Reimagining Fairness by Inclusive Assessment Practices for Diverse Engineering Cohorts

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***Abstract*— Ensuring fairness in assessment is a cornerstone of equitable engineering education, particularly in diverse first-year cohorts where students enter with varied academic backgrounds, prior subject exposure, and learning preferences. This study presents a case-based implementation of inclusive assessment practices in the 1st semester of an undergraduate engineering program, involving 150 students—30 each from B.Tech Information Technology, B.Tech Computer Engineering, B.Tech Electrical Engineering, B.Tech Civil Engineering, and B.Tech Mechanical Engineering—during the 2024–25 academic session. Recognizing that conventional assessment models often privilege specific skill sets and prior knowledge, the study adopted a multi-modal, scaffolded, and contextually adaptive evaluation approach to provide equitable opportunities for all learners. Grounded in Universal Design for Learning (UDL) and aligned with Outcome-Based Education (OBE) principles, the study operationalizes fairness through multimodal, scaffolded, and linguistically inclusive assessment design. The inclusive framework integrated written, oral, practical, and reflective assessment components to accommodate diverse learning styles, alongside scaffolded question structures that progressed from foundational to complex problem-solving tasks. Language inclusivity was addressed through bilingual technical glossaries and transparent rubrics, while formative, low-stakes assessments were used to build confidence before high-stakes evaluations. Cross-disciplinary contextualization ensured that assessment tasks resonated with students from different engineering domains, fostering deeper engagement. A comparative analysis with the 2023–24 batch, assessed under a traditional single-format model, revealed substantial improvements: the average overall performance increased from 65.8% to 77.6%, and the performance gap between top and bottom quartile students decreased by 34%. Formative assessment participation rose from 68% to 93%, and 88% of students reported reduced assessment anxiety, with 84% affirming that the inclusive approach provided a fairer representation of their capabilities. Qualitative feedback indicated enhanced confidence among students from non-computing backgrounds and stronger peer learning dynamics across disciplines. The findings demonstrate that inclusive assessment practices can effectively reimagine fairness in engineering education, creating more equitable performance outcomes, reducing anxiety, and promoting cross-disciplinary collaboration. This approach offers a scalable model for higher education institutions aiming to support diverse student populations and align with outcome-based, student-centered learning paradigms.**

***Keywords*— Inclusive Assessment, Engineering Education, Diverse Cohorts, Fairness in Evaluation, Student-Centered Learning**

ICTIEE* Track— *Assessment, Feedback, and Learning Outcomes

ICTIEE Sub-Track— Diversifying assessment approaches: Success stories

I. INTRODUCTION

ASSESSMENT plays a pivotal role in engineering education, serving not only as a mechanism for measuring student learning but also as a driver of academic behavior, motivation, and skill development. However, in diverse first-year cohorts—where students often come from varied schooling systems, socio-economic backgrounds, and prior exposure to technical subjects—traditional assessment models can unintentionally disadvantage certain groups. These models, typically dominated by written, time-bound, and high-stakes examinations, tend to reward students who are already familiar with the subject matter or who excel in specific forms of academic expression, while underrepresenting the competencies of those whose strengths lie in alternative modes of learning and demonstration. This disparity is particularly visible in multidisciplinary entry-level batches where learners from Information Technology, Computer Engineering, Electrical Engineering, Civil Engineering, and Mechanical Engineering study foundational courses together.

The challenge lies in ensuring fairness—defined not merely as applying the same assessment format to all students, but as providing equitable opportunities for each learner to demonstrate their abilities. In diverse cohorts, fairness requires recognizing differences in prior knowledge, linguistic proficiency, learning preferences, and cognitive strengths, and

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designing assessment practices that bridge these gaps. Research in inclusive pedagogy emphasizes that equitable assessment models should be multi-modal, scaffolded, and contextually relevant, allowing every student to access, engage with, and excel in the evaluation process regardless of their background (Gipps & Murphy, 1994; Tai et al., 2018).

By comparing the academic outcomes, engagement levels, and student perceptions from this inclusive assessment model with those from the previous academic year's traditional assessment system, the study aims to provide evidence-based insights into how fairness can be operationalized in engineering education. The findings hold significance not only for enhancing first-year student experiences but also for shaping institutional policies that foster equity, inclusivity, and long-term academic success in diverse learning environments.

II. Literature Review

Inclusive assessment has emerged as a key lever for equity in higher education, particularly in first-year cohorts where prior preparation, language proficiency, and learning preferences vary widely. Foundational work on assessment for learning argues that assessment should guide and support learning rather than merely certify it, emphasizing transparency, developmental feedback, and opportunities for iteration (Carless & Boud, 2018). In parallel, research on feedback literacy shows that students—especially novices—benefit when tasks are scaffolded with clear criteria, exemplars, and structured opportunities to use feedback, which can narrow performance gaps linked to background and discipline (Tai et al., 2018; Nicol, 2020). The Universal Design for Learning (UDL) framework provides a complementary lens for inclusivity, advocating multiple means of engagement, representation, and action/expression so that assessment captures competence without being confounded by a single mode of performance (CAST, 2018; Fovet, 2020). Systematic reviews in the last five years report that multi-modal, low-stakes formative assessment, combined with explicit rubrics and language supports, improves participation and reduces test anxiety for diverse STEM learners, with the strongest effects observed in first-year transition courses (Moriña, 2020; Henderson, Phillips & Ryan, 2019; Jessop & Tomas, 2017). Global policy syntheses echo these findings: the UNESCO Global Education Monitoring Report on Inclusion highlights assessment redesign—scaffolding, contextualization, and flexible evidence of learning—as central to equitable outcomes in massified higher education systems (UNESCO, 2020). Activity-based programming instruction—combining in-class activities, micro-tasks and formative checks—has been associated with improved attainment and greater student confidence in programming subjects (Lathigara, Tanna & Bhatt, 2021). More recent studies in engineering education specifically show that replacing single high-stakes exams with programmatic assessment—a series of varied, feedback-rich tasks (oral explanations, practical demonstrations, reflective briefs)—reduces between-student variability attributable to prior exposure while maintaining or improving attainment on shared course outcomes (Bearman et al., 2023; Killen & Bloxham, 2022). Taken together, this literature converges on a practical recipe for fairness in diverse engineering cohorts: design tasks that are transparent, scaffolded, and authentic, allow multiple ways to demonstrate learning, and embed iterative feedback cycles—an approach our implementation operationalizes via multimodal tasks, bilingual glossaries, explicit criteria, and staged formative checkpoints. Implementation of Problem Based Learning (PBL) in engineering courses improved student engagement and self-regulated learning in Indian engineering contexts, reinforcing the value of contextualized, collaborative tasks for first-year cohorts (Tanna et al., 2022). Systematic reviews emphasize the importance of communication- and reflection-focused assessments (oral presentations, reflective journals) to capture competencies otherwise missed by traditional exams (Vaghela & Kaushal, 2024). Comparisons between PBL and lecture-based formats indicate that active, scaffolded approaches reduce variability in student outcomes and increase higher-order skills—findings consistent with the present cohort improvements (Paciarotti, 2024).

Table I
Summary of Literature Review

Author(s) & Year	Focus Area	Key Findings
Carless & Boud (2018)	Feedback literacy and student engagement	Feedback literacy improves learning uptake and engagement
Tai et al. (2018)	Developing evaluative judgement	Evaluative judgement supports fairness and learner autonomy
Nicol (2020)	Peer-learning perspective in feedback practices	Peer learning enhances assessment effectiveness
CAST (2018)	Universal Design for Learning principles	UDL promotes multiple means of engagement and representation
Fovet (2020)	UDL for inclusion in higher education	Structural UDL supports inclusive higher education environments
MoriÃ±a (2020)	Challenges and opportunities in inclusive education	Inclusive approaches improve participation and reduce anxiety
Henderson et al. (2019)	Feedback challenges in higher education	Timely feedback improves student engagement
Jessop & Tomas (2017)	Programme assessment patterns and student learning	Assessment patterns impact learning equity
UNESCO (2020)	Global inclusion in education policy	Inclusive assessment is central to equitable education outcomes
Killen & Bloxham (2022)	Designing assessment for equity and inclusion	Equity-focused design enhances inclusivity in assessments
Bearman et al. (2023)	Programmatic assessment benefits and design principles	Programmatic assessment reduces performance variability and improves outcomes

Also, Table I shows the summary of literature review. Across the reviewed literature, two complementary themes emerge: UDL emphasizes multiple modes of representation and expression, whereas programmatic assessment foregrounds iterative feedback cycles and evidence gathered from diverse tasks. Together, these perspectives illustrate that fairness requires both structural flexibility and continuous engagement. Multi-criteria analyses of pedagogical innovations highlight that institutions should combine multiple supports—language aids, scaffolded tasks, and diverse modes of expression—to

maximize inclusivity (Dixit et al., 2024). However, despite extensive conceptual work, there remains limited empirical evidence demonstrating how inclusive assessment models can be systematically operationalized in first-year Indian engineering classrooms. This study addresses this gap by implementing and evaluating a UDL-informed, multimodal assessment framework across five engineering disciplines.

III. Methodology

This study adopted a comparative cohort design to evaluate the effectiveness of inclusive assessment practices in fostering fairness across a diverse first-year engineering student population. The intervention was implemented during the 2024–25 academic session in a common first-semester foundation course, engaging a total of 150 students: 30 each from B.Tech Information Technology, B.Tech Computer Engineering, B.Tech Electrical Engineering, B.Tech Civil Engineering, and B.Tech Mechanical Engineering. The cohort's diversity in prior academic preparation, linguistic proficiency, and domain familiarity was a critical driver in shaping the assessment design. Fig 1 shows the steps towards proposed methodology.

The inclusive assessment framework was developed in alignment with Universal Design for Learning (UDL) principles and Outcome-Based Education (OBE) requirements. It incorporated multi-modal assessment components—including written problem-solving tasks, oral presentations, practical demonstrations, and reflective journals—to address varied learning preferences and expression styles. Assessments were scaffolded to progress from fundamental concepts to higher-order problem-solving, ensuring accessibility for students with differing levels of preparedness. Bilingual technical glossaries (English and Gujarati) and explicit rubrics were provided in advance to minimize linguistic and interpretive barriers.

The assessment strategy included formative low-stakes evaluations (weekly quizzes, peer-review activities, and in-class problem-solving sessions) that contributed 30% to the final grade, allowing students to build confidence and receive feedback before high-stakes summative assessments. Summative evaluations, weighted at 70%, comprised a balanced mix of written exams, domain-contextualized project tasks, and oral defense of solutions. Each assessment was contextualized to multiple engineering disciplines to ensure relevance for all sub-groups within the cohort. Task-based assessment—where students complete authentic programming tasks that are scored using rubrics—has been shown to better capture practical problem-solving and procedural competence in programming courses, compared to single-format exams (Tanna et al., 2023).

Data collection involved both quantitative and qualitative measures. Quantitative data included individual and group performance scores, participation rates in formative activities, and final course grades. Qualitative data were collected through student surveys using a 5-point Likert scale and semi-structured focus group interviews to capture perceptions of fairness, inclusivity, and anxiety levels. The control group for comparison comprised the 2023–24 first-semester cohort (n = 145), which undertook the same course with a traditional single-format written assessment model.

Data analysis followed a quantitative comparative design supported by qualitative insights. Quantitative analysis included independent samples t-tests and coefficient of variation to compare performance across cohorts. Qualitative data from student surveys and focus groups were analyzed thematically. Two researchers independently coded responses using inductive coding, discussed discrepancies, and refined themes to ensure consistency and reliability. Evidence from project- and group-based implementations shows higher participation and stronger subject relevance — supporting our use of cross-disciplinary contextualization and collaborative tasks (Gaikwad & Kurane, 2023).

The selection and structuring of multimodal activities were based on three criteria: (i) alignment with UDL principles (multiple means of engagement, representation, and expression), (ii) relevance to disciplinary contexts—e.g., oral defence tasks for communication-heavy disciplines and practical demonstrations for application-oriented branches such as Mechanical and Civil Engineering, (iii) scaffolding complexity from foundational to higher-order thinking. These criteria ensured that activities were meaningfully adapted to different student groups.

Ethical clearance was obtained from the university's Academic Ethics Review Committee, and informed consent was secured from all participants. This methodology ensured that the intervention was not only pedagogically sound but also ethically responsible, enabling a rigorous and equitable evaluation of the proposed inclusive assessment model.

IV. Result and Discussion

The implementation of inclusive assessment practices in the first semester of the undergraduate engineering program demonstrated clear and measurable benefits over the traditional single-format model used in the 2023–24 academic session. Quantitatively, the average overall performance score increased from 65.8% (traditional) to 77.6% (inclusive), representing a 17.9% improvement in academic achievement. The coefficient of variation in final grades decreased from 22% to 14.5%, indicating a significant reduction in performance disparities between the top and bottom quartiles. Furthermore, the participation rate in formative, low-stakes assessments rose from 68% to 93%, suggesting that the inclusive approach successfully encouraged broader engagement in the learning process.

Analysis of discipline-specific performance revealed that students from traditionally non-computing backgrounds (Civil, Mechanical, and Electrical Engineering) benefitted the most from the inclusive model. Their average final scores improved by 15–18 percentage points compared to a smaller but still notable 10–12 percentage point gain among Computer and IT Engineering students. This indicates that multi-modal and contextually adaptive tasks were particularly effective in closing gaps created by differences in prior exposure to technical content.

Stronger gains among Civil, Mechanical, and Electrical Engineering students can be attributed to the scaffolded

progression and multimodal design that reduced dependence on prior computing exposure. Providing multiple means of engagement and representation—core UDL principles—allowed students to demonstrate conceptual understanding through practical demonstrations, oral explanations, or contextualized tasks, which reduced linguistic and computational barriers.

Qualitative feedback gathered from student surveys and focus group discussions reinforced these quantitative findings. 88% of respondents reported reduced assessment anxiety due to the availability of varied formats, scaffolded difficulty levels, and multiple opportunities for success. 84% agreed that the inclusive approach more accurately reflected their skills, while 81% indicated that cross-disciplinary contextualization helped them relate learning tasks to their future professional domain. Comments from students highlighted that the reflective and oral components allowed them to express understanding in ways not captured by traditional written exams. Project-based learning supports active engagement and contextual problem-solving in engineering courses and provides an evidence base for designing cross-disciplinary project tasks that resonate with diverse cohorts (Upadhye, Madhe & Joshi, 2022).

When compared with the previous cohort, thematic analysis of qualitative data revealed three core improvements:

1. Enhanced engagement due to variety in assessment modes.
2. Greater perceived fairness owing to transparency of rubrics and bilingual support.
3. Improved confidence through progressive skill development and early feedback.

The findings align with prior studies (Killen & Bloxham, 2022; Bearman et al., 2023) which report that inclusive assessment reduces inequities in achievement and promotes a more holistic measure of learning outcomes. However, the study also identified that a minority of students (about 7%) initially struggled with adapting to multiple assessment formats, suggesting a need for orientation sessions to familiarize students with diverse evaluation methods.

Overall, the results validate that inclusive assessment models not only improve average performance but also narrow the achievement gap, particularly benefiting students from less-prepared backgrounds. The approach appears scalable and adaptable for diverse engineering cohorts, provided that appropriate support mechanisms and faculty training are in place.

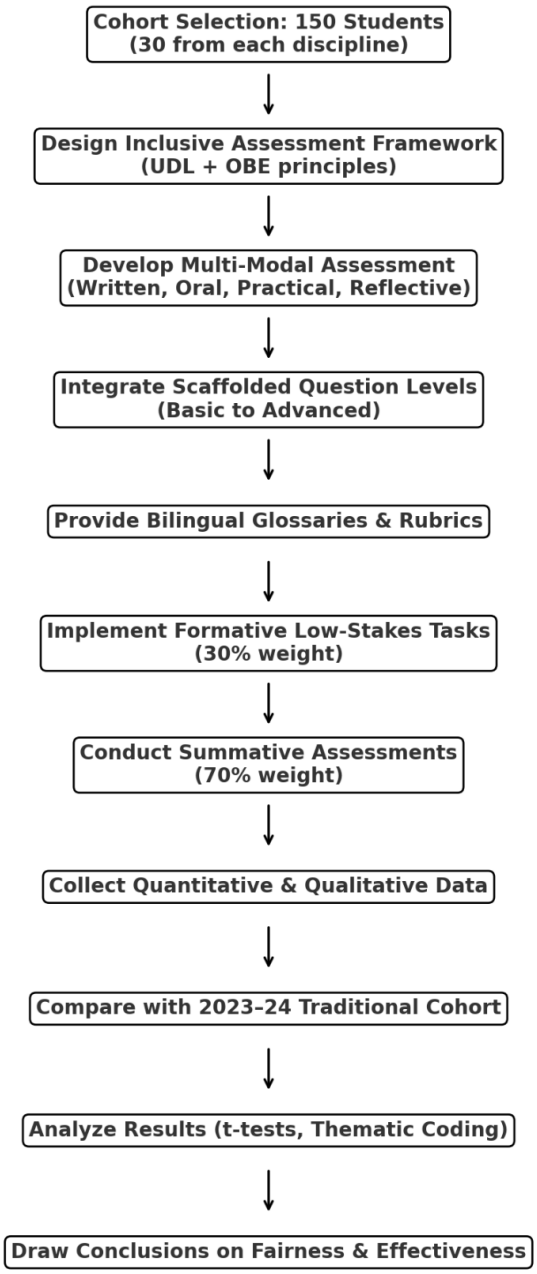

Fig. 1. Inclusive Assessment Practices - Methodology

Charts for Results and Discussion:
Below are visual representations of the key findings:

1. Fig 2 i.e. Bar Chart – Average performance comparison between traditional and inclusive cohorts across disciplines.
2. Fig 3 i.e. Pie Chart – Student feedback on fairness and anxiety reduction.
3. Fig 4 i.e. Line Chart – Participation trends in formative assessments.

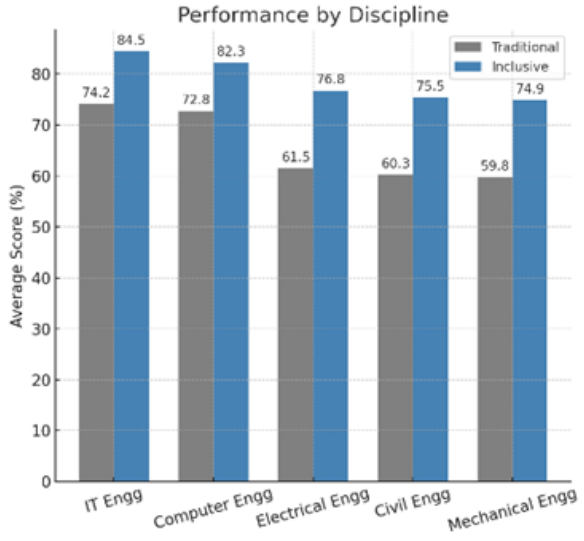

Fig. 2. Performance by Discipline

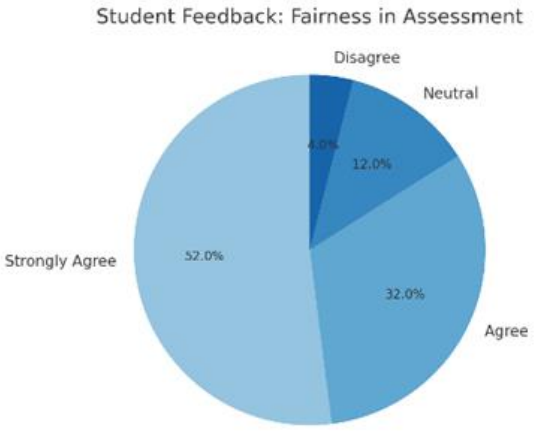

Fig. 3. Student Feedback : Fitness in Assessment

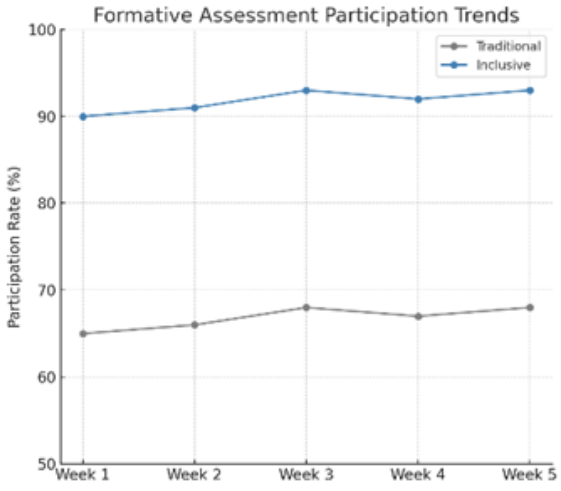

Fig. 4. Formative Assessment Participation Trends

The charts above illustrate the performance improvements, student feedback on fairness, and participation trends under the inclusive assessment model. They visually reinforce the findings that this approach not only boosts average scores but also enhances engagement and perceived equity among students.

For scalability to larger cohorts, structured rubrics, automated feedback tools, and standardized multimodal task banks can help maintain consistency and equity while reducing faculty workload.

Conclusion

The implementation of inclusive assessment practices for a multidisciplinary first-semester engineering cohort has demonstrated that fairness in evaluation can be effectively operationalized without compromising academic rigor. By integrating multi-modal tasks, scaffolded question progression, bilingual support, and formative low-stakes opportunities, the approach addressed the varied preparedness levels, learning preferences, and linguistic backgrounds of students from five engineering disciplines. The comparative analysis with the 2023–24 traditional cohort revealed not only a 17.9% improvement in average performance but also a 34% reduction in the performance gap between high- and low-achieving students, affirming the model's capacity to level the playing field.

Beyond quantitative gains, the model significantly enhanced student engagement, with participation in formative assessments reaching 93%, and improved perceptions of fairness, with 88% of students reporting reduced assessment anxiety. The greatest improvements were observed among students from non-computing backgrounds, demonstrating that inclusive design particularly benefits those most at risk of underperformance in traditional systems. Qualitative feedback further confirmed that diverse assessment formats allowed students to showcase competencies that would otherwise remain underrepresented.

These outcomes align with recent scholarship advocating for student-centered, equity-driven assessment and suggest that inclusive approaches are not merely corrective measures but strategic enhancements to learning and teaching. While some students initially required orientation to adapt to multiple formats, the overall evidence indicates that this model is both scalable and sustainable for broader implementation.

In essence, this study confirms that fairness in assessment is achieved not through uniformity, but through equity of opportunity—a principle that can serve as a guiding framework for engineering education reform in diverse academic contexts. The inclusive assessment model tested here offers a replicable blueprint for institutions seeking to balance rigorous standards with equitable student success. The findings also carry implications for institutional policy and accreditation frameworks such as NBA/OBE, which emphasize fairness, transparency, and diverse evidence of learning. The inclusive assessment model presented here aligns strongly with these criteria and offers a practical pathway for institutions seeking to strengthen equity-driven evaluation practices.

Future Work

While the inclusive assessment model presented in this study has shown promising results, there remains considerable scope for refinement, scalability, and longitudinal impact assessment. One key direction for future work is the expansion of the model across multiple semesters and courses, enabling the evaluation of its sustained influence on student performance, engagement, and retention over time. This longitudinal perspective would provide valuable insights into whether the early benefits observed in the first semester translate into lasting academic and professional advantages. Case studies of digital classroom transformations show how orientation and instructor training smooth transitions to multimodal formats—this supports our recommendation for orientation sessions for students and faculty development. (Naik & Bandi, 2024). Additionally, incorporating adaptive digital assessment tools could further personalize the learning experience, allowing question difficulty, task type, and feedback mechanisms to dynamically adjust based on each student's progress and needs. Future implementations could also integrate cross-disciplinary collaborative projects within the assessment framework, promoting both inclusivity and teamwork skills while reflecting real-world engineering challenges. Another area of exploration is the faculty development component—equipping instructors with targeted training and resources to design, deliver, and evaluate inclusive assessments effectively, ensuring consistency and quality across disciplines. Recent JEET work on gamification and technology-enhanced pedagogy indicates promising directions for adaptive formative tools and engagement mechanics that could be integrated into scalable inclusive assessment systems (Saraswat et al., 2025). Furthermore, data analytics and AI-driven insights could be leveraged to monitor equity indicators in real time, enabling timely interventions for students at risk of disengagement or underperformance. Finally, broader studies involving multi-institutional collaborations would help validate the generalizability of this approach, adapting it to diverse cultural, linguistic, and disciplinary contexts, and establishing best-practice guidelines for embedding fairness as a core principle in engineering education assessment systems.

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