of the GTP context and the acknowledgment of prior experiences as valuable were found to be motivating factors for commitment to the development of the concept. Difficulties in implementing new ideas and activities in an organisation may be reduced if the development process is taking place within the organization and is performed by the persons that are influenced by the changes [9]. Faculty involvement in a bottom-up process was one of the bearing ideas in the development of the GTP concept, and benefitted from the large body of experiences and knowledge about teaching and student learning among the staff at the department. When messages were communicated from the department administration these emphasized the importance of creating a good learning environment for the students at the department. The learning-focused approach was a highly motivating factor in the development of GTP.

In the overview by Southwell and Morgan concerning the impact of research activity on academic staff development and leadership, the authors come to the conclusion that the contextual elements in which university teachers work and teach have shown to be one of the most important factors in the creation and sustain of teaching and learning development [10]. These ideas were taken into consideration during the GTP process to create a community of practice [11]. One prerequisite to creating a community of practice within teaching is to provide the teachers with adequate knowledge about student learning and about how this can be supported during teaching. During the GTP process the participants set out to present this knowledge in a very simple format of one-liners, trying to capture the interest of the audience.

EXISTING INITIATIVES AT THE DEPARTMENT SERVING AS A PLATFORM FOR THE GTP PROCESS

DTU Systems Biology already housed a variety of structures and activities to support teaching and learning development, when the decision was made to develop the GTP concept. These structures are described below.

Infrastructure for teaching and learning development at DTU Systems Biology

DTU Systems Biology has a long tradition for a high priority of teaching and development of teaching competencies. This view has been clearly communicated from the head of the department, as well as from the management level. As other departments at DTU a director of studies has been appointed, who also is the head of the study board. The study board comprises an equal number of students and faculty members. The board takes initiative to different projects in teaching and learning, point out relevant and important questions in this area, go through course evaluations and arrange seminars about teaching and learning regularly at the department. Some of faculty members in the study board have been appointed study leaders for the various educations hosted by the department. In view of the importance of these tasks, study leaders have been appointed for each separate education, i.e., two bachelor study leaders and two master study leaders.

Another part of the educational infrastructure are a number of pedagogical peer coaches, serving as educational supervisors that coaches new staff members towards efficient and high quality teaching at DTU. This peer-coaching serves as a part of the compulsory teacher training programme. Because of the teacher training programme, younger faculty members share a common educational background in teaching and therefore share the same language and ideas about teaching and learning, including the role of teaching at universities. A common language is central for sharing teaching experiences with each other, and to participate in discussions about teaching and student learning on an overall level. The teacher-training program includes a project based upon actual teaching practice of the students.

The department hosts a number of docents, i.e., professors appointed with special tasks in development of teaching and learning which met regularly with the study leaders and the institute head, for discussions on future educational initiatives and developments in the different programs.

To ensure a continuous discussion on teaching and learning among faculty-members, as well as to stimulate the staff to try new methods the director of studies is semi-annually organizing teaching and educational seminars, where different aspects of high quality teaching and assessments.

Together the infrastructure at DTU Systems Biology provided a platform for discussions, debates and dialogue about teaching and learning at the department that enhanced the development of the GTP concept.

Student dissatisfaction leads to initiation of the GTP process

While the department had created a culture where teaching and learning could be discussed and developed in dedicated circles, there were still evident problems in ongoing teaching activities and courses. Student evaluations of certain courses showed recurring problems and students were often complaining to the department head, when they were asked about their satisfaction. To meet those challenges the department head offered the management the task of formulating a set of statements that emphasized the most important elements in good teaching for creation and sustain of the prerequisites for efficient student learning. Those statements should also increase the understanding of good learning in courses and education programmes. For the department educational infrastructure those statements should also point out the requirements that every teacher in the departments was supposed to live up to. All the points should be in accordance with current knowledge about optimal

teaching practice. Professional support in formulating the statements was obtained from LearningLab DTU, the central teaching and learning-developing unit at DTU.

THE GTP PROJECT ON GOOD TEACHING PRACTICE

At the onset of the GTP project, the department tried to take into account the important factors in organisational developing processes that aim at creating sustainable changes, as mentioned previously in this paper, Therefore a more extensive process was implemented to define a set of statements describing good teaching practise, and ensuring that they agreed with the current research in the field of teaching and learning in higher education. Representatives from faculty at the department were invited to join the process, in order to root the concept in the department, and to ensure the relevance of the results for the teachers. A project steering group was formed consisting of the director of studies at the department, representatives from faculty, an educational consultant, and representatives from the department management and administration. The resulting project was launched under the name "Good Teaching Practice" concept, or GTP for short.

Student involvement and focus on student learning

The students following the education programmes at the department of DTU Systems Biology played a central role in the development of the GTP concept. Thus, in the initial phase of the process, students at different stages in their educations, were invited to define what they considered to be recurring problems, and to include their experience in how an optimal learning environment is achieved in different types of courses.

Resulting from this meeting were different student statements that could be structured logically into areas that required further improvements to strengthen the students' learning. Among the important insights were that the students lacked a sense of coherence and progression in the education programmes, they experienced little variation in teaching methods and a lack of continues feedback. With a departure in this feedback, the educational consultant could list a number of means to solve these problems, based upon the theory of student learning in higher education.

The meeting with the students also prompted the assigning the year 2010 to be the year of teaching at the department, where teaching and learning should be in focus. The meeting also resulted in the launch of a teaching debate forum in the form of a blog, where students could write about their experiences from the courses at the department.

Working process involving faculty

To facilitate a sustainable development in teaching and learning it was decided to involve faculty as much as possible in formulating and structuring the statements on good teaching. As mentioned, the strategy was to root the concept in the faculty that should end up using it, so that already existing knowledge and experiences at the department would come into use, as well as to ensure that the end-product would be relevant for the teachers. Therefore the process started with meetings among faculty members to share experiences that each felt could improve teaching. Thereby the concept was implemented directly from the beginning and a sense of ownership for the concept could be created at the department.

It was concluded that it was important to depart from the conclusions from the student meetings to and implement the theoretical knowledge about teaching and learning in higher education in order to develop an evidence based theoretical frame in the concept.

The faculty groups were formed with representatives from faculty around the structured themes. All faculty members were invited, and almost half of all members took part in the process. Groups discussed the meaning of each student derived theme and its implications for teaching and learning at the department. The teachers also shared examples from their own teaching practices and considerations about what they thought were of importance for good teaching practice. The results from the group discussions were structured and edited by the educational consultant in cooperation with the rest of the project group, and further discussed in the working groups in an iterative process.

Along the faculty group meetings there were regular seminars about teaching and learning at the department addressing the work on GTP in order to involve as many faculty members in the process.

The final result was edited by the project group and launched as a web-based tool.

GTP, GOOD TEACHING PRACTICE, - THE CONCEPT

On the surface, GTP is a web-based tool consisting of three levels. Six statements are formulated as “punch lines” about important factors that support student learning in higher education. The six statements concern the planning and conducting teaching with emphasis on student learning, and how to evaluate student learning and teaching in courses:

- Identify the level of your students
- Teach the important aspects
- Encourage deep learning
- Ensure coherence
- Ask students for advice on teaching
- Learn from your colleagues

Among the six central statements that define the GTP core, the last one addresses the fact that faculty need to continually develop their teaching competences and contribute to the discussions about teaching and learning at the department.

Each statement is followed on each new web page by explanations of why that particular statement is important in relation to teaching and learning in higher education. The theoretical frame in GTP rests on the phenomenographic focus on the importance of deep approaches to learning among the students [12] as well as the models of Constructive Alignment and intended learning outcome in course planning [2].

The third part of the GTP concept consists of a toolbox in wiki-format where relevant material and examples from teaching practices at the department are compiled and described. From this toolbox, faculty can get ideas and inspiration from each other on how to apply the six statements in practice. The main purpose of the toolbox is to provide a forum for faculty members where they can be inspired and share experiences from their teaching practice at the department. Materials of relevance from other universities are also available in the toolbox.

The role of the GTP concept is twofold. Its primary role is a supporting tool for the teachers when planning and conducting teaching, but it also serves as a teaching and learning profile at the department.

EXPERIENCES FROM THE DEVELOPMENT OF THE GTP CONCEPT

In order to follow up how the objectives in the GTP project have been met, and to get knowledge about how GTP concept, an initial evaluation has been made. At the time of the evaluation the GTP concept, the web-page had been available at the department for about six months.

Focus groups interviews with 11 out of 55 faculty members were held. The 11 participants were divided in two groups. The topics for the interviews were, how they perceived the GTP concept and how they used it, and if they had done so - under which circumstances.

Some of statements were made by faculty members following both groups. The conclusions from these statements are listed below.

- The process of creating the GTP was very good and useful since it has catalyzed an habit of discussions with colleagues about teaching and student learning at the department.
- Faculty members do not use GTP on every day base.
- If a teacher run into problems about teaching in courses this will be the time to turn to the GTP concept in order to get things right.
- When courses have to be changed or new ones invented, GTP may be very useful.
- Faculty members have gained a greater awareness about the coherence in the education programmes at the department, as well as the importance of considering the position of each course in this coherence.
- Faculty members have learned to know their colleagues better.
- Faculty members have gained insight in how many different methods can be used in teaching and assessment, and that not every teacher does the same. Their conclusion is that they can learn from other teachers and are more interested in trying new methods.
- It is useful to gain knowledge about different examples from teaching and learn from the experiences of other teachers and that they are easy to get access to in the wiki, because they have so little time to find out about new teaching methods in their every day work.
- Faculty members think that GTP will be to a great help for new teachers at the department.
- It is very useful and good that teaching, through the GTP process, has been recognised as one of the main activities at the department and that is now is acknowledged that time and resources also can be spent on teaching an course development.

CONCLUSIONS

So far we may conclude from the GTP project on developing a Good Teaching Practice concept at the department level, that a sustainable development of teaching and learning can

be successfully initiated by fulfilling theoretical requirement stated in the CDIO standard 10 and evidence based studies about learning and development in organisations.

Bringing academic staff together to discuss teaching and learning and by bringing these discussions in the official context of the departments running activities has shown to have a strong impact on creating a consciousness that teaching and learning is a prioritised field. There are some indications from the interviews that many faculty members actually think that research must be the area of highest priority because the importance of teaching is not always explicitly communicated and discussed, neither is the incentive for delivering high quality teaching as evident as the incentives for performing world-class research. The reason for this could be that teaching traditionally is regarded as a private matter resting on traditions that do not need to be openly discussed. An open and structured discussion supported from the management level, signals the importance of continuously developing teaching practices.

Another result of cross-faculty discussions seems to be the recognition that good teaching can be developed and trained instead of being regarded as a gift some teachers are naturally given.

Teaching and learning in higher education is a research field with scholarly knowledge. This is extremely important when trying to enhance the quality in teaching and learning. If this knowledge is used in the everyday teaching practice, this may be the crucial factor for recruitment of students to engineering educations and for providing them with an efficient and motivating learning environment. Early indications suggest that a process like the GTP at DTU Systems Biology, where teachers are actively involved formulating standards for good teaching, can contribute to this. A clear communication and support from management level and staff allocated to take the responsibility for teaching and learning development at the department are important to ensure a sustainable development in this area.

To create a sustainable teaching and learning development there must be clear objectives and a clear frame that sets some standards and contribute to create an understanding among teachers why the criteria are important to fulfil in their teaching practice. To succeed, there must be support systems to provide faculty with structured knowledge about teaching and learning in higher education in addition with a cultural context at the department where teaching is acknowledged as an activity of high priority.

Most important is the creation of a motivating and inspiring learning environment for faculty about teaching and student learning. Inspired teachers with a curiosity to explore teaching and its impact on students learning is the best guarantee for a sustainable teaching and learning development. It is also a guarantee for the motivation of student to obtain high quality learning in courses and educations. Future experiences from the GTP concept and the process started at DTU Systems Biology to create a sustainable teaching and learning development at department level will hopefully bring more knowledge how CDIO standard 10 can be ensured in engineering education.

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Biographical Information

Lars I Hellgren holds a PhD in Plant Physiology from Gothenburg University and was employed as Assistant Professor at the Technical University of Denmark in 1997. He has worked as Associated Professor at Department of Systems Biology at DTU since 2001 and was appointed as Director of the Bachelor programme in Human Life-Science Engineering between 2005 and 2010. Between 2008 and 2010 he also holds the chair as Head of Education and Chairman of the Department Study Board. For the time being, is group leader for the "Systems Biology of Immune Regulation-group", at the Center for Biological Sequence Analysis.

Mogens Kilstrup holds a PhD in molecular biology at the University of Copenhagen and was employed as assistant professor at the Technical University of Denmark in 1994. He has worked as Associated Professor at Department of Systems Biology at DTU from 2000 to 2008 where he was appointed professor with special responsibilities within teaching. From

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