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Published in:
Proceedings of the 37th SEFI conference, World Trade Centre Rotterdam 1 - 4 July 2009

Publication date:
2009

Document version
Publisher's PDF, also known as Version of record

Citation for published version (APA):

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Download date: 03. Aug. 2019
Development of paradigm for teaching portfolio (TP) in Danish engineering education

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Abstract
Increased focus on quality of education and the need for a method for development and documentation of teachers’ pedagogical competencies has given rise to cooperation between the engineering education institutions in Denmark. A project team representing engineering education in Denmark has jointly developed the model for TP, which is expected to be implemented from 2009. The model will serve as a tool for continuous pedagogical documentation, reflection and development of the individual teacher and his teaching practice. The model is a recommendation for how to structure TP in engineering education and is a tool and a method to support the individual teacher’s development of his teaching and personal competencies. The model consists of two parts, a public presentation portfolio and a private working portfolio. The presentation portfolio typically consists of educational CV, including the teacher’s fundamental pedagogical view and a description of the teacher’s teaching practice. The working portfolio is where the teacher works with his own descriptions, thoughts and analysis of his teaching. The structure of the TP has been tested in assistant professor courses and on a group of teachers before it was completed, in order to test the accessibility of the model, and the matching guide for the model.

Keywords: Staff development, Accreditation and Quality assurance, Teaching Qualification in Engineering Education, Teaching Portfolio.

1. INTRODUCTION
In recent years the development of quality teaching in engineering education has come increasingly into focus. Throughout the world several universities have introduced teaching portfolio as a tool for development of the teaching staff [1, 2, 3, 4, 5, 6]. Karolinska Institutet and Uppsala University have described in detail how to do a teaching portfolio and how to make this count in merits [1, 2, 3, 4]. It is described in [5] that there has been an increasing requirement to present teaching portfolio in UK due to the focus on quality teaching. Another example on the focus on quality teaching is the development of the ING-PAED IGIP concept [7]. This concept has been developed and discussed in IGIP (Internationale Gesellschaft für Ingenieurpädagogik). ING-PAED IGIP is a concept for certifying a certain educational level in pedagogy for a teacher, trainer or instructor. To register for the professional register as "International Engineering Educator ING-PAED IGIP" you will have to meet the IGIP standard in this field. New requirements are being imposed for teaching quality in higher education, both externally and internally. These requirements are seen, for example, in connection with quality control of higher education, which now occurs in a systematic way in Denmark by virtue of ongoing evaluation and accreditation, where educational institutions must be able to document good quality learning outcomes for the students [8]. As a consequence of this, there has also been an increase in requirements for the educational institutions to secure pedagogical competence development of teachers, and within the organisations there is intensive work on development of teaching and competencies of teachers, e.g. on appointment, new teachers must either be able to document that they have sufficient teaching competencies or undergo pedagogical training in the first few years following their appointment.

There is now a broad recognition across the sector of an increasing need to be able to document the teaching and developmental credentials of teachers in relation to their teaching performance, and a working group under the Ingeniøruddannelsernes Samråd (forum for engineering educations in Denmark) has developed a model [9] for TP to create the framework for a joint reference for (all) engineering education in Denmark within this area.
1.1 Purpose
The model for TP has been prepared as a recommendation as to how TP in engineering education can be structured in the form of guidelines and criteria for what material should be included in the portfolio. The model also provides a method for how the process surrounding reflection on teaching and learning can be set in motion and continuously developed through the individual personal description, analysis and assessment of the teaching worked on in a TP. Through the process of reflecting on one’s own teaching competencies and documenting them, the teacher increases his or her awareness of these competencies, and how they can be further developed. The work on TP should be seen as a supplement to other education and competence development within educational pedagogy and learning, and TP as a tool provides teachers with an opportunity to profile themselves and to develop as teachers.
As well as a collection of the teacher’s educational material, a TP is a practice-oriented tool and a method for supporting the individual teacher’s development of teaching and his or her own competencies. The model has been prepared as an operational tool with associated guidance (in Danish) that provides the opportunity to:
1. Function as a tool for continuous pedagogical documentation, reflection and development for the individual teacher and his or her teaching practice.
2. Document the pedagogical development of the individual teacher.
3. Promote pedagogical profiling.
4. Promote pedagogical knowledge sharing, including between colleagues.
5. Form the basis for documenting the teacher’s pedagogical competencies, e.g. on appointments.
6. Be comparable across courses of study and educational institutions.
7. Document teachers’ pedagogical competencies, e.g. in connection with accreditation and external evaluation.
8. Form the basis for dialogue on pedagogical development during employee reviews and salary negotiations.

Before the end of the project, the model was tested at a workshop, attended by both assistant professors undergoing pedagogical training and experienced senior lecturers with many years’ teaching experience. The conclusion at the workshop was that the tested model with a few amendments can be used by teachers when they have to prepare their teaching portfolio. After the workshop, the final version of the model was drawn up, and has subsequently been issued in booklet form [9]. The model has also been applied with success on the basic pedagogical course within the Educational Network of the Engineering Programmes (Ingeniøruddannelsernes Pædagogiske Netværk IPN).

1.2 Parts of the TP
The TP model, shown in figure 1, has both a documentational purpose and a more personal developmental perspective. This means that the model is divided into a presentation portfolio (public part), which comprises an Educational CV and a Teaching Practice Description, which shows how the fundamental pedagogical view comes into play in teaching practice and contributes to the students’ learning results; and a personal part, which consists of the Working Portfolio. The working portfolio includes evaluations, log books, learning results, etc. and ideas concerning further teaching development.

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**FIGURE 1. Teaching portfolio model**

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It is important to note that the content of different teachers’ TPs will never be the same, but will depend on the individual teacher’s experience and the purpose of the TP.

1.2.1. Educational CV
The educational CV comprises the first part of the presentation portfolio. It consists of the following obligatory elements, fundamental pedagogical view, teaching experience and pedagogical training which as a minimum should be described. The points mentioned in “4. Other things that may be included” may be described as required or preferred:

<table>
<thead>
<tr>
<th>1. Fundamental pedagogical view/idea (obligatory)</th>
</tr>
</thead>
<tbody>
<tr>
<td>• A description of the pedagogical ideas that form the basis for the selection of teaching methods in relation to practice. The description is important, as it forms the guiding principle for the rest of the TP. It is important for the description of the fundamental pedagogical view to be expressed in relation to the teacher’s own understanding of teaching, so the reader can gain an insight into the considerations and outlook that lie behind the fundamental pedagogical view.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>2. Teaching experience</th>
</tr>
</thead>
<tbody>
<tr>
<td>• A listing of teaching experience. It is up to the individual teacher to determine how much to include. Relevant points that might be included are, for example, extent and duration, number of students, type of instruction, method of evaluation. A guideline with examples (in Danish) is available on the model’s website.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>3. Pedagogical training</th>
</tr>
</thead>
<tbody>
<tr>
<td>• A description of relevant formal pedagogical training, e.g. basic teacher training course, professional postgraduate teacher training for university lecturers, Master’s degree in educational theory, etc.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>4. Other things that may be included:</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Pedagogical job functions</td>
</tr>
<tr>
<td>• Current and previous formal pedagogical job functions in addition to teaching, e.g. head of studies, student adviser, programme coordinator, member of academic study board, member of pedagogical networks, assistant professor adviser, etc.</td>
</tr>
<tr>
<td>• Short courses in educational theory</td>
</tr>
<tr>
<td>• Teacher training courses not covered by item 3 in the educational CV. As a starting point, all courses leading to a qualification are included.</td>
</tr>
<tr>
<td>• Conferences (with or without a paper)</td>
</tr>
<tr>
<td>• Participation in relevant pedagogical national or international conferences (e.g. SEFI) with a brief description of the conference theme and a reference to any paper written for the conference, if relevant.</td>
</tr>
<tr>
<td>• Pedagogical development project</td>
</tr>
<tr>
<td>• Participation in internal and external pedagogical development projects.</td>
</tr>
<tr>
<td>• Contributions to pedagogical development</td>
</tr>
<tr>
<td>• Relevant contributions to pedagogical development not covered under the items above. An example could be participation in the planning and holding of conferences, inspiration or participation in pedagogical development projects and pedagogical networks, etc.</td>
</tr>
<tr>
<td>• Informal course on teaching and educational theory</td>
</tr>
<tr>
<td>• E.g. colleague mentoring, teaching development initiated on the basis of the individual teacher’s interest, etc.</td>
</tr>
<tr>
<td>• Other courses and work that have pedagogical relevance</td>
</tr>
<tr>
<td>• Courses that do not naturally belong under the items covering pedagogical training and course activities. E.g. courses that do not in themselves have a pedagogical purpose, but may be useful as pedagogical tools in connection with teaching.</td>
</tr>
<tr>
<td>• Other</td>
</tr>
<tr>
<td>• A description of other relevant pedagogical conditions that are not naturally covered under the items above.</td>
</tr>
</tbody>
</table>

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TABLE 1. Content of educational CV

See also section 2.1.1.
1.2.2. Teaching practice description
The other part of the presentation portfolio, the teaching practice description, contains selected examples from teaching, a description of targets for the person’s own teaching development and pedagogical competence development in the future. It also reflects how the teacher’s fundamental pedagogical view and other pedagogical competencies are translated into teaching practice. See also section 2.1.2.

1.2.3 Working portfolio
The working portfolio is the personal part of the TP, where the teacher documents and works on his or her own descriptions of, thoughts on and analyses of his or her teaching. The working portfolio is important for the TP, as it constitutes the background for the material selected for the presentation portfolio and forms the basis for the teaching practice description.
Examples of subjects that may be documented in the working portfolio could be:
- Teaching methods
- Examination and other evaluations of students’ learning
- Course evaluations
- Log book of teaching
- Learning results (students’ papers, essays, procedure descriptions, etc.)
- Examples of work with feedback to the students on their results
- Considerations in connection with planning of courses and evaluations
- Considerations in connection with experiments in teaching
- Educational material
- Notes on benefits arising from participation in courses
- Notes from own teaching practice
- Other notes
- Literature that has inspired development of teaching
- Targets for future development.

See also section 2.1.3.

2. PREPARATION OF TP
The work on the TP is a cyclic process, with development taking place in a continuous interplay with teaching practice. Conclusions in the TP influence the person’s teaching, and correspondingly, new experiences in teaching will mean further development of the TP and of the teacher’s understanding of his or her teaching practice and any need for competence development.

2.1. Process for preparation of TP
A possible method for preparation of the TP, which has been tested in connection with the work of the project group, could be to use the following process in connection with the preparation of the initial TP. First prepare the educational CV, then the working portfolio and finally the teaching practice description. The teacher is thus led through the process in a natural order that progresses through all the items. It can be very individual how a teacher prefers to work on his or her TP, and there is nothing to prevent him or her approaching the process in a different way. Some will no doubt prefer to work on all three parts at once, and it is up to the individual teacher which method is chosen on the basis of that person’s own starting point.

2.1.1 Educational CV
When a teacher first begins work on preparation of a TP, it is recommended that the first thing to do should be the educational CV, which provides an overview of the person’s teaching experience and means that the process has been set in motion.
2.1.2 Working portfolio

The working portfolio, see section 1.2.3, deals with both the person’s own teaching practice evaluation, and with the development of his or her thoughts and ideas on teaching. The working portfolio is personal and depends on the teacher’s experience of teaching. In the working portfolio the teacher has the opportunity to maintain and document his or her teaching work and development as a teacher.

The documentation consists of a number of examples of teaching materials, notes about what the teacher experiences through his or her teaching, as well as considerations of evaluations from students. It may also include materials concerning teaching that the teacher considers to be relevant to document.

The most important purpose of the working portfolio is for it to function as a tool that the teacher can use to remember, document and regularly follow up on his or her teaching experience. The working portfolio and the work on this helps the teacher become more aware of his or her own role as a teacher and can also be used to describe competencies and experiences in different contexts. It may be helpful to the teacher to consider the following when evaluating or analysing his or her own teaching:

- What methods were chosen during this teaching assignment or on this course?
- What was it that meant that these were chosen?
- How did it go?
- What improvements might be appropriate for next time?
- How were the student evaluations used, and how are the results of these connected with the teacher’s experiences of teaching and the students’ learning?
- Have these new experiences led to anything being revised in the fundamental pedagogical view?

As illustrated in figure 2, the working portfolio employs a cyclic process where work is continuously being done on teaching. In connection with teaching, what happens in the teaching situation is observed and recorded. The observations are noted and kept. Other things to be kept might be video recordings, activities on smart boards or similar. On the basis of this, a number of documents or other form of documentation are created.

The next phase (reflection) is considerations and reflections on the basis of what was observed. What went well or less well, and how does the teacher carry over the good choices for the next time? This phase also results in a number of documents or other form of documentation. This documentation is included in the working portfolio together with the material from teaching sessions and the observations. The final phase in the process (planning) is where forward planning for future teaching assignments takes place, and where, on the basis of observations and reflections, new ideas are conceived, new teaching activities are found and ideas are obtained from literature or colleagues. The new initiatives can then be tested in practice and the continuing analysis work can continue in the same circle.

This continuing process may ultimately cause the teacher to revise his or her fundamental pedagogical view.

FIGURE 2. Cyclic process
2.1.3. Teaching practice description

The presentation portfolio’s teaching practice description describes and documents the practice that characterises the teaching carried out by the individual teacher. The teaching practice description will typically be a selection of the material produced by the process documented in the working portfolio. The teaching practice description may also, where relevant, refer to the educational CV, so both parts appear as a single unit.

The teaching practice description, which may have a defined aim, consists of a description of the purpose of preparing the teaching practice description where a decision is taken as to why this purpose was selected and to whom the description is addressed (colleagues, management, appointments committee, others?). The teaching practice description contains examples from the teaching that are relevant to display. These examples could, for instance, be descriptions of the content and learning objectives of the teaching, teaching and evaluation methods, external factors that may have an influence (other programme elements, co-teaching, semester planning, premises available, etc.), how the fundamental pedagogical view comes into play in the teaching and in the example in question, and anything else that may be significant. It also explains future teaching development and the teacher’s own competence development based on the experiences gained in connection with the teaching.

As a guide to preparing the teaching practice description, it is recommended that examples from teaching practice be shown. These examples will have first been through the process described in section 2.1.2, working portfolio. It is possible to describe and analyse the teaching in a systematic way with the help of the questions below. This clarifies the link between learning objectives, types of instruction and examination, and how the students achieve these learning objectives.

First and foremost, the content and framework of the teaching should be described, with its content, learning objectives and who the students will typically be. There may also be other documents that are produced to make the aim for the student or the teacher visible or concrete, for example, descriptions of project assignments. Here it may be useful to consider the following:

- Are these the right learning objectives – and why these ones?
- Does the content of the teaching support its learning objects?
- Does the teaching have the right level of specialist detail?

The next is to deal with the teaching and examination method. First and foremost, the method(s) should be described, possibly with lesson plans and considerations of the students’ learning attached. It will benefit the work to include concrete documents such as assignments, papers, exercise guidance, examples from teaching, notes, etc.

The next thing to describe is the reason for such teaching methods, why these examination methods were chosen, and if there are other methods for achieving the learning objectives that were not chosen, what was the reason why these were not chosen?

Development and implementation of courses is often influenced by factors other than the teacher and his/her students. The external environment or overall goals may influence the choice of learning objectives and teaching methods. The next thing to deal with is what external factors may influence teaching planning; examples may include formal requirements for education, physical environment, the positioning of teaching in education, co-teaching and the fundamental pedagogical views and policies of the educational institution [10].

3. ROUNDING OFF

So far the model has been tested in connection with a workshop held by the project group in May at the University of Southern Denmark with participants from member institutions. The participants at the workshop had the opportunity, together with other teachers, to put together a solid foundation for their own TP based on the developed model. The general impression among the participants was that in its existing form the model would be a good tool for teachers to start the process of preparing their TPs. A questionnaire was prepared for the participants to complete at the end of the workshop, which produced comments for subsequent discussion. After the workshop these comments led to the model being corrected in time for final publication at the start of 2009 [9].

The model has also been used on a basic pedagogical course, where one of the final evaluation criteria was the portfolio of the participants. There has been great satisfaction among participants on the course concerning the model and the associated tools, and the expectation is that the model for future courses will be an integral part of the course of study.
4. IMPLEMENTATION

As part of the University of Southern Denmark’s quality policy, in December 2008 a sub-policy was adopted for university educational practice, and according to this, all permanent staff should prepare and maintain a TP. In order to meet these requirements, the Faculty of Engineering at the University of Southern Denmark adopted the following strategy for implementing TP.

In the spring semester of 2009, two volunteers will be chosen from each department, who with the assistance of the Faculty of Engineering’s pedagogical consultant will attend a pilot course where they will prepare their TPs based on the TP model. Through this process, the model will be tested and experiences collected concerning the applicability of the model in Engineering.

- The collected knowledge/experience is summarised and documented by the Faculty of Engineering’s pedagogical consultant and forms the basis for the further process of introducing TP for all the permanent teachers in Engineering.

- In the course of the autumn semester 2009 and the spring semester 2010 a course will be run (several occasions) that will be open to all permanent teachers in Engineering. The goals of the course are the same as for the pilot course and the volunteers from the spring semester of 2009 will take part as facilitators.

- Once a teacher has prepared his or her TP, this, together with a competence development plan, must be included as a natural part of the annual performance and development review.

- Assistant professors who attend the basic pedagogy course of the Educational Network of the Engineering Programmes (Ingeniøruddannelsernes Pædagogiske Netværk IPN) will prepare their TP during the course, and will therefore not be in the target group for these activities.

There is as yet inadequate implementation at the participating institutions and it has not been finally decided to what extent the individual institutions wish to make use of the model.

5. PUTTING IT INTO PERSPECTIVE

As stated in section 4, an implementation round is planned at the University of Southern Denmark that comprises running the course activity on the model in the course of the next 18 months. The process will be continually followed up and the experiences collected will be used in connection with an evaluation/revision of the model.

As all institutions have invested in the development of the paradigm, many are expected to introduce similar strategies in the next few years. This form of employee qualification improvement in the field of educational theory is not new. IGIP has developed a pedagogical certification system [7], which is also documented and evaluated via a portfolio. This certificate is, however, a more comprehensive course that includes a compulsory teaching assignment. However, this article gives an indication of how a concrete portfolio can be put together and hereby promotes the individual teachers reflection on the interaction between teacher and student. A certification system in accordance with ING-PAED IGIP could perhaps be developed in the longer term, but at the Faculty of Engineering at the University of Southern Denmark, the goal in the first instance is to promote interest and development in the pedagogical field and secure documentation for the same, and it is expected in the longer term to provide greater pedagogical knowledge, insight and even better quality in teaching.

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