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ASSESSMENT OF PROFESSIONAL COMPETENCE IN ENGINEERING, PRODUCT DESIGN – AND HIGHER EDUCATION – SPECULATIVE DIRECTIONS FOR DEVELOPING PRACTICE

Chris Dowlen
Visiting Fellow, London South Bank University

ABSTRACT
The IED's development of the Chartered Technical Product Design has prompted an investigation into methods and processes of assessment of professional competence. This is intended to assess competence in normal work and not using an invented assignment. The paper suggests the meanings for professional competence and assesses different assessment methods, comparing them with those currently used for engineers, designers and educators. It concludes that the current processes are generally effective, but includes suggestions to modify current processes rather than suggest a complete replacement.

Keywords: Professional competence, assessment methods.

1 VIGNETTES

Ian Callum was presented with his Chartered Technical Product Designer certificate at the Institution of Engineering Designers' 70th anniversary celebration in St James's Palace in July 2015. His Royal Highness the Duke of Edinburgh asked "And what do you do?" "I design Jaguars". To most of the company that was an understatement. Ian's design work for Jaguar is evident and public knowledge.

Figure 1. Ian Callum presented with his Chartered Technical Product Designer certificate, July 2015

An interview is held for an Industrial Design lectureship. The candidate brings a boxed set of tumblers from a well-known chain store. One of the interviewers commented that they could have come from anywhere. Another thought that was exactly the point. They could have come from anywhere but the candidate had designed them – this ubiquitous set of tumblers. This was his evidence as a designer.
Some people's work clearly demonstrates their professionalism. Others need another way. This paper discusses and evaluates ways of assessing professional competence. The opinions are the author's.

2 INTRODUCTION

In 2015 the Institution of Engineering Designers announced the Chartered Technical Product Designer qualification, along with the post-nominals, CTPD.
The institution has to develop processes and methods of assessing the competence of Chartered Designers. The approach has been to develop a similar process to that used for the Chartered Engineer qualification, CEng.
This has acted as a catalyst to investigate methods of professional assessment. The paper speculates on methods to assess professional competence, starting with an analysis of the meaning of professional competence and how it might be assessed.

3 PROFESSIONAL COMPETENCE

The meaning of professional competence causes some difficulty. To what extent does a degree imply professional competence? Eraut [1] suggests that professional competence is achieved in a work setting and not otherwise. Quoting Dreyfus and Dreyfus [2], he splits this into *competence* and *proficiency*, *competence* being defined as being able to cope with crowdedness, seeing actions at least partially in terms of longer–term goals, able to carry out conscious deliberate planning and able to utilise standard and routine procedures. He identifies *Proficiency* as being able to see situations holistically rather than in terms of aspects, able to see what is most important in a situation, to perceive deviations from the normal pattern, to have a less-laboured decision-making process and being able to use maxims for guidance, whose meaning varies according to the situation. He includes another category of *expert*, who no longer needs to rely on rules, guidelines or maxims, has an intuitive grasp of situations based on deep tacit understanding, uses analytic approaches only in novel situations, when problems occur or when justifying conclusions, and has an overall vision of the possible. Eraut sees trajectories of learning taking place as people learn from their communities of practice in generic and tacit ways. He also sees the assessment of professional competence as derived from the workplace rather than from artificially-imposed exercises. He sees qualifications as perceived public rites of passage from one level of professionalism to another, and as important markers on the trajectories of learning. Wenger [3] would identify qualifications as examples of reification of practice – ie tangible tokens that a level of competence, proficiency, or expertness has been gained. Whilst a degree may be taken as a competence measure, Eraut suggests learning still needs to take place within every workplace and students are never 'oven ready' upon graduation. There seems to be some discrepancy between competencies of those with degree qualifications and others, and a degree is not necessary for assessment of professional competence, although it may allow access to specific 'graduate level' employment. There is an argument that assessment of professional competence should be independent of whether a candidate has degree qualifications. The Engineering Council, for instance, has an experiential route towards every level of membership which does not demand degree qualifications.
Competence relates to the ability to effectively carry out tasks. The professional has sufficient knowledge to carry out representative tasks coupled with the ability to perform them, and can demonstrate they have done so. Exactly what task depends on which profession? At this conference three professions are in evidence – designer, engineer and educator in higher education – and perhaps others. Some attendees demonstrate competence in all three: others in one or two. All are active professions – designing, engineering and educating are all evidenced by practice, and all form communities of practice. Professionally competent individuals are part of the community, whether they are assessed as that or not. Assessing professional competence becomes one of agreeing and formalising an individual as part of that community of practice. The qualification indicates generic professional competence and is a rite of passage for an individual.

3.1 Levels of competence

Eraut lists three levels of professional competence that might be recognised, but others may also be identified. These are something like:

1. general interest and on the border of the community
2. student – a learner and on the community border with a trajectory to enter – Dreyfus and Dreyfus would term this a novice.

2a. a member of an associated profession on the community border who does not consider themselves part of it

3. competent practitioner – can do the job of a designer, an engineer, educator or researcher
4. proficient practitioner – is able and competent to lead projects
5. expert practitioner – able to make a strategic difference in the overall community of practice
6. retired practitioner – was part of the community, has an exiting trajectory and wishes to retain links.

They might be something like affiliate, student, associate, registered [practitioner], chartered [practitioner], principal [practitioner]. For some professions the picture is a little confusing. Table 1 indicates levels for the three professions, but is not the complete picture.

Table 1. Titles for various professional levels

	Level	IED Product Designer	Engineering Council (UK)	Higher Education Academy (UK)
1	General interest	Affiliate		
2	Student	Student	Student	
2a	Associate			Associate Fellow
3	Competent	Registered	Incorporated	Fellow
4	Proficient	Chartered	Chartered	Senior Fellow
5	Expert			Principal Fellow
6	Retired	Retired member	Retired member	

It would be helpful if the confusion was removed and there were consistency. Qualifications need to be clearly linked to levels of competency

4 HOW TO ASSESS

4.1 General principles

The assessment process needs to measure what it sets out and not something else. Much professional learning is by experience and acquisition of tacit knowledge, which pose significant difficulties in determining what is being assessed. Concepts of competence, proficiency and 'expertness' are difficult to identify. Each profession lists criteria that they perceive should be included.

Race [4] suggests several criteria need to be used to evaluate possible assessment methods:

Validity – it needs to measure what it sets out to measure – achievement of professional level

Fairness – it produces the same result every time, for every assessor.

'Whodunit?' – it needs to be clearly done by the person being assessed and not someone else.

Transparency – the candidates must know how an assessment has been arrived at, particularly if unsuccessful. The criteria need to be clear – difficult for tacit learning.

The real world – it must be related to work that is being carried out in the professional's normal work. It isn't an off-line process or carrying out a specific, invented task.

Manageability – candidates and assessors need to do the assessment without excess effort. Timeliness could be included here – Candidates must know that the time between application and result is not too long. Current practice seems to take too long. A 'lean' approach might help [5].

Who carries out the assessment is based on these criteria. Some suggest that fairness, in particular, is improved by anonymity, which can be difficult.

4.2 Which Assessment methods?

Race [4] has compared eleven methods. These are traditional exams, short-answer exams, multiple-choice exams, essays, annotated bibliographies, reports, portfolios of evidence, oral exams, individual presentations, posters and artefacts. Several others can be added: application forms, interviews, multiple mini interviews, citations, free choice arrangements. The Engineering Council uses a combination of application form, professional review report and interview, with a technical report in some cases. The IED's mimics this process for CTPD, but substitutes an annotated portfolio for a technical report. The Higher Education Academy uses a structured review-type report, but accredits other practices in educational institutions. These may use presentations and interview-type discussions. Exams, essays and annotated bibliographies are artificially imposed tasks and removed from the real world and can be dismissed for professional assessment.

This leaves reports, portfolios of evidence, presentations, posters, artefacts, application forms, interviews, citations and free choice arrangements as possible means of assessment. Validity of all of these can be high. Fairness can be a problem, with reports scoring highest, particularly if specific criteria are identified and these are made clear to candidates. 'Whodunit' is better for face-to-face assessments than for remote ones, but plagiarism and cheating are still possible with face-to-face assessments.

Table 2. Comparative evaluation of assessment types for professional assessment

Method	Validity	Fairness	Whodunnit	Transparency	Real World	Manageability	Score
Traditional Exam							9
Short-answer Exam							11
Multiple-choice exam							12
Oral exam							12
Practical exam							12
Essay							0
Annotated bibliography							0
Report							12
Portfolio							12
Presentation							17
Poster							10
Artefact							10
Application form							11
Interview							13
MMI							11
Citation							14
Free choice							9

Table 2 has been drawn up with approximations, and the scores have only four settings: Good (green, 3), OK (Yellow, 2), Possible (Orange, 1) and No good (red, 0) – in some cases a method might overcome inherent difficulties and care can be taken with most assessment methods. The largest number of green markers and the highest score is the presentation, with five greens and a score of 17. The candidate can tailor it to include what they feel is a reasonable to meet the criteria, it is carried out in front of the assessors and so is difficult to plagiarise (not impossible), can be set up with real-world criteria and is manageable. Assessment can be unduly subjective. This can be overcome by recording so moderation can take place, as there can be a tendency for 'creep' to come into play, particularly if several presentations are seen in the same session. Nerves can be difficult, but may be overcome in an

'interview' session afterwards. Although the real world is marked as 'high' there can still be a disconnect as the assessment may be perceived to be on how the individual can talk or use graphics and technology, which can mask the real world skills. The next best method is the citation. This needs a certain amount of clarification. It is the only assessment method in which the candidate does no work. It requires others to put forward the case that the candidate be awarded the qualification, and thus the 'others', whoever they may be, need to be able to put the citation together in such a way that it clearly meets the criteria, putting more emphasis on how the professional body writes these in the first place. But the results of this are unreliable in the sense that they may not produce any candidates to assess – others may not be appreciative or able to provide the answers for the criteria.

The third assessment method that scores highly is the interview. This can be combined with a presentation, following afterwards. It suffers from unfairness and from diversion from criteria. The candidate is not in control of the proceedings, as is the case for a presentation, and can be gently guided around the criteria, which is not possible if the presentation is uninterrupted.

The free choice is marked down for the complexity of its management. But it could be a limited free choice such as the candidate being given half an hour to provide whatever evidence they wish, whether it be a presentation, artefact, poster or portfolio or any combination of these. This then becomes a specialised and augmented interview – it is limited in that it needs to be assessed by a panel there and then, being recorded in the process, presumably. This overcomes some of the difficulty, putting it on a par with some of the other methods.

Kahneman [6] describes the process used for selection that he developed for the Israeli army, using a combination of a report and an interview which was used solely to answer the question of whether the interviewers could see this person being effective as a soldier. An interview (say, following a presentation or after an augmented application form) might take this approach, identifying whether the interviewers see the candidate as a designer, engineer or educator – as well as the being the author of the document they claim to have produced. Kahneman sees an augmented application form being used in conjunction with a limited interview as being the best approach for selection for employment, although he does not evaluate alternatives. He feels that all face-to-face assessments suffer inherently from human failures.

4.3 Criteria

Kahneman suggests a maximum of six succinct criteria, covering diverse aspects. Eraut's distinctions seem to be particularly difficult to assess, and are general ones. The requirement is to identify whether the candidate is a member of the community of practice, and at what level. Are they able to practice effectively? What evidence have they that they have done so? And at the level required? These are intended to be relevant for the whole profession, so they need to be realistic and attainable by every member of the community, and should be perceived as attractive and aspirational by those who are in the process of attaining the level. They may be akin to Learning Outcomes on degree courses. Baume suggests that these should be primarily concerned with practice – doing something [7]. As a joke, perhaps, he uses an exemplar in his booklet of an MA in Professional Judgement. These learning outcomes come significantly close to a general set of professional competencies. As a designer, engineer, educator, do you have evidence that you can design? Or engineer? Or educate? Do you 'know the stuff?' Can you extrapolate from that knowledge to add some form of relevant and situated wisdom into this? Are you in the position of managing staff, projects, developing design, engineering or education strategy? And each profession expects candidates to continue to develop themselves. So the initial criteria would seem to be around practice – actively doing the profession. They might simply be 'Identify your knowledge of engineering / design / Higher education' – with a few useful buzz words to identify the sort of thing expected, such as how students learn, or the engineering methods you use, how you might design for specific populations. Or to provide evidence that you have carried out a significant piece of design or engineering work, or explaining how you have taught groups of students or individual students. One might be around continuing professional development and career choices. Other criteria might be around management competency. Who have you managed? Which projects have you managed? Explain how you led a major design / engineering / education project. They might cover financial aspects, project management or staff management, the decisions you made and why. At the competent level you might not be expected to have managed projects or staff, but will probably want to set your sights on that for becoming chartered, senior or expert. At the proficient level you would wish to cover more evaluative and decision-making aspects of the

profession. Further criteria might be around broader issues such as sustainability, ethical practice and relationship with other professions and society. There are approximately six overall areas - which are general enough to apply to each profession, but which need illustrating with exemplars.

5 CURRENCY

How long should a professional qualification last? All these professions indicate that qualification is life-long – at the moment. But this differs from other professions, which need currency. All of the professions include the requirement of continuing profession development, even if nominally. A trajectory should identify not just those who are entering the professions, but those who are gently finding their way out, providing something to which they might still aspire, perhaps. Keeping professional development records may be an easy way to including currency.

6 COMPARISON WITH CURRENT PRACTICE

The end result was not intended to identify that current practice was acceptable, or was even 'good'. However, to some extent it has confirmed that current professional assessment practices are of higher quality than many other Higher Education assessments. The practice that would seem at most need of changing is that of the standard approach of the UK Higher Education Academy, which is assessed by a paper-based process which is inherently flawed in its 'whodunnit?' score. On the other hand, the requirements of most professional bodies include some form of initial paper-based assessment before a professional interview. A modification of this process is to place a significant limit on the size of the initial paper assessment to enable an easy and quick assessment to take place. It would also argue for a criterion-based initial assessment form of limited size to enable an effective assessment to determine whether the candidate would be likely to be successful in a combined presentation and interview session to follow. This also works as an introductory statement to signal an individual's wish to have the qualification. It should identify not just that the candidate performs the required tasks but also how they carry them out and what processes were used.

The speed of decision-making also needs speeding up, by perhaps considering lean production methods.

7 RECOMMENDATIONS

So which practices should be changed?

Recommendations are to use one than one assessment process, but to limit how many and to combine them if appropriate. Signalling the intention to begin assessment is important, and this signal should contain a limited preliminary assessment. The major processes can be amalgamated into a single presentation (which may include artefacts, posters or illustrations of work) plus a subsequent short interview discussion. And then the job is done, apart from the need for moderation. This is needed to seek to overcome the accusations of a biased committee and to evidence suitable quality standards.

Other methods can be ignored. They take extra assessment time, may be subject to unfairness or may assess something other than what is required.

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