

The Quality of Teaching - Is there any Difference between University Teachers and School Teachers?

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Abstract. An important aspect of the profession of an educator is the assessment and the improvement of the quality of the underlying teaching process, but does this hold for all types of teachers? By collecting best practices of computer science teachers in school we created a teaching maturity model (called TeaM) and recently demonstrated its benefit. The paper now takes this maturity model as a basis and investigates the question about the differences in teaching at Universities and secondary schools. To do so, we randomly selected computer science lectures at our university, assessed them based on the Team Model and looked at the practices in more detail. In our setting it turned out that not all practices are covered at both types of institutions, and especially practices needing documentation and methodologies are lacking at university teaching.

Keywords: CMMI · Teaching Maturity Model · School Teachers · University Teachers.

1 Introduction

Even though university and school teachers (in informatics) deal with different types of students and contents, they all have, among many others, a common goal: assuring the quality of their lectures. There are different ways (and processes) in dealing with the situation of measuring and leveling up the quality of lectures. Existing standards, however, only consider specific factors (like teacher education, course layout, environment, etc.) [19, p.2], and a recent study emphasizes the fact that a better quality of teaching is achieved when considering the teaching process as a whole (so all the teaching factors) [3,2]. The work of Chen et al. is based on the Capability Maturity Model Integration (CMMI) from the Software Engineering Institute (SEI) of Carnegie Mellon University [7]. The model of Chen et al. has several limitations. First, its content is not suitable for schools teachers (as it only focuses on university teachers). Secondly, they conducted only an exploratory study, and finally, no empirical investigation is done (so far) for a continual development of the model. Spurred by the work of Chen et al., we thus created a Teaching Maturity Model (TeaM) [19] that tries

to overcome the above limitations and expands the focus from university to also cover the teaching at schools.

The objective of this paper is now to investigate if, considering the TeaM process model, informatics university teachers can learn from informatics school teachers, and vice versa. To do so, a study was conducted with lectures at the Alpen-Adria-Universität Klagenfurt, looking at their maturity level in detail and comparing it with the official rating of their classes. It turns out that there are still a lot of differences between teaching at universities and at schools, but lessons can be learned from both settings.

The rest of the paper is organized as follows: Section 2 describes the background work and briefly mentions how the TeaM model works. A detail description of the study and the results is presented in Section 3. In Section 4 the results and the threats to validity are discussed. Section 5 concludes with a summary and future work.

2 Background

This section gives a short description of the Teaching Maturity Model's structure and the related models. It demonstrates how they are used to address the quality of teaching.

2.1 Related Work

The traditional form for addressing the quality of teaching by giving personal feedback is seen as quite subjective. This has opened a path for research in assessment models which rely on standards. Here, a lot of authors address the quality of teaching by mainly focusing either on teachers (preparation, communication, engagement), pupils/students, course content, or the environment. Taking a closer look at the existing work, we can divide these models into several groups.

There are models that, for addressing the quality of teaching, focus only on school teachers, and their results reveal the lesson learned by the teachers. Some of the well-known models are: The AQR model which addresses the quality of teaching by assessing the teachers' teaching practices [4]. There, the authors applied the model in thirty physical education lessons with nine elementary teachers in physics. The results emphasize the applicability of the model. The competence based model is another model that assesses the teaching quality through teacher-licensure tests [12]. Mehrens study is more an investigation and analysis of licensure and teachers competency tests. A similar model is the "Competence based model for teachers" defining how to teach [20], and the assessment is based on these definitions.

Furthermore, there is the TALIS model which assesses the quality based on working condition of teachers and the learning environment [16]. The OECD article is a technical report where they applied the model in a pilot test with

five volunteering countries: Brazil, Malaysia, Norway, Portugal and Slovenia. According to the article, the test was successful and helpful for teachers.

There are other approaches that consider the pupils/students and the teachers' interactions for addressing the quality. However, these models fail in demonstrating any practical effect. The CEM model is one of them. It assesses teacher quality based on students' outcomes [1]. Azam and Kingdon applied their model to compare the students' results of the exams from the tenth-grade to the twelfth-grade. Based on the results (that might have improved or not) the teacher's contribution was estimated. Another one is a standard-based learning and assessment system of the National Education Association to show how student learning standards can be connected with teacher education and assessment [14]. Although there is no concrete implementation in practice, they suggest to use the system to measure the quality of teaching. The assessment of teacher competencies and students learning and feelings is another model presented by Snook et al. [21]. In their article, they investigate the school system in New Zealand. The "Angebots-Nutzungs Modell" is a model used to address teaching quality based on teacher-student interaction (results, feelings, and environment) [8]. TEQAS is another model where quality is addressed by assessing the education of teachers [5]. Dilshad showed the applicability of the model by covering five quality variables through interviews (questionnaire) with 350 students and M.Ed. programmes.

Beyond the traditional forms and the assessment methods mentioned above, some maturity models based on principles of CMMI were created. These models do not consider teachers in particular so it is not possible to find out if teachers learned from the model. Researchers in the field of computer science education created maturity models to assess and to improve the curricula or the institution itself [6,9,10]. The validation of these models is referred to a later stage and so far no results are published yet. Ling et al. applied their model in a case study in a private institution of Higher Learning (IHL) in Malaysia and mention that a larger participation of IHLs will be used in future for a better validation of the model [9]. The adaption of CMMI in the educational domain has also been done for courses design either in a classroom environment [17] or online [11,15]. The model of Petri is not validated yet. Neuhauser did the validation of the model in relation to usability, and the answers from the questionnaires revealed that 88 percent of the responders agree with the suggested process areas [15]. Similarly, Marshall and Mitchell validated the processes and the model in the analysis of an e-learning module at New Zealand University [11].

Likewise, in primary and secondary schools, some CMMI-like implementation models with the focus on the institutional level or on the syllabus [13,22,23] were created as well. Montgomery applied her model in six schools for defining the level of using computers and technologies in schools. The model provides goals and practices for making improvements [13]. Solar et al. conducted a pilot study to test the validity of the model and its associated web-support tool [22]. They tested the applicability of the model in different schools and obtained positive feedback from them.

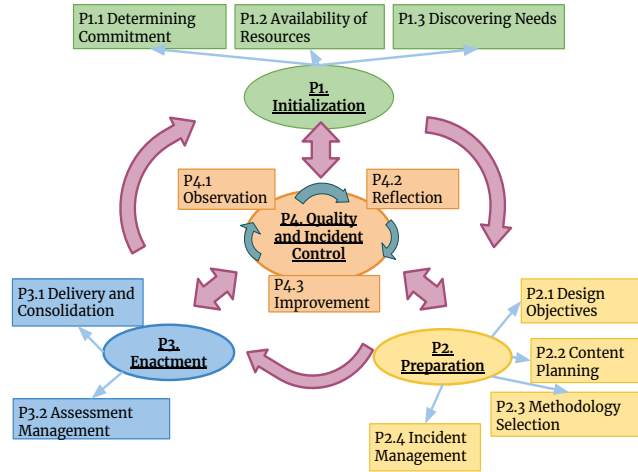


Fig. 1. Graphical representation of the teaching process as defined in the TeaM Model.

Only Chen et al. established a maturity model for observing the teaching process with the focus on university teachers [3]. Although not explicitly stated, teachers should learn from the model. In their paper, Chen et al. address the implementation of their model for primary and secondary schools, but to the best of our knowledge, such a model has not been implemented and/or published yet.

We believe that the quality of teaching is a process that includes all the relevant factors of teaching. So, unlike the aforementioned models, but like Chen et al., we address the quality by looking at the teaching process as a whole. In contrast to Chen et al. we consider not only university teachers but primary and secondary teachers as well.

2.2 The TeaM Model Context

This section contains a brief explanation of the TeaM model's structure and the way how it works. The TeaM model arose from the lack of standards to address the quality of the teaching process with the focus on informatics university and school teachers. Within the TeaM model, the teaching process is composed of four main phases (see Fig.1):

- *Initialization* – where administrative issues are managed;
- *Preparation* – where the course is planned and prepared by teachers;
- *Enactment* – where the implementation of the teaching unit takes place;
- *Quality and Incident Control* – where possible incidents and the teaching process itself are observed, analyzed and refined.

For each of these phases, factors related to the quality of teaching are defined, and in the TeaM model they constitute the basic component named as

Process Areas (PAs). The TeaM model has in total 12 PAs, and each consists of some goals and the related practices [19]. The set of practices was built by the collection of best practices from experienced school teachers (and one university teacher) [19]. The implementation of these practices and the associated goals is done by two representation forms: as continued representation (as Capability Levels - CL), where only one PA is assessed and further managed for improvement, and as stage representation (Maturity Levels - MLs), where a group of PAs associated to a specific ML are assessed.

Following the idea of the TeaM model, a teaching process is mature to a certain level when all the PAs corresponding to that level reach the maximum level of Capability. Making use of the TeaM model helps teachers to evaluate and improve their teaching process by their own, or (which is also possible), the educational institution uses it to evaluate the overall quality of teaching, and when required, to produce a ranking, too.

3 Learning from the TeaM Model

The TeaM model has a twofold aim: first, assessing the maturity of the teaching process and, secondly, learning from the practices of the more mature levels in order to improve the quality of teaching. The practices of the model were collected from informatics school teachers. Making the model more holistic means also testing the practices with university teachers.

3.1 Research Objectives

The focus of the TeaM model is on informatics university and school teachers, although the practices of the model stem from educational sciences and were mainly defined by informatics school teachers so far. The question now is, if the TeaM model is appropriate for all types of teachers, and thus, which practices are useful, useless, and eventually also new. The objective of the study presented in this paper is to deal with this question and to see which practices and goals of the model are shared and which, eventually, could be shared in order to improve the way of teaching. So, within the scope of this paper the following question is raised:

- To what extent do the informatics university and schools teachers differ in their way of teaching (and what could they learn from each other)?

For answering this question, the TeaM model was used by informatics lecturers at Alpen-Adria-Universität Klagenfurt and the results are presented hereinafter.

3.2 Settings

For conducting the study, we selected 19 informatics courses from the Bachelor and Master program at the Alpen-Adria-Universität Klagenfurt. A questionnaire covering the practices and goals of the TeaM model was distributed to the

lecturers of these courses. The questions were answered by the teachers in the presence of members of the department of informatics-didactics, and it is worth to mention that we clearly stated at the beginning of each interview that the aim of the questionnaire was not to assess the quality of teaching but to check if and what teachers can learn from the model. The questions required “Yes/No” answers, but free-text answers were allowed and, for later analysis, recorded.

As mentioned before, the model has 12 Process Areas (PAs), and each PA contains one or more goals to be fulfilled during the teaching process. The goals itself contain practices. And, every practice was associated with one question. Thus, in total there were 76 questions. The questions were provided in an electronic format using Google forms. This makes the questionnaire public and accessible by those who are interested to use such a model¹. The participation is anonymous as no personal data is collected. The questionnaire itself was divided in two parts. First, the 19 interviewees answered the corresponding “Yes/No” questions according to the practices. Secondly, they were invited to provide their opinion or suggestions concerning the practices, goals or the way of how they are assigned to Maturity Levels. All the answers from the interviewees were also collected in an electronic form.

3.3 Results

In the TeaM model framework, a Process Area is satisfied when the related goals are achieved. On the other side, the goals are achieved when the related practices are fulfilled. Due to the size of the TeaM’s practices (76 practices), we generalized them with the corresponding goals and present the results of the study by focusing only on the 31 TeaM goals (running from SG1.1 up to SG4.3, see Fig.2 for an overview). For a clear understanding of how goals and practices are introduced in the TeaM model, Appendix A in the article from Reçi and Bollin [19] provides further information.

Feedback from Teachers During the **initialization phase** of the teaching process, stakeholders think about their commitments (like defining their duties, checking the related curricula, etc.). Two goals are associated to it: *G1.1.1: Define Agreements on Duties* and *G1.1.2: Agree upon Embedding into Curricula*. Almost all the 19 interviewees (except 2) were aware and agreed about implementing the related practices. Another set of questions tangles the resources needed during the teaching process. More concretely, the goals are *SG1.2.1 Manage the Classroom Settings* and *SG1.2.2 Manage the Technical Infrastructure*. Half of the interviewees do not think about arranging the classroom settings based on the methodology they used, as methodology is stable to them. On the other side they take care to provide an adequate atmosphere in the classroom and to use technical infrastructure. *SG1.3.1 Specify the Requirements* is another goal that deals with the predefinition of the knowledge students should

¹ Interested readers can join and give their personal experience in form of practices by visiting the web-site of the TeaM project [18]

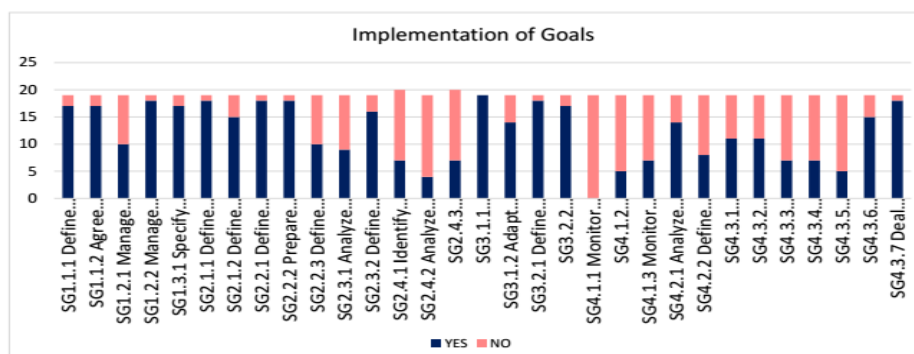


Fig. 2. The number of interviewees who did or did not implement the TeaM model's goals. In total, 19 university teachers interviewed.

have before starting a course, with the requirements that might come from other stakeholders and with their documentation. Almost all of the university lecturers do not implement only the documentation practice, while the other practices are fully fulfilled.

In the second phase of the teaching process (**preparation phase**), important goals of the lecture are related with the design of the course objectives (like course aim, course plan, measurable objectives, etc.). The two goals *SG2.1.1 Define the Course Aims and the Course Plan* and *SG2.1.2 Define the Quantitative and Qualitative Objectives for the Course* are known and implemented by the lecturers. Planning the content of the course is another process required during the second phase. The goals are: *SG2.2.1 Define the Learning Content*, *SG2.2.2 Prepare and Integrate the Materials* and *SG2.2.3 Define the Unit Schedule*. This includes all the steps like defining the course materials, topics and sub-topics, external material, a plan of the unit phases, etc. These goals include also the documentation of the practices. What is noticeable here is the fact that almost all the lectures are aware of such practices, implement most of them, but still do not consider those practices that require a documentation. One such example is "Assign time to each unit phase and document the schedule". Only four out of 19 lectures do it that way. Methodology selection deals with two goals: *SG2.3.1 Analyze Methodologies to be Used* and *SG2.3.2 Define the Methodologies to be Used*. This implies searching for available (suitable) methodologies, their advantages and disadvantages, their effects on the learning outcomes, etc. Ten from the lecturers do not deal with methodologies and consider them in their teaching process. They stick to the one they have been using for a while. However, they try to implement the rest of the practices. The good news is that nine lecturers look for methods of teaching and, when suitable, do implement them. Management of the risk is the last sub-process considered in the *preparation phase*. *SG2.4.1 Identify Possible Problems*, *SG2.4.2 Analyze Possible Problems* and *SG2.4.3 Establish Corrective Plan for Problems* are the goals related to this

sub-process. The practices here consider problems in the classroom, with infrastructure, during unit delivery, and also their analysis, corrective plan and related documentation. Also, here is noticeable that the major part of the lecturers (13 of them) do not think about and document possible problems that might occur.

The third phase of the teaching process (**enactment**), comprises only two Process Areas. In the first PA the delivery and consolidation of the unit based on the schedule, plan, requirements, etc is established. It has two goals: *SG3.1.1 Conduct Lessons According To Agreements/Plan* and *SG3.1.2 Adapt the Lesson based on Requirements*. The results from the questionnaire shows that all the lecturers implements at least one practices, and four of them do not consider to adapt the lecture according to a corrective plan. As they do not consider possible requirement changes during their preparation phase they do not think about a following a plan. In the second PA the assessment is managed. The two goals *SG3.2.1 Define the Knowledge Test Criteria for the Delivered Units* and *SG3.2.2 Implement the Knowledge Test* deal mainly with practices like the definition of criteria for an assessment, type and form of an assessment, the implementation of the assessment, collection and analysis of results, etc. The lecturers interviewed are familiar with these practices and implement all of them during their teaching.

The last phase of the teaching process is **quality and incident control**. One necessary process is the observation of the teaching process. The related goals are: *SG4.1.1 Monitor Teaching (from Initialization and Preparation phase)*, *SG4.1.2 Aggregate the Monitoring Results* and *SG4.1.3 Monitor Incidents*. As their names reveal, the practices deal with the time plan of courses, objectives, methodologies, documentation from the observation and the problems during teaching, etc. The results from the interview show that only two practices are fully implemented by the lecturers. The documentation practices are again not considered at all from almost all the interviewees. As a results, this PA is basically unknown to university teachers. After the observation process, a reflection is necessary. All this is done in order to learn from the sub-processes, reflect on them and to improve teaching at the end. *SG4.2.1 Analyze the results* and *SG4.2.2 Define corrective action* are the two goals of the sub-process. The practices suggest to do periodically analysis of the experiences during observation, to reflect about with colleagues, document the results, think about corrective plans for incidents, etc. The results show that only two practices are implemented. The practices related to the documentation and corrective plan for incidents are not implemented by a considerable part of the lecturers. They explained this with the arguments that bad experiences are directly solved and no further analysis and documentation is needed. The improvement of the teaching process is the last area considered in the TeaM model. It contains seven goals: *SG4.3.1 Improve the Agreements and the Curricula*, *SG4.3.2 Improve the Classroom Settings and the Technical Infrastructure*, *SG4.3.3 Improve the Course Aims and the Plans*, *SG4.3.4 Improve the Learning Content*, *SG4.3.5 Improve the Teaching Methodology*, *SG4.3.6 Improve the Teachers Skills*, and *SG4.3.7 Deal with Incidents*. So basically, the practices point at the improvement of curricula, classroom settings, infrastructure, course aim and plan, the learning content of the course, method-

ology, personal training, documentation of all these practices, etc. Some of the practices are implemented by the lecturers, but when it comes to documentation again, nearly none of them does do it. It is also interesting to mention the fact that four lecturers do not do further personal training during their career (*SG4.3.6 Improve the Teachers Skills*).

Interviewees Suggestions and Comments At the end of the questionnaire the interviewees had the chance to provide feedback and suggestions for the model. Different interviewees gave different suggestions that were collected and assigned to answer categories. Looking at the results, a considerable part of the practices are known and implemented by the teachers. But, the documentation practices are seen as more problematic and not favorable by the lecturers.

Documentation seems to be an issue. One interviewee suggested to rethink the practices in these areas, as based on her/his opinion, not all the improvement activities should be documented. Other lecturers said that no documentation is done because there is no policy that required that, and he or she is not aware if this documentation will be used or shared with the others for further benefits. Another argument against documentation was that lecturers do not have time to do a documentation. Documentation should be considered only in shared laboratory courses as then it can be shared with the colleagues.

Apart from looking closer at the process areas, there has been a set of suggestions to improve the set of practices. In some sense, we see this as practices, that school teachers can now learn from university teachers.

- One interviewee suggested to include student feedback (as it is collected twice a semester in Klagenfurt) as a practice in the TeaM model. The feedback should then be analyzed and taken into consideration during the lecture.
- A lecturer suggested to add a practice where teachers use an anonymous forum to collect questions.
- On a goal level, it was suggested to add a subprocess for motivating and activating inactive students.

According to the questions dealing with practices and goals, we also got some useful comments: First, the TeaM model should consider the different types of lectures (seminar, lecture, lab, etc.) as some of the goals might then be obsolete or more important. Secondly, there should not just be “Yes/No” answers. Next, it was suggested to avoid longer questions (so breaking sentences apart). Finally, we were advised to not just stick to Google-Forms interviews, but also making use of an instructor (assessor) leading through the evaluation.

In all, acceptability was satisfying. The lecturers implemented quite some of the practices, but they were never thinking about some relation between them and that all of them are important for the teaching process as a whole. Have a TeaM model assessment now already had a positive impact on them as they started to think more about the quality of teaching and the use of standards to help them managing that quality.

4 Discussion and Threats to Validity

For answering the question about the (number of) differences in teaching practices between university and school teachers, we looked at all the different part of the teaching process step-by-step. The suggestions and comments received during the questionnaire now allows us to tell more about the commonalities and differences. The practices related to *documentation* aspects were the largest problem for university lecturers and they tried to argue why such practices were not to be implemented. From the perspective of school teachers, we still see documentation as something important and necessary. On the other side, university teachers are quite open-minded according to being evaluated, something that we find harder in the school setting.

Another difference between school and university teachers is to be found in SG2.4. There, *incident management* is not seen as something important by university teachers. Identification and resolution of incidents is only dealt with when required. This is, due to a different setting, handled different in the case of school teachers, where teachers, members of the rectorate and/or in the best case also psychotherapists work together to prevent or resolve incidents in classes.

Another difference can be found in SG4.1, where the *observation of the teaching process* is seen as not so significant by university teachers. Quite often the only feedback they get is by looking closer to the students' results and the students' feedback at the end of the semester. This is contrary to schools teachers, where the continuous observation is related to class improvements and also pupils motivations. A partial difference is also shown in SG4.2, where the absence of the *reflection over the teaching process* is observed. From the perspective of schools teachers, this is a practice that always needs special consideration and university teachers could learn a lot from it.

Finally, a small difference is to be found in SG2.3, *methodology selection*, and in its *improvement* in SG4.3. Choosing suitable methodologies is important for schools teachers, but the same holds for university teachers.

To summarize, only 12 out of 31 goals are nearly completely met by university teachers. 9 goals are at least partially fulfilled. The teachers are weak in the aspects of documentation, incident management, teaching process observation and reflection. But they are strong in the areas of commitments, dealing with resources, discovering needs, designing course objectives and in content planning.

To conclude, there might also be some threats to the validity of the study. For its implementation, we tried to avoid any bias by selecting different informatics lectures at our university, choosing lectures from different fields of study, and also of different characteristics. However, the results are restricted to our university and might not be generalizable to other universities.

The same interviewees were present until the end of the study. The questionnaire remained the same until the last lecturer was interviewed. The study duration was no more than three weeks, and the participant did not have the possibility to evolve their ways of teaching in-between. However, we can not guarantee that some of them had the chance to speak to each other, influencing the results. The participation in the questionnaire was voluntary, and we assume

that the answers were correct. But, we can not guarantee that the interviewees were honest in their answers, even though that we believe so, as their answers had no influence on their reputation.

5 Summary and Future Work

It was clear from the beginning that there are differences between university and school teachers (in informatics). However, this work systematically focuses on all different areas related to teaching and analyzes the situation. This study shows that there are in total 4 main differences: Documentation, methodology, teaching process observation and reflection are not considered by university teachers. On the model level, we can say that university and schools teachers differ in 9 out of 12 PAs in our TeaM model. Apart from differences, we also have additional practices suggested by the university teachers that might be relevant and considered by the schools teachers. Basically two practices are suggested: the repetitive and standardized evaluation of the course and using different (and anonymous) ways in communicating with the pupils. The comments from the interviewees show that they like the idea behind the TeaM model and looking at the teaching process as a whole. They were somehow surprised about the compact representation of the practices in our framework. The TeaM model made them think about some practices they ignored before. Looking at the feedback results, we answered our research question and can also state that, eventually with some minor extensions, it is appropriate for university teachers, too.

For future work, we plan to look closer at the quantitative results that we collected and relate them to the quantitative feedback that students provide end of the semester. The objective is to see if there is a correlation that helps us identifying more influential factors in our model.

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