

A Competency Based Maturity Model for OBE

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Abstract—The Indian education system is seeing radical changes in the last one decade. Both at K-12 and higher education levels, there is a shift to learning outcomes from content, to thinking from memory based learning and to self directed learning from coercive learning. Our attitudes and systems are still stuck in the old school of thought. In this transition phase, we are facing a challenge of creating outcomes using a set of systems and people where qualifications and exam scores take precedence over competencies. Until such time that those scores and qualifications are an accurate measure of competencies, we need to create a competency based perspective on the existing people. Taking a cue from the People CMM, this paper proposes to use capability maturity perspective for colleges. Based on extensive training experience and on research in learning science elsewhere, a list of teacher and student competencies and key areas is arrived at. The five levels of maturity for students and teachers are also enumerated in each of these key competence areas. This model helps to look at the accreditation process and OBE as a continuum. It gives us a tool to assess people's capabilities in an objective way and enables us to prepare them for the tasks. The model is at an initial stage and there are several questions to be answered before we can deploy this on a pilot basis. This is work-in-progress for a model for teacher-student interactions. If we can predict learning outcomes for specific pairs of competencies, accurate interventions can be designed for either teacher or student or both.

Keywords—*Outcome-based education, teacher competencies, student competencies, maturity model*

I. INTRODUCTION

Accreditations are used by educational institutes to certify the quality of their teaching programs in terms of their infrastructure, faculty, student intake, governance and the alumni. These accreditations have been made very quantitative and marks are allotted to various criteria. A lot of work has gone into converting subjective criteria into measurable values.

In industry, quality certifications like ISO and CMM are used to make a statement about the quality of their products by certifying the processes that produce them. ISO is more broad-based while CMM caters to software and related industry. Specific industries also have other specialized certifications. Software Engineering Institute introduced the idea of Capability Maturity Model and certifications in 1995 which became quite popular worldwide as this reflected levels of maturity unlike the ISO certification.

In both these segments, while organizations are competing to sell their services or products and want the quality of these certified, they are also competing for the talent pool that is used to generate or deliver those products and services. They need to attract the right kind of people to remain in the forefront of their service or product market.

For industries, People CMM [1] stepped into that area, where organizations can improve their people management practices and thereby get an edge over their competitors in terms of hiring and retaining talent. Companies reported increase in employee satisfaction, reduction in errors or defects, increased consistency in management practices, better communication and coordination, better long term career planning and reduced attrition after adopting best practices in People CMM.

India is going through a similar crisis in terms of its educational institutes at all levels. The corporate culture has set into K-12 as well as higher education. The huge gap in employability of the products of this system has brought in some reforms both at K-12 level (Continuous Comprehensive Evaluation - CCE) and in higher education in terms of NAAC and NBA accreditations that are outcome based. CCE [2] advocates less emphasis on pen paper tests and more of activities and interdisciplinary projects. Even in the pen paper tests, higher order thinking questions must form a significant part. After the Central Board of School Education (CBSE) implemented CCE, most State Boards of school education have also adopted it. These reforms have set the stage for quality improvement since parents and students are aligned to the assessment. Until such time as the graduates from these new curricula join the workforce, there is a gap. The teachers (from old school) who need to deliver these revised curricula and outcomes find themselves challenged. Another area of challenge is the student competencies which either facilitate or hinder the achievement of educational objectives. The pipeline contains students who are accustomed to rote learning. I have been into teacher training for the last seven years and have interacted with more than 4000 teachers and an equal number of students. I learnt many lessons in this journey. In this paper, I propose a different perspective of the people – the faculty and the students - that may help us to understand the human dynamics in achieving OBE. Instead of getting frustrated about not achieving required outcomes or looking at the accreditation process as merely a documentation exercise, this model helps us give right inputs to the people.

II. PCMM AND ITS RELEVANCE

A. Why is competency management important?

The quality of education in an institute is driven by many factors like the quality of its teaching, the infrastructure, the curriculum and the learning eco-system as a whole. While infrastructure does play a key role in today's smart teaching world, it is relatively easy to create good infrastructure and supporting systems. What is hard is to find good faculty and even harder is to retain them.

The People CMM consists of five maturity levels to develop individual competencies, to develop effective teams, motivate improved performance, and shape the workforce which the organization needs to accomplish its future business plans (Fig 1) By following this framework, an organization can avoid introducing workforce practices that its employees are unprepared to implement effectively. Usually any organization is assumed to be at level 1, and as we can see the competency management is at the very next level. Colleges must take a cue from this well established framework.

The PCMM is a useful analogy, but cannot be directly applied in an educational institute, for the following reasons -

- The product and raw material in education are human beings and therefore the outcome depends not just on the teachers and the institution support but the 'capability maturity' of the learner too
- The regulatory framework for education allows hiring which is qualification based and not competency based. PCMM starts at competency based hiring practices.
- The remuneration structure is also highly regulated in higher education (even in private sector) and unstructured in K-12 whereas industry salaries are quite competitive and driven by market and are competency based.



Fig 1 Levels of maturity in People CMM

B. Why a new perspective?

The current criteria for accreditation are based on Engineering Criteria EC2000 of ABET, do try to bring some best practices into place and they have some measures too in terms of student intake and outcomes, faculty qualification, number and quality of publications, retention, other activities in the college etc. The accreditations have become quite transparent and are numbers based. There is also an element of measuring *improvement* in this process by asking a college to provide all the numbers of last three years. The colleges are thus expected to evaluate their data and take steps to improve their programs. In the rush for accreditation, colleges are trying to expect outcomes that are clearly not possible with the existing workforce. In a 2004 survey of EC2000 (OBE), no significant impact was reported on the technical competencies of graduates though faculty and students reported more 'active' learning. The report also shows mixed results for social and team skills. This is rather an old survey reported in [9], but a more recent one could not be found.

Perhaps, the step wise development of people involved is very important to consider. It is important to understand that merely orientation and training to new graduate attributes and awareness of modern teaching methods does not translate into active classrooms. Many factors play a role in this transformation and this model proposes to give deeper insights into these issues and perhaps some approaches to address those issues.

III. COMPETENCIES OF FACULTY

Taking lessons from PCMM, academics need to move to competency based people management. Based on my experience, I have categorized competencies into Content(C), Pedagogical Skills (P) and Professional Growth (G) and Student Orientation (O). All four areas are crucial for the new kinds of learning that we are expecting in the 21st century. Even Lowman in [5] talks about two dimensions of teaching Intellectual Excitement (knowledge and love of subject and ability to explain) and PR Positive Rapport (connecting with students). And in [6] Fink et al advocate that teaching and learning must be viewed in a scholarly way in order to meet the professional requirements now. These findings are reflected in the four areas listed above.

These categories of competence are not watertight; some competencies can fall into multiple categories. Table 1 gives a list of competencies needed for faculty in different roles to facilitate student learning. For simplicity, I have taken roles as Junior Teacher (JT), Senior Teacher (ST), Mentor (M), Lab Instructor (LI), Project supervisor (PS) and Head of the Department (HOD). This mapping of competencies to roles is indicative for an affiliated college and does not include research oriented institutes or university. This is summarized in Table 1.

The letters in the parenthesis denote the primary areas to which that competency belongs. Instead of calculating the number of required faculty for a student – teacher ratio and

having a cadre ratio of 1:2:6, AICTE and NBA must come up with some numbers for each competency.

IV. COMPETENCIES OF LEARNERS

TABLE 1 Competency mapping with roles

	JT	ST	M	PS	LI	HOD
1.Has teaching expertise in subject (C)	✓	✓			✓	✓
2.Self directed learning (contemporary topics) (C-G)	✓	✓	✓	✓	✓	✓
3.Deliver lessons/sessions (P)	✓	✓			✓	✓
4.Use Technology Effectively (P)	✓	✓	✓	✓	✓	✓
5. Manage classroom (P)	✓	✓			✓	✓
6. Guide experimental learning (labs, hands-on) (C-P)		✓		✓	✓	✓
7. Follow up with learners for deliverables (assignments and projects) (O-P)	✓	✓	✓	✓	✓	✓
8. Mentor learners (O)		✓	✓	✓		✓
9. Use assessment data (P)	✓	✓	✓		✓	✓
10. Reflect upon one's own competencies (G)	✓	✓	✓	✓	✓	✓
11. Design effective teaching/training strategies (P-C)		✓				✓
12. Design lesson/session plans (P-C)	✓	✓			✓	✓
13.Design Assessment activities and tests (C-P)		✓		✓	✓	✓
14.Excite learners to learn and to perform (O-C)	✓	✓	✓	✓	✓	✓
15 Respond to learners' interests and questions (O-C)	✓	✓	✓	✓	✓	✓
16.Design experimental and interdisciplinary learning (C-P)		✓		✓	✓	✓
17.Enable learners to develop Higher Order Thinking (C-P)		✓		✓	✓	✓
18. Review lesson/session plans (P-C)		✓				✓

Teachers have the primary responsibility for creating a climate where students feel inclined to learn. Every teacher strives to create such an environment in his or her class. But privatization and provisions and reservations have brought in students from various socio economic backgrounds, motivation levels and goal orientation into professional courses. The fee reimbursement scheme of the state government is the proverbial last straw on the camel's back. The Government of Andhra Pradesh had introduced a student sponsorship project in 2008-09 which essentially made education free for a large section of students; the government gives the fees to the college for admitted students. This resulted in seats being filled up indiscriminately, with several students lacking interest and capability. And achieving *Graduate Attributes* is certainly a challenge.

The responsibility of preparing these students for learning cannot be solely left to accident. We need to consciously work on the competencies of students. Here I use the areas Content (C), Learning and Thinking Skills (S) and Goal Orientation (G) categories

1. Learning this subject is a goal (G)
2. Awareness of Learning Styles and Strategies (S)
3. Discipline – regularity (G)
4. Involvement in Learning (C-S-G)
5. Prior Knowledge (C)
6. Readiness to put effort to learn (G)
7. Academic Ethics (G)
8. Willingness to go beyond curriculum (G)
9. Collaboration (G-S)
10. Hands-on skills (S-C)
11. Technology Usage for learning (S)
1. Creative ideas (S)
2. Language Skill- reading comprehension of standard material, writing and speaking (C-S)

Right now many students are used to rote learning at K-12 level and are low on many of these competencies. But, once the CCE system is in place, the incoming students to colleges may be better equipped. A special mention must be made about hands-on projects or labs which are so essential in an engineering discipline. The +2 education in India has grossly neglected this aspect in its entrance exam coaching system.

V. MATURITY MODEL FOR TEACHERS AND STUDENTS

The role of faculty in achieving higher order thinking in students is unquestionable. According to a study conducted by Umbach [3] on two national data sets, students achieve higher levels of learning when faculty members use active and collaborative learning techniques, use hands-on experiences, emphasize higher-order thinking skills in the classroom, interact with students and challenge students academically.

Another study conducted by Teagle Foundation [4], asserts that effective undergraduate learning happens when faculty engage in research. This report specifically talks of 'teacher-

scholars' who can model knowledge creation and the *process* of learning in a much better way since they themselves are engaged in it as research scholars. In an engineering college, where there is less of scholarly research, this means faculty must engage in hands-on projects and also keep themselves updated with state-of-the-art.

Walther's concept of *accidental competency formation* goes one step further to state that behavioral outcomes are formed by other elements of the education environment and not just the 'targeted instruction' or learning activities. The five elements are a) learning activities, b) other curricular elements like assessments, c) extra-curricular elements like social interaction and part-time jobs, d) student disposition and e) meta-influence of the teacher and the institution's self image and culture [8].

The challenge is that most teachers have come from a teacher centered and content centered education system.

Given in Table 2, is a teacher capability maturity model that can help administrators as well as teachers themselves to see where they are and where they would like to be. The levels in the table are Initial, Developing, Functional, Proficient and Advanced.

TABLE 2 Teacher Capability Maturity Model

Level/ Areas	1	2	3	4	5
Subject Knowledge or Content (C)	Barely enough for a class	Well read for teaching	Contemporary and Application oriented	Continuous Self assessment	Unlearn and relearn new knowledge
Pedagogic Skills (P)	Lacks basic skills of teaching and assessment	Basic lecture mode with good explanation, memory based assessment	Interactive and interesting. Student oriented. Application level assessment	Promoting higher order thinking. Higher assessments	Facilitating Professional skills.
Professional Growth (G)	No awareness. No goal. Or teaching is not the goal.	Aware of better practices but not yet ready to adopt. Indifference to improvement even if teaching is a long term goal	Ready to learn and improve practice. Intention to continue teaching.	Supervision and mentoring required for action. Demonstrating improvement in specific skills through commitment	Reflective and self directed teacher. Concrete plan and steps to become an exemplary teacher

Student Orientation (O)	Disconnected or indifferent.	Limited to classroom. Isolated personal interactions or no agenda.	Conscious effort to find student needs both in terms of content and learning styles, but unstructured approach to meet student needs	Systematic approach to differentiated instruction. Guidance on adopting learning styles to facilitate thinking. (both challenged and gifted students)	Personal rapport and highly developed methods to differentiated instruction. Matching learning and teaching styles for optimum results.
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In Table 3, a learner capability maturity model is presented that is based on the competencies listed in section IV. While pedagogy and technology are all the more important now for this demography of students, students need orientation to and mentoring on the specific competencies. They must be made aware of the benefit of these competencies for their future professional life.

TABLE 3 Learner Capability Maturity Model

Level / Area	1	2	3	4	5
Content	Lacks basic knowledge	Memory based, ready made answers	Text book knowledge	Uses multiple sources of information	Contemporary and extensive knowledge
Learning and Thinking Skills	No awareness	Conscious of own learning methods	Uses proven methods systematically to optimize own learning.	Uses collaboration and other learning strategies that enable higher order thinking.	Creative ideas and learning beyond curriculum is the norm.
Goal Orientation	Neither Learning this subject nor Certificate interests the student	Certificate is the goal but learning is not. Likes to take unethical or incorrect methods.	Understands the importance of learning and getting the degree and manages to do that.	Takes interest in the subject and likes to get involved in the learning and do the tasks assigned by the teacher.	Self directed and task oriented learner. Takes initiative.

VI. USING THE MODEL

- OBE requirements roughly map to high levels of this maturity model, both for teachers and students
- An institute must honestly assess the current levels of maturity
- Training and guidance must be given in specific competencies to both students and teachers
- In this context, we should realize that we are working simultaneously on building competency in students as well as teachers. Hence, administrators and policy makers also must shift their thinking from teacher as a *role model* and *expert* to teacher being a *facilitator*. If we believe that students cannot be trained unless faculty has all those competencies then it is a long and difficult road.

The institute can directly use the PCMM model for its people management processes as shown in Table 4. The model is very detailed with process areas, practices etc but it is sufficient in this paper to list out the areas of PCMM for college in Table 4. This needs some change in the regulatory framework for area of recruitment and to some extent in career growth. But in the rest of the areas, college has full autonomy.

Good governance leads to some of these outcomes and administrators must pay conscious attention to the training, role assignment and institutionalized pedagogic practices and use of technology. Active learning must be the norm than an exception, as it is now.

TABLE 4 Institute People Capability Maturity Model

Areas / level	Initial	Defined	Managed	Measured	Optimized
Recruitment	Numbers based	Informal identification of competencies	Competency based	Work group based	Future ready
Training and mentoring	Non existent	Isolated, no agenda	Well defined for faculty and students, including leadership	Competency based	Future ready
Role Assignment	Ad hoc	Trial and error	Competency based	Systematic rotation	Succession planning
Teaching-Learning Process	Ad hoc. Person dependent	Isolated processes	Organizational processes, templates for practice, documenting knowledge base	Measured, monitored and documented practice	Continuously improving based on outcomes

Use of Technology	No existent or isolated	Recommended but no follow up	Systematically used	Dedicated facilities and processes	Optimized
Career Growth	Norms not followed	Norms, ad hoc criteria	Performance measured and rewarded	3600 degree assessment	Institute aligned with individual aspirations
Attrition	Severe due to mismatch of competencies	Reduced but no feedback into process	Minimal attrition due to interpersonal or competency issues	Almost no firing for lack of competency	Systematic effort to retain competent people

VII. FUTURE WORK

This paper presents some preliminary thoughts on competency based perspective on the people involved in achieving OBE. There are several questions to be answered before we can deploy this on a pilot basis.

1. How do we measure these competencies? If we again use evidence like course plans, assessment samples, research output etc for faculty, how will this be different?
2. This model relies on self-assessment by the people. How authentic will that be?
3. How do we measure the interactions between these competencies of teacher and student?

I am collaborating now on building a simplified model for student-teacher interaction in and outside class and then using it for validating the scenarios that we see in colleges. The lists of competencies and the 5 levels of maturity are currently very complex to conceptualize a model. We will work with a simplified set. We will then use the models to change the scenarios by suitable interventions. Finally, we should be able to predict the outcomes for specific competency pairs.

For a country with an estimated 80,00,000 (in 2011-12) students earning Bachelor's or Master's in science (allied subjects like Veterinary, Agricultural and Medical Sciences), technology and engineering from various universities and colleges[7], there are hardly any innovations or products to boast of. Even in the larger segment of Humanities and Social Sciences with an estimated 120,00,000 students, there are no path breaking ideas or reforms in Indian systems. Neither are there scholarly works.

I believe that this model will help colleges and universities to optimize their resources and focus on things that are important and relevant for creating the kind of professional graduates we need. As curriculum moves from content based to outcome based, management of people should also move from qualification based to competency based.

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