Title: A Competency-based Approach to Polytechnic Education for the Learning Age

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Abstract:

This paper presents efforts to revisit the concepts of competence and competencies, and outlines a model for polytechnic education. The model, still in its preliminary shape, was developed by working backwards starting with the highest outcome desired - the desire for competence in the workforce of the future – and backtracking to the development of discipline-specific competencies which themselves are treated as a function of attitudes, skills, and knowledge. The crux of this model is in the fusion of these three components of a competency in the development, delivery, and assessment stages of a diploma course.

The paper also outlines a preliminary procedure to facilitate staff recasting the existing module development and structure in this move towards fusion.

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Part I: The Desired Competence

A. Competence in the 21st Century workforce

Competence is 'the ability to operate to the highest standards anywhere.'
R M Kanter in World Class

If this is the goal, then it can be inferred that the attributes of a competent workforce would go beyond that of being highly trained and skilled in specific job tasks. The core attributes for a world class workforce would include the following:

- Flexibility
- Transferability
- Manoeuvrability
- Adaptability
- Globality
- A spirit of innovation
- Collaborative abilities
- Enterprise
- Quality consciousness
- Rootedness

Each employee would then need to be competent and continue to remain competent in a changing business/commercial environment.

B. Competence of an Employee

The indicators of **competence** of an employee in a dynamic workforce would be **the ability to efficiently perform** a variety of industry-related tasks, the **ability to function professionally** in a range of roles and situations, and the **capacity for continuous learning, development and change**.

These abilities and capacities are enabled and supported by the **competencies** that an employee acquires through education (especially for entry-level workers), training, and experience. **Competencies** can therefore be seen as the **foundation of competence**, as illustrated in Fig. 1.

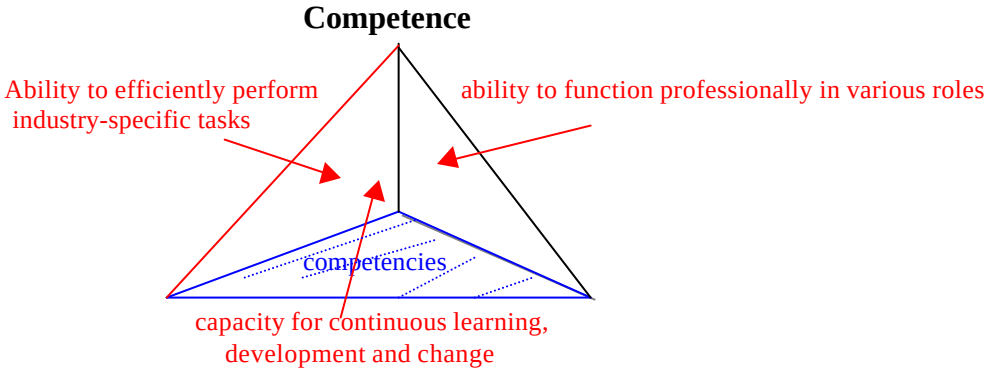


Fig 1: Competence of an Employee

Part 2: Competency – a definition

If competencies are the foundation of competence especially for an entry level employee, then to develop competence, a graduate must have satisfactorily acquired and honed a set of profession-specific and inter-disciplinary competencies (as education takes on a multi-disciplinary focus).

As seen in Figure 2, each competency is a function of three core components: **attitude (behaviours), skills and knowledge**. Admittedly, the teaching of a competency may have a particular bias towards any one of these components. However, this does not preclude the existence of the other components which should also be made explicit in the learning experience.

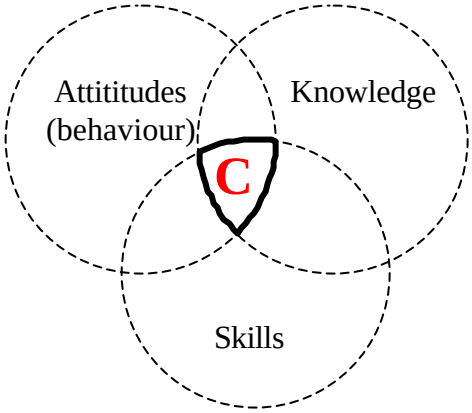
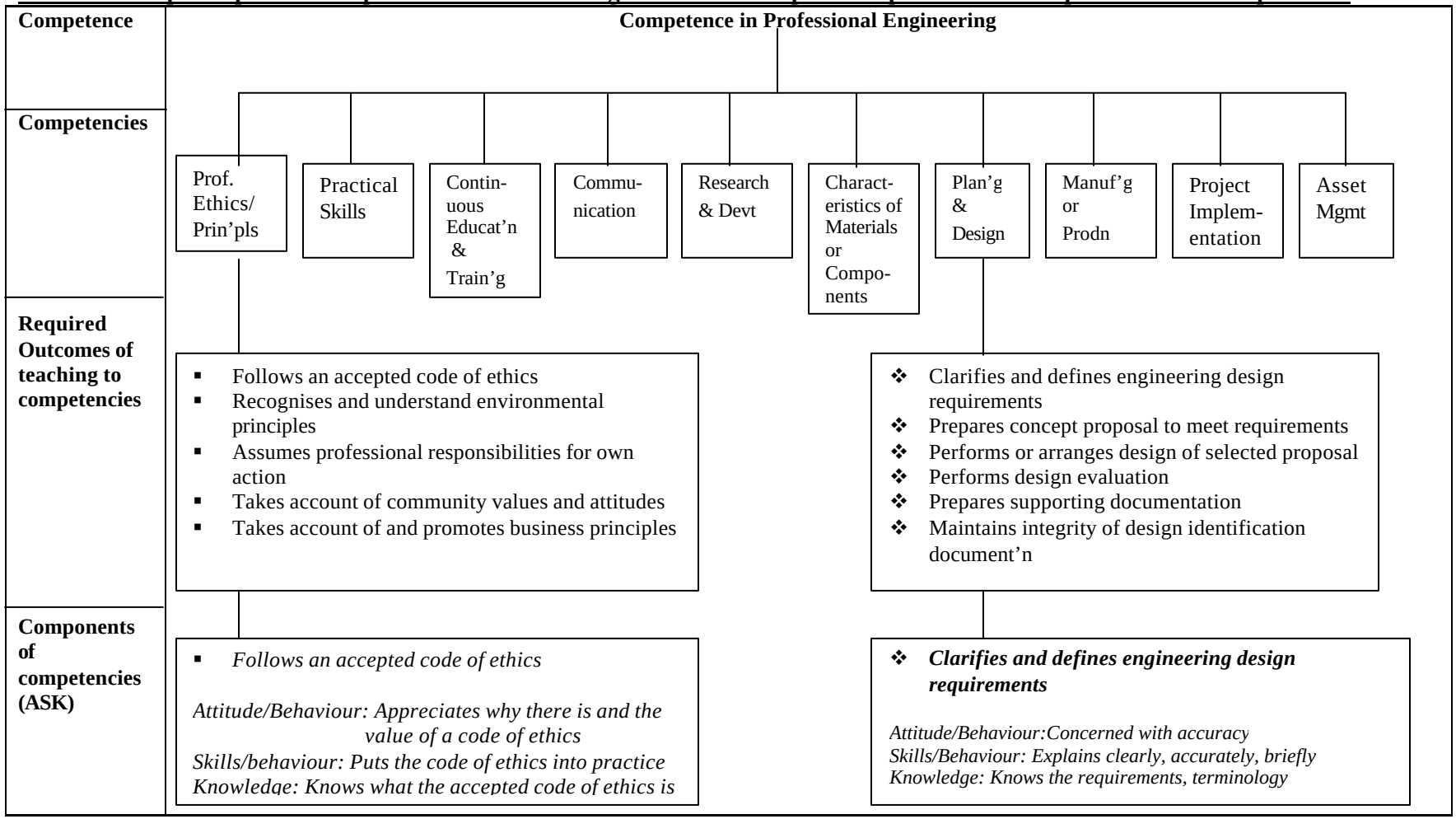


Fig 2: Core components of a competency

In the strictest sense of this interpretation, a student who excels in the content component of a competency but not in the other two components, cannot be seen to have satisfactorily mastered the competency. This has implications for assessment and teaching, which will be touched upon in Part 5, and 6 of this paper.

This concept of competence and competencies also has implications for the shape and structure of a course take. Part 3 attempts to recast an engineering programme in this model looking at engineering competence as a series of competencies that the engineer must (should) have. It then looks at the required outcomes of these competencies and attempts to identify and make explicit the attitudes, the skills, and the knowledge components of the competency. Modules that contribute to that particular competency must then ensure that their structure, delivery and assessment also contribute to the required outcomes.

Part 3: A discipline-specific example of a curriculum designed on the concept of competence and discipline-relevant competencies



(adapted from Bowden, J.A. & Masters G.N, 1993, *Implications for Higher Education of a Competency-Based Approach To Education*

Part 4: A Competency-based model for teaching and learning

A. The suggested model

- The suggested model would be a fused model which recognises that all teaching and learning experiences foster the development of all three components of competency. This would mean that when one teaches skills, one should also explicitly bring to the foreground the relevant knowledge and attitudes underpinning the skill. Likewise, when one teaches knowledge, one should also explicitly bring to the foreground the skills and attitudes underpinning the knowledge.
- All teaching and learning within the Polytechnic will focus on helping students acquire the range of competencies necessary for their course.
- All assessments for a competency have to be designed such that they elicit and assess the three components, preferably simultaneously.

A.1: Example

Thus, as in the example in Part 3, a teaching staff engaged in a module fostering the competency of 'Planning and Design' will have to make explicit not just a knowledge of the principles of design, but also how these translate into the skills required for design and the necessary attitudes such as accuracy, quality and so on. Likewise, a teaching staff engaged in fostering 'Professional Ethics and Principles' will have to make explicit, not just the attitudes of being ethical and professional, but also the specific code of ethics within engineering which presumably would include a commitment to accuracy and quality, the reasons for these codes, and the accepted behaviours that indicate that the code of ethics is being practised.

A.2: Advantage of this model

A curriculum which sees such a synthesis of content knowledge, attitudes, and skills (behaviours) is probably more likely to nurture the desired attributes of flexibility, adaptability, transferability and the habit of breadth and depth of thinking, and the ability to vision new and different connections, applications and possibilities. This model would help develop competencies in a deeper and richer sense. It would also facilitate the transfer of learning in one competency to the development of other competencies.

B. The Current Model for a Curriculum

The current curriculum includes clusters of modules address all three components are seperately. The overlap and fusion of the three is not explicitly built into the model.

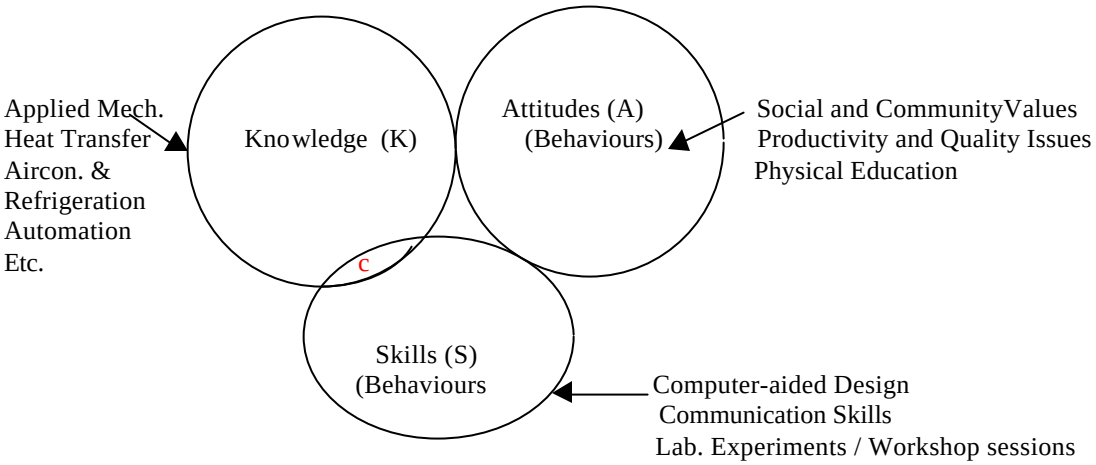


Fig 3: Diagrammatic representation of the existing engineering curriculum

B.1 Limitation

The drawback of this model is that the compartmentalisation becomes a barrier to competency which is the synthesis of and not just the sum of the three components. Exacerbating this division is that this model tends to bias assessment towards discrete content recall or performance of discrete skills.

The challenge for learning in this model would be that the student would to try and fuse, transfer, and synthesise the components. However, the assessment in such a model tends not to demand much synthesis and transfer, which calls into question the role of the course in the development of the competent employee and the desire for competence.

Part 5: Implications for Assessment

Assessment forms and methods will have to reflect the integration and may have to shift to include a greater emphasis on performance-based methods. Assessments can do this in one of many ways, Problem-based Learning assessment being one of them.

At Ngee Ann Polytechnic, it was decided that the existing basket of assessments for a module would be reworked to be more ASK-focussed. This was felt to allow a gentler transition from the existing model in Fig. 3 to the explicit fusion of the components in Fig. 2.

This meant that each item in the basket should explicitly elicit all the components satisfactorily. This required modifications to the current thinking about assessment. This would also require a fine-tuning of the performance feedback channels to explicitly include both the summative as well as the more formative and developmental estimations of learning.

B.1: Example - Engineering Mathematics I (one module in a cluster of other modules which teach to the competency of Planning, Design, and Troubleshooting)

An ASK-focussed basket of assessments for this competency could be:

- Computerised assessments which will test mainly in the area of content application (K), computation skills, the skill of working within a time given (S), and a concern for accuarcy (A). Performance feedback here could be immediate allowing for learner reflection, review, and retesting to indicate performance improvement. The feedback descriptors should take into account the three components.

- Written tests which will elicit the process of application of the mathematical theory (K), reasoning and computational skills (S), the attention to detail and a concern for clarity and precision in the presentation of solutions (A). Feedback could be a summative mark as well as comments on the strengths and weaknesses of the answers in terms of the three components

- Mini-projects which require some research, collection of data, analysis of the data, computation of results, drawing inferences from the results, a concern with accuracy, details, a feel for figures and estimation, and so on (ASK). Feedback should be both a point-in-time summation of the performance in marks or grades, as well as developmental feedback for improved performance.

- A final written examination which will elicit the processes of application of all the mathematical theories covered in the semester (K), reasoning and computational skills (S), the attention to detail and a concern for clarity and precision in the presentation of the

solutions (A). Feedback would most likely be a quantitative summation of the estimated quantity and quality of learning for the semester.

Part 6: Stepping Towards Fusion: a pilot attempt

The proposed fusion model requires that the curriculum be fine-tuned to identify the desired discipline-specific competencies which the various modules / subjects hope to foster. Each module should then be revisited to ensure the explicit inclusion of all three core components of a competency. The model also requires that assessment design, practices, and marking be reviewed to be in tandem with the intentions to foster fusion.

Fig 4: The Journey towards Fusion

We have documented 4 stages in the progress towards fusion.

Stage 1: Re-visioning the curriculum in terms of competence and competencies
- Re-visioning a diploma qualification as a competence and a set of diploma-relevant competencies.
- Re-grouping the modules / subjects under the respective competencies

Stage 2: Re-focussing the module directions on outcomes and components of a competency
- Identifying the required outcomes of teaching a module to the competency
- Stating explicitly the knowledge component, skills component, and the attitude component of the required outcomes

Stage 3: Revisiting existing design and structure of a module
- Reviewing and revise the existing set of learning objectives in the module document in the light of these explicitly stated components of the competency.
- Reviewing and analyse the existing basket of assessments in terms of the outcomes / components/ and revised objectives
- Analysing the questions, the points of difficulty in the paper, and the possible reasons for the difficulty levels.
- Reviewing the marking scheme and rubric for how they treat the components

Stage 4: Redrafting the module documents
- Redrafting existing module documentation to include the outcomes and components of a competency, with a focus on making the attitudes more explicit.
- Revising assessments, and teaching and learning strategies to align them with contributing to achieving the required outcomes of the competency.

Part 7: Concluding Remarks

The pilot attempt at moving towards this model of fusion requires painfully challenging rethinking. The realisation of this model depends on staff successfully

- Articulating the characteristics or performance indicators of graduate fit to be certified as competent.
- Identifying the competencies and, not just the subjects or modules, that go into the development of this competence.
- Articulating explicit attitudes, skills and knowledge that make up a competency.
- Identifying and grouping the modules that contribute to the different competencies.
- Analysing and revising the basket of assessments and marking schemes to include the components.

Staff agree that the model tries to address fundamental issues for setting students on the path towards competence: the need to explicitly include the nebulous component 'attitude' and the need to ensure that students see not just the parts of a curriculum but the whole of their qualifications. Staff are however unsure as to whether this model can be realised, given that the current system of thinking has locked them into the compartments of the subject or module that they are responsible for.

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