

Date : 20/06/2016

Version : 1.4

Teaching Maturity Model (TeaM)

Elisa Reçi and Andreas Bollin

Institute of Informatics Didactics, Alpen-Adria Universität,
Universitätstr. 65-67, 9020 Klagenfurt, Austria
{elisa.reci, andreas.bollin}@aau.at
<http://iid.aau.at/>

1 TeaM Model

The objective of an educational institution is the quality of teaching. Due to practical experiences in teacher training, we know that a lot of factors are relevant. Among others, these factors are: teachers skills, methodology, motivation of teachers and pupils, the mood of teachers and pupils, the set of teaching materials, infrastructure/environment, and so on. In this paper we now concentrate on the teacher factor and on his/her teaching process in primary, secondary and higher education.

Table 1. The Capability and Maturity levels of TeaM

Level	Capability Level
0	Deficient - None of the relevant factors of the teaching process are implemented.
1	Accomplished - The relevant factors of the teaching process are taken into consideration but there is no plan on implementing them.
2	Reflected - The relevant factors of the teaching process are planned and implemented in accordance to the policy. There is the plan for performing the process, resources are provided, responsibilities are taken, is controlled, monitored and reviewed.
3	Defined - The relevant factors of the teaching process are standardized.

Level	Maturity Level
1	Chaotic - the teaching process is neither controlled nor efficient.
2	Initial - the teaching process is under minor control and little efficient.
3	Repeatable - the teaching process is sparsely standardized and monitored.
4	Stable - the teaching process is standardized, monitored and controlled.
5	Optimizing - the teaching process is continuously improved and ready for further teaching process upgrades.

1.1 TeaM Levels

The teaching maturity model (TeaM) aims at assessing and improving the teaching process. The improvement and assessment are defined by two representation paths: continuous representation (*Capability Level* – CL) and stage representation (*Maturity Level* – ML). Continuous representation improves the process by focusing on an individual process areas. Stage representation improves the process by focusing on a set of related process area. We say that a process has improved when it upgrades the steps until the maximal level is reached. Table 1 shows the features of the Maturity and Capability levels. Unlike CMMI, TeaM has four levels for Capability and five levels for Maturity.

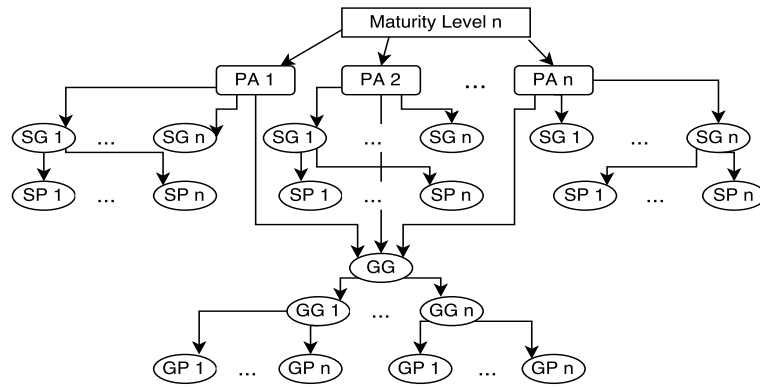


Fig. 1. The Specific and Generic Goals and Practices.

1.2 TeaM Process Areas

Process Areas (PAs) are the fundamental activity for TeaM. Each PA consists of Specific Goals (SG), which include Specific Practices (SP) and Generic Goals (GG), which include Generic Practices (GP). Specific Goals are specific to a PA, while Generic Goals are common for all PA (Fig.1). The latter have to do with the institutionalization of the Process Area (Capability Level). A set of Specific Goals should be fulfilled in order to pretend the Maturity of a process. A Maturity level is achieved when all the Process Areas assigned to that level reach the maximum Capability level (completion of all Generic Goals). For instance, to reach Maturity level 2, all Process Areas assigned to Maturity level 2 must achieve Capability level 2 or 3. To reach Maturity level 4, all the Process Areas assigned to Maturity levels 2, 3 and 4 must achieve Capability level 3 (the maximum level).

The whole model comprises 10 PAs (6 PAs are loaned from CMMI-Service), 30 Specific Goals (table 2) and 3 Generic Goals (table 3). Each Specific Goal is

achieved when the corresponding Specific Practices are fulfilled (see Appendix for more details). The relationship among the Key Process Areas is presented in Fig.2.

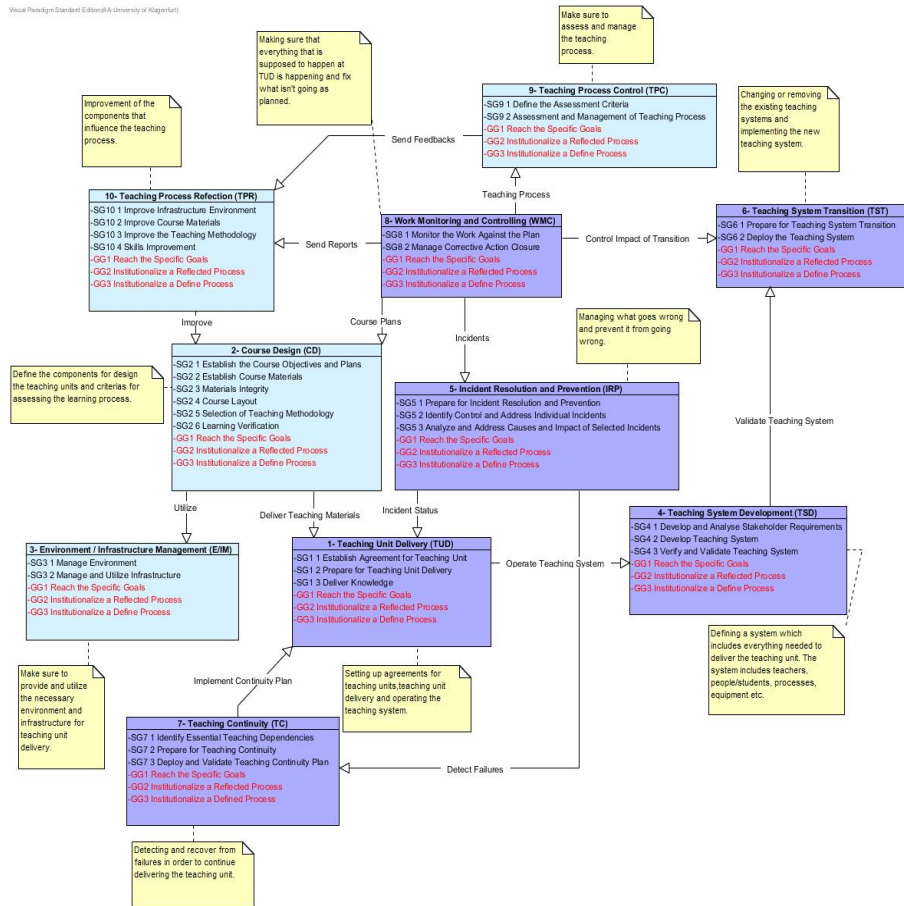


Fig. 2. The Relationship Among Process Areas.

2 Case Study

In order to demonstrate the usability of the model, let us introduce two teachers (their names are camouflaged, of course).

Klara provides the necessary materials for creating the teaching units, does assessment of her methodology, uses the infrastructure, takes notes and implements the rules, regulations and the system for delivering the teaching unit and

Table 2. The TeaM Process Areas with the corresponding Specific Goals

Process Area	ML	Specific Goals
Teaching Unit Delivery	2	SG1.Establish agreement for Teaching Unit SG 2.Prepare for Teaching Unit Delivery SG 3. Deliver Knowledge
Incident Resolution and Prevention	3	SG 1. Prepare for Incident Resolution and Prevention SG 2. Identify, Control and Address Individual Incidents SG 3. Analyse and Address Causes and Impact of Selected Incidents
Teaching System Development	3	SG 1. Develop and Analyse Stakeholder Requirements SG 2. Develop Teaching System SG 3. Verify and Validate Teaching System
Teaching System Transition	3	SG 1. Prepare for Teaching System Transition SG 2. Deploy the Teaching System
Teaching Continuity	3	SG 1. Identify Essential Teaching Unit Dependencies SG 2. Prepare for Teaching Continuity SG 3. Deploy and Validate Teaching Continuity Plan
Work Monitoring and Controlling	4	SG 1. Monitor the Work Against the Plan SG 2. Manage Corrective Action Closure
Environment / Infrastructure Management	2	SG 1. Manage Environment SG 2. Manage and Utilize Infrastructure
Course Design	2	SG 1. Establish the Course Objectives and Plans SG 2. Establish Course Materials SG 3. Materials Integrity SG 4. Course Layout SG 5. Selection of Teaching Methodology SG 6. Learning Verification
Teaching Process Control	4	SG 1. Define the Assessment Criteria SG 2. Assessment and Management of Teaching Process
Teaching Process Reflection	5	SG 1. Improve Infrastructure / Environment SG 2. Improve Course Materials SG 3. Improve the Teaching Methodology SG 4. Skills Improvement

Table 3. The TeM Generic Goals for each Capability Level

Capability Level	Generic Goals	Generic Practices
Deficient		
Accomplish	GG 1. Reach the Specific Goals	GP 1.1 Implement specific practices of a PA
Reflected	GG 2. Institutionalize a Reflected Process	GP 2.1 Establish an organization policy GP 2.2 Plan the process GP 2.3 Provide resources GP 2.4 Assign responsibility GP 2.5 Train people GP 2.6 Manage outputs GP 2.7 Establish and involve the stakeholders GP 2.8 Monitor and control GP 2.9 Objectively appraise obedience GP 2.10 Review with higher level management
Defined	GG 3. Institutionalize a Defined Process	GP 3.1 Establish a defined process GP 3.2 Collect and include improvements

Table 4. The Maturity level of the Case Study

Process Areas	Chaotic	Initial	Repeatable	Stable	Optimizing
Teaching Unit Delivery	0	2	3	3	3
Incident Resolution and Prevention	0		1	3	3
Teaching System Development	0		2	3	3
Teaching System Transition	0		2	3	3
Teaching Continuity	0		3	3	3
Work Monitoring and Controlling	0			2	3
Environment / Infrastructure Management	0	1	3	3	3
Course Design	0	2	3	3	3
Teaching Process Control	0			2	3
Teaching Process Reflection	0				3

prepares for the incidents and the changes that might occur. The teaching process is monitored and controlled. She takes part in further training and reflects on improving the teaching class hour.

Ana, a teacher with little experience and minor motivation who only provides the necessary materials for creating the teaching units. She does not do assessment of her methodology, sparsely manages the infrastructure and rarely takes notes. She is not interested in implementing rules and regulations nor in getting prepared for the incidents and the changes that might occur. The teaching process is not monitored and controlled. She neither takes part in further training nor reflects on improving the teaching class hour.

Now let us take a look on how the model can be helpful for assessment (but also for personal improvements). Table 4 includes the TeaM Proces Areas – PAs with the corresponding Capability Level – CL (0-3) for each Maturity Level – ML. Regarding the descriptions given above, Klara is at ML 5 (Optimizing) because she implemented all the PAs. Ana is at ML 2 (Initial) because she implemented only three PAs (Teaching Unit Delivery, Environment/Infrastructure Management and Course Design). In order to move to the ML 3, Ana should implement four PAs (Incident Resolution and Prevention, Teaching System Development, Teaching System Transition and Teaching Continuity). Simultaneously, she repeats the implementation of the PAs of ML 2. So for upgrading the stages till to the Optimizing level, she should implement the PAs of the next ML by also repeating the implementation of the PAs from the previous levels.

References

1. Forrester,E.C., Buteau, B.L, Shrum, S.: CMMI for Services. Guidelines for Process Integration and Product Improvement. Second Edition. Pearson Education,Inc. USA.(2011).
2. Simple Easy Learning. CMMI tutorial, <http://www.tutorialspoint.com/cmmi/index.htm>
3. Chen, C.Y., Chen, P.C., Chen. P.Y.:Teaching Quality in Higher Education: An Introductory Review on a Process-Oriented Teaching-Quality Model. Total Quality Management and Business Excellence, 25, 36–56 (2014).
4. Lutteroth, C., Luxton-Reilly, A., Dobbie G., and Hamer, J.: A maturity model for computing education. Computing education, 66, 107-114 (2007).
5. Neuhauser, C.: A maturity model: Does it provide a Path for Online Course Design? The Journal of Interactive Online Learning 3,1 (2004).
6. Neuhauser, C.: A five-step maturity model for on-line course design. In Proceedings of the 19th Annual Conference on Distance Teaching and Learning (2005).
7. Duarte, D. and Martins, P.V.: A Maturity Model for Higher Education Institutions. Proceedings of the 23rd International Conference on Advanced Information Systems Engineering Doctoral Consortium (CAISE), 1, 25-45 (2011).
8. Petrie, M. L.: A Model for Assessment and Incremental Improvement of Engineering and Technology Education in the Americas. In Proceedings of Second LACCEI International Latin American and Caribbean Conference for Engineering and Technology (2004).

9. Marshall, S. and Mitchell, G.: Applying SPICE to e-learning: an e-learning maturity model?. Proceedings of the Sixth Conference on Australasian Computing Education, Australian Computer Society, Inc., Darlinghurst, Australia, Australia, 185191 (2004).
10. Montgomery, B.: Developing a Technology Integration Capability Maturity Model for K-12 Schools. Published Diploma thesis. Concordia University, Montreal, Canada (2003).
11. Solar, M., Sabattin, J., Parada, V.: A Maturity Model for Assessing the Use of ICT in School Education. Educational Technology and Society, 16 (1), 206218 (2013).
12. White, B., Longenecker, H., Leidig, P., Reynolds, J., Yarbrough, D.: Applicability of CMMI to the IS Curriculum: A Panel Discussion. The Information Systems Education Conference (ISECON), San Diego, CA (2003).
13. Ling, Th.C., Jusoh, Y.Y, Rusli, A., Alwi, N.H.: A Review Study: Applying Capability Maturity Model in Curriculum Design Process for Higher Education. Journal for the Advancement of Science and Art, 3, 1, (2012).

Appendix: Specific practices of TeaM

1. Teaching Unit delivery (TUD)
 - SG 1. Establish Agreement for Teaching Unit
 - SP 1.1 Analyse Existing Agreements and Data
 - SP 1.2 Establish the Teaching Agreement
 - SG 2. Prepare for Teaching Unit Delivery
 - SP 2.1 Establish the Teaching Unit Delivery Approach
 - SP 2.2 Prepare for Teaching System Operation
 - SP 2.3 Establish a Management System for new Requirements
 - SG 3. Deliver Knowledge
 - SP 3.1 Operate the Teaching System
 - SP 3.2 Maintain the Teaching System
2. Incident Resolution and Prevention (IRP)
 - SG 1. Prepare for Incident Resolution and Prevention
 - SP 1.1 Establish an approach for Incident Resolution
 - SP 1.2 Establish an approach for Incident Prevention
 - SG 2. Identify, Control and Address Individual Incidents
 - SP 2.1 Identify and Record Incidents
 - SP 2.2 Analyse Individual Incident Data
 - SP 2.3 Resolve Incidents
 - SP 2.4 Monitor the Status of Incident to Closure
 - SP 2.5 Communicate the Status of Incidents
 - SG 3. Analyse and Address Causes and Impact of Selected Incidents
 - SP 3.1 Analyse Selected Incidents
 - SP 3.2 Establish Solution to Respond to Future Incidents
 - SP 3.3 Establish and Apply Solution to Reduce Incident Occurrence
3. Teaching System Development (TSD)
 - SG 1. Develop and Analyse Stakeholder Requirements
 - SP 1.1 Develop Stakeholder Requirements
 - SP 1.2 Develop Teaching System Requirements
 - SP 1.3 Analyse and Validate Requirements
 - SG 2. Develop Teaching System

- SP 2.1 Develop the design
- SP 2.2 Implement the Teaching Design
- SP 2.3 Integrate Teaching System Components
- SG 3. Verify and Validate Teaching System
 - SP 3.1 Prepare for Verification and Validation
 - SP 3.2 Perform Peer Reviews
 - SP 3.3 Verify Selected Teaching System Components
 - SP 3.4 Validate the Teaching System
- 4. Teaching System Transition (TST)
 - SG 1. Prepare for Teaching System Transition
 - SP 1.1 Analyse Teaching System Transition Needs
 - SP 1.2 Develop Teaching Transition Plans
 - SP 1.3 Prepare Stakeholders for Changes
 - SG 2. Deploy the Teaching System
 - SP 2.1 Deploy the Teaching Components
 - SP 2.2 Assess and Control the Impact of the Transition
- 5. Teaching Continuity (TC)
 - SG 1. Identify Essential Teaching Dependencies
 - SP 1.1 Identify and Prioritize Essential Functions
 - SP 1.2 Identify and Prioritize Essential Resources
 - SG 2. Prepare for Teaching Continuity
 - SP 2.1 Establish Teaching Continuity Plans
 - SG 3. Deploy and Validate Teaching Continuity Plan
 - SP 3.1 Implement the Teaching Continuity Plan
 - SP 3.2 Verify the Teaching Continuity Plan
 - SP 3.3 Validate the Teaching Continuity Plan
- 6. Work Monitoring and Controlling (WMC)
 - SG 1. Monitor the Work Against the Plan
 - SP 1.1 Monitor Work Planning
 - SP 1.2 Monitor Commitments
 - SP 1.3 Monitor Stakeholders Involvement
 - SP 1.4 Conduct Progress Assessment
 - SP 1.5 Documentation of Assessment
 - SP 1.6 Monitor Incidents
 - SG 2. Manage Corrective Action Closure
 - SP 2.1 Analyse Issue
 - SP 2.2 Take Corrective Action
 - SP 2.3 Manage Corrective Actions
- 7. Environment / Infrastructure Management (E/IM)
 - SG 1. Manage Environment
 - SP 1.1 Establish Climatic Convenient Working Environment for the Trainer
 - SP 1.2 Establish Climatic Convenient Working Environment for the Trainee
 - SG 2. Manage and Utilize Infrastructure
 - SP 2.1 Establish an Infrastructure
 - SP 2.2 Utilize an Infrastructure
 - SP 2.3 Use of ICT in Teaching
- 8. Course Design (CD)
 - SG 1. Establish the Course Objectives and Plans
 - SP 1.1 Establish the Course Aim
 - SP 1.2 Establish the Course Topics

- SP 1.3 Establish the Course Time-plan
- SP 1.4 Establish the Course Schedule
- SP 1.5 Identify the Teaching Incidents and Uncertainty
- SG 2. Establish Course Materials
 - SP 2.1 Define the Basic Course Materials
 - SP 2.2 Provide Additional Materials
- SG 3. Materials Integrity
 - SP 3.1 Identify the Materials Content
 - SP 3.2 Communicate New Versions of Materials
- SG 4. Course Layout
 - SP 4.1 Material Integrity of Shareholders
 - SP 4.2 Arrange and Document the Shareholders Schedule based on SG1
 - SP 4.3 Establish and Maintain a Shared Vision
 - SP 4.4 Implement the Integrated Course
- SG 5. Selection of Teaching Methodology
 - SP 5.1 Selection of a Teaching Methodology
 - SP 5.2 Assessment and Documentation of the Teaching Methodology
- SG 6. Learning Verification
 - SP 6.1 Establish Criteria for Assessment of the Learning Process
 - SP 6.2 Implement Assessment
 - SP 6.3 Analyse and Document the Data
- 9. Teaching Process Control (TPC)
 - SG 1. Define the Assessment Criteria
 - SP 1.1 Define Key Elements for Assessment
 - SG 2. Assessment and Management of Teaching Process
 - SP 2.1 Analyse Data (from CD, WMC)
 - SP 2.2 Identify the Shortcomings
 - SP 2.3 Establish Improvement Teaching Process
 - SP 2.4 Implement Improvement
- 10. Teaching Process Reflection (TPR)
 - SG 1. Improve Infrastructure / Environment
 - SP 1.1 Update with the Latest Techniques
 - SP 1.2 Implement and Evaluate New Techniques
 - SP 1.3 Validate the New Techniques
 - SG 2. Improve Course Materials
 - SP 2.1 Up-to-date Information
 - SP 2.2 Identify student/pupils needs/performance
 - SP 2.3 Up-to-date based on student/pupils needs/performance
 - SG 3. Improve the Teaching Methodology
 - SP 3.1 Alter Methodology
 - SP 3.2 Implement the New Methodology
 - SP 3.3 Verify and Document the New Methodology
 - SG 4. Skills Improvement
 - SP 4.1 Improve Personal Skills
 - SP 4.2 Participate in Further Training
 - SP 4.3 Establish Collaboration for Similar Profiles
 - SP 4.4 Determine Differences and Shortcomings
 - SP 4.5 Improve from Differences and Shortcomings