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Assessment of Experiential Learning for Engineering Professionals

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ABSTRACT

CONTEXT

In a diverse engineering workforce, professionals have significantly different formal qualifications and learning journeys that can be unique to their situation. Due to new regulatory requirements and other needs, an increased number of individuals are seeking occupational classification assessment outcome in their area of practice at the level of professional engineer. Individuals without the required formal learning generally find it difficult to demonstrate their competencies through experiential learning. It is often challenging for educational providers and professional bodies to implement an approach to assess diverse experiential learning pathways in a consistent manner.

PURPOSE OR GOAL

This paper explores possible challenges professionals encounter in demonstrating how experiential learning meets a set of competencies related to their area of practice in engineering. It also discusses the common constraints from an assessor’s perspective (the authors) in using a standardised evaluation approach. Common gaps in understanding experiential learning, skills and competencies are highlighted. Current policies and practices around assessment approaches are discussed.

APPROACH OR METHODOLOGY/METHODS

To identify the challenges, common practices are reviewed and compared to existing policies, guidelines, and published recognition of prior learning (RPL) practices through experiential learning. A systematic gap analysis is required to identify competency gaps when comparing someone’s experiential learning and knowledge acquisition against a competency standard. A rubric analysis approach against accredited graduate attributes is often used to ensure an objective and consistent assessment. This paper focusses on the experience of the authors in establishing knowledge gaps against a standard and presents reflective observations from an on-going initiative to implement experiential learning assessment of engineering competencies.

ACTUAL OR ANTICIPATED OUTCOMES

Key possible challenges for engineering professionals to demonstrate how experiential learning meets gaps in knowledge obtained through formal learning is presented. The difficulties in assessing experiential learning and future opportunities are also presented. In the authors opinion a holistic assessment of experiential learning against required engineering competencies is a key to establishing robust, consistent and defendable experiential learning assessment tools and techniques.

CONCLUSIONS/RECOMMENDATIONS/SUMMARY

This paper aims to identify the key challenges and possible opportunities related to experiential learning assessment against competencies. The paper also provides the reflective background for future experiential learning assessment against competency elements. An in-depth understanding of the identified challenges will inform the critical requirements for a robust, consistent and defendable competency assessment procedure that is also efficient. This will provide guidance for future development of a high standard experiential learning assessment approach for professional bodies and the higher education sector.

KEYWORDS

Experiential learning, competency assessment, recognition of prior learning, articulation.

Introduction

The engineering workforce in Australia is made up of professionals with many different formal qualifications and learning journeys. Individuals without the required formal learning generally find it difficult to demonstrate the entry-to-practice engineering competencies developed through experiential learning in order to receive endorsement at their target occupational category. Anecdotally, it appears that many people working in engineering-related roles often perceive that experiential learning attained in the workplace should enable them to demonstrate competencies that were not acquired through formal education.

One of the widely referred definitions of experiential learning is presented by Kolb (1984): “the process whereby knowledge is created through the transformation of experience. Knowledge results from the combination of grasping and transforming experience”. The Association for Experiential Education (AEE 2024) adopts a similar definition emphasising construction of knowledge, skill, and value from direct experiences to frame experiential education. Kolb’s experiential learning theory highlights the need for concrete experience, reflective observation, abstract conceptualization, and active experimentation for effective experiential learning (Kolb, 1984). Resnick (1987) highlighted some key differences when learning inside, compared to learning outside formal learning spaces. The principal difference identified is school learning and performance is more individual in nature whereas outside the school, learning can be socially shared. Integration of experiential learning in engineering education is not new and has been considered a part of engineering education since the mid-1950s (Evans et al., 1990).

An individual's life experiences, education, and work are pivotal in shaping their learning, how they understand new knowledge and develop competencies (Fry et al., 2009). However, effective experiential learning requires a learner-focused approach which is well-structured and emphasises a heuristic process (Anthony et al., 1990). Attainment of required learning goals is easier to demonstrate in a formal learning environment compared to the workplace. Tembrevilla et al. (2024) conducted a systematic review of experiential learning in engineering education and presented several elements as the key to successful experiential learning. Their review indicated that the effectiveness of experiential learning largely dependent on presence of appropriate theoretical basis. Experiential learning components, when embedded in an engineering education, are not difficult to assess for individuals. This is due to the systematic approach to clearly demonstrate the attainment of competencies from experiential learning by the graduates against objectives through assessment of learning outcomes. Experiential learning through a structured internship part of the engineering learning journey can also be effective (Tener et al., 2001). Good summaries of various aspects of experiential learning in engineering education are provided by Steele (2023) and Badiru (2020).

Workplace learning often lacks the appropriate ingredients for effective experiential learning to ensure attainment of competencies at the required level. As the learning phenomenon is associated with a specific cultural content, learning in various workplace environments is different from the learning that happens in a typical tertiary educational setting. Experiential learning can transpire in diverse contexts at different stages of an individual’s career, contributing to significant variation in the level of competency gained from workplace activities. Professional development opportunities can provide individuals with unique learning journeys and knowledge development through on-the-job training, mentorship, coaching, and formal training. Assessing the proficiency level of a competency gained from experiential learning is often challenging. Due to the uniqueness of an individual’s learning journey, it is difficult for educational providers and professional bodies to implement a consistent RPL approach.

The absence of structured learning goals in a workplace can hamper the level of acquisition of experiential learning (Eisenstein & Hutchinson, 2006). Based on a series of experiments these authors concluded “managers and consumers should increase their use of objective analyses and decrease reliance on experience or intuition”. It was observed in their study that “reliance on some type of experiential learning can either be accurate and efficient or erroneous and biased”. The absence of learning goals, insufficient objective observations, and lack of knowledge synthesis learning in the workplace might result in insufficient learning or learning which is not fully founded on solid fundamentals (Tynjälä, 2008). Variation in proficiency levels and a lack of understanding of underpinning knowledge can create added layers of uncertainty for an assessor when assessing experiential learning.

Although research on the role of experiential learning in engineering education is not scarce, extensive investigation of on-the-job learning and development of competencies is limited. A recent Organisation for Economic Co-operation and Development (OECD) working paper highlights RPL as a key building block of national skills policy which can empower upskilling strategies of a country (Meghnagi & Tuccio, 2022). Despite the potential value of RPL, it remains challenging to be implemented extensively.

An enhanced understanding of the challenges and possible opportunities for assessing experiential learning is fundamental to achieving fair and consistent RPL. It can also better equip professionals keen to demonstrate their competencies gained through experiential learning.

Frameworks for Recognition of Experiential Learning

It is desirable that RPL of skills and competencies is based on fairness, transparency and consistent assessment. Available policies and guidelines from different regulatory bodies aim to provide guardrails for consistent RPL assessment. The policy requirements for RPL in higher education are provided by the Australian Qualification Framework (AQF) and the Higher Education Standards Framework (HESF) of the Tertiary Education Quality and Standards Agency (TEQSA, 2021). The AQF prescribes capturing individuals' actual knowledge and skills regardless of how they were acquired.

The guidance notes on credit and recognition of prior learning from TEQSA attempts to provide some directions to the higher education sector for RPL implementation. To practice transparent and consistent RPL assessment, Section 1.2 of HESF places the onus on the higher education providers to develop and document RPL policies and procedures.

Higher education institutions develop their own policies in compliance with AQF and TEQSA standards to maintain academic standards and integrity. Higher education providers often apply structured approaches to assess specific types of evidence to provide consistent outcomes for applicants. To provide RPL for a course or a program, the evidence provided by the student is mapped against the learning outcomes of that course or program. This ensures alignment and relevance. When assessment of experiential learning requires evidence to be mapped against competencies instead of learning outcomes, the process becomes more complex.

Engineering Professional Competency

The national standards and competency frameworks established by Engineers Australia (EA) set out the competencies required for different levels of professional engineering practice within Australia. Different competencies and proficiency levels are required under the EA framework for three occupational categories: Professional Engineer, Engineering Technologist, and Engineering Associate (EA PSF, 2023). The competency standard of EA clearly distinguishes between the set of competencies required for entry-to-practice and for independent practice.

Entry-to-practice competencies are closely aligned with knowledge, skills and their applications whereas independent practice competency elements focus on attributes required for independent practice built upon entry-to-practice foundation. The EA National Competency Standard (EA NCS) is aligned with the Graduate Attributes and Professional Competences (GAPC) prescribed by the International Engineering Alliance (IEA) (IEA 2021). As the internationally recognised authority with jurisdictional responsibility for the competency standards for the profession in Australia, EA maintains the standards of competency that support engineers to practice competently and ethically and thereby adding value to the community through their work.

Engineers Australia accredits engineering degrees at the Engineering Associate, Engineering Technologist, and Professional Engineering categories under the Dublin, Sydney, and Washington Accords, respectively. Accord accredited academic programs ensure the attainment of competencies in the relevant category. Professionals without formal academic qualifications working in engineering industry often seek to demonstrate their competencies at their target occupational category level with a combination of their formal and experiential learning to receive their desired occupational classification.

Competency in some of the entry-to-practice elements to a desired proficiency level is not required in many workplaces, therefore the scope of learning and applying those skills might not be available for some professionals despite their long industry career. As an example, an individual with a non-typical learning journey who has never been exposed to advanced mathematical topics, numerical analysis, and other relevant theoretical background knowledge, may be able to progress successfully in the construction industry to engineering leadership roles. Although this person might have obtained high levels of proficiency in many of the independent practice competencies, they may find it challenging to demonstrate some of the competency elements at the entry-to-practice level.

Assessment of Experiential Learning for Competencies

The basic qualification that satisfies the entry-to-practice competency for EA membership in the Professional Engineer occupational category is an accredited four-year Australian Bachelor of Engineering (Hons) degree (AQF8) or accredited Australian Master of Engineering degree or equivalent (AQF9). The basic requirement for the Engineering Technologist category is an accredited three-year Australian Bachelor of Engineering Technology or Engineering Science degree or equivalent (AQF7). Similarly for Engineering Associate classification an accredited two-year Australian Advanced Diploma or Associate Degree or equivalent (AQF6) is required.

Introduction of state regulatory registration requirements in several states in Australia has contributed to some professional hurdles for individuals working at an occupational category without the appropriate formal qualification at that level. EA provides an articulation service where an existing member can seek advice on their competencies against another occupational category. Commencing at the end of 2023, Engineers Australia has received an increased volume of applications for articulation where members were requesting articulation advice to be eligible for an occupational category which is different from their existing category. This increase is thought to be linked to the introduction of more state regulatory registration requirements in NSW, Vic, ACT and WA. Queensland has had a registration requirement for engineers since 1929. The author’s involvement in EA’s articulation service provided them with the background to identify the key challenges associated with demonstrating experiential learning for engineering competencies. The extent of further learning required to demonstrate competencies to a target occupational category depends on the existing competency gaps identified when formal and experiential learning are both considered.

For articulation, a member is required to demonstrate the attainment of competencies against EA’s entry-to-practice competency standards for their target category. For each case, generally a candidate’s formal learning is benchmarked against comparable accredited programs to identify knowledge, skills, and possible competency gaps. Evidence of informal learning, training, workplace engineering tasks, continuous professional development (CPD), and other activities are analyzed to establish if the gaps in knowledge and skills are bridged, and the required level of proficiencies are demonstrated. Based on the review of both formal qualification and experiential learning, final competency gaps are identified. Required articulation study plans are developed for those individuals to meet the identified gaps and ensure their attainment of competencies to the required level of their target occupational category after completion of the study plan.

Possible challenges for the candidates

There are key areas where candidates commonly expect to face difficulty in presenting their competencies to the level expected based on their qualifications and work experience. Some of the identified key challenges are:

Comprehension of competency requirements

Inconsistent and irrelevant claims of competencies can raise the question about the comprehension of the competency requirements by the candidates. Lack of adequate understanding of the competency elements and attainment indicators can contribute to their inability to identify their own competency gaps and present evidence accordingly. Successful demonstration of attainment of competencies requires a candidate to differentiate between skills and competencies or between knowledge and skills. Inadequate understanding of those aspect may result in candidates trying to utilise their leadership, management and other independent practice competencies to claim their entry-to-practice competencies.

Understanding of how experiential leaning can bridge competency gaps

An inadequate understanding of experiential learning can lead to a perception that the number of years of their work experience is a measure of experiential learning to meet competency elements.

Understanding the level of proficiency required for each occupational category

Although Professional Engineer and Engineering Technologist occupational categories have similar competency elements, the proficiency level and contextual depth requirements are different. EA’s competency attainment indicators provide guidelines for the applicants to assist with understanding the level of proficiency required for each occupational category. Professionals seeking to demonstrate attainment of competencies are expected to comprehend the difference in academic terms, such as “open-ended” vs “broadly defined” problems. A proper understanding of those terms is expected to contribute self-understanding of their existing competency level.

Evidence to justify competency claims

It can be anticipated that based on a career path and job roles that some engineering professionals may have acquired certain competencies. One primary challenge for those individuals can be to produce appropriate evidence. The reasons for their inability to produce necessary evidence can be varied; examples may include artifacts not preserved, lack of a name of the candidate on an artifact and no access to the documents from previous roles.

Narrowly focused job roles

Narrowly focused job roles may not contribute adequately to the development of advanced knowledge synthesis competencies within broader areas of their engineering disciplines.

Career progression in management and leadership from an early career stage

Some engineering professionals may find they have limited exposure to core engineering duties due to their career progression in non-engineering areas or in management and leadership from an early stage of their career.

CPD activities not aligned with entry-to-practice competency

Often professionals may choose to engage in CPD activities in areas which contribute to the enhancement of independent practice competencies. Many common CPD activities in management, leadership, or planning helps develop independent practice competencies, but are not expected to contribute to advanced engineering knowledge or engineering research direction. These CPD activities in non-core engineering areas are not expected to bridge entry-to-practice competencies.

Possible challenges for the reviewers

The combination of formal and experiential learning for each engineering professional can be different. Benchmarking of formal education to identify the knowledge gaps is generally required to understand the foundation of an individual's knowledge and skills background. Conducting benchmarking for individual cases can be resource intensive. In-house Large Language Models (LLM) have the potential to assist assessors and reviewers to complete an initial benchmarking of a candidate's qualifications against required competencies. To implement a LLM based approach, a comprehensive validation of the predictions is required to ensure fairness and equity in any initial assessment. Some key challenges and prospects of automatic assessment of text-based responses is summarised by Gao et al. (2024) which highlight the need for a careful approach in implementing any automatic assessment.

Assessing the experiential learning from various activities for a candidate is always challenging. The level of difficulty can be augmented by insufficiently addressed competency elements or failure to address some elements. An inadequate comprehension of competency elements at the required proficiency level has the potential to contribute to the claims of competencies which are not supported by the evidence. Establishing the extent of proficiency level based on evidence from workplace activities is challenging from the reviewer's point of view. Validating the authenticity of artifacts submitted as evidence for experiential learning is challenging in many instances. Workplace learning is commonly unguided, unformatted, and unassessed. Hence, from the submitted evidence it can be difficult to establish the amount of contribution, level of learning, and attainment of specific competencies. Due to the level of complexity involved in reviewing experiential learning cases, there are risks of variation in interpretation of proficiency levels and competency attainment.

Improvements in RPL for Engineering Competencies

Improved RPL for engineering competencies can be based on bridging the gaps in understanding the process from the perspectives of an individual seeking RPL and the institution assessing and granting the credit. Providing tailored information to individuals can assist their preparation and application for RPL. As previously discussed, working professionals might not be familiar with some of the terminologies used for competency assessment and RPL. A few of the possible challenges discussed in the previous section stem from inadequate understanding of concepts and terminologies associated with experiential learning assessment. Uniform skills and competencies taxonomy at a national level can be propagated to the engineering professionals for their increased understanding of competency requirements. Regulatory guidelines on competency mapping for experiential learning can assist professional bodies to deliver consistent outcomes in a faster timeframe.

Introduction of Generative AI (GenAI) to benchmark the formal qualification against accredited qualifications can significantly reduce the effort needed for conducting a review. A guide on acceptable artefacts from different aspects of experiential learning can help the assessor and an applicant to establish a competency element. Introduction of AI-based self-assessment tools for professionals has the potential to help individuals to receive an indication about their level of competencies. This type of tool can also help individuals plan for their future CPD activities to bridge their competency gaps.

The application of a multifaceted process involving various methods to review experiential learning has the potential to provide an assessor or reviewer with an adequate level of confidence to endorse the attainment of competencies by an individual through experiential learning. Inclusion of ePorfolios, performance reports, video reflections on experiential leaning can help the review process (Farrell, 2020). Utilisation of a panel instead of individual review can be expected to increase the reliability of the process.

Future study utilising real case studies of individuals claiming competencies through a combination of formal and experiential learning is expected to confirm the challenges previously discussed. This type of further investigation will help in preparing guidelines for professionals seeking endorsement in an engineering occupational category. This may also assist improve some aspects of the policies and procedures currently available for RPL in context of engineering learning.

Conclusions

The level of experiential learning engineering professionals gain in the workplace is different from the learning that occurs under a well-structured engineering education program. Due to significant variation in the learning journey, mapping experiential leaning against competency elements is challenging and resource intensive. Engineering professionals can face difficulties demonstrating competencies from their experiential learning. Better communication, information sharing, and limited training for those professionals are expected to significantly assist them in preparing improved submissions to demonstrate their competencies.

The introduction of new tools such as GenAI is expected to improve an assessor's ability to provide a quick and consistent outcome. Multifaceted review processes can also positively contribute to assessing experiential learning for competencies. In existing policies and frameworks there are opportunities to provide a comprehensive outline for the professional bodies to facilitate and encourage RPL for engineering professionals which has the potential to contribute significantly to the upskilling of the engineering workforce.

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