Gauging the Gears: Student Perception of Formative Assessment in Engineering Education-

Kartik Ramesh Patel[1]
[1]K J Somaiya School of Engineering (formerly known as K J Somaiya College of Engineering),
Somaiya Vidyavihar University, Mumbai
[1] kartik@somaiya.edu

***Abstract*— Formative assessment (FA) is a cornerstone of effective pedagogy, intended to monitor student learning and provide ongoing feedback. However, its successful implementation in engineering education hinges significantly on student perception and engagement. This paper presents a comprehensive study on the perceptions of undergraduate engineering students towards various formative assessment techniques. It investigates how students perceive the implementation of these methods, the challenges they face, and their preferences for feedback. A mixed-methods approach, employing surveys and focus group discussion, was used to gather data from 100 undergraduate Electronics and Telecommunication Engineering students. The results indicate a generally positive perception of FA, particularly its role in clarifying complex concepts and preparing for summative evaluations. However, significant challenges were identified, including inconsistent implementation by faculty, feedback that is often delayed or lacks actionable details, and increased workload. The study reveals a disconnect between the intended purpose of FA and its practical execution from the students' viewpoint. Based on these findings, the paper proposes a strategic pathway for educators and institutions to enhance the effectiveness of formative assessment, fostering a more interactive and supportive learning environment in engineering disciplines. This roadmap emphasises faculty training, integration of technology for timely feedback, and co-creation of assessment strategies with students.**

***Keywords*— active learning, assessment challenges, engineering education, formative assessment, student perception**

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

ICTIEE Sub-Track— Enhancing Student Performance through Formative Feedback

I. INTRODUCTION

THE landscape of engineering education is continuously evolving, driven by the need to cultivate graduates who are not only technically proficient but also possess critical thinking, problem-solving and lifelong learning skills. In this context, assessment practices have shifted from a purely summative focus (measuring what has been learned) to an integrated approach that includes formative assessment (FA)-assessment for learning. The goal of FA is to provide real-time feedback to both instructors and students to guide and improve the ongoing teaching learning process (Black et al., 2018). Techniques such as quizzes, concept maps, peer reviews, and minute papers are designed to identify learning gaps and misconceptions early on.

Despite the well-documented pedagogical benefits of FA, its efficacy is deeply intertwined with how it is perceived and experienced by students (Johnson et al., 2022). If students view formative assessment merely as an additional, upgraded workload or if the feedback provided is not timely or constructive, the intended benefits are lost (Turan et al., 2025). In the demanding and curriculum-heavy domain of engineering, understanding the student perspective is paramount for successful integration of these valuable pedagogical tools. This study, therefore, aims to explore the perceptions of undergraduate engineering students regarding the use for formative assessment. It seeks to identify the nuances of its implementation, uncover the principal challenges faced by students (Careless et al., 2018), and ultimately, purpose a practical pathway for its enhancement in engineering programs.

The pedagogical promise of FA is not guaranteed simply by its implementation. Its success is critically dependent on a factor often overlooked in the high-pressure environment of engineering curricula: student perception. If student view these valuable learning tools as mere busywork, an additional source of stress, or a series of hoops to jump through, their formative potential is lost. This is particularly salient in engineering programs, where a demanding workload and a performance-driven culture can lead students to perceive every task through a summative lens (O'Malley et al., 2024).

This experience report addresses this critical gap, it moves beyond the theoretical benefits of FA to investigate the ground reality of its implementation from the perspective of undergraduate engineering students. By systematically "gauging the gears" of student perception, this study aims to identify the primary challenges they face, understand their preferences for feedback, and synthesize these findings in to a practical, actionable roadmap for educators and administrators. This paper, therefore, provides a student-centric analysis intended to help institutions refine their assessment strategies to better foster the development of competent and self-regulated future engineers.

Annual Status of Education Report (ASER)- 2023 was conducted for foundational and applied skills of youth aged 14-18 in rural India and it was found that 43.3% of youth could solve applied functional division problems; tracked by "learning by doing" capabilities (ASER, 2023). The report presented by FICCI-EY Parthenon AI adoption survey 2025 highlights that 57% of HEIs have AI policies; 86% of students use AI for active tasks like problem solving. (Tomar A., 2025). Authors (Gupta B. et al., 2024) presents a survey of 617 faculty members across Indian technical institutes regarding barriers to PBL implementation and found that institutional barriers (lack of autonomy, curriculum rigidity) are primary hurdles despite high faculty interest.

The rest of this paper is structured as follows. Section II describes literature survey. Section III presents implementation plan. Section IV describes research method with research instrument and sample size. Results and related discussions are presented in section V and section VI concludes the paper.

II. Literature Survey

The body of research on formative assessment in higher education is extensive. This review synthesizes recent literature focusing on four key areas: the established value of FA, the role of student perception and feedback literacy, specific implementation challenges in engineering, and the mediating role of technology.

A. The Established value of Formative Assessment

The consensus in educational research is that well-implemented FA positively correlates with student learning outcomes. (Black et al., 2018) foundational work continues to be validated, with recent studies confirming that regular, low-stakes assessment can reduce student anxiety, increase engagement, and lead to better performance on summative evaluations. Analysis by (Santos et al., 2023) found that engineering students who engaged in weekly formative quizzes demonstrated a 15% average improvement in final exam scores compared to control groups (Winstone, 2022) The feedback generated from these activities is the "active ingredient", enabling students to identify and correct misconceptions before they become ingrained (Al-ababneh, 2020).

B. Student Perception and Feedback Literacy

While the benefits are clear, recent scholarship emphasizes that these benefits are not automatic. The effectiveness of FA is heavily mediated by how students perceive and use the feedback they receive (Sutton et al., 2024). The concept of "feedback literacy"- defined by (Gupta et al., 2022) as the "understandings, capacities and dispositions needed to make sense of information and use it to enhance work or learning strategies"- is central to this discussion (Evans, 2023). Research by authors in (Pater, 2021) highlights a common "perception gap", where instructors provide rich, formative comments, but students, conditioned by a grade-focused culture, only look at the marks. A study by (Henderson et al., 2019) in a civil engineering program found that student often dismissed ungraded peer feedback as unreliable, thereby nullifying its potential benefits. These findings underscore that the student is not passive recipient but an active agent whose beliefs and attitude determine the ultimate impact of any formative practice. Students need feedback in timely manner. They need to assimilate feedback before moving on and need to receive it before next assessment is due (Zhang T, et al., 2025).

C. Implementation Challenges in Engineering Education

Translating FA into theory into practice within engineering programs presents unique and significant challenges. The most cited barrier is faculty workload, especially in large foundational courses (Al-Ababneh, 2020), (Garcia et al., 2022). Providing timely, detailed, and personalized feedback to over one hundred students is logistical impossibility for many instructors. In the field of education, and particularly in graduate programs, formative assessment has emerged as a key practice for fostering deep and meaningful learning. (Spector J.M et al., 2025). A 2022 survey of engineering faculty reveled that while 90% believed the value of FA, less than 30% felt they had the time and resources to implement it effectively (Yan et al., 2021). Furthermore, the packed and highly technical nature of the engineering curriculum can lead to "assessment fatigue", where students feel overwhelmed by a constant stream of tasks, diminishing the value of each (Winstone, 2022).

D. Technology as Mediator

In response to these challenges, many institutions have turned to technology. Digital platforms now offer automated grading for quizzes, sophisticated peer-review management systems, and learning analytics dashboards that can provide students with instant feedback (Lee et al., 2023). A massive Open Online learning course (MOOCs) are considerably different from traditional classroom and integrates technology enhanced learning for students with examples and problems. (Zheng et al., 2020). Authors (Kumar et al., 2025) presents usage of a coding auto-grader found it significantly improved students' debugging skills through immediate, iterative feedback. However technology is not a panacea. Research also points to the impersonal nature of automated feedback, the potential for technical glitches, and the risk that poorly designed online tools can simply amplify bad pedagogical practices (Lee et al., 2023)., (Gupta et al., 2022). The consensus is that technology is a powerful enabler, but it must be thoughtfully integrated into a sound pedagogical framework, not used as a replacement for it.

The review reveals that while the "what" and "why" of formative assessment are well understood, the "how"- especially a "how" that is sensitive to the engineering student's perspective and the program's structural constraints- remains a critical area for investigation. This paper contributes to this need by synthesizing these themes through an empirical study of student experiences to build a practical roadmap for improvement.

III. IMPLEMENTATION

Fig. 1 below depicts assessment model of a course which consists of theory continuous assessment and laboratory continuous assessment having equal weightage of 50%. Various methods that are implemented as formative assessment for laboratory sessions and theory are mentioned. As highlighted the role of faculty member is crucial in planning and implementation of the formative assessment. Challenges faced by teachers and students are discussed in the later part of the paper.

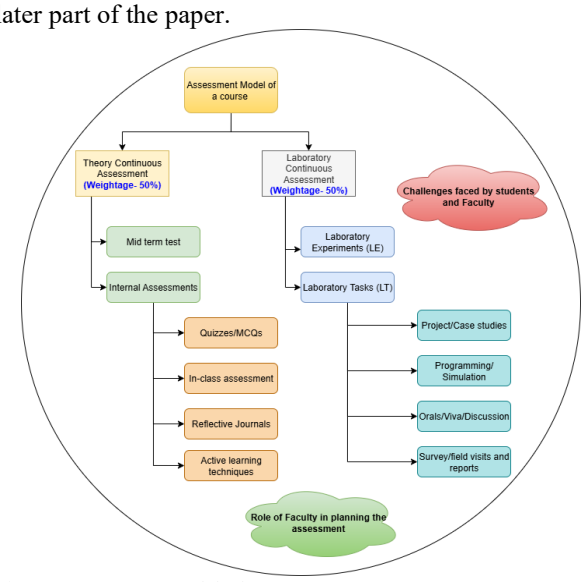

Fig. 1. Assessment model of a course

The implementation plan covers the three courses of three different semesters for undergraduate electronics and telecommunication engineering students. Depending on the course type the formative assessments are conducted in live classroom, interactive simulation platforms (Network Simulator), programming platforms (MATLAB), digital tools (poll) and online collaborative platforms (learning management system). The analog communication course (ACOM) is in semester-IV, Digital communication course (DCOM) is in semester-V and Wireless communication course (WCOM) is in semester-VI. For all the courses one laboratory and one theory sessions were spent to give the task related to simulation based assessment, online quizzes, interactive coding assignments, online discussion forums. Some of the activities were part of the regular laboratory experiments. The students were informed about the assessment scheme, evaluation rubrics in at the beginning of the semester in the prescribed format.

If the assessment is a part of laboratory experiment (such as interactive coding assignment, wireless network simulation) then each experiment is evaluated out of 25 marks. These marks are distributed as performance of experiments (8 marks), recording observations and presenting write-up (8 marks), writing valid conclusion (4 marks), interaction in the laboratory with teacher (3 marks) and timely submission of the experiment (2 marks).

A. Analog Communication Course (ACOM)

1) Online Quizzes (Multiple Choice and Short Answer Questions)

These questions are given to the students live in the classroom using Google chat poll and Google form. Students can practice applying formulas, conceptualizing key differences, and revisiting foundational theories of modulation.

2) Simulation-based Assessment (MATLAB Simulation)

Such assessment provides hands-on experience with digital representation of analog concepts, helping students understand the practice implications of modulation techniques.

3) Conceptual Mapping

Students create a conceptual map showing relationship between various analog modulation techniques, encourages collaboration and understanding of comparative aspects of modulation methods.

B. Digital Communication Course (DCOM)

1) Interactive Coding Assignments (MATLAB)

Student should write program of line coding, source coding, promotes programming skills, reinforces theoretical knowledge of error correction, and provides practical application.

2) Online Discussion Forum (Interactive collaboration)

Encourages active learning through peer-to-peer engagement and provides real-time interaction and feedback.

C. Wireless Communication Course (WCOM)

1) Real-Time Online Polls/Quizzes

It reinforces learning of key wireless communication concepts such as signal loss and interference in real-time scenarios.

2) Wireless Channel simulation (Using NetSim)

It demonstrates the practical importance of diversity techniques in improving signal robustness in wireless communication systems.

As described in Fig.1 equal weightage is given to formative assessment (continuous assessment) and summative assessment (end semester examination). Because of equal weightage 50% FA and 50% SE more assessments are conducted throughout the semester in the theory as well in the laboratory sessions. This will not only increase number of assessment per course for the students but also increases the workload of the faculty in designing the assessment for theory sessions, ensuring that same questions and method should not repeat for the laboratory session assessment. In this workload the assessments are not conducted on time, the papers are not assessed and the constructive feedback is not provided to the students on time which is the main aim of the formative assessment. Various challenges faced by the students and teachers are presented in Table I and II respectively.

TABLE I
SUMMARY OF CHALLENGES FACED BY STUDENTS

Category	Challenge	Impact
Increases Workload and Stress	Required to balance formative assessment across multiple courses (on an average five courses per semester)	Stress: Continuous presser of assessment Time management issues
Difficulty in Prioritizing	Prioritizing the assessment, type of assessment	Missed deadlines, focus shifting
Cognitive load from diverse type of assessment	Multiple type of assessment across different courses and understanding method and then attempting	Mental Fatigue, Learning Gaps
Inconsistent feedback loops	Feedback is not in timely or clear	Delayed improvements, feedback overload
Increases pressure from formative assessments impacting summative exams	Student need to continually perform at high level across semester	Summative exam pressure, long-term retention issues

TABLE II
SUMMARY OF CHALLENGES FACED BY TEACHERS

Category	Challenge	Impact
Increases grading and feedback load	Grading multiple types of formative assessment	Time constraints, delayed feedback
Balancing formative and summative assessment task	Repetition of questions, type of assessment	Planning complexity, Cognitive load
Difficulty in maintaining objectivity and fairness	Ensuring formative assessments are fair, unbiased, and consistent	Bias in grading, perceived inconsistencies
Technological challenged in implementing Digital FA	Technological issues, literacy	Technical problem, faculty training
Aligning formative assessment with curriculum goals	Assessment should be aligned with learning objectives and overall curriculum goals	Curriculum FA disconnect, course redesign

IV. RESEARCH METHOD

Fig.2 below describes research methodology used for this study which is based on research questions, and instruments such as survey questions, semi-structured interviews, and informal discussion with faculty members. Interviews are conducted in the laboratory sessions having average batch size of 20 students.

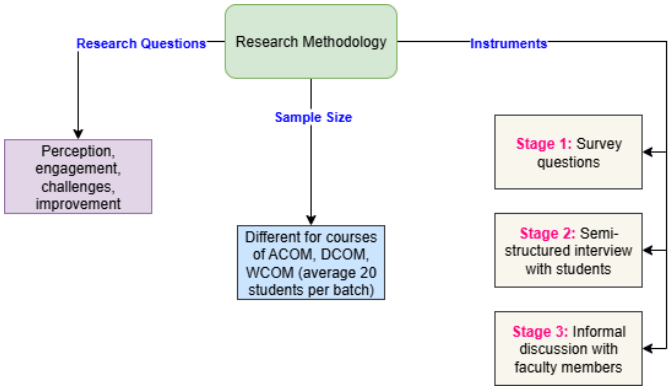

Fig. 2. Research Methodology

A. Research Questions

RQ1: How to undergraduate engineering students perceive formative assessment in terms of its relevance and effectiveness?

RQ2: What challenges are encountered in the implementation of formative assessment from both student and instructor perspectives?

RQ3: How does formative assessment influence student engagement and learning outcomes in engineering courses?

RQ4: What strategies or pathways can improve the design, implementation, and impact of formative assessment in engineering education?

B. Sample

The study involved a cohort of 100 second-and third-year students from the Electronic and Telecommunication Engineering program during the 2023-2024 and 2024-2025 academic years. The sample included both male and female students, aged between 18 and 20 years, representing a range of academic performance levels based on their previous semester grades. Participants varied in their prior experience with programming platforms used for formative assessment: some were familiar with these tools, while for others, it was their first exposure. Prior to their participation students were fully informed about the study's objectives and consent was obtained. Participation in both survey and semi-structured interviews was entirely voluntary, with no impact on their academic grades or standing. To ensure confidentiality, all collected data was anonymized.

.

C. Instruments

The research questions outlined in the previous section were evaluated using variety of data collection instruments, including student surveys, semi-structured interviews, faculty discussions, classroom observations, and collaborative discussions. Data was collected online via Google Forms, capturing student perceptions of formative assessment (FA). Additionally, faculty members were engaged in discussion regarding the challenges they face in implementing FA and strategies for improving its effectiveness. Quantitative data were analyzed using descriptive statistics to identify patterns and trends. The implementation of FA across various courses included the use of different platforms and assessment types, such as weekly quizzes, weekly tests, in-class assessments, short reflective assignments, and laboratory tasks, designed to measure student engagement and learning outcomes in real-time. Questions that were asked in the survey and semi-structured interview are given below relating each research questions.

1. How relevant do you feel formative assessments are to the course learning objectives? (RQ1)
2. To what extent do formative assessments help you understand the core concepts of your course? (RQ1)
3. Formative assessment help identify my strengths and

weakness in the subject (RQ1)
4. Formative assessments help me retain knowledge for a longer duration (RQ1)
5. What difficulties do you face in completing formative assessments (e.g. time management, clarity, resources?) (RQ2)
6. Do you feel any anxiety or stress associated with formative assessments? If so, can you elaborate? (RQ2)
7. How useful is the feedback provided in formative assessment for your learning? (RQ2)
8. What improvements would you suggest to make formative assessments more effective or less challenging?
9. Formative assessments motivate me to spend more time studying and understanding course concepts. (RQ3)
10. Formative assessments encourage me to think critically and solve problems more effectively. (RQ3)
11. Which type of formative assessment (quizzes, lab exercises, assignments, projects) do you find most effective in enhancing your learning, and why? (RQ3)
12. Formative assessment should be designed to align more closely with learning objectives and real-world applications. (RQ4)
13. The inclusion of technology-based assessments (simulations, virtual labs, programming) can improve engagement and learning. (RQ4)
14. Institutional support (training, workshops, resources, courses) for faculty members would improve the quality of formative assessments. (RQ4)
15. How can instructors better design formative assessments to maximize learning and engagement? (RQ4)

V. Results and Discussion

To know the perception of the students and the research questions were evaluated through feedback surveys using a 5-point Likert scale, and semi-structured interview was conducted with student with open ended questions to discuss about the challenges they faced. Informal discussion with faculty member is carried out to know the challenges they are facing in implementing the formative assessment. The results are presented in this section.

1. RQ1: How to undergraduate engineering students perceive formative assessment in terms of its relevance and effectiveness?

A. Students Perception for Formative Assessment (RQ1)

1) Response of survey questions

The response of the feedback questions from the student are show in Table-III below. From the response trend it is observed that students are positive towards formative assessment and 88.8% students strongly agree that formative assessment helps them to understand the core concepts.

TABLE III
Response of Students Perception on Formative Assessment

Students Perception on Formative Assessment Questions	Strongly Agree (%)	Agree (%)	Neutral (%)	Partially Agree (%)	Disagree (%)
I feel formative assessments relevant to course learning objectives	78.3	16.4	4.3	1	0
Formative assessment help me to understand the core concepts	88.4	8.4	3.2	0	0
Formative assessment help me to identify my strengths and weakness in the subject	75.4	18.2	4.2	1.7	0.5
Formative assessment help me to retain knowledge for a longer duration	79.2	10.4	3.4	4.4	2.6
Technology/programming based formative assessments are good for engagement	90.7	5.4	3.1	0.7	0.1

2) Semi-structured interview response

In response to the interview question "How relevant do you feel formative assessment for course learning objective and help to understand core concepts?" Students replied as follow:

1. Student 1: The internal assessment tests which were conducted for us in the communication system (ACOM) course were innovative; we have never attempted such tests in our previous semester. This way of keeping assessment not only makes our concept clear but encourages us to study the concepts in detail. The assessment planned was in line with the course objective and parallel conducted in theory and laboratory session which helped us to gain practical concepts also.
2. Student 9: The assessment test on interactive simulation platform (Netsim) for wireless communication course (WCOM) was engaging as it is drag and drop environment we could visualize the entire network, its design. The assessment test was on changing parameters and observes its effect on the output and reflects on our understanding.
3. Student 16: MATLAB based assessment on writing reflection from constellation diagram helped me in understanding the modulation type, effect of signal to noise ratio. The test was aligned with the learning objective mentioned in the syllabus. Use of such tool for the assessment is great idea. Such visualization of constellation diagram and change of it with real time parameters help me to retain the concepts for long duration.

2. RQ2: What challenges are encountered in the implementation of formative assessment from both student and instructor perspectives?

B. Challenges faced by the Students and Faculty (RQ2)

1) Response of survey questions

The response of the feedback questions from the student are show in Table-IV below. From the response it is clear that 88.3 % students agrees that managing time in the assessment is difficult and use of different platform for different courses are confusing.

TABLE IV

RESPONSE OF CHALLENGES FACED BY STUDENTS

Challenges faced by students					
Questions	Strongly Agree (%)	Agree (%)	Neutral (%)	Partially Agree (%)	Disagree (%)
I find difficult in managing time of assessment, understanding of task	88.3	5.5	3.2	3	0
I feel anxiety/stress during formative assessment	47.3	2.3	3.5	20.4	26.5
Formative assessment provides quick feedback on my learning	96.4	3.1	0.5	0	0
Use of different platforms for different courses are confusing for the assessment	85.3	9.4	3.2	1	1.1
Back to back assessment in week is difficult for us to balance the academic workload	96.2	2.2	1.2	0.3	0.1

2) Semi-structured interview response with students

In response to the question "What difficulties you face in completing formative assessment and time management" student response are as follow:

1. Student 8, 3: The difficulty I face in attempting laboratory task is the time management. Though the assessment was for five marks and time limit given by the instructor was 10 minutes which is appropriate, but since we were attempting such laboratory task for the first time which was replicating the signal generation given by teacher, it took us long time to understand the task, remember the commands and execute.
2. Student 10, 15: Different course teacher uses different programming platform as per requirement of the course for example for communication engineering MATLB is used, for artificial intelligence python is used and for communication networks packet tracer is used. So it is difficult for us to remember commands, syntaxes, GUI of this software quickly and attempt formative assessment task in the limited time.
3. Student 12, 21: As per the declared scheme and time table for conducting internal assessment task for the different courses at the beginning of the semester, all the tests are scheduled in 6th and 7th academic term and therefore we face multiple tests in the week sometimes two tests on one day which we find difficult. Teachers also use different assessment methods; time limit and diversity of questions are the challenges for us.

3) Informal discussion with faculty members

1. Faculty 1: The laboratory continuous assessment is the challenge for us to keep the assessment type different from theory, setting different questions, encouraging students to attempt it actively.
2. Faculty 2: Because of 50% weightage to the continuous assessment we have to keep assessment challenging as well as more components in assessment. Even if the task is conducted there is delay in the assessment and providing timely feedback to the students which is main aspect of the formative assessment
3. Faculty 3: Managing the assessment in the large classroom around 70 students is difficult as there are limitations of the internet connectivity, conduction of parallel activity, managing time and discipline in the classroom by a single teacher. Staggering timings for assessment by making different batches requires more number of questions.

C. Student Engagement and Learning (RQ3)

1) Students choice on methods of FA

Following Fig. 3 describes the responses obtained from the student survey regarding choice on diversified methods of formative assessment methods that can be used.

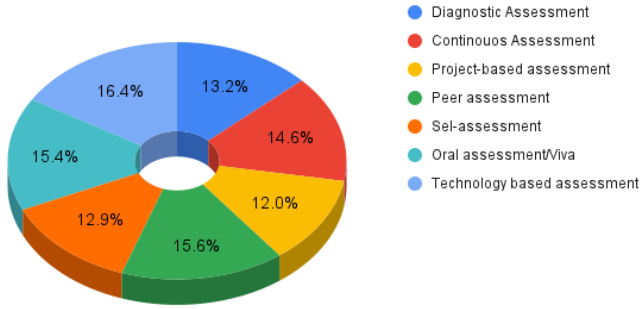

Fig. 3. Students response to choice of diversified FA methods

TABLE V
MATRIX OF STRATEGIES FOR IMPROVING PLANNING AND IMPLEMENTATION OF FA

Type of Assessment	Examples
Diagnostic Assessment	Pre-test, post-test, quizzes
Continuous Assessment	Weekly quizzes, homework assignment, simulation based task
Project-based assessment	Case studies, projects, design of sections
Peer assessment	Discussion forums, peer evaluation of task
Self-assessment	Reflection journal
Oral assessment/Viva	Lab viva, theory viva, concept questioning
Technology based assessment	LMS, Google classroom, interactive apps of Google workspace, programming platforms, AI platforms

2) Semi-structured interview response with students

In response to the question "formative assessment helped me to think critically, help me to spend more time, engaging activities" student response is as follow:

1. Student 13: All the internal assessment task and laboratory task conducted are interesting, engaging and motivating for learning. The task of discussion

forum was very interesting where I have posted my discussion and my friends are replying to it some are supporting me and some are adding new points to it. I also got a chance to add new points the post of my friends. Since marks were kept for posting the discussion in time and replying to at least two of our friends there was good discussion in the entire forum.

2. Student 11: The formative assessment techniques were engaging, self-motivating for learning. The tools used were programming and interactive platforms which helped us in visualizing waveforms, real time changing parameters and observing its effect on the output.

D. Pathway to improve design and implementation of FA (RQ4)

1) Matrix: Strategies for Improving Planning and Implementation of Formative Assessment

The following Table-VI shows the matrix of student and faculty agreement/perception for improving planning and implementation of Formative Assessment.

TABLE VI
MATRIX OF STRATEGIES FOR IMPROVING PLANNING AND IMPLEMENTATION OF FA

Improvement Strategy	Description	Students' Agreement / Perception	Faculty's Agreement / Perception	Example Responses / Notes
Clear Alignment with Learning Outcomes	FA tasks should map explicitly to course objectives and summative assessment.	High – 4.5/5	High – 4.7/5	Students want quizzes/projects linked to what they need to know; faculty see clear outcome alignment reduces redundancy.
Timely and Constructive Feedback	Feedback should be specific, actionable, and provided quickly.	High – 4.7/5	High – 4.6/5	Students prefer feedback within a week; faculty suggests using automated tools for initial evaluation.
Balanced Assessment Load	Spread FA tasks evenly to avoid overloading students and faculty.	High – 4.3/5	High – 4.2/5	Students want 1–2 small quizzes per week rather than multiple per day; faculty suggests scheduling FA to reduce grading bottlenecks.
Use of Technology and Online Tools	Integrate LMS, simulation software, or auto-graded platforms.	High – 4.4/5	High – 4.5/5	Students prefer online quizzes, MATLAB/Simulink exercises; faculty sees tools reducing manual workload.
Interactive and Engaging FA Methods	Include discussions, peer-assessment, and problem-solving sessions.	High – 4.6/5	Moderate – 4.1/5	Students find interactive FA more engaging; faculty note logistics and time constraints.
Faculty Training and Support	Faculty needs training on FA design, technology use, and effective feedback methods.	Moderate – 3.8/5	High – 4.8/5	Students notice inconsistency in FA methods; faculty highlight need for workshops or mentoring.
Integration with Syllabus and Curriculum	FA should fit naturally into course schedules without hampering coverage of key content.	Moderate – 3.9/5	High – 4.3/5	Students want FA spaced with major topics; faculty suggest planning FA along syllabus milestones.
Incentivizing Participation	Awarding marks or recognition to encourage active engagement.	High – 4.5/5	Moderate – 4.0/5	Students more motivated with grade or participation credit; faculty caution against over-emphasis on marks.
Collaborative Planning	Involve students, faculty, and administrators in FA design and scheduling.	Moderate – 3.8/5	High – 4.5/5	Students appreciate input opportunities; faculty recommends collaboration for practical scheduling and alignment.

2) Semi-structured interview response

In response to the question "suggestion for improvement of assessment, incorporating technology" student response is as follow:

1. Student 18: There should be proper time management of keeping the assessment. All teachers of one semester should work together to plan the assessment so that students do not get assessments back to back so as to balance our load.
2. Student 14: The assessment should be short if possible should be conducted in the classroom, and should be based on technology tools. If the assessment if group based or collaborative then proper rubrics should be defined by the teacher so that each student in the group is responsible for the work and task should be equally divided in the group members
3. Student 22: The assessment feedback should be given on timely manner; many times we observe that we get late feedback and because of that we repeat same mistake again the next assessment and our marks are cut again. The assessment should be application based and should include real-world example and task.

3) Informal discussion with faculty members

1. Faculty 4: The weightage for the laboratory continuous assessment can be reduced and converted to end semester orals which will test the knowledge of the students before their end semester examination.
2. Faculty 5: Keeping assessment in theory as well as laboratory requires meticulous implementation planning and time management. One of which can be reduced up to certain level. Teacher should have

knowledge of many assessment tools to keep diversity of the methods in theory as well as laboratory.

3. Faculty 6: Because of the workload, and many assessments, timely feedbacks are not provided to a student which is essence of formative assessment.

Based on the research findings we propose a three-pronged pathway (Fig. 4) for enhancing the implementation of formative assessment in engineering education. Based on the discussion above author present a systematic methodology (Fig. 5) of implementing FA techniques so that challenges faced by the students and teachers can be addressed. Implementing a formative assessment in large classroom with limited resources is a challenge and hence teachers need to shift from "individual correction" to "aggregate feedback" and "peer learning". In such case students will get immediate and relevant feedback in time. Implement digital tools like Mentimeter, Kahoot, or simple Google chat poll, LMS poll etc. to clarify the misconceptions during lecture sessions.

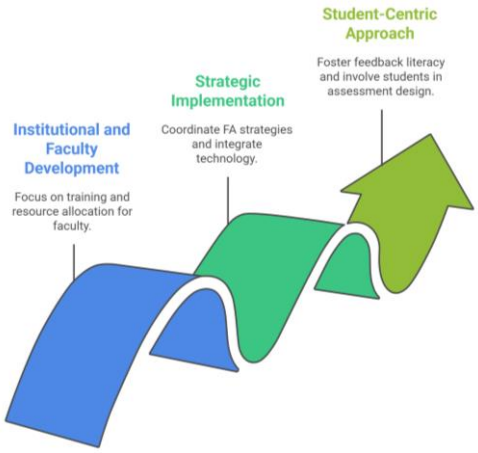

Fig. 4. a pathway forward: Recommendations
(source: image generated from https://www.napkin.ai/)

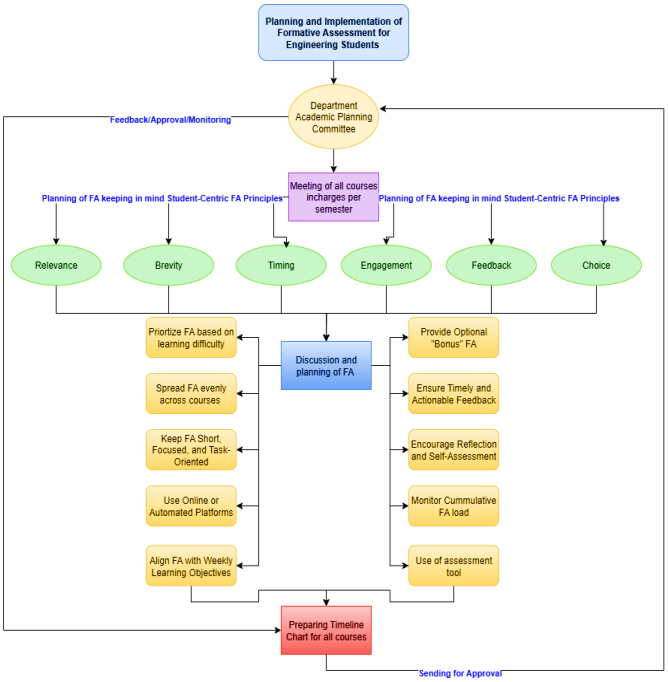

Fig. 5. Stages of systematic planning and implementation of FA

CONCLUSION

This study confirms that engineering students recognize the intrinsic value of formative assessment as a tool for learning. However, its potential is significantly hampered by practical challenges in implementation, primarily related to the quality and timeliness of feedback, workload, and inconsistency. The student voice provides a clear directive: for formative assessment to be truly effective, it must be part of a supportive, consistent, and dialogic academic culture. 90% of students strongly agree that technology/programming based assessment is good for engagement and learning. Students generally perceive FA positively, but challenges such as feedback timing, assessment design can limit effectiveness. The results clearly demonstrate that formative assessment, when carefully designed and implemented, is an effective pedagogical strategy for engineering education, provided that practical challenges are addressed through structured interventions. The limitations of the FA are the time constraint and pressure of completing curriculum pressure, for the large size classroom providing high-quality descriptive feedback to a student is also difficult. By focusing on faculty development, strategic technological integration, and more student-centric approach, engineering programs can bridge the gap between the promise and the reality of formative assessment. Future work could explore longitudinal studies to track the impact of implementing these proposed changes on student learning outcomes. With rise of AI, research is needed to understand the difference between AI –generated and teacher-generated feedback.

ACKNOWLEDGEMENT

The author is thankful to SY and TY EXTC program students for their cooperation in the responding to feedback questionnaire and participating in the interview. Author acknowledges anonymous reviewer and program committee of

ICTIEE 2026 for giving insightful reviews. Author expresses particular thanks to Director, K J Somaiya School of Engineering and management of Somaiya Vidyavihar University, Mumbai.

REFERENCES

Zhang, T., & Wang, J. (2025). The impact of timely formative feedback on university student motivation. Assessment & Evaluation in Higher Education, 50(1), 112–128.

Turan, M., & Koç, S. (2025). Decoding teachers' dilemma: Unveiling the real obstacles to implementing formative assessment in the classroom. Journal of Qualitative Research in Education, 41, 95–118.

Kumar P., Sharma R. (2025), Immediate and Iterative: The Role of Auto-graders in Developing Foundational Programming Skills. Proc. ACM Technical symposium on Computer Science Education, Boston, pp-310-316.

Spector, J. M., & Ma, S. (2025). The current landscape of formative assessment and feedback in graduate studies: A systematic literature review. Frontiers in Education, 10, 1509983.

Sutton K.L. (2024), Student Perception of Formative assessment and feedback in STEM courses, Journal of Science Education and Technology, vol. 33, pp-245-259.

O'Malley C.R. (2024). Student trust and the efficacy of peer feedback in civil engineering design course. IEEE Transaction on Education. Vol. 67, no.1, pp. 92-99.

Evans C. (2023), Making sense of assessment feedback in higher education, Review of Educational Research vol. 93, no.1, pp-147-185.

Santos R., Patel V. (2023). The Impact of Low-Stakes Quizzing in Engineering Disciplines: A Meta-Analysis. Computers & Education, vol. 195, Art no. 104721.

Lee J. Miller H.F., (2023), Promise and Pitfalls of Technology-Enhanced Formative Feedback in Higher Education. Educational Technology Research and Development, Vol. 71, pp-879-899.

Gupta A., Nguyen T., (2022) Formative Assessment in Practice: A National survey of Engineering faculty perceptions and barriers. Proc. American Society for Engineering Education (ASEE) Annual Conference, Minneapolis, MN, USA, pp. 1-14.

Johnson M.T., Chen L. (2022). Formative Assessment in STEM: A Review Efficacy and Faculty Workload Challenges. Journal of Engineering Education. Vol. 111, no.2, pp.-45-62.

Winstone, N. E., & Boud, D. (2022). The need to disentangle assessment and feedback in higher education. Studies in Higher Education, 47(11), 2230–2242.

Gupta B., Gupta P., (2021), Project Based Learning in Technical Institutions. Journal of Engineering & Technology Education. Vol. 15, pp.1-8.

Patar M. (2021), The role of online formative assessment in a blended learning environment for engineering students. Journal of Engineering Education vol.110, no.1, pp-123-140.

Yan, Z., & Brown, G. T. L. (2021). A systematic review of self-assessment in higher education: A conceptual analysis. Assessment & Evaluation in Higher Education, 46(5), 635–652.

Al-Ababneh (2020), The Perception of University Students on the Use of Formative Assessment in Higher Education. International Journal of Instructions, vol. 13, no.3, pp-481-496.

Zheng, L., Bhagat, K. K., Zhen, Y., & Zhang, X. (2020). The effectiveness of the flipped classroom on students' learning achievement and cognitive load: A meta-analysis. Educational Technology Research and Development, 68(4), 1455–1482.

Henderson M., & Ajjwai R. (2019). The impact of feedback in higher Education: A synthesis of recent research. Assessment & Evaluation in Higher Education, vol. 44, no.8, pp. 1198-1214

Black D.J., & William P. (2018). Developing the theory of formative assessment. Educational Assessment, Evaluation and Accountability, vol. 30, no.1, pp-5-31.

Carless D. & Boud D., (2018). The development of student feedback literacy: enabling uptake of feedback. Assessment & Evaluation in Higher Education, vol. 43, no.8, pp. 1315-1325.

Annual Status of Education Report (ASER)- "Beyond Basics" (2023): https://asercentre.org/aser-2023-beyond-basics/

Tomar A. (2025). Harnessing AI in higher education: Opportunities and the road ahead. https://www.ey.com/en_in/insights/education/harnessing-ai-in-higher-education-opportunities-and-the-road-ahead