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Manoj Ravi & Mohsen Besharat

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A holistic consideration of authentic assessments: student perception of assessment design, delivery, flexibility and creativity

Manoj Ravi[a,b] and Mohsen Besharat[b,c]

[a]School of Chemical and Process Engineering, University of Leeds, UK; [b]Leeds Institute for Teaching Excellence, University of Leeds, UK; [c]School of Civil Engineering, University of Leeds, UK

ABSTRACT

Although 'authentic assessment' is widely used in higher education, its interpretation is often limited to an assessment task's technical relevance. This paper explores a more holistic conceptualisation of authenticity by probing authentic design and authentic delivery of student assessment. Findings from a UK University survey show that while students use various resources for coursework assessments, opportunities to incorporate personal opinion and exercise systems thinking are limited. Notwithstanding the assessment's technical content, how students work towards deliverables is often misaligned with professional engineering practice, with a comparative paucity of peer review and feedback practice among students. With student perceptions of authentic assessment being relatively underexplored, this study highlights the pitfalls of a myopic interpretation of authenticity, resulting in minimal opportunities to express creativity and flexibility in assessments. These findings challenge engineering educators to reconsider assessment authenticity by incorporating aspects of the student's lived experience that promote a more meaningful assessment experience.

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Authentic assessment; flexible assessment; student creativity; student perceptions

1. Introduction

Assessment authenticity is increasingly recognised as an effective component of the educational journey in higher education settings, which is perceived to lead to higher engagement and achievement (McArthur 2023). The concept of authentic assessment finds root in the constructivist theory of education emphasising the importance of contextual active learning experiences (Herrington and Herrington 1998). Authentic assessment is often described as assessment tasks that reflect 'real' professional practices, thereby enabling students to demonstrate their knowledge and skills in a practical context (Gulikers, Bastiaens, and Kirschner 2004) as opposed to a decontextualised assessment based on memorisation (Wiggins 1990). Coursework-type assessments encourage students to engage with professional scenarios, thereby fostering deeper learning and preparation for professional challenges (Ashford-Rowe, Herrington, and Brown 2014; Villarroel et al. 2020). Assessing students through coursework could also enhance student engagement and passion by providing opportunities for creativity and independent research. When it comes to engineering education, the emphasis is on the application of engineering principles in coursework-type assessments to

CONTACT Manoj Ravi m.ravi@leeds.ac.uk

solve practical, real-world problems using technical skills, problem-solving ability, and professional competencies specific to the engineering field (Palmer 2004). An extensive literature review carried out by Halls et al. (2022) provides a comprehensive overview of current trends in engineering education assessment, highlighting gaps in areas like workplace-based assessments, student engagement, and program-level design, suggesting that these require further research to align engineering education with broader best practices in higher education.

The importance of incorporating authentic assessments into engineering education, particularly to align student learning with real-world applications is presented in another study by Ullah (2020) to explore the challenges of designing assessments that not only reflect real-world problems but also safeguard against contract cheating, a growing concern in higher education by presenting examples of authentic assessment questions, which integrate context, complexity, and personalisation to enhance student engagement. Likewise, the implementation of an authentic assessment strategy can be facilitated through industry projects where students work in teams to solve problems provided by industry partners, with their performance assessed through group reports, peer evaluations, and self-reflective journaling, enabling students to apply knowledge across disciplines and improve communication and problem-solving skills (Wellington et al. 2002). Within the chemical engineering education space, a recent analysis by Ravi (2023) reveals the increasing use of digital tools to deliver group-based authentic assessments and the necessity to integrate interdisciplinary and synoptic assessments to produce socially responsible and globally competent graduates. Guzzomi, Male, and Miller (2017) explored the importance of 'perfection' in engineering through an authentic assessment designed to mirror industry expectations, incorporating a novel grading scheme to promote high-quality work. While the study found that the assessment motivated students to exert more effort, it also revealed mixed student responses, with criticism directed at the grading system and lack of clear instructions. These findings highlight the critical need to balance authenticity with sufficient support to prevent disengagement.

In addition to coursework considerations, some studies (Koretsky et al. 2022) have explored the integration of authentic assessments into engineering exams, such as a two-stage exam that combines a traditional, individual first stage with a second stage involving collaborative decision-making in a computer-simulated engineering task. While the authentic assessment improved student engagement with realistic engineering problems, it revealed a gap in students' ability to operationalise knowledge in complex, open-ended tasks. These studies underscore the critical need for assessment methods to mirror real-world professional practices, highlighting how traditional assessments often fail to capture essential skills.

Furthermore, for students to be attuned to the challenges of the engineering profession upon graduation, it is not sufficient if assessment tasks alone mirror those of the professional world (i.e. authentically designed assessment), but so should the actual student working process of problem-solving and producing assessment deliverables (i.e. authentically delivered assessment). While most of the existing literature focuses on design of authentic assessment (Strobel et al. 2013; Ullah 2020; Vargas-Mendoza, Gallardo-Córdova, and Castillo-Díaz 2018; Wellington et al. 2002), the authenticity of assessment delivery is equally crucial. Assessment delivery in this study is defined as an overarching term encompassing the entire student experience from the commencement of an assessment task to its final submission. This includes all emotional, technical and logistical aspects involved in working towards completing the assessment.

Extending authenticity to assessment delivery assures that the authenticity is maintained throughout the process. When it comes to authentic assessment, the aim is often to incorporate 'real-world' scenarios in assessment tasks, which basically portrays the education environment as an unreal isolated world (McArthur 2023). Here, the concept of 'real-world' can be troublesome by disconnecting from practices and the broader society that are vital to close the learning cycle. Rather, assuming that the educational world is part of the 'real-world' will change the mindset to put students in a position to experience the whole cycle of learning that includes social values and also how they deliver their work. Therefore, assessment delivery encompasses not only

administrative processes but also how feedback is provided and how the learning environment is structured to support authentic engagement (Gulikers, Bastiaens, and Kirschner 2004). Authentic assessment delivery aims to ensure that conditions under which assessments are conducted reflect professional working procedures, thereby maintaining the integrity of the assessment cycle (Villarroel et al. 2020). By extension, the authors see this as a means to enhance the social grounding of assessments as proposed by (McArthur 2023), where the emphasis is not solely on the assessment task in isolation but more holistic in considering student working practice, self-efficacy, creativity and well-being. Drawing on this body of work, the authors' position is that such a holistic consideration of 'authenticity' would need to centralise students' assessment working practice and assessment experience as much as the professional engineering relevance of an assessment task.

Following this line of thinking, this work tries to draw more attention to the concept of authentic assessment delivery through a process of offering greater flexibility in student assessment working practice, referred to as 'assessment flexibility'. Assessment flexibility has already been considered in a few previous studies including a study by Palmer (2001), where the challenges and benefits of flexible teaching and learning systems in engineering education was explored emphasising the need for flexibility in delivery, including modular curricula, recognition of prior learning, and the integration of learning technologies. Although flexible delivery can cater to diverse student needs and enhance access, it introduces challenges such as the need for clear structure and management of resources highlighting the importance of balancing flexibility with academic rigour and professional practice expectations. Flexible pedagogies have been sought to enhance engagement and attainment by allowing students to demonstrate their learning in ways that align with their strength and skill preferences (Gibbs and Simpson 2005; Ryan and Tilbury 2013). For instance, flexible assessment formats might provide a choice between written reports, oral presentations, or design tasks, thereby catering to different skill sets. Hence, assessment flexibility can refer to variability in assessment formats (Irwin and Hepplestone 2012), tasks (Wanner, Palmer, and Palmer 2024), submission dates (Verleger 2023), etc., in an inclusive manner that accommodates the needs and circumstances of students. Irwin and Hepplestone (2012) emphasise that allowing students to choose from various assessment formats can empower them and improve learning outcomes, although they caution about challenges in maintaining validity and reliability across formats. Similarly, Kessels et al. (2024) demonstrated that offering engineering and business students' flexibility in assessment characteristics, such as timing and format, significantly improved student autonomy, particularly when the choices offered aligned with individual learning preferences and are accompanied by appropriate support.

Although these studies explore the concept of assessment flexibility, they do not directly address the gap in extending authenticity to assessment delivery. Despite being a student-centred practice, research reporting student voice data on this topic is scarce. To bridge this gap, the current research aims to shed more light by incorporating students' perspectives on their experience of authentic assessment. For instructors, assessment is a means of measuring the attainment of learning outcomes, providing feedback and fostering deeper understanding (Boud and Falchikov 2007; Gibbs and Simpson 2005). However, from the students' point of view, assessments are critical determinants of academic success as they directly impact marks and future opportunities (Taras 2002). These differences in perspectives could lead to potentially conflicting expectations, which is why it is important to examine authentic assessment not only from a learning design perspective (the more widely studied educator standpoint), but also from a lived experience perspective understanding how students engage with the different aspects of authentic assessments, which is what this research endeavours to examine.

By investigating students' views on both assessment design and delivery, this work does not aim to propose a definitive solution but rather provides a foundation for instructors to reflect on and challenge their current practices. The study seeks to understand authentic assessment in its fullest sense by capturing students' lived experiences, focusing on their perceptions of assessment flexibility, creativity, and the sense of purpose and accomplishment they derive from engaging with

assessments. By incorporating student voice – an often-overlooked aspect in such studies – the paper offers valuable insight into how authenticity, in its complete holistic sense, can be better integrated into engineering assessment practices. This contribution adds significant value to the literature by encouraging educators to reassess their practices for a more enriched and meaningful assessment experience. The paper is structured as follows: Section 2 outlines the Research Approach and Data Analysis, including both quantitative and qualitative methods. Section 3 presents the Results and Discussions, featuring the quantitative analysis of authenticity in design, delivery, and student creativity, followed by qualitative analysis using reflexive thematic analysis. This section concludes with the Limitations of the Study. Finally, Section 4 provides the Conclusions, summarising the key findings and their potential implications for assessment practices.

2. Research approach and data analysis

The current study aims to explore trends and perceptions of authentic assessment among students majoring in engineering and physical sciences at a UK university, addressing the gap in extending authenticity to assessment delivery using the essential element of student voice. The central research question that this study explores is:

> What is the student perception of their assessment experience and how does it align to principles of authentic assessment for engineering education?

A student survey approach was taken to address this research question as it is scalable across programmes and years of study. Furthermore, the survey allowed for collection of quantitative and qualitative data, allowing researchers to investigate commonalities of the free-text responses to those received for quantitative questions, but also to capture a more holistic student opinion on the subject of investigation that might not be possible with scale-type questions alone. Our survey-based approach was also informed by the findings from the National Student Survey (NSS), a survey completed by final-year undergraduate students in the UK.

NSS data has always revealed a lower degree of satisfaction among engineering students on the theme of assessment and feedback compared to other disciplines. In the latest sector-level data released for 2024, close to 20% of 'engineering and technology' subject students felt that assessments did not allow them to demonstrate what they had learnt and less than 65% reported that lecturer feedback helped them improve their work – the equivalent number for business and social sciences students is nearly 10 percentage points higher (National Student Survey data: provider-level 2024; OfS 2024). Although these findings emerge from relatively big data sets (over 19000 'engineering and technology' student respondents from all over the UK), the NSS is designed to investigate student experiences at a high level. In this context, the survey designed in this paper is to probe more specific issues on assessment and feedback that national surveys do not address.

To elicit student perspectives of authentic assessment, 5-point Likert-scale questions (ranging from 'Never' to 'Always' or 'Strongly Disagree' to 'Strongly Agree'), consistent with the format of the University's module evaluation surveys, were designed based on University-level guidance on indicator frameworks used by graduate recruiters and the features of authentic engineering assessment as identified by Guzzomi, Male, and Miller (2017). Survey aspects were examined using two sets of Likert-scales: based on the frequency of use/exposure (always, often, sometimes, rarely, never) and based on the extent of agreement (strongly agree, agree, neutral, disagree, strongly disagree). Specific capabilities or skills identified from the indicator framework and included in the student survey are: peer review, reflective practice, engaging with multiple conflicting requirements and commercial awareness. In addition to surveying how often students exercise these abilities in University assessments, their broader assessment working practice was also probed to enable a more rounded understanding of 'authentic assessment' that does justice to the depth and multi-dimensionality of the term. Specifically with regards to assessment working practice, this links to time and project management, student feelings of stress, passion and accomplishment during different

times of working towards an assessment deliverable and student perspectives of expressing creativity in their assessed outputs. In this context, survey questions were also designed to collect student opinions on flexible assessments as a means to enhance the authenticity of assessment working practice in a holistic manner. Table 1 shows the mapping of our Likert-scale questions to the dimensions of authentic assessment for engineering education prescribed by Guzzomi, Male, and Miller (2017). Furthermore, an open-ended free-text question asked students to propose changes to assessments that would enable them to exercise greater creativity and produce a high-quality submission. The full list of survey questions can be found in the Supplementary material (Table S1).

The findings presented herein are based on the survey carried out at the Faculty of Engineering and Physical Science (EPS) at the University of Leeds through the JISC Online Surveys platform. Ethical approval was obtained at the University (Ethics Ref: 0836). The ethical review was conducted via an online platform comprising questions on project ethical risks, recruitment and informed consent process, research data management and storage, and university policy and protocol compliance. Prior to participating in the survey, a project information sheet was supplied and informed consent was obtained at the start of the survey. The survey was designed to take approximately 10–15 min to complete and responses were collected anonymously with participation being voluntary.

To help with data classification and study diversity of student responses across disciplines and year of study, survey respondents were asked to state their 'programme of study' and select their 'year of study' (Level 1, 2, 3 or 4/MSc). In total, 154 responses were received on the survey platform (approximately 4% of total cohort). All respondents selected their 'year of study', but seven respondents provided no or incomprehensible information on 'programme of study'. Based on the programme of study, data was classified into the eight schools/departments that make up the EPS Faculty: (i) Chemical and Process Engineering (CAPE) (ii) Civil Engineering (CIVIL) (iii) Electronic and Electrical Engineering (EEE) (iv) Mechanical Engineering (MECH) (v) Chemistry (CHEM) (vi)

Table 1. Mapping of survey questions designed for this study to features of authentic assessment proposed by Guzzomi, Male, and Miller (2017).

Features of authentic assessment	Questions explored in the survey
Based on real engineering problem, which is open-ended and has multiple possible valid solutions	• Engage with multiple conflicting requirements or considerations (technical, business, environmental, social)? • Use commercial awareness in an assessment submission? • Incorporate personal opinion in an assessment submission? • Express creativity in your coursework assessments? • Use a wide range of resources (apart from lecture notes and recommended reading material) in the preparation of your coursework submission?
Assessment is similar to a professional tender process (briefing document, students respond as if they had won the tender, submission deadlines)	• To what extent the way you prepared your submissions reflect actual professional practice in your discipline? • Guidelines for coursework assessments restrict expression of creativity? • Work on coursework starts very close to the submission deadline? • Last days before the submission deadline used to check for formatting issues? • How much flexibility do you have in your assessments? • Incentivising early submission through bonus marks?
Involves teamwork, peer review and professional feedback	• Engage in peer review and feedback? • Incentivising early submission through instructor feedback that can help improve the quality of final submission?
Feedback and assessment structure encourages reflective practice	• Engage in reflective practice? • Experience a sense of passion and purpose when working on assignments? • Experience a sense of accomplishment on submitting assignments?
Exercise is challenging and requires high level of effort from students	• Assessments challenge you to learn on the go? • Challenge assumptions to develop or propose new ideas?

Table 2. Distribution of respondents across the programme of study.

Programme of study	Number of respondents	Percentage
MECH	30	19%
MATHS	24	16%
CIVIL	23	15%
COMP	21	14%
CAPE	17	11%
EEE	15	10%
PHYS	10	6%
CHEM	7	5%
Incomprehensible responses	7	5%
Total	**154**	**100%**

Computing (COMP) (vii) Mathematics (MATHS) and (viii) Physics and Astronomy (PHYS). Table 2 shows the respondents' distribution across the programme of study.

For analysis based on programme of study, data for PHYS and CHEM has not been reported since the ratio of collected data to all data is less than 10% (Table 2) and does not provide a meaningful representation of those programmes. With the sample size in the current study, no meaningful interpretation could be drawn from distinctions between agree/strongly agree and disagree/strongly disagree responses, as well as between never/rarely and often/always. For this reason, the analysis was carried out and presented using a 3-point criteria.

2.1. Quantitative data analysis

Responses to the Likert-scale questions were coded into numbers – for example: strongly disagree (−2), disagree (−1), neutral (0), agree (1) and strongly agree (2) – on MS Excel spreadsheets to calculate percentage of students selecting each option; besides the overall analysis of all 154 responses, this analysis was extended at year-level and programme-level to enable comparison of statistics across different years and programmes of study, respectively. Classified by year groups, 48, 43, 18 and 44 responses from first-, second-, third- and fourth-year students were received, respectively. To investigate relationships between responses to specific questions, a pairwise correlation analysis was performed using the 'corr()' function in the Pandas Python library to generate pairwise correlation heatmaps (Pandas 2024). The 'corr()' function examines the degree and nature of the correlation between two sets of data outputting a value for the Pearson correlation coefficient in the range of −1 to 1, where the extreme values represent a perfectly negative and positive correlation respectively.

2.2. Qualitative data analysis

Qualitative data can provide deep insights into the complexities of educational practices and the lived experiences of learners, offering a rich, nuanced understanding that quantitative methods alone cannot achieve (Creswell and Poth 2016). This research used Reflexive thematic analysis (RTA) as a thematic analysis method, which is appreciated for its flexibility and systematic approach towards qualitative analysis (Braun and Clarke 2006, 2019) allowing to uncover themes and relationships within data. A distinctive feature of RTA is its dual approach to coding, which can capture both semantic (surface-level) and latent (underlying) meanings. This capability allows to explore both explicit content and implicit patterns within the data, providing a comprehensive understanding of the studied phenomena (Terry et al. 2017). The RTA is a six-phase process as demonstrated in Figure 1. This analysis followed this six-phase process of RTA to analyse student responses to the free-text question in the survey. This process is iterative rather than linear, often requiring the researchers to revisit earlier phases to refine the analysis (Braun and Clarke 2006; Nowell et al. 2017). Reflexivity is central to RTA allowing researchers to continuously reflect making RTA a

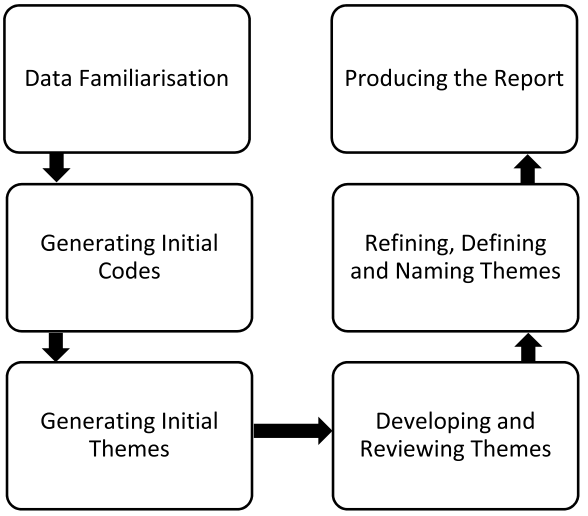

Figure 1. RTA six-phase process (Braun and Clarke 2006).

robust tool for qualitative research (Braun and Clarke 2021). Several key themes, each highlighting different aspects of the student assessment experience, were identified through the RTA exercise following the approach outlined by Byrne (2022). Herein, the two authors worked on the RTA of the survey data individually, which allowed for a more reliable qualitative analysis outcome. The two outcomes were then analysed and discussed in depth, benefitting from various perspectives to arrive at a richer final shared understanding.

3. Results and discussions

3.1. Quantitative analysis: authenticity in design

Critical application of knowledge in engineering and physical sciences often requires the use of multiple resources and a majority of the surveyed student respondents state that they 'always' or 'often' use a wide range of resources in preparing their coursework submissions (Table 3). Interestingly, among the 13% who say this is 'never' or 'rarely' the case, there is a disproportionate representation of students from non-engineering disciplines, particularly mathematics. Although the usage of diverse resources may often not be required for mathematical problem-solving, it is a lever of authentic assessments that mathematics educators have been called onto consider to improve overall student competence (Ukobizaba, Nizeyimana, and Mukuka 2021).

Contrary to the opinion on using diverse resources for coursework, general student opinion on opportunities to incorporate personal opinion and use commercial awareness in assessment submissions is mostly negative, with 52% and 54% respectively saying they 'never' or 'rarely' have an opportunity to do so (Table 3). A large share of the negative responses was from mathematics students, among whom the equivalent numbers were 67% and 79% respectively. However, appreciable differences are present even among the engineering disciplines, where students saying they 'never' or 'rarely' incorporate personal opinion ranged from 24% among chemical engineering students to 53% in mechanical engineering (Figure 2).

Interestingly, there is no appreciable increase in the percentage of students who say they 'often' or 'always' incorporate personal opinion in assessments with an increase in year of study for the first three years (percentage of positive responses in Figure 3). Although these year-wise trends might not hold for engineering students at other institutions or countries, such findings surface the opportunity to improve assessments for subjective personal opinion in undergraduate programmes,

Table 3. Overall student perceptions of authentic assessment ranked in descending order of percentage of positive responses.

Survey Question	Percentage of positive responses	Percentage of neutral responses	Percentage of negative responses
I would welcome incentivising early submission through instructor feedback that can help improve the quality of my final submission.	86	6	8
I experience a sense of accomplishment on submitting my assignments	76	18	6
Assessments challenge you to learn on the go	57	33	10
I usually spend the last days before the submission deadline checking for formatting issues	56	12	32
Use a wide range of resources (apart from lecture notes and recommended reading material) in the preparation of your coursework submission	51	36	13
I experience a sense of passion and purpose when working on my assignments	45	37	18
I would welcome incentivising early submission through bonus marks	36	16	48
The guidelines for coursework assessments restrict me from expressing my creativity	33	54	13
Engage in reflective practice	30	33	37
Engage in peer review and feedback	29	24	47
I often wait until very close to the submission deadline to start my coursework	25	19	57
The way you prepare your submissions reflect actual professional practice in your discipline	24	49	27
Engage with multiple conflicting requirements or considerations (technical, business, environmental, social)	20	39	41
Incorporate personal opinion in an assessment submission	18	30	52
Challenge assumptions to develop or propose new ideas	16	39	45
You can express creativity in your coursework assessments	14	43	43
Use commercial awareness in an assessment submission	13	32	54
How much flexibility do you currently have in your assessments (these can be flexibility in submission deadlines, submission formats, topic of a coursework assignment, etc.)?	7	26	66

Positive responses refer to agreement to the statement (agree + strongly agree) or high frequency of use/exposure (always + often). Negative responses refer to disagreement to the statement (disagree + strongly disagree) or low frequency of use/exposure (never + rarely).

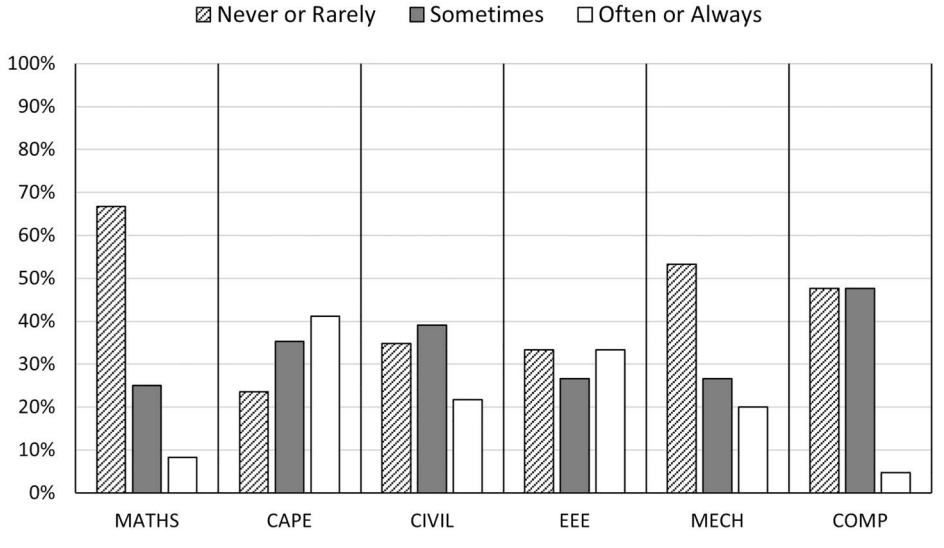

Figure 2. Students' perception about incorporating personal opinion in assessment submissions.

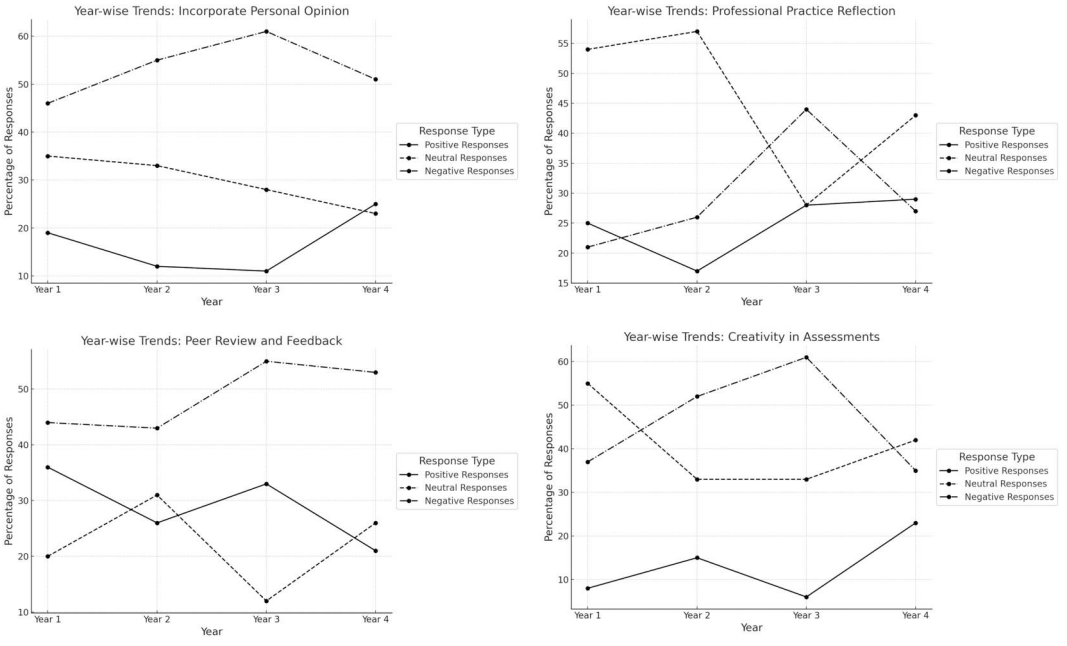

Figure 3. Year-wise trends of positive, neutral and negative responses based on survey questions.

whereby there are more chances to integrate subjectivity with technical understanding as students' progress on their programme, as proposed by (Palmer 2004) for engineering education. Although engineering subjects mostly deal with quantitative problems, the translation and application of emerging technologies and solutions to the global society often require a more rounded consideration of issues and implications; thereby, providing opportunities for students to couple technical nous with subjective personal opinion resonates with the holistic approach to authentic assessment posited by (McArthur 2023). Since 25% of fourth-year students, i.e. taught postgraduate students, declare incorporating personal opinion in assessed work 'often' or 'always', much more than the 11% of third-year students (Figure 3) – many of whom might graduate with an undergraduate degree and seek job opportunities – the trickling down of some of the assessment ideas implemented at the postgraduate level to the final year of undergraduate study would be worth exploring. This could also have other positive side-effects, such as smoothing the transition to postgraduate study.

As a way of further exploring student opportunities to exercise systems thinking in assessments (Godfrey, Crick, and Huang 2014; Monat, Gannon, and Amissah 2022), in addition to incorporating personal opinion and commercial awareness, students were asked to rate their engagement with multiple conflicting requirements or considerations (technical, business, environmental, social) as part of their assessment tasks. This elicited a comparatively more positive response but still a significant 41% polled 'never' or 'rarely' (Table 3). Similarly, the equivalent figure for the statement on having to challenge assumptions to develop or propose new ideas is 45% (Table 3). Thereby, the student voice suggests a lack of sufficient opportunities to exercise systems thinking, challenge assumptions and incorporate personal opinion in assessments, with these statements receiving nearly twice as much negative responses as positive (Table 3).

3.2. Quantitative analysis: authenticity in delivery

The next set of survey statements examines the extent to which the student assessment working practice might mirror professional working practice. When asked to comment on this by reflecting

on their coursework assessments, most of the surveyed students are neutral (49% say their preparation of assessment submissions 'sometimes' reflects actual professional practice) with an almost symmetrical divide of respondents on the positive and negative side (Table 3). When classified by year of study, third-year students are the most critical, with 44% saying this is 'never' or 'rarely' the case, while the equivalent figure is less than 28% for all other year groups (percentage of negative responses in Figure 3). Two interpretations can be drawn from this: (i) Among the undergraduate students, the third-year students being the most critical could well be because of having a better understanding of actual professional practice compared to the lower years but (ii) with the postgraduate fourth-year students being comparatively less critical, ways to transfer some of the assessment practice at this level to the year below could be explored to increase assessment authenticity in the advanced years of the undergraduate programme.

In terms of managing time to prepare their assessment submission, 56% of the students either 'agree' or 'strongly agree' to spending the last few days before the deadline checking their work for formatting issues (Table 3). However, there is an underlying heterogeneity to this number, with students from mechanical engineering (73%), electronic and electrical engineering (73%) and chemical engineering (71%) agreeing more considerably than students majoring in mathematics (38%) and civil engineering (43%) (Figure 4).

The working attitude of the majority of respondents is that they do not wait until the last minute to start a coursework: 57% disagree or strongly disagree to the statement 'I often wait until very close to the submission deadline to start my coursework' (Table 3). Although spending the last few days before the deadline checking for formatting issues and waiting until close to the deadline to start coursework could be envisioned to be opposing statements, only a weak negative pairwise correlation between these two statements was observed for all year groups (Figure S1 – question numbers 4.2 and 4.3). Hence, student responses to this pair of statements are quite mixed and on average, an affirmative response to the former only translates in a weak disagreement to the latter statement and vice versa.

Although professional engineers and scientists would regularly engage in peer review, feedback and reflective practice in the process of discovering solutions, there appears to be a paucity of such practice in assessments. Close to 50% of student respondents say they 'never' or 'rarely' engage in peer review (Table 3). Interestingly, higher-year groups are not engaging in as much or more peer review and feedback compared to the earlier-year students (Figure 3). Hence, even if an assessment

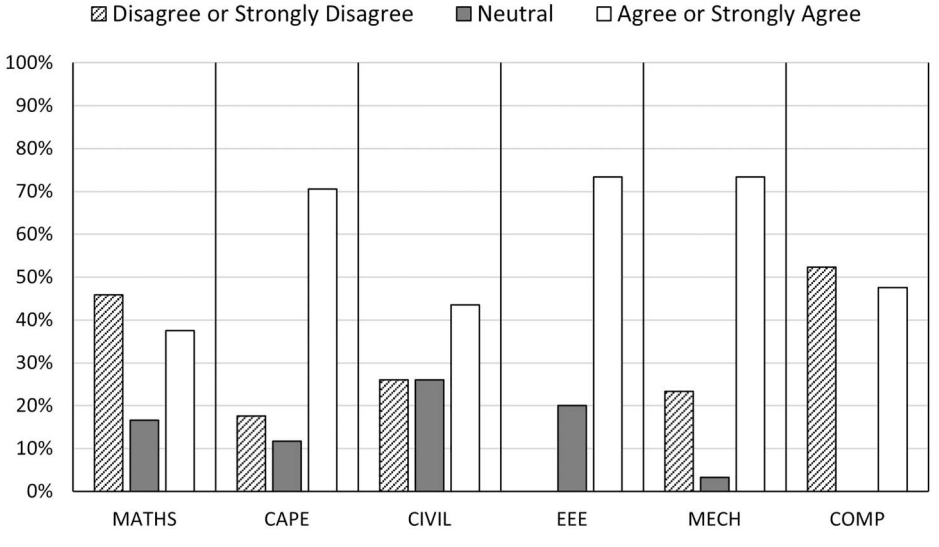

Figure 4. Students' opinion on whether they spend last days before the submission deadline to check for formatting.

task is designed to be open-ended problem-solving, the delivery of such an assessment would also need to embrace authentic practice since open-ended problem-solving is hardly ever done in silos in the professional world. Assessment methods that explicitly build in opportunities for peer review, such as collaborative re-testing (Nease et al. 2021), can benefit student performance and satisfaction, while at the same time improving authenticity in the entire assessment cycle. As opposed to peer review and feedback, reflective practice is more prevalent with only 37% of students saying they 'rarely' or 'never' engage in this exercise (Table 3). The integration of reflective practice within the engineering curriculum is expected to have been catalysed by the latest accreditation guidance published by the UK's Engineering Council, which explicitly lists reflective practice as a programme-level learning outcome (Engineering Council 2020).

In examining the lived experience of students when they prepare their assessment submissions, about 45% either 'agreed' or 'strongly agreed' to experiencing a sense of passion and purpose when working on assignments with the equivalent number rising to 76% for experiencing a sense of accomplishment on submitting the assignment (Table 3). This significant increase for the latter statement might suggest that for some students 'sense of accomplishment' is closer to a 'sense of relief' as the positive feeling experienced upon submission is not concomitant with similar feelings when working towards the assessment deliverable – although speculative, these students could potentially be engaging with assessments for the sake of degree completion as opposed to seeing them as a means to express and produce creative knowledge work.

Hence, modulating assessment delivery by embedding opportunities for peer feedback and encouraging student creativity and critical thinking to prevent assessments being viewed as a mere academic exercise will enhance the authenticity of assessment working practice. Making such changes to assessment delivery calls for embracing greater flexibility and eschewing the rigid structure often associated with student assessment in higher education. As introduced earlier, flexibility could be offered in several ways including flexible submission deadlines, submission formats for coursework or the topic of an assignment, but the majority of student respondents (66%) say they have 'never' or 'rarely' experienced such flexibility in their assessments, making it the survey statement with the highest percentage of negative responses (Table 3).

Professional engineers and scientists often engage in multiple rounds of feedback to improve a submission or an output while students often tend to complete assessment tasks in isolation – a potential way to address this is by incentivising early submission (flexible deadlines) through formative feedback from the instructor, which effectively feeds forward to the final submission. The vast majority (86%) of students cutting across disciplines are in favour of such an approach (Table 3). These findings on feeding forward align well with the relatively low student satisfaction in the UK's NSS on the usefulness of feedback for students to improve their work – ranging from 59% for mechanical engineering students (>4000 respondents) to 65% for civil engineering students (>3000 respondents) (OfS 2024). Although formative feedback for typically large engineering courses can be demanding on staff workloads, providing cohort-level feedback based on common shortcomings in student work could be a more realistic way forward as opposed to individual formative feedback. Likewise, existing office hours could be leveraged to provide informal verbal feedback. Another alternative would be to incentivise early submission through bonus marks as a way of mimicking productivity being rewarded in professional practice – this is expectedly more controversial and student opinion is polarised (Table 3). Approaches incentivising early submission would need to be executed carefully to ensure it is equitable and doesn't disadvantage certain students, for example, students with approved disabilities or mitigating circumstances. Hence, submission incentives would need to be integrated into existing assessment support structures that students might have in place.

3.3. Quantitative analysis: expression of student creativity

Creative thinking is a key attribute for innovative problem-solving and as stated earlier, assessments encouraging creativity and open-ended critical thinking could help unlock a sense of passion or

purpose in students, while at the same time, taking assessments closer to actual professional practice. Only 14% of survey respondents say they 'often' or 'always' can express creativity as part of their assessments (Table 3) and this varies over a broad range across disciplines: from a very low 3% among mechanical engineering students to 30% for civil engineering (Figure 5). Although it would be expected that higher-year groups should have more opportunities to express creativity, there are no appreciable differences in the data particularly across the first three years (Figure 3).

Despite expression of creativity being apparently limited, the majority of students declare that they have been challenged by assessments to 'learn on the go' with only 10% of them saying that this is 'never' or 'rarely' the case (Table 3). Therefore, the apparent lack of opportunities to express creativity is not because assessment tasks have been designed to assess student's ability to regurgitate. However, as mentioned earlier, designing an open-ended assessment question constitutes only one dimension of authentic assessment. Providing greater flexibility in how students demonstrate their ability to successfully address such a question (for example, through multiple submission formats: reports, posters, presentation, etc.) could foster student creativity and would require educators to make assessment guidelines less rigid.

Assessment guidelines appear to be more of a hindrance for creativity than the content of assessments itself – while most students are neutral in their response to the statement 'The guidelines for coursework assessments restrict me from expressing my creativity', an overall inclination in favour of the statement was identified with those in agreement being more than twice than those who disagree (Table 3). Considering this coupling of creativity to coursework guidelines, a reasonably strong negative correlation (−0.4 to −0.5) can be seen among first- and second-year students between the extent to which they feel they can express creativity and on whether guidelines restrict creativity (Figure S1 – question numbers 3.3 and 4.1). The same correlation coefficient is nearly zero for fourth-year students suggesting that students early on in their degree programme prefer the scaffolding that assessment guidelines provide and do not see it as impeding creativity, while for the more advanced students, the two statements become virtually decoupled. To further probe the nexus between authentic assessment, student creativity and assessment anxiety from a student perspective, the research proceeds to analysing the qualitative data collected for the following question: 'Reflecting on a recent coursework submission, comment on what changes could be made to make the assessment less stressful for you and that would have helped you come up with a more creative and high-quality submission'.

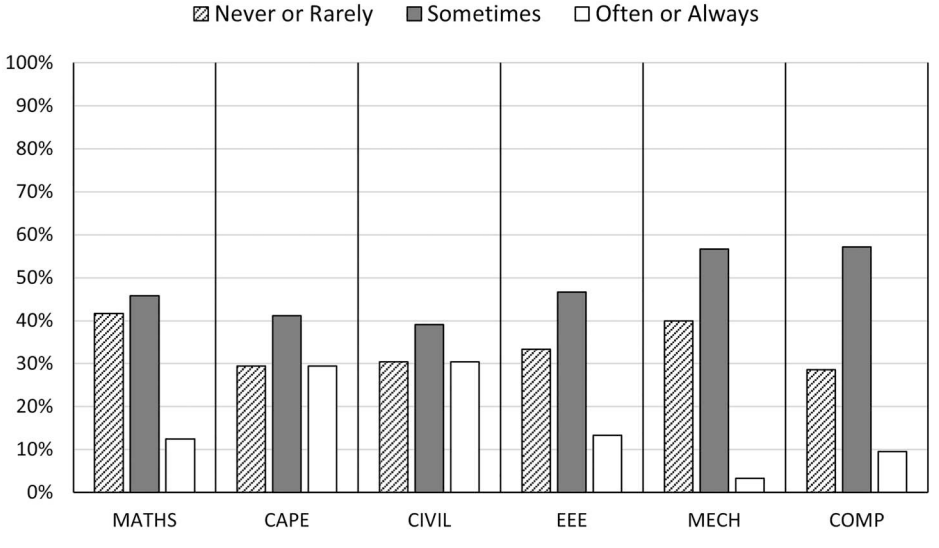

Figure 5. Students' opinion about opportunities to express creativity in assessments.

3.4. Qualitative analysis: reflexive thematic analysis

The qualitative data collected from the survey was analysed using RTA, and the analysis results were fed into two mind maps to visualise the findings. Independent analysis by the two authors led to two versions of the mind map, herein called Mind map A and Mind map B presented in Figure 6. Within that, the ovals represent key themes, and the rectangles refer to sub-themes. The relationship between themes is shown using a dashed line, while themes and sub-themes are connected by solid lines. Similarities between the two mind maps are colour-coded in Figure 6.

Mind map A shows the connection between themes using dashed lines, where arrows demonstrate the direction of the influence of one theme on another. The relationships between themes within the Mind map A are intertwined and mutually reinforcing. *Assessment Structure and Timing* emerges as the most influential theme encompassing sub-themes of *Assessment Timing and Clarity*, *Clear Marking Scheme*, *Assessment Options and Weight* and finally *Comprehensive Module Handbook*. Here, the assessment structure refers to anything shaping the assessment 'before' (Villarroel et al. 2020) it is presented to the learner (except the assessment experience) including available options, mark weightage, marking criteria and module handbook to act as point of reference to understand the structure. The hand-in dates/deadlines are also envisaged as a vital part of this structure. *Assessment Structure and Timing* directly impact *Stress and Workload Management*. Student comments reveal the importance of designing assessments at a programme-level and not just at module-level: when assessments are well-structured and deadlines are staggered, students experience less stress and can manage their workload better. Illustrative student quotes are as follows:

> The deadlines usually come at the same time. It would be better if there's some gap between different deadlines.

> If there are 4-5 subjects try to divide the deadlines of assessment that doesn't overlap each other, try to give enough time to work on it.

Mind map B shows the connection between themes through sub-themes, where sub-themes are linked to two or more themes (Figure 6(b)). This mind map shows high non-linearity in connections between various themes and sub-themes. For instance, the theme *Feedback* encompasses multiple things: the need to receive timely feedback, which is tailored and also given for a draft work, not solely the final submission. Multiple comments evidenced the importance students associate to instructor feedback, a sample of which is:

> Quicker quality feedback on previous coursework or assignments: For modules with multiple assignments that build on each other, getting good feedback, if any, makes an enormous difference on how I would approach and work on the current coursework. Feedback is usually one of the following: vague (e.g. where does a part fall in a simple criteria table), late, or a grade only. All of the previous points are not very helpful and are similar to not receiving feedback at all

This sentiment is also broadly reflected in the NSS data with timely and actionable feedback emerging as one of the statements with the lowest satisfaction among engineering students – both at the national level and for the institution that the authors are affiliated to (OfS 2024). Consequently, there has been a renewed focus on feedback practice in the institutional assessment strategy (OD&PL 2021). Providing tailored feedback on draft work is one form of *Coursework conversations* that students want to have with educators. There is an explicit reference to wanting greater encouragement/support from lecturers including through tutorial sessions and an introductory session about the coursework/assessment. This links into the theme of *Assessment Expectations Clarity*, where students seek clarity on G*uidelines and Criteria* and the *Marking scheme*:

> Access to more specific marking criteria for assessment would be preferred. Often marks are lost from not understanding the requirements of the task due to lack of clarity rather than a lack of ability to deliver the result when it is clear what the task is.

While students comment that for greater creativity to be exercised, *Coursework Content* would need to be *Open-ended and Exploratory*, and be of manageable *Complexity* with an emphasis on the *Real*

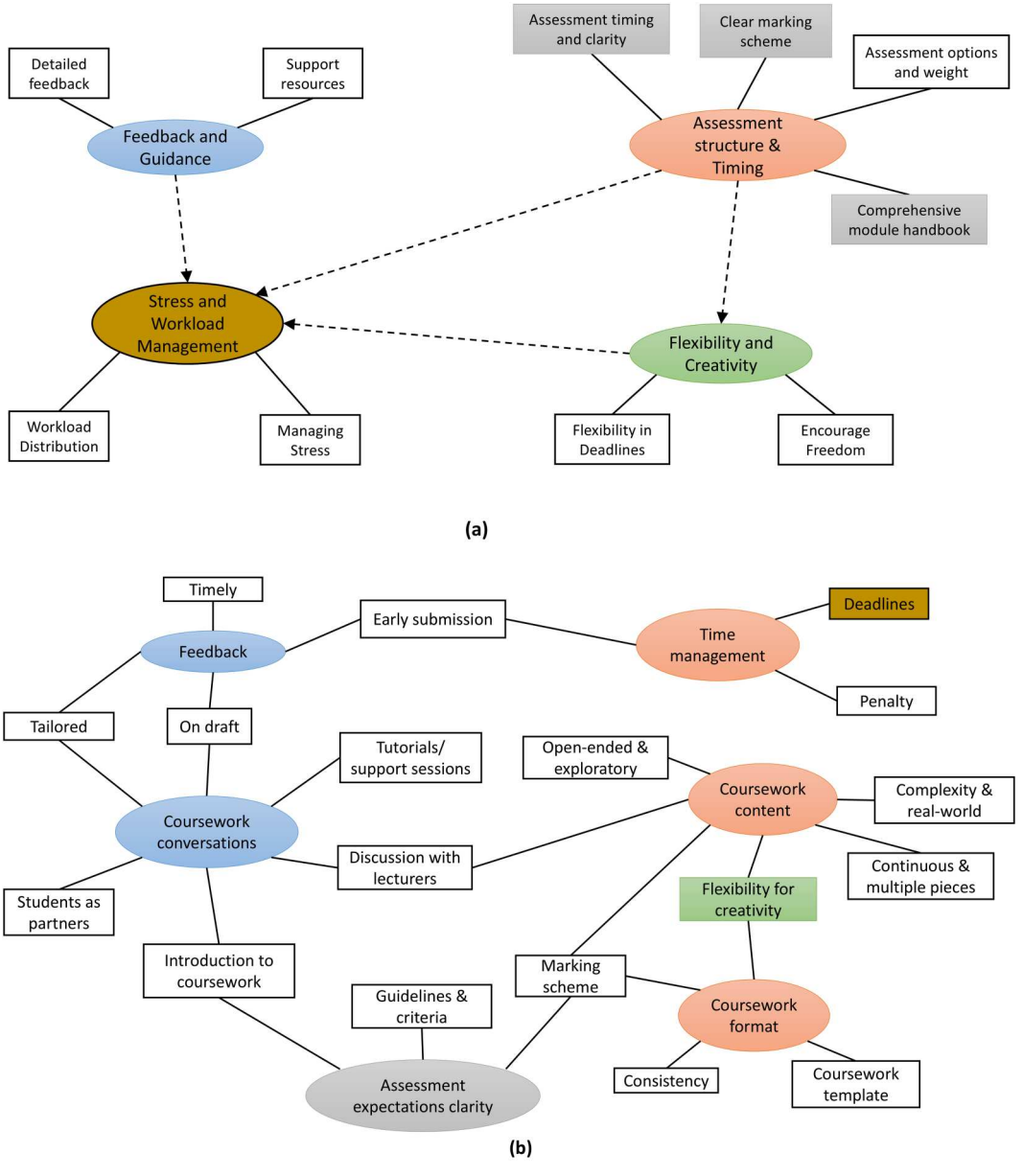

Figure 6. Mind maps produced from the RTA; (a) Mind map A, (b) Mind map B.

World, this results in a delicate trade-off between the assurance that detailed *Coursework templates* and *Marking schemes* provide and the suppression of student creativity that these could potentially lead to. For example, consider the contrasting nature of the following quote compared to the former:

> Stop making briefs which are essentially mark schemes. Give us a problem statement and the (fundamental) skills to tackle the problem and let us come up with the rest.

In summary, the RTA performed herein reveals the low-hanging fruits for an authentic student assessment experience: these are to have a well-planned assessment structure with appropriate opportunities for feedback. The next action point centres around the instructor providing adequate

support/guidance to students when they prepare their assessment deliverable. As for flexibility in assessment practice and fostering greater student creativity, there is no one-size-fits-all approach. This would need to be considered on a case-by-case basis to ensure that sufficient scaffolding is present to make assessment expectations clear but not be overly prescriptive to the extent that guidelines stifle expression of creativity.

3.5. Limitations of study

Although this study was carried out across multiple disciplines, student responses were collected from a single UK University. Furthermore, student perceptions recorded here likely represent their 'average' assessment experience based on several pieces of assessment on their course and it is not possible, through this survey, to elicit student perspectives on specific or precise assessments. Although students across the engineering schools are frequently reminded of their degree programmes being accredited by PSRBs and the implications this has in terms of assessment design to evaluate specified learning outcomes, this was not mentioned in the context of the survey. Also, the results from two disciplines namely chemistry and physics is not included in the analysis due to very low number of responses. Taken together, the results presented herein need not be representative of the student voice at UK Universities or more broadly globally. In order to consider changes to assessment practice at other institutions, it would be best to run a similar survey locally and use the resulting data to inform decision-making. However, this study does provide a ground for reflection for academic instructors to challenge their current authentic assessment approaches. Likewise, the presented data does not allow for analysing the underpinning reasons behind the differences observed between engineering disciplines in several questions. This would ideally require a series of follow-up open-text questions, which if included in the survey, would have made it unreasonably long and adversely impacted the survey completion rate. The authors believe that using a focus group methodology locally within each engineering department/school can help surface the reasons behind the trends observed from the survey data. This information would be useful for more granular-level details on how to make assessments more authentic from a student viewpoint. Although the lack of this information is a limitation of this work, the perspective offered herein would help engineering educators (re)evaluate assessment authenticity holistically in terms of design and delivery, and assessment flexibility to foster greater student creativity.

4. Conclusions

This study was carried out to explore the extension of assessment authenticity beyond assessment brief, aiming to make the assessment preparation journey a valuable experience that prepares graduates for professional challenges. In this endeavour, incorporating students' perception added a crucial dimension, making the exploration richer and more reflective. The authors hope that this study encourages instructors to consider a broader extension of authenticity, incorporating a student-centred perspective. Findings demonstrate that from a student perspective, although diverse resources are generally used when attempting assessments, there is still considerable potential to integrate systems thinking skills requiring a more holistic consideration of technical expertise. This can be achieved by more explicitly interfacing subject-specific expertise with business, environmental, social and commercial considerations as well as personal opinion. Hence, from an assessment design standpoint, this calls for two important action points for engineering educators: (i) embed greater systems thinking within assessment tasks and (ii) articulate to students how they are exercising and honing this skill through assessment practice.

In terms of student working practice when preparing assessment submissions, good engagement in reflective practice is observed but peer review and feedback is limited. The authors also see that a substantial fraction of the surveyed students do not experience a sense of passion or purpose when working towards their assessment deliverables. This is even though majority of the surveyed student population stating that assessments challenge them to learn on the go. Hence, the ineffectiveness in

rendering a rich authentic assessment experience to the student is not because of educators designing unauthentic assessment questions/tasks but largely because of a myopic interpretation of what authentic assessments mean. Extending authenticity to assessment delivery requires rising beyond rigid assessment structures that prevent student discussions prior to submission and expression of creativity.

On average, students report having little flexibility with their assessments and limited opportunities to express creativity. These shortcomings can only be addressed through a multipronged conceptualisation of authentic assessment, which encompasses the technical relevance of an assessment task, the environment offered to the student to develop solutions, and the student lived experience of engaging with the assessment. Reflexive thematic analysis of student comments clearly emphasise the importance of timely and tailored feedback that feeds forward to summative assessments for students to deliver creative and high-quality outputs. Embedding flexibility is primarily recommended when thinking about the structure of the assessment (submission formats, hand-in dates, marking schemes etc.); however, the implementation of such flexibility in an endeavour to promote greater creativity must be done with due caution. While overly prescriptive assessment guidelines stand to suppress student creativity, guidance still needs to be provided in sufficient detail to clarify the expectations of the assessment.

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Notes on contributors

Dr Manoj Ravi is a Lecturer in Chemical Engineering at the University of Leeds. Manoj is a Fellow of Advance HE and a Fellow of the Leeds Institute for Teaching Excellence. He is also the Programme Lead for the Chemical Engineering undergraduate programme at Leeds. He has diverse interests in the teaching and pedagogic research space including curriculum design, student belonging, sustainability, and artificial intelligence.

Dr Mohsen Besharat is an Assistant Professor at the School of Civil Engineering, University of Leeds. Mohsen is the Programme Leader for Civil Engineering undergraduate programmes and leads modules in two successful MSc programmes, i.e., Water, Sanitation and Health; Environmental Engineering and Project Management. Inspired by his extensive industry experience before joining academia, he is interested in assessment authenticity to enhance students' learning experiences through assessments that prepare learners for professional career challenges. Mohsen is also interested in the use of digital solutions to enhance students' engagement and performance. In addition to pedagogic research, Mohsen is working on research topics related to digital solutions in water infrastructure and enhancing understanding of complex hydraulic phenomena such as two-phase transient flow conditions.

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