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# Teaching Competencies

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## **ABSTRACT**

In search of a model of teaching competencies for engineering education, we led a focus group discussion as a workshop at SEFI2023, where we got practitioners' perspectives on essential competencies for teaching. These were compared to a model of teaching competencies called the S2L model, developed and used at a technical university in Sweden. The aim of the workshop was to enrich the participants' understanding of which competencies are essential for teaching and to challenge and improve the S2L model. After the workshop, the competencies collected from the participants were analysed using content analysis. The results show that the teaching competencies suggested by the participants fit into the S2L model, giving the model support. The participants agreed that a model for teaching competencies is very useful for educators, for example, in self-development and when supporting new colleagues, as a checklist and a common language. They also expressed that the workshop had widened their views on teaching competencies.

## 1 INTRODUCTION

There is an ongoing discussion within the engineering education community about engineering competencies, i.e. the competencies our students need to develop. This is included as one of the themes of this conference, SEFI2023. In the same way, we argue that there is value in getting a better idea of what competencies we, the educators, need to develop. A description of teaching competencies can be a tool for developing engineering educators, for example, to identify individual needs for improvement and to contribute with a common language to use when talking about our development. It may also add perspectives in the process of identifying pedagogical competence, or lack thereof, when developing, promoting, or hiring staff.

Despite research showing that teachers' abilities are essential for student learning (Darling-Hammond 2006; Hattie 2008), there is no consensus on which the essential teaching competencies are. Is it that the teacher is able to listen to the students, that the teacher explains well, that the teacher uses modern methods and tools for teaching, or that the teacher can motivate the teaching methods in an informed way? Or is it that the teacher is very knowledgeable and shows love for the subject, that the teacher continues to develop, or all the above?

In an earlier study, we studied a model of teaching competencies, the S2L model, developed at Chalmers University of Technology in Sweden, where it is used both in a mentor program for new staff and as a basis for program development in a combined engineering and teacher education program (Bengmark nd). This study is a continuation of that study, in search of saturation of data, i.e. that new data does not add new perspectives, in this case, that it is consistent with the S2L model.

The research questions in this study are:

1. Are the essential teaching competencies suggested by the participant in this focus group consistent with the S2L model?
2. To what extent and in what way is a model of teaching competencies useful according to engineering educators?

We choose to frame the description of the teaching competencies as a scientific model. A scientific model, often called just a model, is a description that helps grasp some aspects of reality (Gerlee and Lundh 2016). As teachers of engineering subjects, we know how valuable and useful models are, despite being simplifications of the phenomenon. Models can be used for creating understanding, predictions, development, and a common viewpoint. These applications fit well with the goal of this research, which is to frame the essential teaching competencies.

## 2 WORKSHOP DESIGN AND ACTIVITIES

The aim of the workshop was two-fold: to enrich the participants' views of teaching competencies and to collect their opinions on the matter to develop and validate an existing model. After having stated these aims, we started the workshop by defining competency as follows. "A competency is a human knowledge or skill that increases the individual's ability to do what is sought". Examples and non-examples of competencies were discussed. This was followed by the first activity, which was to individually list teaching competencies the participants see as essential in teaching, by drawing on their own teaching experiences. Each selected competency was noted on a separate sticky note. In groups of three to four, the participants then discussed and compared their noted competencies to clarify for themselves and the other group members what each chosen competency entailed. At the same time, the groups combined the individual answers into a joint compilation by grouping notes referring to the same competencies.

After this group work, the workshop leader presented the S2L model of teaching competencies as described below. The model was also briefly compared with other models from the literature (Darling-Hammond 2006; Niss 2003; Koehler and Mishra 2009). This comparison is not included in this text but can be found in the earlier study about the S2L model.

During the second activity, the workshop participants used the S2L model as a framework onto which they mapped the competencies their group had identified. This was done by placing their sticky notes on an A2 poster handed out at the workshop, where the model was illustrated. They were asked to give special notice to notes that they found hard to fit into the model, notes that would fit under several parts of the model, and areas of the S2L model that were left empty, i.e. without notes. The workshop continued with a common discussion about the relationship between the S2L model and the competencies suggested by the participants. Had the participants suggested teaching competencies that do not fit into the S2L model? Are there parts of the S2L model that are considered superfluous?

The third activity at the workshop was group discussions about why and when a model for teaching competencies can be useful. This was followed by a common discussion where all groups expressed their ideas while these were written on the board by the workshop leader.

The fourth and final activity was letting the participants self-estimate their teaching competency profile according to the S2L model in an anonymous digital poll and reflect on the aggregated result.



*Fig. 1. The S2L-model for Teaching Competencies, consisting of nine sub-competencies grouped into three main competencies.*

### 3 THE S2L MODEL OF TEACHING COMPETENCIES

We now give a short exposition of the S2L model of teaching competencies, more thoroughly described in (Bengmark nd). The model consists of nine competencies grouped into three main competencies, Subject Competency, Learning Cultivation Competency, and Leadership Competency, see Figure 1, which are described below.

Subject Competency has three sub-competencies. Firstly, there is Subject-internal Competency, which includes knowing facts, understanding concepts, being able to use procedures and methods, and problem-solving within the subject. Secondly, Subject-external Competency refers to the ability to use the subject knowledge in connection to other areas and the real world. Thirdly, Scientific Competency means knowing how evidence is formed, and how scientific methods are used to establish results within the subject. It also includes the ability to interact with other experts.

Learning Cultivation Competency has the following three sub-competencies. Assessment Competency is the ability to pinpoint the learners' current competencies and to extract knowledge on an aggregated level about common misconceptions. Design of Learning Competency is the competency to design learning activities in an informed way that affects the learners' competencies. The third is Explaining Competency, which is the ability to make the learning objects understandable, maybe by reformulating, visualising, or using metaphors.

Lastly, we have Leadership Competency, which also has three sub-competencies. The first sub-competency is Goal Competency, which is about choosing and formulating goals. Then there is Organisational Competency, which is the competency to create structures that enable the attainment of the goals. The last sub-competency, Influencing Competency, concerns the ability to make people strive, for example, by motivating and giving feedback.

The S2L model should be considered together with three related categories. These are not considered to be teaching competencies, although closely related (Bengmark and). Two of these categories are fundamental in the sense that the teaching competencies build on them. The first is Personal Characteristics, which include features such as patience and kindness. The other is Collaboration and Communication Competency, which are general competencies of value in all of the three main competencies of the S2L model. The third and final category is Developmental Competency which includes the ability to improve your teaching competencies over time.

#### **4 METHODOLOGY**

We view this workshop as a focus group discussion, a qualitative research tool involving the participants in structured discussions, allowing an exploration of participants' perspectives and experiences (Gibbs 2012). The group consisted of 14 engineering educators active in various disciplines, making up a convenience sample as the participants voluntarily chose between parallel sessions during SEFI2023. The participants were told about the research on the S2L model and were informed and asked to withhold their data if they did not agree to participate in the research.

A structured discussion guide developed by the author was used. All questions posted and instructions given during the workshop were given both orally and on PowerPoint slides. The workshop leader facilitated the discussion, encouraged participants to share their thoughts and experiences, and probed for further elaboration when needed. The data collected consisted of essential teaching competencies suggested by the participants written on sticky notes and by writings of the workshop leader on the whiteboard during the common discussions, documented as photos after the workshop.

Content analysis (Krippendorff 2018) was used when analysing the suggested competencies, starting with the frame (Given 2008) consisting of the nine competencies in the S2L model together with the three related categories described above. Each item was considered for each of these categories. As each item was found to fit into one of the categories, there was no need for inductive categorisation.

The data from the discussion was structured and condensed on the board during the actual discussion and directly reported here. While not part of the research, we report on the self-assessment using simple descriptive statistics to characterise the participants and we also include representative comments about the participants' takeaway from the workshop.

## 5 RESULTS

The participants all together suggested 72 separate written items. Analysing their relation to the model gave results similar to those found in an earlier study. Seven of the items were about Subject Competency, 23 about Learning Cultivation Competency, and 24 about Leadership Competency. Two of the nine sub-competencies in the S2L model were not validated by the data, namely Subject-internal Competency and Scientific Competency. In a discussion at the workshop, the participant claimed that this omission was due to them taking these two sub-competencies for granted. Hence, this focus group valued all nine sub-competencies as essential.

Eighteen items that did not fit into the S2L model, but did fit into the three related categories described above. In the category Developmental Competency, we placed items such as *receive feedback*, and *learn from mistakes*. Into Personal Characteristics, we placed items such as *patient*, and *creativity*. The third and final set of items that did not fit into the model was related to Collaboration and Communication Competency, with items such as *communication*, and *teamwork*. Hence, the items suggested at the workshop did not identify gaps in the S2L model.

The workshop participants were enthusiastic about the usefulness of a common model or teaching competencies. The mentioned areas of use included self-development, and supporting the development of new colleagues. Participants pointed to the value of having a common language to use when talking about teaching competencies, maybe helping some realise that it is not only about subject knowledge and helping others not to forget to include leadership competencies. The participant also pointed to the usefulness of a model for teaching competencies when hiring new teachers, as a tool to broaden the perspective on what to discuss and look for.

In the anonymous self-assessment, the highest average was found in Design Competency with a mean of 4.5, where 1 meant very weak and 5 very strong. The lowest average and the biggest variation appeared for Scientific Competencies, indicating a wide range of scientific backgrounds among the participants.

Finally, when the participants were asked to anonymously write down their takeaway from the workshop, they were all positive about their enriched perspective, writing comments such as: *Very useful model that I would like to explore and use further*, and *Nice clear model for conversations around teaching, Thank you! This is a great framework to discuss teaching in a neutral manner and clearly highlight what we can do and what we're not so good at*, and *Very useful for my program. Better understanding of competencies and nice activity!*

## 6 CONCLUSIONS

The S2L model has earlier been studied in similar settings with almost 300 respondents in total. The data collected at this focus group discussion was consistent with the previous results, giving support to the model and indicating that we may have reached saturation in the collective data. We will continue to collect data to validate the models. However, our interpretation is that this model by now has sufficient support and is mature enough to be tested and used in practice by others. The example given by the participants of such practices includes using the model as a framework for self-development or collegial development. We hope that one of the next steps will include finding engineering educators interested in using the model in real-world settings, and in collaboration, study the model's usefulness in these applications.

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