An Innovative Assessment for a Research Methods Module: Assessing Master's Students Analytical Skills Beyond a Traditional Dissertation

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SUMMARY

Research methods education is significant for enabling postgraduate students to demonstrate a mastery of knowledge and skills required to achieve their degree (QAA, 2020). Yet there is a lack of research on how students are assessed in research methods apart from a 'final project' (Earley, 2014). This presents a gap in pedagogical scholarship in engineering education on the assessment of student's analytical skills to conduct research. To address this gap, the paper investigates the research question: "How to assess engineering master's student's analytical skills for research?" The authors present a case study of reflective practice in which an innovative analytical skills assessment was designed for 955 full-time postgraduate students enrolled on a transferrable skills module offered to 6 master's courses. The paper presents challenges in designing a constructively aligned assessment for a diverse group of students with varying research interests and disciplines. Based on the authors' reflections, recommendations are provided on the design of innovative assessment of analytical skills for a large class of engineering and business students as well as a call to develop a culture of engineering education scholarship on research methods education.

INTRODUCTION

To evidence a mastery of knowledge and skills, postgraduate students are expected to develop analytical skills (QAA, 2020). These analytical skills are developed in research methods (RM) education and are transferable to work in industry and academic study as they enhance students' ability to create evidence-based solutions to address new problems. Due to the academic and professional importance of analytical skills, research focusing on teaching and assessment of RM is crucial.

However, the body of research in RM education is limited, particularly among postgraduate students (Earley, 2014; Matos et al, 2023). For instance, there is a lack of clarity in how students are assessed and provided with the feedback and feedforward to develop their understanding, application, and evaluation of RM as part of their learning journey. In addition, there are calls to develop a pedagogical culture for RM in the social sciences (e.g. Kilburn, Nind and Wiles, 2014), yet there appears to be a lack of similar calls to action in engineering education. Consequently, a key challenge is to develop pedagogical scholarship in engineering education that informs the design, teaching, learning and assessment of RM best suited to engineering master's students.

Hence the paper addresses this gap through the question: "How to assess engineering master's student's analytical skills for research?" The authors present a case study on the design of an innovative RM assessment that enables postgraduate engineering and business students to investigate and evaluate RM in their discipline. The assessment is innovative in that it requires students to communicate their analytical skills in a format that differs from a common 'final project' (Early, 2014; Hoidn and Olbert-Bock, 2016), and is also separate to the project proposal or dissertation. The authors reflect on the design of the innovative assessment in order to contribute recommendations for practice of RM assessment in engineering education.

LITERATURE REVIEW

Higher Education Institutions (HEIs) have a significant role in research and the training of researchers. In the UK, quality assurance bodies list RM training as an essential requirement for masters' students to obtain their degrees (QAA, 2020). Hence, RM training has been integrated in the curriculum to equip students with the necessary skills and knowledge to conduct rigorous research. In acquiring analytical skills, students gain proficiency in RM and develop vital competencies, including critical thinking, effective communication, and the ability to adapt and learn independently (Joynes, Rossignoli, & Fenyiwa Amonoo-Kuofi, 2019). Hence, RM training is an important aspect in the formation of future engineering professionals.

While this training is crucial, existing research in this area appears to be limited. Two systematic literature reviews (Earley, 2014; Matos et al, 2023) identified limited studies on RM teaching and learning with none in engineering. In relation to RM, gaps are evident on the courses' content and how students are assessed (Early, 2014; Hoidn and Olbert-Bock, 2016). Scholarship in these areas is needed to inform quality provision that meet regulators' requirements and contributes towards students' academic success and transferrable skills.

Analytical skills appear to be assessed through two traditional approaches. One is a project proposal, yet a variation in master's student's ability to 'get started' on the design of research can influence their independent learning to find a research topic and select appropriate methods (Pringle Barnes and Cheng, 2019). Another approach is a summative assessment at the end of a student's degree, a 'final project', used as an assessment method in RM modules (Early, 2014; Hoidn and Olbert-Bock, 2016) in which a methodology is designed, applied, and evaluated to conduct research and typically written in a dissertation. Yet differences in the experience of project supervision can compromise student's development of analytical skills in practice. At the undergraduate level, other assessment approaches for RM are identified, including the analysis of a research article (Bachiochi et al, 2011) and reflective essays (Gardner, 2023). However, due to the integral nature of RM education for postgraduate students, scholarship is needed on the assessment of analytical skills beyond a traditional research project that can be beneficial to the student learning experience whilst achieving mastery of RM. This is also significant for improving scholarship on RM in postgraduate engineering education.

ASSESSING THE ANALYTICAL SKILLS OF A LARGE MASTER'S COHORT

In a large UK university, a transferrable skills module including analytical skills is delivered to 955 engineering and business students on 6 different master's courses. The module is delivered separately and prior to the submission of an individual dissertation, which is a core requirement for successful completion of the postgraduate course. The student cohort is diverse not only in the courses they are enrolled on, yet also their backgrounds as a significant majority are international students new to UK education and many students have worked in industry before continuing their studies.

Due to the characteristics of the cohort, a key challenge in the design of an innovative RM assessment is to offer flexibility for students to investigate areas of their subject interest. This was particularly important to ensure students appreciated the relevance of research methods to their own disciplines. The quality of flexibility is similar to a master's dissertation

in which students independently decide what to research and how, yet the module assessment can enable students to analyse and evaluate research designs prior to the submission of the dissertation. Therefore an aim of the assessment is to help students overcome the challenges of 'getting started' (Pringle Barnes and Cheng, 2019).

The RM assessment comprises of three parts. In the first part, students identify three credible sources (two journal articles and a conference paper) within their discipline and justify their selection based on the methodology used, ethical risks involved and source credibility; this is presented in a table in which students must concisely state their justifications with supported literature. In the second part, students evaluate the extent to which the selected methodology commonly used in the selected sources is used within their discipline in a brief essay; while a short essay is not a novel approach to analytical skills assessment, it is believed this would provide students with some familiarity in demonstrating knowledge and skills to support a positive student experience. In the third part, students reflect on the application of study and professional skills to complete the assessment; this is presented in a visual format in which students creatively produce an image or figure, for instance, of the transferrable skills applied during the assessment (such as how individual skills are implemented in a timeline and/or stages of creating the work) and how the skills improved (for example, a comparison of how the skills were enhanced by completion of the work). The assessment maintains constructive alignment with the learning outcomes and teaching activities of the module (Biggs and Tang, 2007).

This assessment is innovative since students can demonstrate their skills through alternative means of communication, such as a concise table and visual. This contrasts with a written assessment such as an essay or dissertation. Hence the assessment may be seen as an alternative to a traditional postgraduate assessment of analytical skills.

Another consideration in pedagogical innovation is the benefit to student learning and experience (Major, et al, 2020). For instance, assessment can be an emotional experience so it's important students are supported, such as by inclusive instructions that are "accessible, consistent and clear" and feedback opportunities (Hong-Meng Tai, et al, 2023: 410). Therefore, the authors considered an individual assessment most appropriate so student's questions can be addressed to benefit their personal development of analytical skills. With 955 students on the module, the virtual learning environment offered opportunities to inclusively communicate the assessment requirements, such as provision of an explanatory video with transcript, and respond to student questions online. These are in addition to twice weekly face-to-face drop-in sessions. This is significant to providing students a positive experience of assessment since students may not have previously engaged in similar assessments that enabled flexibility and autonomy to select relevant research in their discipline (for instance, students may have yet to meaningfully begin their master's project)

or created their own images or figures that demonstrates hierarchical thinking of application, analysis, and evaluation (Anderson and Krathwohl, 2001).

REFLECTIONS ON THE INNOVATIVE ASSESSMENT

An initial reflection of the innovative assessment is provided by the authors post-marking and moderation:

The innovative assessment was constructively aligned with the learning outcomes, which enabled the team to assess where students, whether as individuals or as a class, had common strengths and weaknesses. For instance, students showed they were able to select relevant, credible literature and create research questions and objectives. However, there appeared to be a lack of deep understanding of 'paradigm' and how this links to methodological design, as well as evaluation of ethical risks in conducting research. Whilst these aspects were covered in the module and reiterated to students in guidance on completing the assessment, the teaching team reflected that the master's students may benefit from deeper explanation and analysis of paradigms and ethical risks. For example, conducting risk assessments of published research so students are better able to apply, analyse, and evaluate these complex concepts and skills. In addition, the assessment may be improved by clarifying its instructions: for instance, the guidance can direct students to examples of ethical risks they might consider. To evaluate whether student's lack of knowledge of paradigms and research ethics is due to the teaching activities, assessment design, or both, its important students are approached for feedback.

The assessment incorporated a reflection on how a student applied their study and professional skills to complete the assignment, yet the quality of reflection varied. For instance, the extent students specified which skills they applied and when these were applied in the process of producing the work. Hence further support can be provided to students in following a process for reflection and techniques for creatively communicating increasing levels of critical thinking in a visual (such as drawing connections between skills and designing icons to note strengths and weaknesses of the skills).

The communication of the innovative assessment to students provided detailed information to set a direction and scope, yet students may benefit with greater time to review the assessment guidance and ask questions beyond the six weeks before submission. Furthermore, releasing the assessment guidance earlier in the module may encourage students to recognise connections between what they are learning and the assessment, thus motivating students to deeply engage with topics such as paradigms and research ethics.

The constructive alignment of the assessment with module requirements also proved helpful in providing feedback and feedforward to students. As a summative assessment of the module, assessors could direct students to relevant sections of the module, providing clear guidance on how to further develop their understanding. And in anticipation of the independent research project (a dissertation), feedforward was provided in relation to how concepts learnt could be applied to this work. This is significant as the feedforward is additional support beyond supervision to enable students to successfully complete their project, and class feedback-feedforward meant that common issues are being addressed prior to submission and communicated to supervisors to look out for.

Overall, the authors believe the assessment was successful as it enabled students to develop their application, analysis, and evaluation of RM in their discipline in a way that allowed flexibility and creativity for students to express their learning in different forms of communication. While the innovation is not radical, the small, intentional 'newness' of the assessment for how students communicate may offer an alternative to a traditional project, which may support the student experience and achievement of learning objectives within the context of a large class (Major, et al, 2020).

DISCUSSION

The design of an innovative assessment is significant to enhancing RM education that enables master's students to develop analytical skills beyond a traditional final project. Such an assessment may help students develop the skills needed to 'get started' on a project (Pringle Barnes and Cheng, 2019) without the pressure of the final project, thus supporting students to achieve the learning objectives while benefitting their experience (Major, et al, 2020).

This initial reflection on practice forms the basis of a larger investigation into RM assessment. Further exploration is needed on the relation of this assignment to dissertation performance and the student experience of the assessment. This level of analysis will provide additional evidence on the effectiveness of innovative assessment methods in RM education for postgraduate engineering and business students. In addition, the innovative assessment would benefit from further evaluation from the student perspective, such as how different components of the assignment supported accessibility and inclusivity, the clarity of instruction, and alignment with learning objectives and teaching activities. Incorporating the student voice is important to ensure innovation supports student learning and experience.

CONCLUSIONS & RECOMMENDATIONS

This innovative RM assessment is one approach to assess postgraduate student's analytical skills separately from a dissertation. This is significant so students receive feedback and feedforward beyond supervision to succeed in a final dissertation and achieve a master's degree. In designing innovative assessments, engineering educators can reflect on how the assessment provides flexibility, supports the student experience, and is constructively aligned. In addition, it is important educators consider how the assignment instructions are communicated and the opportunities available for students to ask questions and seek clarity on the assessment and feedback-feedforward. Since research on teaching, learning and assessment of RM in engineering education is limited, innovation and reflective practice in assessment is relevant to further develop this area of pedagogical practice. Hence this paper contributes to the development of a pedagogical community of engineering educators committed to enhancing RM education.

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