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# ASSESSEMNT OF CURRENT METHODS OF CLASSROOM TEACHING BASED ON STUDENTS LEARNING SATISFACTION FOR UNDERGRADUATE ENGINEEIRNG PROGRAM AT AN INDIAN UNIVERSITY

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**ABSTRACT**

Engineering students need to be prepared with cutting-edge knowledge and skills to align with rapid strides in engineering, and technology. This work examined the effectiveness of current teaching pedagogy for classroom teaching through a survey conducted on undergraduate students of Engineering. Analysis of this survey reflected the need of alternate teaching pedagogies based on students' response. Exploratory Factor Analysis (EFA) confirmed that 75.8% of participating students are into the Multiplicity stage of Perry's Intellectual growth. These students are able to take charge of their learning needs, hence, can be trusted with their opinions, and they seek a change in the traditional methods of teaching for better course content delivery. For such students, experiential learning-based teaching pedagogy would be highly useful as it emphasizes cognitive development, hence, students are able to understand the topics efficiently. The advantages of employing Experiential based teaching pedagogies have also been discussed in this paper.
**Keywords:** *Learner's Satisfaction, Experiential Learning, Perry's Intellectual Model, Engineering Education, Teaching pedagogy*

## 1. INTRODUCTION

In engineering education, content delivery is one of the most critical aspects of teaching, and it highly impacts students' learning. Effective content delivery aims to encourage, engage, and motivate the learner to gain deeper, significant, and meaningful knowledge. With the changing need of engineering education, Institutes emphasize on providing a conducive learning environment, designing of the effective course curriculum, and state of art learning facilities. To meet the learning needs, institutes are regularly receiving the students' feedbacks also. Academic feedbacks mainly address the issues such as curriculum design, availability of the facilities, on time completion of the syllabus, regular conduct of assessment and assignments. These feedbacks help to continue with the existing facilities or also gives insight, where changes are needed.

Feedback of all the students is important for the areas like learning facilities, and academic environment. While taking the feedback of the students on the existing educational process, it is important to find out their perception on the teaching learning processes along with other factors like learning support facilities and learning environment[1]. Apart from these, few feedbacks are collected to understand the process of learning by focusing on the teaching -learning methodology. Method of content is delivery is one of such significant area. As discussed earlier, technology is changing, as these changes are modified and updated during the designing of curriculum. Curriculum is designed in such a way that it covers foundations courses and relate it with the advance courses. Major changes have been observed in the curriculum design of undergraduate engineering programs. But method of content delivery is still the same, means in the past few years, not many changes has been introduced in the teaching

pedagogy. It is important to know, whether, students are satisfied with way, they are taught in the classroom. A survey was conducted for the students' feedback to understand the students' views on this topic of discussion. The objective of this paper is to find out the students' satisfaction with the existing method of content delivery. As a practice, students are encouraged to participate in surveys, and analysis is done on their collective feedback.

Recent work to find students' satisfaction have utilized statistical methods to find the validity and reliability of the responses. These, survey questionnaire has large number of questions, and sometime may result in the random responses[2].

Reliability of students' opinions was ensured through Perry's model of intellectual development. Perry's model is as it is based on cognitive-structural theories [3] that discusses students' cognitive development on nine stages that are simplified in four stages of intellectual development [4]. These stages are Dualistic, Multicity, relative, and commitment. It says that the students' cognitive development may vary for the students in similar age groups or similar programs. Based on the analysis of the responses, students could be in Dualism, where students can perceive the situation as of right and wrong, and they are not able to question the authority, whereas students who have reached the Multiplicity have begun to develop their own opinion based on the cognition [5]. The level of student satisfaction should be a crucial factor during the planning phase of teaching methodologies [6]. This paper proposes a feasible method for implementing experiential learning to satisfy students learning needs.

## 2. POPULATION AND DATASET:

Department of Electronics & Communication Engineering surveyed 295 students of the undergraduate engineering program at Amity University, Lucknow campus on content delivery, an essential parameter in teacher-student interaction, to understand the level of student's satisfaction on the current method of content delivery. No categorization was made on the gender and cultural backgrounds of the student for the survey. All participants were of the same undergraduate program in their pre-final semester with an average age of 22 years. One hundred eighty-three male students and 112 female students participated in the survey. The responses of the students were collected on the google form as well as hard copies.

Survey questionnaire was divided into two sets; Set I and Set-II. Survey questions in set-I aimed to seek the students' response on the methods of the current teaching pedagogy. They had to respond on a three-point Likert scale; agree, disagree, and neutral. Two hundred thirty-one students responded critically as agree or disagree, whereas 64 students responded as neutral. Students who have responded 'Neutral' are those students who have not formed any opinion about the methods of content delivery, and they rely entirely on the teachers and Institution for teaching and are still in the dualistic stage. Students, having any opinion, have progressed in their cognitive development, and have developed their point of view, which they have voiced by agreeing or disagree with the questions have grown into the Multiplicity stage of Intellectual development. Survey questions in Set -II focussed on the need for innovative or alternate teaching methods for effective content delivery. Feedback was taken on a three-point Likert scale. Analysis of the mean values of these responses shows that 222 students believe that alternate teaching pedagogy could be helpful in better understanding the courses taught to them. These students are in 'Multiplicity' and understand that different methods exists for knowing the truth. Seventy-three students have responded either in disagreement or as Neutral.

The calculated mean value of the responses of the two sets of questions implied that 78.3% of students gave consistent responses in both sets of questions.

In the end, it is suggested that experiential learning-based teaching methods are effective methods of teaching in engineering education. Advantages of experiential leaning based teaching methods have been discussed.

## 3. SIGNIFICANCE OF STUDENTS RESPONSES AND ITS RELATIONSHIP WITH LEARNING SATISFACTION OF STUDENTS:

University Course curriculum stipulates the method for course- content delivery to achieve the expected learning outcomes. Teaching methods follows a basic pedagogy as lecture and classroom discussion, and practical experiments with few open-ended experiments.

The learning satisfaction of students depends on various factors like individual characteristics, material conditions, learning facilities, learning outcomes, learning environment, peer relationships, teacher, and instructional activity [7]. Effective

instructional activity produces a degree of coherence in learners if it fulfills their learning expectancies [8][9]. It has been established through a comprehensive discussion that students' interaction with the instructor is significant in establishing the level of learners' satisfaction [10]. Teaching practices in the current setting are the first-level teaching methods that include class lectures and discussion, and sometimes these discussions are conducted as case studies or open-ended experiments. Student

## 4. RESEARCH QUESTIONS AND RESEARCH METHODOLOGY BASED ON THEORY OF PERRY' INTELLECTUAL DEVELOPMENT OF COGNITION:

### 3.1 Formulation of the research questions:

The survey determined the learners' satisfaction with the current practices of teaching pedagogy. Two groups of questions were Set-I and Set-II. Questions in Set -II drawn dependencies from the questions in Set -I. Selected parameters for the questionnaire are on the existing method of content delivery and its impact on industry readiness:

(a)Requirement of the subjects (b) utility of the subjects (c) relevance of the subjects (d) understanding about the association between courses in program structure (e)Need of innovative methods of teaching (f) additional teaching pedagogy based on contemporary instructional design.

Survey questions in the SET-I as shown in Table -I, acquired basic information on their understanding of Program structure from students. Students' responses were measured on three points Likert scale; agree, neutral, and disagree.

*Research Question 1*. Does Students' agree that the courses they are studying in the program are relevant to their professional needs?

*Research Question 2*. Do they agree that the succession of courses provides association for meaningful understanding between the fundamental courses and application-based courses?

*Table -1Survey Questions In SET-I Questionnaire*

| | |
|---|---|
| Q1 | You are not able to understand the requirement of many subjects taught in your course. |
| Q2 | Do you feel that some of the subjects taught to you are not useful for the course you are pursuing? |
| Q3 | Do you often miss the connection between the theory taught in the class and its real-world application? |
| Q4 | You are generally not able to understand the connection of subjects studied in the current semester to courses studied in previous semesters. |

Survey questions in Set-II questionnaire as shown in Table-II, aimed to know the students' satisfaction with the current teaching pedagogy, raising the following research questions:

*Research Question 3*. Is the teaching pedagogy sufficient to fulfill the need to organize new and structured information to work with the backgrounds and experiences of learners?

*Research Question 4*. Is there any requirement of modifications in the teaching pedagogy for creating a better association between the various courses taught in Engineering education?

*Table -2 Survey Questions In SET-II Questionnaire*

| | |
|---|---|
| Q5 | You think that skills development required for fast-changing industrial needs requires innovative teaching-learning methodology. |
| Q6 | You would prefer an educational methodology through which most teachers can better connect their subjects with the other subjects taught in all semesters. |

### 3.2 Summary of students Responses for the questions of SET-I & SET-II:

Students with an average age of 22 years of the pre-final year of the undergraduate program participated in the survey. They all have studied the same courses of Electronics and communication engineering programs in subsequent semesters. All participants responded to all six questions. Graphs in Figure 1 and Figure 2 illustrate the response of all students corresponding to Set-I and Set-II.

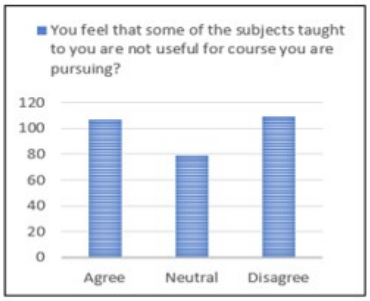


*Figure 1.Response pertaing to Question 1*

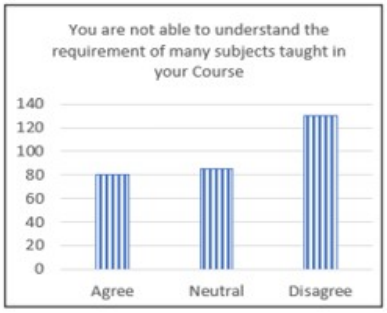


*Figure2. .Response pertaing to Question 2*

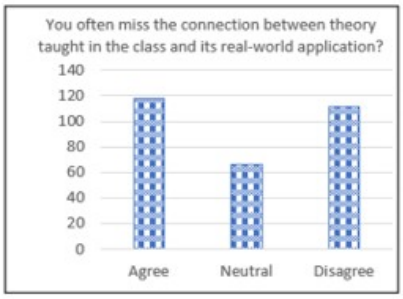


*Figure 3.Response pertaing to Question 3*

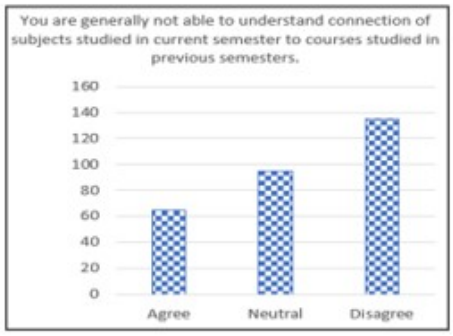


*Figure 4.Response pertaing to Question 4*

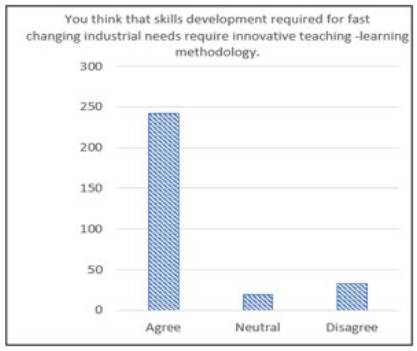


*Figure 5.Response pertaing to Question 5*

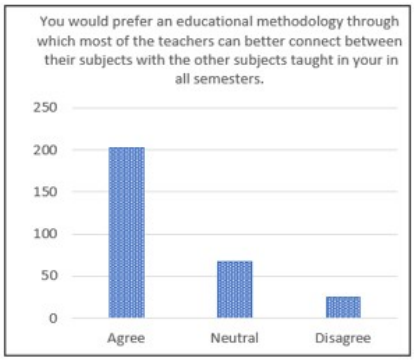


*Figure 6 .Response pertaing to Question 6*

### 3.3 Calculation of sample size of the average of Mean response of Set–I:

Questions in Set-I are for the evaluation of the students on their general awareness and understanding on the course curriculum.

Reliability of students' opinions was established on the basis of their responses on the current teaching methods and learning methods. To analyze the intellectual stage of students; whether they still belong to the dualistic stage of intellectual development or have reached Multiplicity [11]. Questions in the set I, Q1, Q2, Q3, and Q4 meant to find out their understanding of existing courses and their content.

Three scales responses were in agreement, neutral, and disagreement. Questions were framed in simple language so that all students can easily understand and provide a response. Students who understand the course content and course structure will show their agreement or disagreement based on their individual experiences. Students who have responded as 'Neutral' are passive recipients of the content taught to them and cannot provide definite opinions on the relevance of courses or the structure of courses.

$\mu_A$, $\mu_N$ & $\mu_D$ are the mean values of the responses of individual questions as shown in Table-I. To calculate the total sample size for the agree, disagree, and neutral, overall mean values were calculated as $\mu_A'$, $\mu_N'$ & $\mu_D'$ for agree, disagree, and neutral. A sample size of the students responding on three scales was calculated by multiplying N (295) with overall means values of the three responses, respectively as shown in Table-3.

A sample size of the respondents in the agreement was 139($N_A$), for disagreement it was 91($N_D$), and 64 ($N_N$) responded in Neutral implicates that nearly 21.7% of the students are still in the Dualistic stage, and their opinion may not be much reliable whereas 78.3% students can provide their concrete opinion when intrigued and they could be the part of the focus group.

Dualistic students rely only on the resources of learning provided to them without having their own discrete opinion, even when they grow in higher studies, so they unquestionably believe in the authorities [12]. At the Multiplicity stage of Intellectual development, they show withdrawal from the reliance on authorities.

*Table-3 Mean Value Of Set-I Questions And Calculation Of Adequate Sample Size To Create Focus Group*

| SN. | Questions in Set -I | ($\mu_A$) | ($\mu_N$) | ($\mu_D$) |
|---|---|---|---|---|
| | | Mean value of responses | | |
| 1 | You understand the requirement of most of the subjects taught in your course. | .48 | .24 | .27 |
| 2 | You feel that most of the subjects taught to you are helpful for the course you are pursuing. | .45 | .19 | .36 |
| 3 | You understand the relevance of the theory taught in the class with real-world application. | .43 | .17 | .40 |
| 4 | You understand the connection of subjects studied in the current semester to courses studied in previous semesters. | .53 | .24 | .22 |
| | Sample Size (N): 295 | Adequate sample size based on responses | | |
| | $\mu_A$'= Avg($\mu_A$) =.47 | $N_A$' = 139 ($\mu_A$' X N) | | |
| | $\mu_N$ := Avg($\mu_N$)=.21 | $N_N$' = 62 ($\mu_N$'X N) | | |
| | $\mu_D$'= Avg ($\mu_D$) = .31 | $N_D$' = 94 ($\mu_D$'X N) | | |

### 3.4 Analysis of the responses of Set-II:

Second part of the questionnaire (Set-II) is drawn from the questions of Set-I, expecting the students to present their opinion on teaching-learning methods based on their experiences. These questions aimed to know the students' satisfaction with the current model of teaching-learning.

All 295 students participated in the survey. Based on the responses of the Set-I questionnaire, 78.3% of students provided meaningful feedback; hence, they have reached the Multiplicity stage and do not entirely rely on the facts provided to them through the teaching practices existing at University.

In the analysis of Set-II responses,

$M_A$, $M_N$, and $M_D$ are the mean for agreement, Neutral, and disagreement, respectively. Overall average of individual mean values $\mu_A$", $\mu_N$" and $\mu_D$" were used to calculate the sample size of the students in agreement, Neutral, and disagreement. Out of 295 students, 222 students agreed with the research questions showing the dissatisfaction of 75.25% of students with the current teaching method and learning method, comparing the sample size of participating students in Set-I and Set-II, suggesting that the number of students qualifying in Multiplicity in Set-I is almost the same as the number of students responding in agreement in Set-II. Hence, the students who can self–regulate their learning want to explore a better understanding of knowledge gathering to enhance the learning experience.

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## 5. RELIABILITY ANALYSIS TO CREATE FOCUS GROUP, BASED ON TWO STAGE FEEDBACK ANALYSIS:

Reliability analysis of students is essential as both types of thinkers may appear as same on the surface. They can be separated based on reflection that formulates their views. Students were not segregated based on CGPA, as it is a possibility for students who can memorize may achieve better grades even without having the ability to introspection into whatever they have studied [13]. So, both types of learners may appear the same on the surface, but when they are intrigued for deeper understanding, these traits become noticeable. Students who cannot discern their learning may not provide a trustworthy opinion. As learning evolves, their beliefs develop different perspectives to provide valuable feedback in enhancing the learning environment through exploration. To filter out these students, Set-I was helpful, and the response of the students in Set-II are analyzed as shown in table-4, and the sample size of the students responding in the agreement have been calculated. $m_A$, $m_N$, and $m_D$ are the mean values of the responses in agreement, neutral responses, and responses in disagreement with the statement of the questions.

*Table-4 Mean Value Of Set-Ii*

| S.N. | Questions in Set -II | $m_A$ | $m_N$ | $m_D$ |
|---|---|---|---|---|
| 5. | You think that skills development required for fast-changing industrial needs requires innovative teaching-learning methodology. | .82 | .06 | .12 |
| 6. | You would prefer an educational methodology to better connect their subjects with the other subjects taught in previous semesters. | .69 | .22 | .08 |
| Average value of mean responses | | Adequate sample size based on responses | | Sample Size (N): 295 |
| $\mu_A$" =Avg($m_A$) | | $N_A$' = $\mu A$"X N | | 222 |
| =.754 | | | | |
| $\mu_N$" =Avg($m_N$)=.148 | | $N_N$' = $\mu N$" X N | | 43 |
| $\mu_D$" = Avg($m_D$)= .098 | | $N_D$' = $\mu_D$" X N | | 30 |

Figure 7 shows the creation of focus group was created on the basis of their responses to the questions asked in Set-I and Set-II. Number of mean values of the neutral responses in the Set-I are almost equal to the disagreement, and neutral responses in the Set-II questionnaire. When students have a concrete opinion about existing teaching methods, then they shown agreement with the methods or disagreement with the methods. In the absence of concrete opinion, they are unable to provide reliable feedback, hence, such students cannot be relied for their responses. Students having concrete responses are shown as Focus group in the Figure 7.

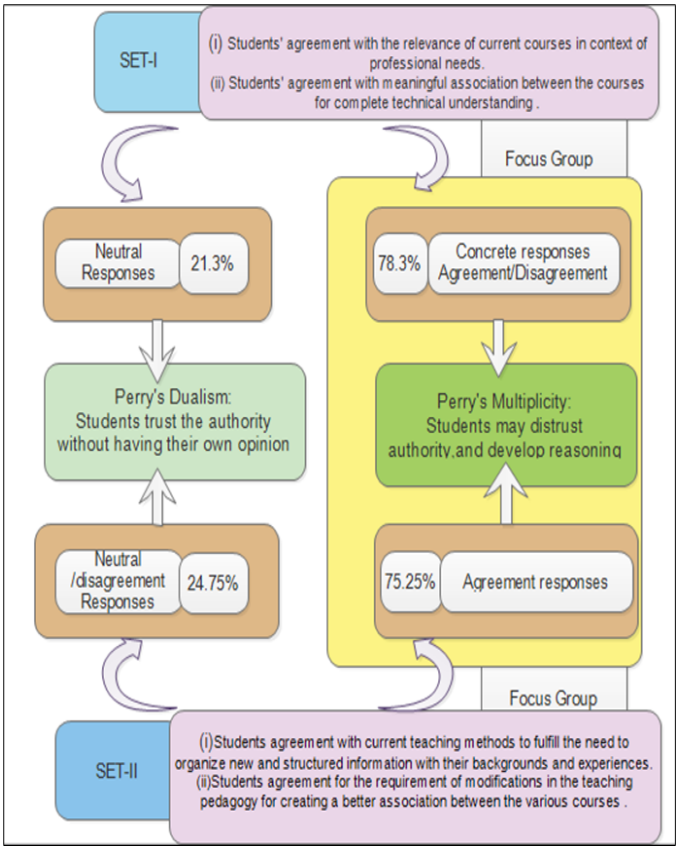


*Fig 7: Focus group based on Perry's Multiplicity*

## 6. EXPERIENTIAL LEARNING BASED ON PERRY'S STAGES OF INTELLECTUAL DEVELOPMENT:

Many students in Multiplicity agree that the inclusion of alternate methods in current teaching pedagogy would be more helpful for understanding the association of courses that would prepare them for industry readiness. Active learning models have been considered suitable methods in engineering as they have various methodologies based on cognition and different methods of assessment that would be beneficial to evaluate students' learning at all levels [14]. Experiential learning has models that are helpful as they enhance the cognitive abilities of students. When new information links with the existing knowledge, the rate of retention increases as new material contextually fits within existing cognitive structures. This structural information is easily retrievable for analysis and application. Based on Perry's stages of Intellectual development, experiential learning could be a suitable methodology for teaching and learning. [15].

Degree of concreteness, directness, and involvement in activities, when developed through experience, highly relies on these experiences for a continuum from direct to vicarious. Experiential learning supports experiential education to facilitate knowledge creation and knowledge transfer in teaching, training, and skill development. Extensive experiential components help students mature toward more complex thinking and make good engineering problems ambiguous real-world [16].

Experiential learning provides ample opportunities for constructive learning; still, many factors are essential while integrating experiential learning with different modules of the courses [17].

### 5.1 Advantages of alternate teaching pedagogies in engineering education; Project-Based learning, problem-based learning, Game-based learning:

Engineering curricula have already implemented Experiential learning-based methods. There are various advantages of these methods over traditional teaching methods: it brings satisfaction to students in terms of theoretical and practical knowledge [18].

**5.1.1 Student Centric Learning:** These courses have dedicated faculty members to guide them at various stages. Most of the time teaching assistant is allotted to each group of students to help them during the designing and implementation of the project. Game-based learning is very engaging and motivating that provides rich contextual knowledge and interaction. Outcomes of each course are constructed and based on this information; students define their learning objectives while completing the tasks. Students develop an understanding of the purpose of studies based on the course curriculum and the significance of various theories. Thus, experiential learning is student-centric learning where students design and implement the project, understand the program structure, and develop their course objectives [19].

**5.1.2 Opportunities for innovation:** Experiential learning-based teaching-learning methods are student-centric methods that enable students to enhance content knowledge, technical skills, and practical skills. Students learn through imprecise and broken information to address the system requirement. Designing provides them the opportunities for continuity in the experience of projects. It makes students self-directed towards learning by integrating information from various disciplines to solve a particular problem. The accomplishment of project implementation is also possible through participation in competitions. Participation in competition motivates the students by generating a sense of recognition in students. They also learn to create projects based on strict guidelines and limited timeframe [20]. With this, they can identify high potential, technology-intensive commercial opportunities.

**5.1.3 Differential assessment** method: The design process is multifaceted; hence the rubrics are defined weekly for the assessment. It results in close monitoring of each student based on peer assessment, viva-voce, quizzes, and presentations. Based on their performance in the assessment, students can reflect on their knowledge and seek improvement. A continuous feedback loop encourages the students to upgrade themselves. Assessment of final performance through internal and external assessments in the final examinations [21-22].

**5.1.4 Learning through cognition:** Experiential learning theories focus on learning through experience to acquire knowledge through practice. Students need to learn the technologies in the same way as they are implemented and understand the in-hand technology. These facts are deeply ingrained during project implementation and help students create more knowledge-based on earlier facts. They become ready for more challenges related to the current technology [23].

**5.1.5 Opportunities through Meta-cognition:** When students work through the practice, they have the opportunity to reflect on their performance. They evaluate their performance during project designing, simulation, and implementation. This evaluation is a meta-cognition process where one assesses their understanding and performance to develop higher-order skills [24]. It proves to be helpful in engineering studies where applications and requirements are ever-changing.

**5.1.6 Encouragement for collaboration:** Most of the case studies based on the experiential earning methodologies fund competent Institutes. Hence, these activities also encourage the faculty in charge to look for collaborations. This collaboration turns useful for students and universities to encourage technical exchanges regarding the student exchange program, technology transfer, and knowledge sharing [25].

**6.Trajectory Driven Pedagogy: Alternate Teaching pedagogy for Undergraduate engineering Program at Amity University**

Engineering education needs to be flexible with the changing technology, and it must be a blend of traditional and new teaching pedagogy for the overall knowledge creation in the students.
Teaching pedagogies based on experiential learning are highly dependent on various factors, and one such factor is the dependency on the teachers [26]. Therefore, these pedagogies are complicated and multifaceted and hold many limitations [27][28]. To fulfill the learning requirement on the students feedback, Trajectory-driven pedagogy is proposed in this work, would embed the knowledge as associative learning in the students. This pedagogy cam be implemented at Amity University within the existing program structure, where a few changes in the course structure will be needed. In the program structure of Amity University, pre-requisites courses are given. These are those courses whose preliminary knowledge is important for studying the current course. If the course content can be planned in such a way that each topic is taught as the association of the courses along with its pre-requisite courses, then students will be able to associate the courses of different semester as a complete learning experience.

## 7. CONCLUSION:

This survey found that majority of the students understand that knowledge requirements for industry readiness require teaching-learning practices beyond the traditional methods. Students feedback is indicating that students are not satisfied with existing methods for course content delivery.
This paper has established that engineering undergraduate students at the University believe that advances in the field of engineering and technology can be taught effectively by traditional methods of teaching. For the knowledge creation, more appropriate methods of teaching -learning must be implemented. A Survey on 295 students was conducted to know about their opinion on current teaching methodologies, based on their responses, a focus was identified for the trustworthy opinions. These students insisted on including alternative teaching pedagogies in classroom learning, along with traditional methods of teaching. Based on the evidence, it has been established that experiential learning-based teaching techniques are more suitable for engineering undergraduates. Students' are agreeing that alternate method of teaching pedagogy will be helpful for a better understanding of the association between various courses where they could relate the core courses with the application-based courses in engineering undergraduate programs.

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