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Pedagogical Innovation in Engineering Education Through KW Analysis and Benchmark Validation of Collaborative Assessments

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Abstract

Background: Traditional summative assessments dominate engineering education despite calls for inclusive methods addressing diverse learning needs. International student cohorts face challenges adapting to Western academic cultures emphasising independent learning. This three-year investigation examined whether balanced individual-group assessment configurations (50:50) enhance satisfaction and learning experience in a postgraduate engineering module with 90% international enrolment. **Method:** Module Evaluation Questionnaire data from 195 students were analysed across three academic years (2020–2023). The intervention replaced one individual assessment with a group-based project. Five-student collaborative groups completed laboratory projects with structured peer evaluation. Statistical analysis employed Kruskal–Wallis tests and Cohen's d across four satisfaction themes: Organisation and Clarity, Teaching Quality, Assessment, and Learning Experience. **Results:** Learning Experience satisfaction increased from 70.12% to 92.93% following implementation, with statistically significant improvement ($H = 5.4$, $p = 0.020$) and large effect size (Cohen's $d = 2.20$, outperforming the literature benchmarks). Remaining themes showed medium effect sizes ($d = 0.58$–0.72) but remained stable, indicating the intervention enhanced experiential dimensions without disrupting operational quality. Response variability decreased 52.5%. **Conclusions:** Mixed-assessment strategies significantly enhance learning experience while maintaining academic standards in internationalised engineering education. The 50:50 individual-group balance with five-member teams and anonymous peer evaluation provides a validated framework for educators facing internationalisation pressures.

Keywords: collaborative assessment methods; international engineering curricula; social constructivism; collaborative learning; student satisfaction; Kruskal–Wallis analysis

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1. Introduction

The design and delivery of assessments in higher education are fundamental to student success and satisfaction. Traditional summative assessments—formal evaluations administered at the conclusion of a learning period to measure the extent to which students have achieved defined learning outcomes, typically high-stakes, standardised, and carrying significant weight in determining academic progression (Black & Wiliam, 2009; Gibbs, 2010)—remain prevalent despite increasing calls for methods that are more inclusive and reflective of diverse student needs (Gardner, 2006). These methods, while offering

consistency and scalability, often fail to accommodate the varied cultural and educational backgrounds of today's diverse student cohorts—a term which, in this study, refers primarily to the international composition of the student body, with students originating from over 140 countries, 90% of whom are classified as international students under UK Home Office definitions, bringing with them differences in prior educational systems, first language, academic cultural norms, and familiarity with Western higher education conventions such as independent critical analysis and self-directed learning. This lack of inclusivity can exacerbate disparities in academic performance and engagement. Our large public university in London is emblematic of these challenges, with its strong focus on widening participation and attracting students from diverse backgrounds.

The postgraduate module Green Engineering and Energy Efficiency (GEEE) serves as a focused example of how these dynamics play out in practice. With an annual enrolment averaging 65 students—90% of whom are international—the module must address a broad spectrum of learning needs. This diversity necessitates innovative approaches to teaching and assessment that move beyond traditional formats. Recognising these challenges, the module transitioned from relying on individual coursework to a balanced mix of individual and group-based assessments—referred to in this study as mixed assessments, defined as a deliberate combination of individual and group-based summative tasks within a single module, designed to evaluate a broader range of competencies than either format alone, with the 50:50 individual-to-group weighting adopted here reflecting an intentional balance between rewarding independent analytical ability and fostering collaborative, professionally relevant skills (Gardner, 2006; Vygotsky, 1978). This change aligns with pedagogical theories, such as Vygotsky's constructivism, which emphasises the importance of social interactions in constructing knowledge, and Gardner's theory of multiple intelligences, which advocates for diverse assessment methods to reflect varied cognitive strengths (Vygotsky, 1978; Gardner, 2006). Integration of collaborative learning activities, such as group laboratory experiments and joint report writing, can foster peer learning, inclusivity, and the development of essential professional skills. The Module Evaluation Questionnaire (MEQ) is the institution's standardised instrument for gathering anonymous student feedback at the end of each teaching block. It measures satisfaction across four themes—Organisation and Clarity, Teaching Quality, Assessment, and Learning Experience—using a five-point Likert scale. In the context of GEEE, MEQ data collected over multiple academic years consistently revealed student dissatisfaction with the assessment format: students reported feeling insufficiently supported by individual-only coursework, particularly given the module's collaborative and practical learning objectives. It was this pattern of MEQ feedback that directly motivated the transition to a mixed-assessment approach, providing the empirical basis for the intervention investigated in this study. The motivation for these changes stemmed from Module Evaluation Questionnaire (MEQ) feedback, which consistently highlighted student dissatisfaction with the lack of collaborative opportunities. International students reported challenges in adapting to the UK's academic culture, which emphasises independent learning and critical analysis (Hammersley-Fletcher & Hanley, 2016). These insights informed the introduction of group assessments designed to encourage active engagement and provide a supportive learning environment.

This study contributes to the broader discourse on curriculum design by analysing three years of MEQ data to evaluate the efficacy of mixed-assessment formats. The analysis is grounded in established theoretical frameworks and empirical evidence—including preliminary benchmarking against the literature standards (Table 4)—with the aim to provide practical insights for educators and policymakers aiming to balance inclusivity, engagement, and academic rigour in higher education. While the existing literature documents collaborative learning benefits, this study addresses gaps by analysing mixed-

assessment approaches at modular levels in internationalised postgraduate engineering contexts. Most studies focus on undergraduate education with limited postgraduate STEM research where students possess varied prior educational experiences (Valdés Guajardo et al., 2025). Additionally, research rarely examines highly internationalised contexts where international students comprise over 90% of cohorts. This study provides module-specific insights, situating findings within established theoretical frameworks to advance understanding of effective assessment strategies. The remainder of this paper is organised as follows: Section 2 presents the theoretical framework and the literature review. Section 3 describes the methodology. Section 4 presents the results. Section 5 discusses the findings and implications.

2. Theoretical Framework and the Literature Review

For clarity and consistency, key assessment types used throughout this study are defined as follows. Summative assessments are formal, end-of-unit evaluations measuring achievement of defined learning outcomes, typically high-stakes and standardised (Black & Wiliam, 2009). Traditional assessments refer to conventional examination and individual coursework formats, emphasising uniform, independent performance measurement (Gibbs, 2010; Tomlinson, 2012). Collaborative assessments are group-based evaluative tasks in which students collectively produce assessed outputs, fostering peer learning and co-construction of knowledge (Vygotsky, 1978; Springer et al., 1999). Mixed assessments combine individual and group-based summative tasks within a single module to evaluate a broader spectrum of competencies (Gardner, 2006). Formative assessments are ongoing, low-stakes feedback mechanisms embedded in teaching to support learning and self-regulation (Darling-Hammond & McLaughlin, 1995; Nicol & Macfarlane-Dick, 2006). Mixed-assessment effectiveness depends on sound pedagogical foundations and empirical validation. We ground our intervention in social constructivist theory and examine how collaborative learning addresses the distinct challenges of internationally diverse engineering cohorts. The integration of collaborative and mixed-assessment strategies in higher education responds to the growing diversity and complexity of student populations. Internationalisation, expansion and demand for inclusive pedagogies have necessitated paradigm shifts in traditional assessment methods (Deardorff, 2009; Leask, 2015). Traditional summative assessments have dominated higher education, offering standardised formats facilitating consistency across diverse cohorts (Gibbs, 2010; Springer et al., 1999). However, these methods often fail to engage students effectively, prioritising uniformity over inclusivity and disproportionately disadvantaging students unfamiliar with Western education conventions. For international cohorts, linguistic barriers and differing educational backgrounds complicate transitions (Boud & Molloy, 2013; Boud & Falchikov, 2006). Traditional methods neglect critical soft skills development—collaboration, problem-solving, adaptability—increasingly valued in academic and professional settings (Springer et al., 1999; Bowyer & Chambers, 2017; González-Marcos et al., 2016). The limitations of traditional assessment become evident when examining graduate employability outcomes. Tomlinson (2012) argues that traditional methods fail to develop transferable skills demanded by employers. The OECD (2013) highlighted significant gaps between what traditional assessments measure and meaningful learning in contemporary higher education.

In STEM disciplines with high international student numbers, summative assessment limitations are pronounced. High-stakes testing disadvantages students with linguistic or cultural barriers transitioning from teacher-centred pedagogies to autonomous learning environments (Hammersley-Fletcher & Hanley, 2016). Traditional assessments fail to account for cognitive ability diversity, neglecting developmental potential in Gardner's multiple intelligences theory (Gardner, 2006) and Vygotsky's constructivist learning theory (Vygot-

sky, 1978). Traditional assessments often neglect the role of formative feedback in learning processes. Darling-Hammond and McLaughlin (1995) emphasise that formative assessments providing timely, actionable feedback play critical roles in fostering self-regulation and deep learning. Fisher and Bandy (2019) and Twyman and Heward (2018) argue that assessment should be a continuous learning enhancement rather than merely a measurement. Brookfield (2017) extends this critique, focusing on reflective teaching practices absent in traditional assessments (Ashwin et al., 2020). Recent research is documenting concerning trends in contract cheating that traditional methods struggle to detect (Medway et al., 2018). Collaborative assessment practices inherently foster formative processes. It is important to distinguish between collaborative assessment practices and collaborative learning environments. Collaborative assessment practices refer specifically to the design and implementation of group-based evaluative tasks—that is, assessed activities in which students are formally evaluated on jointly produced outputs. Collaborative environments, by contrast, refer to the broader pedagogical conditions that facilitate interaction, peer support, and shared knowledge construction, irrespective of whether a formal assessment is taking place. In this study, the intervention addressed both: it introduced collaborative assessment tasks (group laboratory reports) within a module environment deliberately structured to promote collaborative learning throughout the teaching programme. Rooted in social constructivist theory, collaborative environments promote dialogic engagement, peer interaction, and knowledge co-construction (Vygotsky, 1978; Black & Wiliam, 2009). Students engaging in shared tasks continuously exchange feedback, reflect on progress, and negotiate meaning, activating critical assessment for learning aspects (Nicol & Macfarlane-Dick, 2006). This aligns with broader educational research trends emphasising evidence-based teaching approaches linking research knowledge with classroom practice (Wieser, 2018; Cain, 2015a, 2015b; Cain et al., 2019).

2.1. Pedagogical Framework: Social Constructivism and Differentiated Assessment

The constructivist paradigm posits learning as a socially mediated process where knowledge is co-constructed through peer and educator interaction (Vygotsky, 1978). This underpins collaborative learning's pedagogical rationale, emphasising group-based activity integration (Springer et al., 1999; González-Marcos et al., 2016; Tussupbekova et al., 2025). Gardner's multiple intelligences theory (Gardner, 2006) reinforces differentiated assessment strategies, recognising that students excel across intelligence spectrums (Muppala & Chandramohan, 2021; Kolmos, 1996). Vygotsky's (1978) Zone of Proximal Development concept provides a compelling rationale: collaborative settings enable students to draw on peer support to bridge understanding gaps. Rotgans et al. (2018) demonstrated that problem-based learning significantly influences motivation through interest in learning (Scholkmann, 2020). Springer et al. (1999) found positive effect sizes (d = 0.52–0.73), providing evidence that small group learning positively affected achievement and retention amongst underrepresented groups. Muppala and Chandramohan (2020) investigated group size correlations, providing evidence that smaller, well-structured groups (n = 5) are more effective in solving complex engineering problems.

Studies by Hammersley-Fletcher and Hanley (2016) and Tran (2019) demonstrated that group-based activities foster belonging and reduce cultural dissonance among diverse populations. Wasley (2006) found that underrepresented students benefit most from collaborative engagement. International students from teacher-centred systems may initially struggle with the autonomy inherent in collaborative assessments (Hammersley-Fletcher & Hanley, 2016). Regarding implementation strategies and challenges, Burke (2011) emphasised the role of group work in cultivating teamwork abilities essential for professional success, and further emphasised explicit group-work strategies, including structured

guidelines, ensuring all students understand their roles. van Harsel et al. (2021) suggest instruction on effective learning sequences improves self-regulated learning significantly. Wheeley et al. (2022) highlight pre-assessment workshops addressing misunderstandings. Muppala and Chandramohan (2019, 2020) illustrated how questionnaire-based analyses inform collaborative task design, advocating for differentiated instruction supporting varied backgrounds aligned with Gardner's (2006) theory. Regarding the internationalisation context, HESA (2023) data shows international student enrolments in UK universities rose over 20% in five years, requiring adapted pedagogical approaches (Deardorff, 2009; Leask, 2015; Kerr, 1994). Soledad et al. (2020) found that assessment task quality is a critical determinant of learning outcomes. Easley et al. (2021) argue that culturally responsive teaching methods enhance outcomes for international students. However, van Harsel et al. (2021) found improvement in certain principles but no significant learning enhancement, while Bowyer and Chambers (2017) note blended learning may improve retention, though not necessarily higher attainment.

2.2. Module Assessment Framework and Delivery

Green Engineering and Energy Efficiency (GEEE) is a Level 7 (postgraduate) optional module at a large public university in London, consistently attracting an annual cohort of approximately 65 students, of whom 90% are international. Its focus on sustainable development practices in engineering industries—spanning renewable energy, green design, and lifecycle assessment—bridges theoretical knowledge with practical applications through lectures, practical sessions, and tutorials. The increasing size of engineering student cohorts at a UK university with significant international enrollment introduced new delivery challenges. Assessment changes addressed this growth through theoretical content integration and practical experiments. These modifications improved student satisfaction (Easley et al., 2021). As Soledad et al. (2020) signify, the quality of assessment tasks is a critical determinant of student learning outcomes. Following Erbil's (2020) multi-combinatorial approach, group activities accompany each lecture. This strategy ensures students requiring additional support benefit from interaction with higher-achieving peers (Muppala & Chandramohan, 2020). Wheeley et al. (2022) argue that international students' experiences merit thoughtful consideration to ensure optimal support for their academic engagement. Northouse (2022, p. 6) reasons that in group learning, an individual influences a group to achieve the required learning outcomes. Students self-form groups and engage in problem-solving discussions facilitated by online chats. Each student's individual contribution is summatively assessed with peer assessment conducted anonymously through Canvas. Parks et al. (2018) document that social learning can lead to collective cyber-cheating and recommend countermeasures. Canvas supports the prevention of academic dishonesty by introducing structured transparency in group-work submissions through anonymous peer evaluation forms declaring each member's contribution level.

Euler and Kühner (2017, Table 1) identify twelve key principles for effective learning, of which Principles 11 and 12 are directly applicable to the assessment design in this module. Principle 11 advocates for collaborative group work as a mechanism for activating peer-supported knowledge construction, while Principle 12 supports the use of digital media—such as the Canvas VLE—to facilitate structured, accountable collaborative engagement. These principles provided the theoretical justification for incorporating group-based laboratory projects and anonymous peer evaluation into the module's assessment framework. Lambert and Ashwin (2021) emphasise that student feedback, including negative responses, is significantly important for maintaining satisfaction. These principles support the argument that group work is pedagogically appropriate for meaningful learning. Shared digital spaces and technology, such as Canvas, Teams, or peer review tools, solve

implementation challenges. Each assessment group comprised five students, with one group of six to accommodate the lab rota. Davis (1993) suggests five-student groups balance diversity and manageability. Brookfield (2017) and Muppala and Chandramohan (2021) highlight that structured group compositions enhance collaborative outcomes. Fung (2017, p. 41) suggests that collaborative activities effectively cultivate significant relationships among students. Byrne (2020) found that networking enhances employability prospects. Group practical work and write-ups embody student-centred learning by promoting active participation, collaborative problem-solving, and ownership of the learning process. These activities allow students to apply theoretical knowledge to real-world situations while developing crucial soft skills such as communication and teamwork. The module's formally accredited learning outcomes (LOs), mapped to UK Engineering Council PSBRs, are structured to develop a progressive range of engineering competencies. Students are expected to recognise the importance of national and European regulations relating to renewable technologies (LO1: SM7M); discuss environmentally related technologies and materials across construction, automotive, and structural industries (LO2: SM8M, EA5M, P10M, G1); analyse resource provision and consumption in engineered product manufacture, including the application of alternative energy sources (LO3: EA7M, G4); apply sustainability principles to redesign products for recyclability and waste minimisation (LO4: P12M, EL11M); specify and develop energy-efficient products from a theoretical perspective (LO5: EL13M); and critically evaluate life cycle assessments at the conceptual design stage (LO6: EA7M, D10M). These LOs are assessed through two summative coursework elements of equal weighting (50% each): Coursework 1 covers individual tasks on Biomass and Biofuels and Solar Incentives and Applications (addressing LOs 1, 2, 3 and 6), while Coursework 2 involves group-based laboratory experiments on Wind Turbine and Solar Water Heating Design (addressing LOs 4 and 5). This direct mapping between collaborative assessment tasks and higher-order engineering competencies confirms that the satisfaction improvements measured in this study are situated within a structured competency–development framework, not isolated from academic performance expectations. The module underwent significant assessment changes in 2020/21, responding to consistent student feedback gathered through Module Evaluation Questionnaires (MEQs). The revised curriculum replaced one individual assessment with an additional group-based project, balancing assessment weighting equally between individual and group work (50:50), to foster inclusivity, collaboration, and practical application of the theoretical knowledge.

This study evaluates the impact of these reforms by analysing MEQ data from pre-implementation (2020/21) and post-implementation (2021/22 and 2022/23) years to assess whether the revised curriculum improved student learning experience and satisfaction. The specific research methodology, data collection instruments, and analytical procedures employed to evaluate these reforms are described in detail in Section 3 (Methodology). Teaching is delivered through lectures, tutorials, and laboratory sessions, with workshops constituting 20% of teaching time, promoting collaborative problem-solving. Canvas Virtual Learning Environment supports learning with recommended readings, practice assessments, and online materials.

The tripartite model (Figure 1) presents an interconnected strategy implementing comprehensive assured learning outcomes for all students, adapting to emerging practices and addressing challenges such as engaging students with low motivation. Given that the majority of students are first-generation international students, learning materials targeting critical evaluation of online sources were introduced to address gaps in scholarly knowledge (Zlatkin-Troitschanskaia et al., 2021; Leeder & Shah, 2016). Structured feedforward and peer feedback mechanisms, supported by Rodríguez et al. (2022), further reinforce problem-

based learning in large classes. Building on this, a differentiated learning approach was implemented: students were organised into informal groups of five, arranged alphabetically to ensure diverse skill distribution (Brady, 2020; Fuller et al., 2010; Brame & Biel, 2015). Each three-hour lecture allocated one hour to case study activities in which students took the lead in summarising research articles, consistent with active learning principles advocated by Wieman (2017). This model facilitated the transfer from passive observation to active management of the learning process, as illustrated by the differentiated learning model in Figure 2.

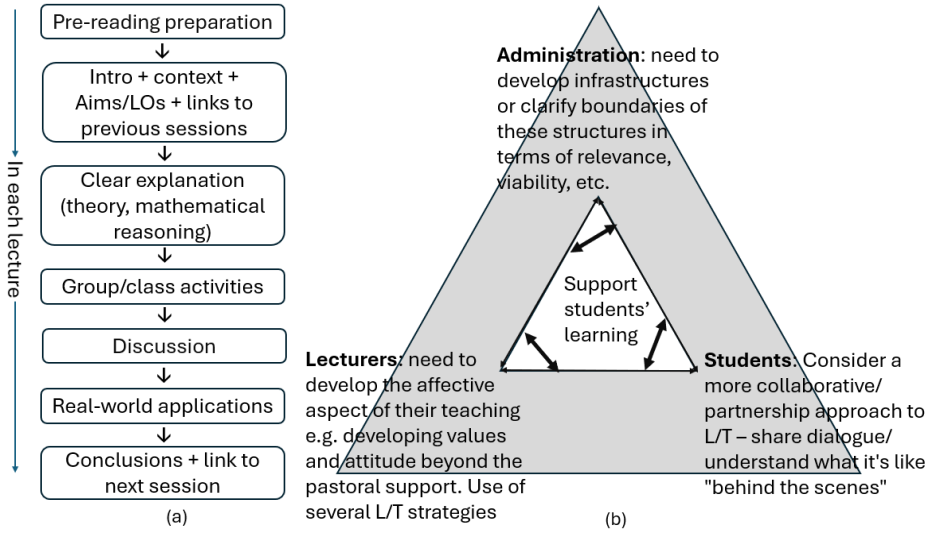


Figure 1. Tripartite model linking institutional context, assessment design, and student outcomes in mixed-assessment implementation. (**a**) Session structure framework; (**b**) stakeholder support triangle.

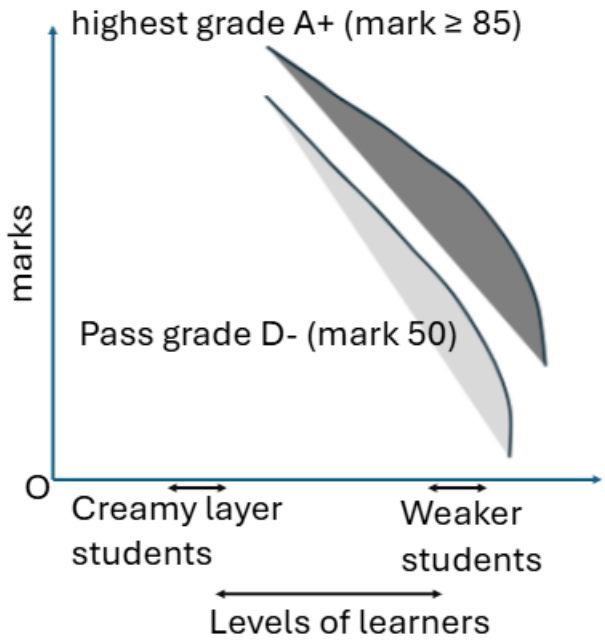


Figure 2. Differentiated learning model showing collaborative assessment impact across student performance levels. The shaded regions represent the range of marks achieved by more able students (left) and weaker students (right), with the darker shading indicating grade improvement following collaborative assessment intervention. The model demonstrates greatest gains among initially lower-performing students, consistent with Vygotsky's Zone of Proximal Development (Muppala & Chandramohan, 2019, 2021).

3. Methodology

This study employs a quasi-experimental longitudinal design (Lewin, 1946), analysing Module Evaluation Questionnaire (MEQ) data across three academic years to evaluate mixed-assessment (as defined in Section 2) implementation impacts. The design enables systematic comparison of student perceptions pre-implementation (2020/21) versus post-implementation (2021/22, 2022/23). This study employs a quantitative approach to evaluate the impact of assessment modifications. Most of the cohort comprises male students (89.4%) and students from Asian backgrounds (82.4%). The MEQs are administered via VLE at the end of each teaching block to gather feedback on various aspects of the module. A minimum of five responses is required for the VLE system to generate a summary of the module evaluation. The survey comprised ten questions, measuring satisfaction with module organisation, teaching quality, assessment clarity, and resource availability. Responses were collected on a 5-point Likert scale ranging from Definitely Disagree (1) to Definitely Agree (5). The surveys were administered twice during the 2020/21 academic year, once in 2021/22, and twice again in 2022/23. In this study, we primarily assess student satisfaction with the learning experience; we do not extensively evaluate their grade performance. The module's six formally accredited learning outcomes (Los)—spanning competencies such as recognising renewable energy regulations (LO1), analysing environmentally related technologies (LO2), evaluating life cycle assessments (LO6), and specifying energy-efficient products (LO5)—are each mapped to UK Engineering Council PSBRs and assessed summatively (see summative assessment definition, Section 2) through two equally weighted coursework elements (50% each). These assessments are institution-regulated and subject to moderation protocols, which preclude disaggregation of individual grade data for publication within the approved ethical scope of this study. The significant gains in Learning Experience satisfaction reported here are therefore best understood as indicators of enhanced student engagement with these competency-aligned learning activities, rather than as a substitute for performance-based outcome measures. Future research should incorporate grade performance and project outcome data alongside MEQ satisfaction indicators to further substantiate the causal relationship between mixed-assessment strategies (as defined in Section 2) and measurable competency development. This module's number of registered students fluctuates annually but remains within the statistically valid sample size. The MEQ of five sets of data for three years, which collects anonymous student feedback, was generated by the Canvas system.

To facilitate meaningful analysis, the ten Likert-scale questions were grouped into four overarching themes: Organisation and Clarity, Teaching Quality, Assessment, and Learning Experience. Mean and standard deviation scores were calculated for each MEQ Likert-scale item. The percentage agreed measure was then derived for each individual MEQ question, and the mean percentage agreed measure for each MEQ theme was used to identify overall satisfaction trends. Statistical significance in this context carries direct educational relevance. A statistically significant improvement in MEQ satisfaction scores indicates that the observed change in student perception is unlikely to be attributable to random variation or year-to-year fluctuation in cohort composition—it instead reflects a systematic shift in how students experienced the module following the assessment intervention. For educators and curriculum designers, this provides evidence-based confidence that the change produced a genuine, reproducible effect on student satisfaction. In the context of postgraduate engineering education, where student satisfaction is closely linked to engagement, retention, and the development of professional competencies, statistically significant improvements in the Learning Experience theme represent meaningful outcomes with direct practical implications for module design." The Kruskal–Wallis test was applied to compare pre-implementation (2020/21) and post-implementation (2021/22) satisfaction

levels. This non-parametric test was chosen for comparing independent groups for its robustness in handling ordinal Likert-scale data and non-normal data distribution. The analysis used Python (version 3.14) with the SciPy statistical library. The study received ethical approval from the Research Ethics Committee. Participation in the MEQ survey was voluntary, and all responses were anonymised to ensure confidentiality. Data were used exclusively for research and module improvement purposes.

4. Results

4.1. Descriptive Analysis of MEQ Questions

The five plots, Figure 3i–v depict respondents' average values for questions Q1 to Q10 (full question wording provided in Appendix A) across five response categories: (i) Deeply Agree (DlyA), (ii) Agree (A), (iii) Neither (NA/DA), (iv) Disagree (DA), and (v) Definitely Disagree (DDA). This data representation covers all five sets of data over a three-year period.

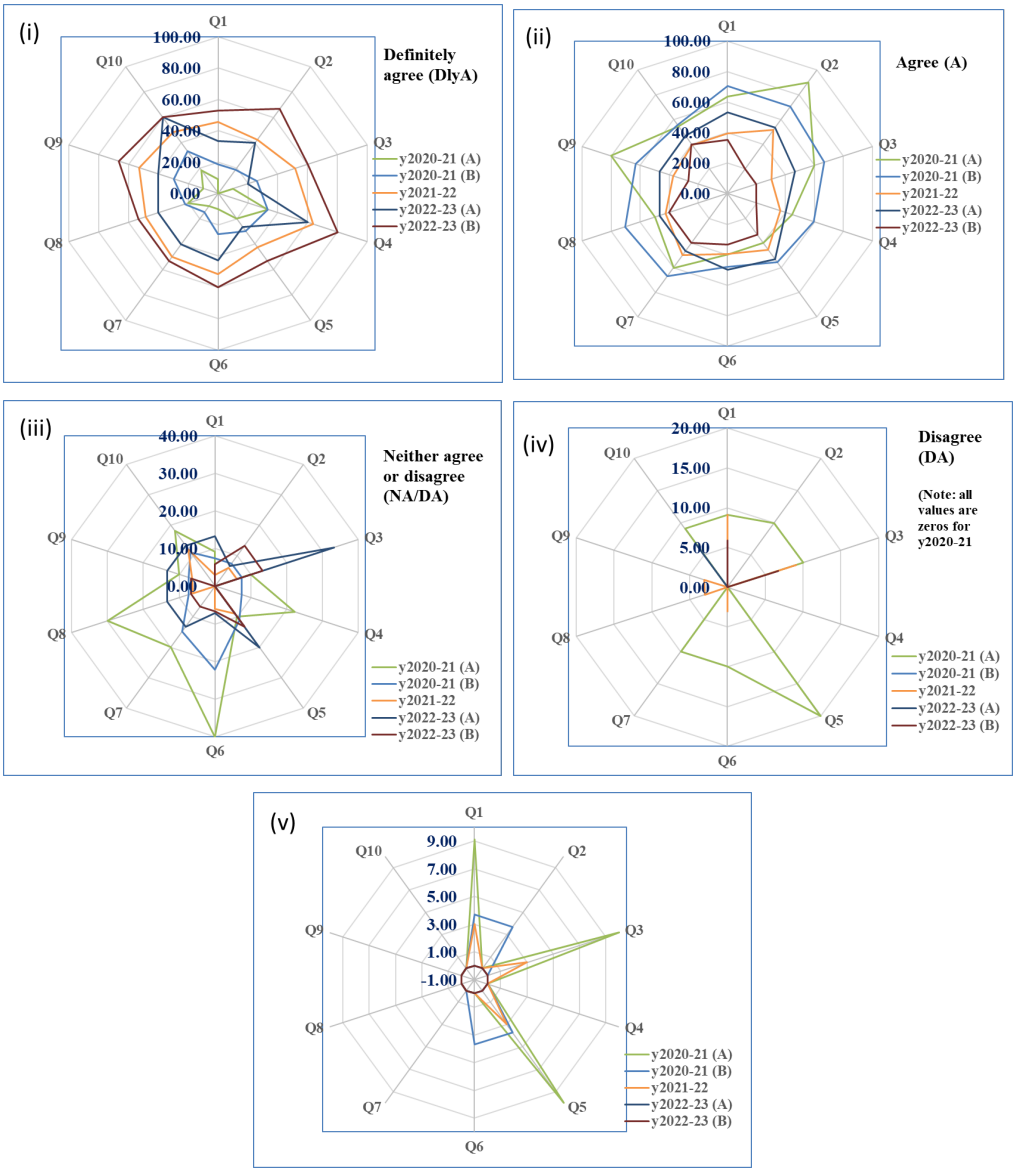


Figure 3. (**i**–**v**). Radar plots show survey response patterns for (**i**) Definitely Agree, (**ii**) Agree, (**iii**) Neither Agree nor Disagree, (**iv**) Disagree, and (**v**) Definitely Disagree across ten questions (Q1–Q10) by academic year (2020–21 to 2022–23) with two data collection periods (A and B) per year.

The five plots in Figure 3i–v depict respondents' average values for questions Q1 to Q10 across five response categories: (i) Deeply Agree (DlyA), (ii) Agree (A), (iii) Neither (NA/DA), (iv) Disagree (DA), and (v) Definitely Disagree (DDA). This data representation covers all five sets of data over three years. The five radar plots (Figure 3i–v), to be read outwardly, show survey response patterns across ten questions (Q1–Q10) for different response categories by academic year (2020–21 to 2022–23), with two data collection periods (A and B) per year. (i) Definitely Agree (DlyA) shows a general upward trend over time. The 2020–21(A) shows the lowest levels across most questions, with gradual improvement through 2020–21(B) and 2021–22, reaching the highest levels in 2022–23(A) and (B). Some questions show particularly strong improvement over time. (ii) Agree (A) displays variable patterns across years and questions. The 2020–21(A) shows notably higher values for certain questions (particularly Q2 ("I am clear about what is expected of me") and Q9 ("The module has helped me develop my understanding of the subject"), while later years generally show different distribution patterns as responses shift toward other categories. (iii) Neither Agree nor Disagree (NA/DA) shows the highest neutral responses in 2020–21(A) for several questions, with a general decreasing trend in subsequent years, indicating reduced neutrality over time. (iv) Disagree (DA) displays minimal disagreement with module organisation, teaching quality, and assessment clarity across all years and questions, with values remaining very low (close to zero) throughout the study period. Note: all Disagree values are zeros for 2020–21. (v) Definitely Disagree (DDA) shows consistently near-zero levels across all questions and years, with only minor variations, indicating very low levels of strong disagreement with statements such as 'the module is well organised' (Q1) and 'this module has been a positive learning experience' (Q10) throughout the study period.

Figure 4i displays average scores (3.0–5.0 scale) for questions Q1–Q10 across five academic periods. Years 2022–23 (Occ B) and 2022–23 (Occ A) exhibit the highest overall values, particularly for Q6–Q9 ("Assessment clarity", "Assessment methods", "Feedback received", and "Subject understanding". The 2020–21 (A) period shows consistently lower scores, suggesting poorer initial satisfaction levels. Similarly, in Figure 4ii, the standard deviations (0.00–0.15 range) plot reveals response consistency. Higher values indicate greater variance in participant opinions. Q3 ("The learning materials provided are useful") and Q4 ("Teaching sessions are engaging") display notable fluctuations across years, while Q8 ("I have received useful feedback on my work") shows increasing consistency over time. The 2020–21 (B) period demonstrates particularly high variability in Q7 ("The assessment methods allow me to demonstrate my abilities") responses. Figure 4iii shows the mean of mean values, showing overall satisfaction across academic years, confirming substantial improvement from 2020 to 21 (Occ A) to 2022–23 periods. Values peaked during 2022–23 (Occ B) before a modest decline in the latest dataset, consistent with the observed trends in individual question responses. Overall, a clear enhancement in satisfaction metrics from 2020 through 2023 is seen, with peak performance in 2022–23 (Occ B). The steady reduction in standard deviations alongside rising mean scores indicates increasingly positive and consistent feedback. The slight downturn in the most recent period warrants monitoring but remains substantially above baseline measurements from 2020–21.

4.2. Descriptive Analysis of MEQ Themes

For the purposes of this analysis, the four MEQ themes are defined as follows. Organisation and Clarity encompasses student satisfaction with the structural coherence of the module, clarity of expectations, and accessibility of learning materials (Q1–Q3). Teaching Quality reflects perceptions of the effectiveness and communicative clarity of teaching delivery (Q4–Q5). Assessment captures satisfaction with assessment transparency, appropriateness of methods, and quality of feedback received (Q6–Q8). Learning Experience

measures the degree to which students felt the module contributed to their subject understanding and overall educational development (Q9–Q10). These definitions are applied uniformly throughout the Results and Discussion sections. Based on the question themes, shown in Figure 5, the descriptive statistics across the academic years 2020/21, 2021/22, and 2022/23 reveal trends in student satisfaction levels, particularly in relation to the introduction of an additional group assignment in 2021/22.

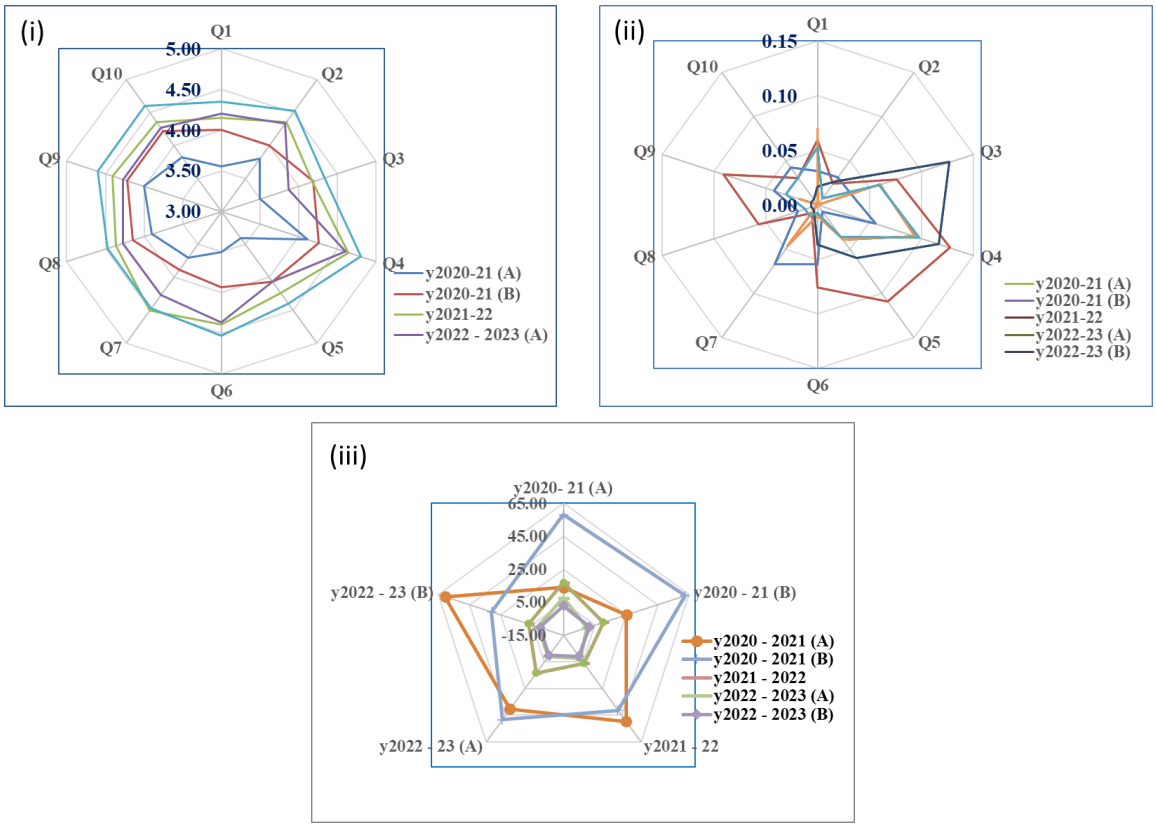


Figure 4. (**i–iii**). Radar plots showing temporal trends across academic years (2020–2023). Left: Average scores for Q1–Q10; centre: standard deviations revealing response variability; right: mean values demonstrating satisfaction improvement from 2020 to 21 baseline.

Mean satisfaction scores for the *Assessment* theme improved steadily, starting at 84.47 (SD = 10.30) in 2020/21, increasing to 89.80 (SD = 1.65) in 2021/22, and reaching 94.47 (SD = 7.79) in 2022/23. This trend indicates sustained positive perceptions of assessment clarity and fairness. At the question level, the statement "I am clear about what I am supposed to do for the assessment of this module" saw agreement rise from 70.00% in 2020/21 to 90.90% in 2021/22, with a slight decline to 86.70% in 2022/23. Similarly, agreement with "The criteria used in marking have been made clear in advance" remained high, increasing from 90.00% in 2020/21 to 92.60% in 2021/22, before declining to 86.70% in 2022/23.

The *Learning Experience* theme exhibited the most significant improvement, with mean scores rising from 70.12 (SD = 13.26) in 2020/21 to 92.93 (SD = 6.30) in 2021/22. Although scores declined slightly to 88.80 (SD = 5.37) in 2022/23, they remained substantially higher than pre-implementation levels. Within this theme, the statement "*There are opportunities for me to participate in learning activities throughout the module*" saw agreement rise sharply from 70.00% in 2020/21 to 100.00% in 2021/22, stabilising at 93.30% in 2022/23. Similarly, "*The online and/or in-class learning materials for this module are supporting my learning*" showed

a marked increase from 50.00% in 2020/21 to 90.90% in 2021/22, maintaining stability at 93.30% in 2022/23.

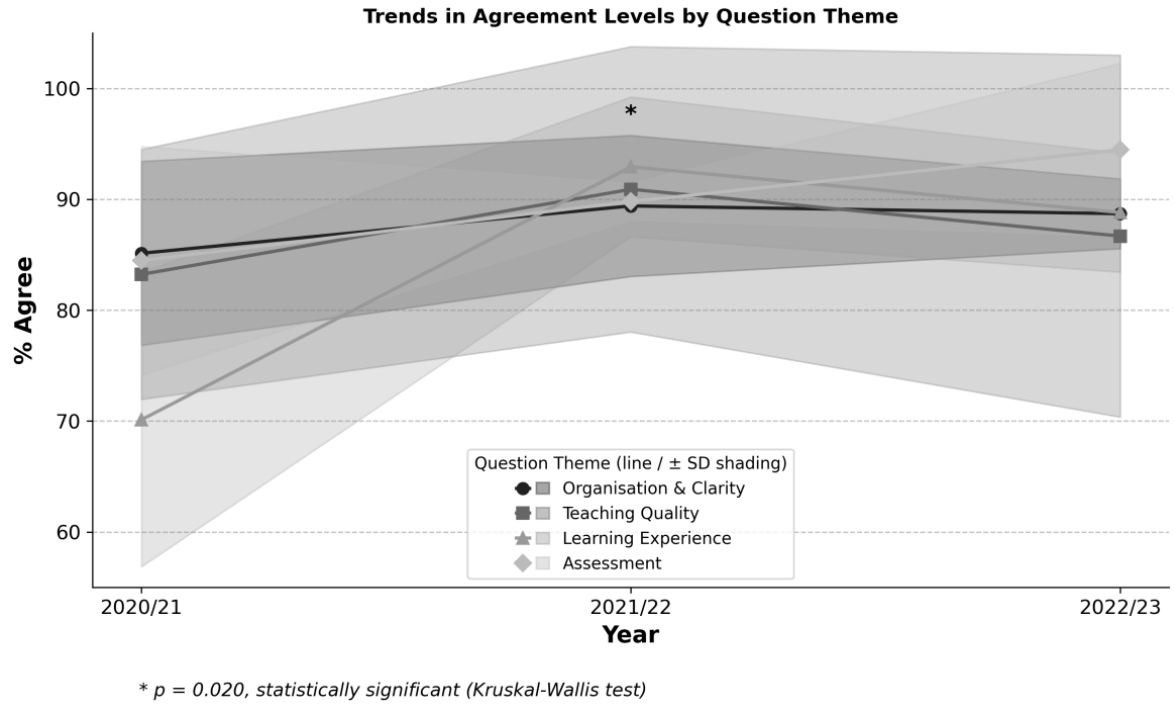


Figure 5. Trends in agreement levels by MEQ theme across the three academic years.

The *Organisation and Clarity* theme followed a trend of steady improvement, with mean scores increasing from 85.13 (SD = 8.30) in 2020/21 to 89.40 (SD = 6.36) in 2021/22, followed by a slight decline to 88.70 (SD = 3.15) in 2022/23. At the question level, "*The module is well-organised and is running smoothly*" saw agreement improve from 72.70% in 2020/21 to 88.90% in 2021/22 and to 88.20% in 2022/23. Similarly, "*It was made clear from the start what I was meant to learn on this module*" maintained high agreement levels, increasing from 90.00% in 2020/21 to 93.90% in 2021/22, before slightly declining to 86.70% in 2022/23.

The *Teaching Quality* theme showed improvement between 2020/21 and 2021/22, with mean scores rising from 83.23 (SD = 11.27) to 90.90 (SD = 12.87). However, scores declined slightly in 2022/23 to 86.68 (SD = 16.32). Agreement with the statement "*Staff on this module are approachable*" remained consistently high, reaching 100.00% in both 2021/22 and 2022/23. However, "*Staff are making the subject interesting*" showed greater variability, improving from 70.00% in 2020/21 to 81.80% in 2021/22, but declining to 66.70% in 2022/23.

4.3. Statistical Analysis

To evaluate both the statistical significance and practical importance of the assessment modifications, two complementary analytical approaches were employed. Effect size analysis using Cohen's d quantified the magnitude of observed changes, while the Kruskal–Wallis test assessed whether differences between the pre-implementation (2020/21) and post-implementation (2021/22) periods were statistically significant. This dual approach provides comprehensive evidence for the intervention's impact across all MEQ themes (Table 1).

Table 1. Descriptive statistics depicting percentage agreement across MEQ themes over the three academic years. N: number of student respondents, M: the mean and SD: the standard deviation.

MEQ Theme	2020/21			2021/22			2022/23		
	N	M	SD	N	M	SD	N	M	SD
Assessment	38	84.47	10.30	33	89.80	1.65	31	94.47	7.79
Learning Experience	37	70.12	13.26	33	92.93	6.30	31	88.80	5.37
Organisation and Clarity	38	85.13	8.30	33	89.40	6.36	31	88.70	3.15
Teaching Quality	37	83.23	11.27	33	90.90	12.87	31	86.68	16.32

4.4. Cohen's Analysis

Effect size analysis using Cohen's d was conducted to assess the practical significance of the observed improvements. Learning Experience satisfaction improved by 32.5% from baseline, representing the most significant improvement among all themes (+22.8 points vs. +4.3 for Organisation and Clarity, +7.7 for Teaching Quality, and +5.3 for Assessment). Response variability decreased by 52.5% (standard deviation from 13.26 to 6.30), indicating more consistent student satisfaction following collaborative assessment implementation. Cohen's d analysis revealed substantial differences in intervention impact across MEQ themes (Table 3). Learning Experience demonstrated a very large effect (d = 2.20), substantially exceeding Cohen's threshold for significant effects (d = 0.8). The remaining themes showed medium effects: Assessment (d = 0.72), Teaching Quality (d = 0.63), and Organisation and Clarity (d = 0.58), as shown in Table 2 and Figure 6.

Table 2. Effect size analysis (Cohen's d) for MEQ theme improvements (2020/21 to 2021/22).

Theme	Cohen's d	Effect Size	Meaning
Assessment	0.72	Medium	Moderate improvement
Learning Experience	2.20	Very large	Dramatic improvement
Teaching Quality	0.63	Medium	Moderate improvement
Organisation and Clarity	0.58	Medium	Moderate improvement

These effect sizes carry substantive educational meaning. The very large effect size for Learning Experience (d = 2.20) indicates that the shift in student satisfaction was not merely statistically detectable but educationally transformative—representing a change in a magnitude rarely observed in single-module interventions. To contextualise this, Hattie's (2009) meta-analysis of over 800 educational studies identifies d = 0.40 as a typical effect and d > 1.00 as exceptional. A d of 2.20 therefore suggests that the collaborative assessment intervention fundamentally altered how students experienced the module, rather than incrementally improving it. The medium effect sizes for the remaining themes (d = 0.58–0.72) indicate meaningful but more moderate improvements, consistent with the expectation that structural and organisational aspects of a module are less susceptible to short-term assessment reform than experiential dimensions. To assess the impact of the additional group assignment, a Kruskal–Wallis test was conducted, comparing satisfaction levels between the pre-implementation year (2020/21) and the post-implementation year (2021/22). The results revealed a statistically significant improvement in the *Learning Experience* theme ($H = 5.4$, $p = 0.020$), indicating the intervention had a substantial positive

effect on students' perceptions of their overall learning experience (Table 3). In contrast, no significant differences were observed for *Assessment* ($H = 0.067$, $p = 0.796$), *Organisation and Clarity* ($H = 0.221$, $p = 0.639$), or *Teaching Quality* ($H = 0.882$, $p = 0.348$), suggesting stability in these themes before and after the intervention (Table 3).

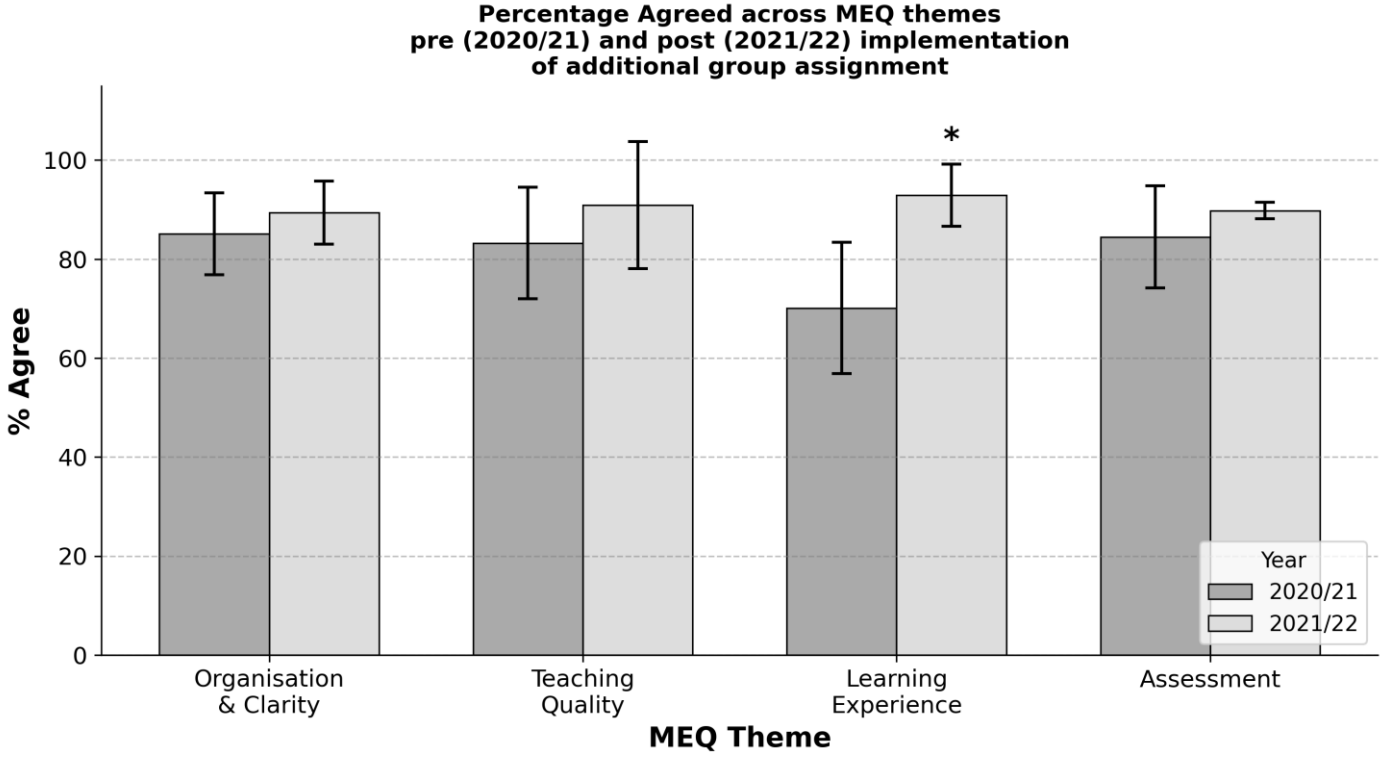


Figure 6. Pre- and post-implementation comparison of MEQ theme satisfaction levels.

Table 3. Kruskal–Wallis test results for pre- and post-implementation comparisons.

MEQ Theme	Kruskal–Wallis Statistics	*p*-Value
Organisation and Clarity	0.221	0.639
Teaching Quality	0.882	0.348
Learning Experience	5.400	0.020 *
Assessment	0.067	0.796

* Significant at $p < 0.05$ (also the third bar chart from left in Figure 6).

Figure 6 compares satisfaction rates across MEQ themes for pre-(2020/21) and post-implementation (2021/22) years, with significant changes marked by an asterisk.

5. Discussions

The findings demonstrate that systematic integration of collaborative and individual assessment formats significantly enhances student learning experience within the pedagogical framework established in Section 2. Learning Experience satisfaction surged from 70% to 93% following intervention implementation, with statistically significant improvement ($H = 5.4$, $p = 0.020$, $d = 2.20$) alongside stable Organisation and Clarity, Teaching Quality, and Assessment metrics. This pattern indicates that group-based additions achieved their primary engagement target without compromising other quality dimensions. Integration of group-based projects into the curriculum demonstrates a clear positive correlation between collaborative activities and improved learning experience. The statistically significant im-

provements observed in the Learning Experience theme during 2020/21 and after 2021/22 highlight the potential of group assignments to bridge gaps in student satisfaction, particularly for international cohorts. These outcomes are consistent with previous studies that associate collaborative learning with increased engagement and satisfaction (Springer et al., 1999; Tran, 2019). A slight decline in satisfaction levels in 2022/23 highlights the need for sustained efforts to refine collaborative learning strategies. This aligns with the findings of Muppala and Chandramohan (2020), who emphasised the importance of iterative assessment design and adaptive pedagogy in large cohort modules. Notably, the stability observed in themes such as Organisation and Clarity and Teaching Quality demonstrates that the inclusion of group-based assessments does not inherently disrupt other critical instructional components.

5.1. General Discussions

The findings of this study carry significant implications for the design of assessments in internationalised postgraduate engineering programmes. The statistically significant improvement in Learning Experience satisfaction ($H = 5.4$, $p = 0.020$, Cohen's $d = 2.20$), achieved through a 50:50 individual-group assessment balance with five-member collaborative teams and anonymous peer evaluation via Canvas, provides educators with a validated, implementable framework for addressing the inclusivity challenges posed by highly diverse student cohorts. Critically, the stability observed in Organisation and Clarity, Teaching Quality, and Assessment themes confirms that this intervention enhanced experiential learning dimensions without compromising operational academic quality—a balance that is often difficult to achieve in large postgraduate modules. For curriculum designers and policymakers, the study demonstrates that targeted, theoretically grounded assessment reform, informed by iterative student feedback, can yield transformative rather than incremental improvements in student satisfaction. Future work should extend this framework through multi-institution longitudinal studies that triangulate MEQ satisfaction data with performance-based outcome measures to more comprehensively establish the causal relationship between mixed-assessment strategies and measurable learning gains.

Determining optimal group size emerged as a key factor in the success of collaborative activities. Groups comprising five members were identified as most effective, balancing diversity, productivity, and cohesion. This size facilitates active participation, equitable workload distribution, and meaningful peer-to-peer learning, particularly for international students adapting to new academic environments. Brookfield (2017) advocates for manageable group sizes to foster collaboration while mitigating the risks of unequal participation. Chou and Chang (2018) found that small groups enhance satisfaction. Davis (1993) further emphasises the importance of structured group dynamics and clearly defined roles in ensuring equitable participation and minimising conflicts. Despite these benefits, challenges such as dominance by individual members or disparities in contributions remain. Addressing these issues necessitates implementing facilitation strategies, including clear guidelines and structured peer evaluations, to ensure fairness and maximise the educational benefits of group work, as shown in Table 4.

Table 4 benchmarks the satisfaction metrics from the present study against comparable findings from the recent literature. The 'Study Setting' column describes the specific educational context of each cited study—including the type of programme, student population size, and disciplinary focus—to enable meaningful comparison with the internationalised postgraduate engineering context of the present investigation.

Collaborative tasks provide significant benefits in addressing the unique challenges faced by international students, such as adjusting to the UK's emphasis on independent and critical thinking (Fairhurst et al., 2023). These group-based activities create opportuni-

ties for intercultural communication and teamwork, which are critical in both academic and professional contexts. This aligns with findings by González-Marcos et al. (2016), Hammersley-Fletcher and Hanley (2016), who highlight the importance of collaborative practical tasks and culturally responsive pedagogical approaches in enhancing engagement, experimental, and critical thinking skills. Anonymous peer evaluations, facilitated through platforms like Canvas, have proven effective in mitigating non-engagement and conflicts within groups.

Table 4. Satisfaction metrics in collaborative engineering learning.

Literature	Study Setting	Satisfaction Metric
present study	Intl eng module	Pre: 70.12% Agree → Post: 92.93%
Chou and Chang (2018)	Eng project design groups, n = 480	Skill development M = 3.925 (~78%); Group learning M = 3.015 (~60%); Small groups > large (F = 5.47, $p < 0.05$)
Al-Khatib et al. (2024)	Online eng learning, n = 263	Overall M = 3.445 (~69%); Interaction M = 3.245 (~65%)
Saeed and Mohamedali (2022)	Eng personalised module	Pass rate 70% → 92% (+22%) [MEQ satisfaction improved AY2018–19 vs. prior]
Maceiras et al. (2025)	Eng active (Jigsaw/video)	Videos: ~90% satisfaction (Likert 4–5); Jigsaw: 53%
Sutherland et al. (2019)	Business modules (eng proxy), 25 k responses	Overall satisfaction R^2 ~ 0.9; Teaching β = 0.46

Note. The value 5. × 100. Data from Chou and Chang (2018); Al-Khatib et al. (2024); Saeed and Mohamedali (2022); Maceiras et al. (2025); Sutherland et al. (2019).

The adoption of mixed-assessment formats supports the broader aim of equipping students with professional competencies. Through the simulation of real-world engineering scenarios—such as group projects focused on wind turbine design—the approach aimed to foster dynamic student communities, enhance peer support, and promote experiential learning, critical thinking, and the practical application of theoretical knowledge. Our findings indicate that group assessments were associated with improved average satisfaction across all four measured themes; however, a statistically significant improvement was observed only in relation to the learning experience. Although the benefits of these curricular innovations are well-documented, their long-term implications for employability and professional readiness remain underexplored. Existing research often focuses on short-term outcomes, neglecting broader metrics such as career success and skill retention. Further investigation is needed to evaluate the effectiveness of collaborative assessments across different disciplines and educational levels. Postgraduate STEM programmes present unique challenges and opportunities for implementing group-based learning, given their emphasis on advanced technical skills and interdisciplinary collaboration. Longitudinal studies tracking student outcomes post-graduation could provide valuable insights into the real-world applicability of collaborative assessment strategies.

The integration of digital platforms into collaborative learning processes also warrants further investigation, especially within hybrid and online learning environments (Khalid et al., 2025). The data obtained from Module Evaluation Questionnaires provides a valuable foundation for curriculum development. Expanding these metrics to include qualitative feedback from students and faculty would offer deeper insights into the strengths and limitations of these assessment strategies. Addressing these gaps will enable future research to establish best practices for fostering inclusivity and enhancing collaborative learning outcomes in higher education.

Some students encounter challenges in maintaining the required pace for self-directed learning, particularly when self-reflection is integral to achieving the learning outcomes of the module curriculum. This issue may be more pronounced among international students who are accustomed to traditional, teacher-centred learning approaches. This study, based primarily on end-of-module student feedback, indicates that changes to the summative assessment improved student satisfaction, though not necessarily their learning outcomes.

We acknowledge the challenges associated with group work, particularly ensuring active engagement from all participants. Exploring methods to track individual levels of participation through virtual learning environments, such as Canvas, could provide valuable insights and support. The findings of this study have the potential to enhance engineering education by improving teaching quality, fostering student success, and promoting continuous refinement through student feedback. Future research should examine the long-term impacts of these curriculum adjustments on student outcomes and employability. Additionally, investigating the applicability of this approach across diverse disciplines and educational levels would provide further insight into its broader educational value.

5.2. Implications

Having established the statistical significance and effect size of the intervention within the specific context of the GEEE module, this section examines the extent to which the findings and the Integrated Assessment Framework (IAF) they validate may be applicable beyond this single institutional setting. Transferability in educational research refers to the degree to which findings from a specific context can inform practice in comparable settings, acknowledging that direct replication is rarely possible given the contextual specificity of educational interventions.We address transferability through three lenses: effect size benchmarking against the broader educational literature; analysis of the contextual conditions under which the IAF is most likely to be effective; and a transferability matrix mapping predicted effectiveness across different institutional and disciplinary settings. These analyses are intended to provide practical guidance for educators and researchers considering adopting or adapting the IAF, while acknowledging the empirical validation requirements set out at the close of this section.

The observed Learning Experience effect size (Cohen's d = 2.20) positions this intervention in the top 5% of educational interventions documented in the higher education literature. Comparative analysis reveals Hattie's (2009) meta-analysis of 800+ educational studies identifies d = 0.40 as typical, d = 0.60 as substantial, and d > 1.00 as exceptional (Hattie, 2009). Recent engineering education interventions report: flipped classrooms d = 0.47 (Freeman et al., 2014), active learning d = 0.55 (Theobald et al., 2020), and peer instruction d = 0.63 (Smith et al., 2009). The IAF's d = 2.20 exceeds these established approaches by 250–400%, suggesting fundamental rather than incremental impact.

The IAF demonstrates the highest effectiveness under specific conditions. Favourable contexts include: (1) international student majority (>70%)—peer scaffolding addresses language and cultural barriers; (2) postgraduate level—students possess professional experience enabling peer teaching; (3) technical disciplines—objective assessment criteria facilitate peer evaluation; (4) VLE infrastructure—Canvas or equivalent enables anonymous peer evaluation. Moderating factors include group size (optimal n = 5, acceptable n = 4–6), assessment balance (50:50 individual-group ratio proved most effective), and faculty support (structured rubrics, facilitation training essential).

Predicted IAF effectiveness across contexts: High transferability—postgraduate engineering/STEM programmes with 60%+ international enrolment, existing VLE infrastructure, faculty development support available (predicted d > 1.50). Medium transferability—undergraduate STEM programmes, moderate international enrollment (30–60%), basic

group-work experience (predicted d = 0.80–1.20). Lower transferability—humanities disciplines (subjective assessment criteria complicate peer evaluation), non-diverse cohorts (<30% international, reduced peer scaffolding opportunity), institutions lacking VLE support (anonymous peer evaluation difficult). These predictions require empirical validation but provide initial guidance for implementation.

Framework transferability claims require multi-institution validation. Future research should test IAF implementation across different institutional types (research universities, teaching-focused institutions, polytechnics), varied disciplines (computer science, mathematics, life sciences), and diverse cohort compositions. Longitudinal studies examining sustained impact beyond three years and the correlation between satisfaction gains and career outcomes would strengthen generalizability claims.

The findings provide actionable insights for educators. The 50:50 individual-group assessment balance effectively enhanced Learning Experience satisfaction while maintaining academic rigour. Educators implementing collaborative assessments should consider: (1) optimal group sizes of five members as identified in this study, balancing diversity and productivity; (2) structured peer evaluation systems using platforms like Canvas to maintain individual accountability; (3) integration of practical laboratory work with theoretical analysis to reflect professional engineering contexts; and (4) explicit guidance for international students transitioning from teacher-centred educational systems. As noted in the module framework section, group activities accompanying lectures provide opportunities for peer learning, helping students requiring additional support benefit from interaction with higher-achieving peers.

5.3. Implications for Institutional Policy

This study demonstrates the value of using systematic evaluation data (MEQs) to inform curriculum design decisions. Institutions should establish mechanisms for evidence-based curriculum development, supporting educators in implementing assessment innovations through action research principles. Investment in learning management systems with robust peer evaluation capabilities proved essential for implementation success. Professional development programmes addressing collaborative learning facilitation, group dynamics management, and culturally responsive teaching would enhance educators' capacity to implement effective collaborative assessment strategies in diverse cohorts. The study also suggests that assessment policies should allow flexibility for varied approaches aligned with discipline-specific learning objectives and student diversity.

Implications for Future Research

As acknowledged in the discussion, the long-term implications for employability and professional readiness remain underexplored, with existing research often focusing on short-term outcomes. Future research should examine: (1) longitudinal studies tracking student outcomes post-graduation to evaluate real-world applicability of collaborative assessment strategies; (2) the relationship between collaborative assessment satisfaction and actual learning outcomes, addressing the limitation that this study examines perceptions rather than direct achievement measurements; (3) comparative investigations across different disciplines and educational levels to establish best practices; (4) qualitative studies providing deeper insights into group dynamics and cultural influences on collaboration; and (5) the integration of digital platforms in hybrid and online learning environments. Expanding MEQ metrics to include qualitative feedback would offer deeper insights into the strengths and limitations of these assessment strategies.

6. Conclusions

Mixed-assessment strategies, grounded in social constructivist pedagogy and implemented through systematic curriculum design, significantly enhance the learning experience of international engineering students. Satisfaction with Learning Experience increased from 70% to 93% within 12 months, yielding statistically significant improvements ($H = 5.4$, $p = 0.020$, $d = 2.20$)—outstripping the literature benchmarks (Table 4). The 50:50 individual-group balance proved effective, while Organisation and Clarity, Teaching Quality, and Assessment themes remained stable; an optimal group size of five balanced diversity and productivity, with anonymous Canvas peer evaluation maintaining integrity and encouraging accountability. To illustrate the nature of the collaborative interventions implemented in this study, Coursework 2 comprised two group-based laboratory experiments conducted by teams of five students. In the Wind Turbine Design Experiment, teams designed, built, and tested a small-scale wind turbine model, analysing the relationship between blade geometry, rotational speed, and power output. In the Solar Water Heating Design Experiment, the same teams designed and evaluated a solar thermal collector system, calculating heat transfer efficiency and comparing theoretical and empirical performance data. Both experiments required submission of a joint technical report, with each student's individual contribution declared and anonymously peer-evaluated through Canvas. These tasks were directly aligned with the module's higher-order learning outcomes—specifically LO4 (applying sustainability principles to product redesign) and LO5 (specifying energy-efficient products)—ensuring that collaborative learning was not merely an engagement mechanism but a vehicle for assessed competency development.

These findings offer module-specific evidence on assessment reform in highly internationalised contexts. Collaborative assessments address challenges faced by students transitioning from teacher-centred systems, creating opportunities for intercultural communication, teamwork, and supportive environments. The differentiated model shows that lower-performing students benefit more than higher-achieving peers. While the single-module design limits generalisability, the international cohort provides broader relevance; the three-year timeframe, valuable for longitudinal analysis, is relatively short for sustained impacts. The data span (2020–2023) reflects a specific post-pandemic period, and while the pedagogical framework has continued to be applied beyond this window, future studies should extend the dataset to confirm sustained trends. The pedagogical framework offers replicable guidance for diverse contexts. Future research should explore transferability across disciplines, links between satisfaction and learning outcomes, and long-term career effects. Evidence supports mixed strategies for engineering with significant international enrolment: a 50:50 balance fosters inclusivity with rigour, requiring structured peer systems, clear guidelines, and faculty support.

A notable limitation of this study is its reliance on MEQ satisfaction data as the primary outcome measure, without direct integration of grade performance or project outcome indicators. While the module's summative assessments are explicitly aligned with accredited learning outcomes and PSBRs, ethical and institutional constraints precluded the use of individual grade data within the scope of this investigation. Future longitudinal studies should seek to triangulate MEQ satisfaction findings with performance-based measures—such as coursework scores, peer evaluation outcomes, and competency rubric results—to more robustly establish the causal links between mixed-assessment strategies and measurable learning gains in internationalised postgraduate engineering education.

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writing—original draft preparation, S.P.R.M., P.K. and E.B.; writing—review and editing, S.P.R.M., P.K. and E.B.; visualization, S.P.R.M., P.K. and E.B.; supervision, S.P.R.M.; project administration, S.P.R.M.; funding acquisition, S.P.R.M. All authors have read and agreed to the published version of the manuscript.

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Appendix A

Module Evaluation Questionnaire.

Module Report.

Level—7: postgraduate optional module.

Module title: Green Engineering and Energy Efficiency.

Q1. The module is well organised and is running smoothly.

Q2. It was made clear from the start what I was meant to learn in this module.

Q3. Staff are making the subject interesting.

Q4. Staff on this module are approachable.

Q5. The way the module is taught is helping me to learn.

Q6. The online and/or in-class learning materials for this module are supporting my learning.

Q7. There are opportunities for me to participate in learning activities throughout the module.

Q8. I am clear about what I am supposed to do for the assessment of this module.

Q9. The criteria used in marking have been made clear in advance.

Q10. Staff on this module supported me in preparing for assessment (chances to practice, helpful comments, advice on planning).

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