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Analysing the Impact of Emerging Technology Course on Student Satisfaction by Exposing Freshmen to Dynamic Industry Trends

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Abstract : Technology is an inescapable necessity; it dominates almost every aspect of human existence. Emerging technology helps to unlock new possibilities for connecting things/people. At the same time, technological advancement changes industrial trends and the demand for engineering graduates' expertise. Hence, it becomes necessary for the students to imbibe the skills of continuous learning and understand the emerging trends, right from the inception year of engineering education. Also, with an amendment to the national education policy (NEP), the Indian Government has shown its clear intention to promote a holistic and multidisciplinary approach to technological developments through engineering education. Therefore, to accomplish this, it is critical to bridge the gap between industry and academia. The proposed course in this article is an initiative taken by Chitkara University Punjab to bring industry mentors and first-year students face-to-face and promote holistic learning amongst themselves. A total of 1000 freshman engineering students took part in this course and participated in the post-course survey to express their satisfaction level with the course thus introduced. The Cronbach's Alpha coefficient α = 0.957 shows the high Reliability of data obtained through a survey questionnaire. Students expressed high motivation levels after completion of the course. The survey shows that the course gave the students clarity about the attributes required by the industry, which can help them decide their action points towards their career development. In the future, a hybrid model of teaching-learning can be employed to provide an added advantage of industry mentor interaction with students in live physical space.

Keywords: Emerging-technology, NEP2020, Reliability, Engineering, Student-satisfaction, Motivation.

1. Introduction

Emerging technology trends have made it necessary for engineers across the globe to upskill and/or reskill themselves. Therefore, the skills acquired today may not be relevant in the next 2-3 years (Emerging Software Technologies | Top 5 Most In-Demand Tech Skills, 2021). According to a WEF report published in 2016, the traditional jobs are now compromised due to redundancy. In contrast, jobs

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requiring contemporary and multidisciplinary skills are proliferating (World Economic Forum, 2016). In addition to this, the outbreak of pandemic also added another dimension to working from anywhere in a contactless world (Duggal,2021). Therefore, it becomes necessary for freshman to understand the challenges cum opportunities of dynamic industry trends much before joining the industry to secure a job. Hence, responsibility of higher education institutes (HEI) and faculty members become more crucial to bring industry-academia interface to freshman, which plays a pivotal role in shaping their careers. Traditionally, Final, or pre-final year students are exposed to the placement/ internship process by a relevant industry, which is too late for the student to prepare themselves as per the industry's needs. This leads to an unwanted burden for the student in the crucial years along with their academics. Hence, it is important to expose the student to such a course which can give them realm of emerging technologies and industry-trends from the very beginning.

A considerable number of students get enrolled in universities and engineering institutions in India every year. These students join the universities with several expectations and always need direction to quickly adjust to the new environment. They enter the professional institutions in the dazed state about their Career and professional growth. Furthermore, they have more dependency on their family, friends, and personal understanding instead of study program guide to choose their career (Fuhrmann, 2019). The year 2020 was even more challenging for freshmen due to the Covid pandemic. They had to start the first semester online and adjust to the virtual working environment where the low student satisfaction level (Hamdan et al., 2021). Because of the situation, the students were unable to interact with their instructors, peers, and seniors on campus, nor were they able to determine the clarity about the relevant skillset and technology they should acquire to advance their career. At the beginning of the first semester, their knowledge about essential skills and industrial requirements is limited because they are freshmen and have only completed courses at the secondary school level (Lathigara et al., 2021). Subsequently, they are exposed to different specializations offered by the higher education institutions (HEI) like machine learning, artificial intelligence, IoT, Robotics, etc. Not able to identify their interests and decide for themselves, they take advice from their seniors, teachers, and Industry acquaintances.

HEIs, on the other hand, have defined program-educational-objectives (PEOs), and one of the essential objectives in engineering is "To make the graduates employable and industry-ready." Curriculum improvements with the inclusion of industry-oriented projects, industry-tailored courses, and internships help to improve the employability skills of the students (Barbarà-i-Molinero et al., 2017; Jackson, 2013). Course-specific program objectives are also enhanced and focused on skill development. In addition to this, the students can also choose their courses according to their interests, particularly in the Choice-based Credit System (CBCS). In addition to the programme core and required courses, the CBCS programme structure of undergraduate engineering programmes gives the student the freedom to select any electives as per the specialization of his/her choice. It also becomes vital to guide students towards making the best decisions for themselves to advance their careers. These elective courses contribute to major portion of total credits earned in bachelor's engineering programmes at the HEI level. Thus, the orientation has to be inculcated from the very beginning. A first-year student faces a considerable challenge to decide a particular specialization of interest that can contribute to career selection and development. Therefore, early interventions by the industry in academics can help the student be more confident about their choices for their skill development. Therefore, HEIs must play an essential role in creating the skills and preparing the task force with the help of the industry. Most of the HEIs are now having a solid Industry-academia interface. However, very few courses are introduced in the first semester. Thus, the freshmen get a chance to interact with the industry and understand the requirements. Most of the introductory courses are limited to explaining the technology in its current state, and the industry intervention/ interaction is almost negligible. With this in mind, we introduced a course on emerging technologies to freshmen in first year, and tried to find out the answer to the following research questions:

1. Will the intervention of industry expert in teaching-learning process helps in building generic skills in freshmen students?

2. Does the interaction with industry expert motivate the freshman students to choose their career path rightly?

In this article, authors have presented a systematic process of introducing an emerging technology course

in the first semester of the engineering program, wherein a direct interface was provided to the students in the form of industrial exposure through a series of sessions delivered by multidisciplinary industry experts. The sessions were bidirectional, and the students were provided a chance to interact with the experts during the session. Post-course survey was conducted to measure the outcome of the course and is presented in later section of this paper. Section-2 highlights the literature in support of the context mentioned above. Section-3 of the article discusses proposed course framework and section-4 discusses the results, followed by the conclusion and future scope in section-5.

2. Literature Review

Even though there has been a significant investigation in different countries about the inclusion of industry-oriented courses in the first year, very few focused on understanding the outcome of student satisfaction, motivation, and learning outcome. In a study on management students (Chavan & Carter, 2018), it was observed that the students had vague expectations due to limited experience and socio-economic background, which tend to change and take a realistic shape throughout their under-graduation. According to Jolla, a four-dimensional conceptual model of personal identity, academic identity, pre-professional identity, and workplace professional identity can help the undergraduates to develop their professional identity which includes their expectations and job requirements (Jolla, 2020). The study supported the development of pre-professional identity to improve skills in a specialized area(s) by graduation. It is also a well-known fact that orientation programs for freshmen have been very effective and improved the retention and academic performance of the students (Richardson & Dantzler, 2002). Freshman advising seminars organized in these programs fulfill one of the most critical goals, i.e., to expose the freshmen to the challenges and excitement of engineering (Hatton et al., 1998). In addition, engineering institutions attempt different approaches to conduct the orientation programs based on first-year students' learning styles and requirements (Collofello & Hall, 2012).

Multiple authors have reported an elevation in student motivation through the inclusion of industry-oriented courses. The lecture-oriented approach is passive, whereas the inclusion of case studies from industry requires active involvement, thus positively affecting the students' motivation. Also, industry-linked project-based learning nurtures students' motivation and helps them attain graduate attributes (Daun et al., 2014, 2016; Penzenstadler et al., 2013). In addition, a collaborative teaching approach with industry experts has encouraged high school students and their teachers (LI, 2020). The inclusion of innovative technology-based courses at the freshmen level enhances the learning attitude, motivation, and engagement (Fuhrmann, 2019; Malhotra et al., 2020), which is beneficial for the professional development of the students. (Jonsson, 2013) advocates the inclusion of introductory courses covering an overview of engineering degree programs for freshmen to increase their interest and motivation. (Scerri et al., 2020) also highlighted that the systematic mentoring process in industry-linked courses boosts student motivation and employability outcomes.

However, the current requisition of the industry is beyond the application of the technical skills acquired during the graduation course. Li emphasized on the education supply chain to improve the product of the higher education sector (Li, 2020). Employers expect fresh graduates to have critical thinking, creativity, leadership qualities, and a professional attitude (McGunagle & Zizka, 2020). Further, engineering education supported by research and inquiry-based learning aids in developing intellectual and practical skills among the students (Eppes et al., 2020). Therefore, it is crucial to imbibe these skills in the students from day-1 through the courses and best practices and further evaluate the outcome of such courses based on the parameters highlighted by ABET, NBA, NAAC, and other statutory bodies (Bhat et al., 2020).

3. Proposed Course Framework

The study attempts to identify the outcome of the industry-oriented course on emerging technologies offered in the 1st semester of the engineering program. It focuses on the need for the introduction of interaction-based industry-oriented courses. As shown in Figure.1, the course framework involves an industry mentor and an academic mentor. They collaboratively help the engineering freshmen cohort to identify their attitude toward their professional Careers. The course focuses on making the freshmen (a) understand the emerging trends with a multidisciplinary mindset; (b) identify the skills required to enrich their professional Careers; (c)

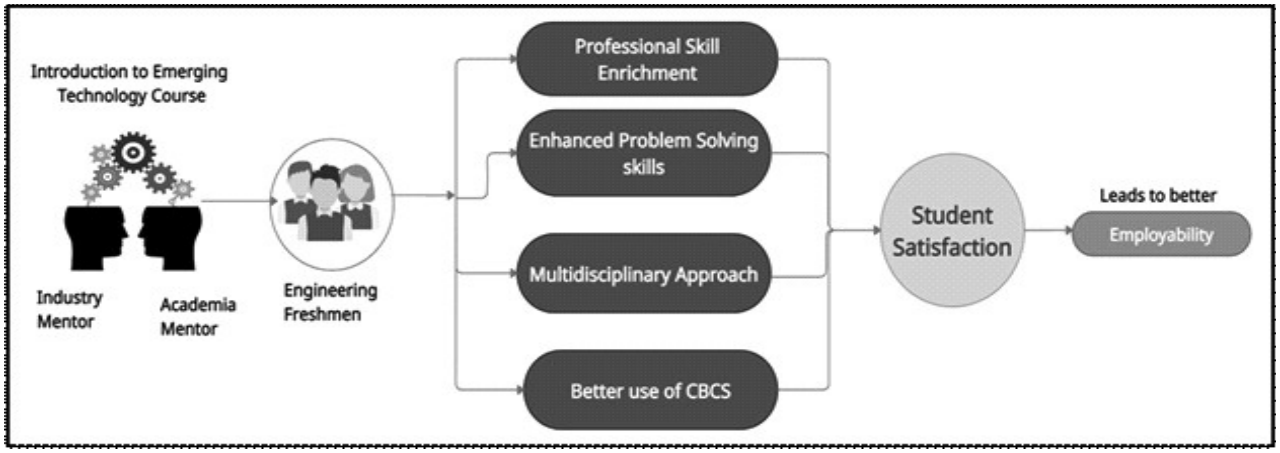

Fig. 1: Introduction to Emerging Technology Course Framework

identify the reasons to choose courses offered in the graduation program and (d) Enhance their problem solving and critical thinking through report writing and quizzes. This approach further leads to enhancing the ability of the student to understand the requirements of the industry. Also, it helps them to choose the course(s)/specializations according to their interest and career choice. The student satisfaction survey then further investigates whether industry intervention in the very 1st semester helped the students to understand real-world problems and motivate them, which can further lead to better employability in later years of engineering. Table-1 mentions the four-course objectives.

A. Course Implementation

The course "Introduction to Emerging Technologies – GE102" followed a three-step implementation process as depicted in Figure. 2 below. The first step before initializing the course begins with conducting a pre-course survey to understand the demographic profile of the freshman students as the research participants of this study.

Table-1 Emerging Technology Course Objectives

S. No	Course Objectives
1	Identify key technologies that have the potential to solve real -time problems in the current and imminent scenario.
2	Examine the challenges and opportunities in designing projects that implement new and emerging technologies such as 5G, ML, AI, and Robotics and their impact on society and the environment.
3	Identify the importance of digital empowerment, self-confidence, logical thinking, and ethical practices.
4	Ability to comprehend and develop professional skills to effectively socialize with peers and prepare technical reports and presentations.

Fig. 2 : Course Implementation Process

The survey questionnaire included questions about the economic background, attitudes toward pursuing higher education (Engineering), along with demographic profile (Lathigara et al., 2021). The survey questionnaire was shared with first-year engineering students of Batch 2021 at Chitkara University, India, using Google Forms. The notion behind this survey was to understand the current state and attitude of the students towards aligning themselves to pursue higher education in various engineering fields. Based on the information gained from the pre-course survey, the plan for course work was prepared. It consisted of interactive sessions by industry experts, a post-session quiz, a group discussion with an academic mentor and peer group, and the submission of a reflection report.

The course work was conducted in online mode from mid of August to October 2021 and offered to 1000 students in their 1st Semester. The process of mentoring is as shown in figure 3 below. The industry

expert brought an understanding of the sector, current needs, necessary expertise, and applications pragmatic to the industry. The expert concentrated on methods for developing a skill set, particularly in a technology, depending on various job profiles. Additionally, after the expert session, the students were split into smaller groups of 50 students each, where academic mentors offered support. The mentors conducted several discussion sessions on their queries as and when required and aided with teaching learning resources to enhance concept clarity applicable in the respective context. Academic mentors also facilitated collaborative learning environment where the student groups interacted at least once a week (blended mode).

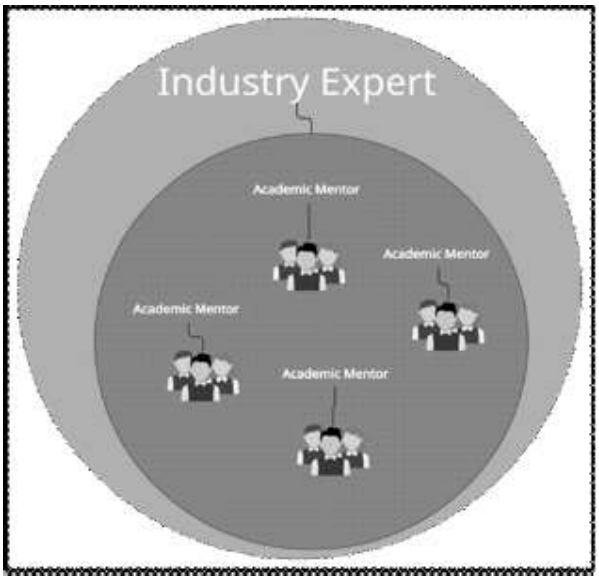

Fig. 3: Industry-Academia Mentorship Framework

In 10-weeks, a total of 25 interactive sessions were conducted with the help of industry experts from various domains. Each session was immediately followed by a one-to-one question and answer round with the industry expert and a short quiz based on the contents covered in the session. The questions in the quiz were based on the first two levels of Bloom's taxonomy (Remembering and Understanding) (Stanny, 2016)(Romanovs et al., 2012)

The online sessions majorly focused on the three aspects: Professional Skill Development (PSD), Skill development -Analytics (SDA), and Skill development - Multidisciplinary (SDM), as shown in figure 4 below. The topics covered under PSD focused on identifying future tech skills (due to dynamic industry trends and post-Covid scenario), generic personality, Human resources (HR), leadership skills, stress management, and life skills. SDA and SDM sessions were focused on the latest trends and technologies such as data analytics, machine learning, artificial intelligence, industry 4.0, data 4.0, cybersecurity, and a multidisciplinary approach to solving real-time problems.

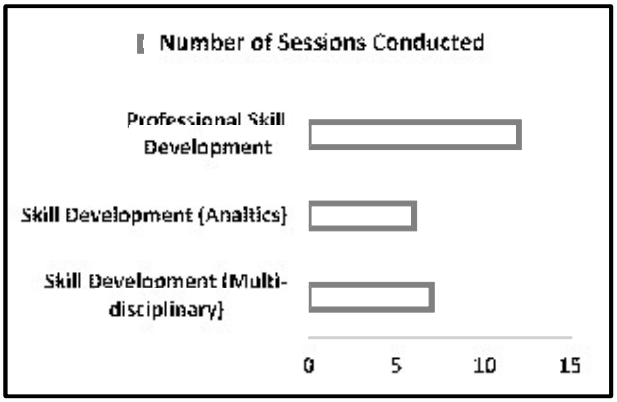

Fig. 4: Classification of Online Sessions Conducted in the Course

Soon after the culmination of the online session and quiz, the student must submit a reflection summary report of the individual session within a limited timeframe (usually 24hrs) given by the academic mentor. Students were given the leverage to select the topic of their interest and submit their reports. A cap of ten reflection reports was kept for every student as a mandatory requirement of the course. The academic mentor conducts discussion sessions with their respective cohorts. Students were given a chance to share their learning experience and highlight specific points from the session of their interest. This course element allowed freshman engineers to think, review and choose the e professional skill/specialization of their choice keeping demands of current industry needier mind (Fabien & Vereen, 2017).

B. Course Assessment

The assessment plan followed for the "Introduction to Emerging Technology – GE102" course is tabulated in table 2 below. Component 1(A) is the cumulative average score obtained by everyone in an online quiz session, comprised of 80% weightage of the total marks.

Whereas, Component 2(B), weighing 20% marks, is assessed through the quality of the reflection report submitted for each session (total of 10 in numbers). The total weightage for the course is 100 marks, and it

Table 2: Description of Evaluation Component

S. No.	Evaluation Component	Assessment Type	The weightage (%)
1	Component 1 (A)	Online Quiz	80%
2	Component 2 (B)	Reflection Report (any 10 sessions)	20%
	Total (A + B)		100%

is the open elective mandatory course for all students of first-year engineering students irrespective of their discipline chosen. Minimum 50% marks are required for qualifying for this course.

C. Course Outcome Assessment

The assessment of course outcomes for any course is crucial to assess and map students learning outcomes with the outcomes of the course. In this study, a post- course survey was planned as the third step in the course framework. The post-survey questionnaire quantifies students' satisfaction based on the pedagogical aspects - Teaching Experience (TE); generic skills developed after undergoing this course – Generic Skills (GS), and Learning outcome as represented by Learner.

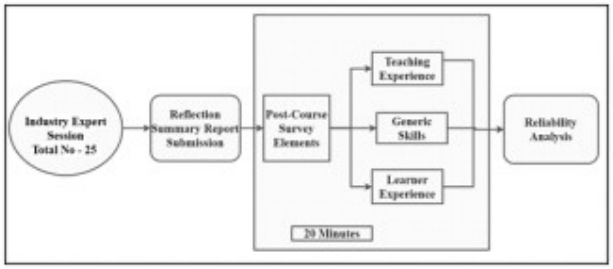

Fig. 5: Concept Note for Post-Course Survey

Experience (LE). The detailed plan of post-course survey is presented in figure 5 below. The survey questionnaire consists of 15 test items based on a five-point Likert scale, where 1 – "Strongly Disagree" and 5 – "Strongly Agree," designed by Fieger, 2012 is used in this study. The number of test items for each aspect are as: TE – 4, GS – 4, LE – 6, and Overall Satisfaction –1(Fieger,2012;Lin,2021).The detailed survey elements of post-coursesurvey are presented in table4.

5. Results And Discussion

The participant responses gathered from pre-survey and post-survey were analyzed and discussed below as Demographic analysis and Reliability analysis.

A. Demographic Analysis

The pre-course survey aimed to obtain the demographic profiles of the target participants. The survey questionnaire contains 11-items focused on: general information, financial background, and attitude towards pursuing engineering (Lathigara et al., 2021). According to Burtner, "Determination towards pursuing engineering degree is influenced by the academic preparedness of the students, socio-economic status, purpose of doing engineering and perception of professional status achieved after completion" (Burtner, 2004). These factors influence

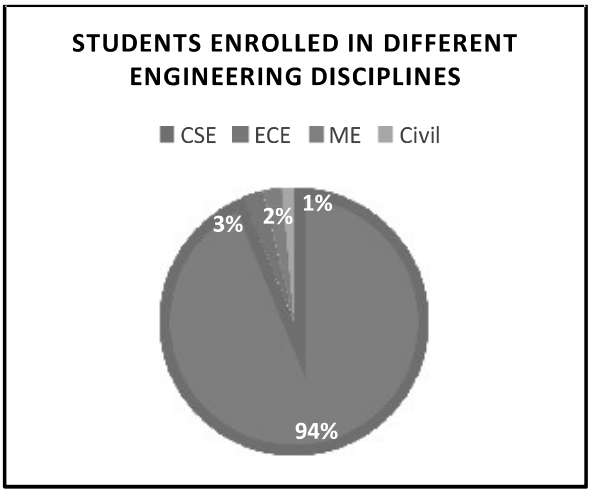

Fig. 6 : Distribution of Participants as per Engineering Disciplines

the decisions of the students while studying engineering. Therefore, through the pre-course survey, we tried to find the determination of the students. The population of this study was 1000 freshmen engineering students at Chitkara University.

From figure 6, it is very much evident that the maximum participants (94%) are enrolled in the Computer Science Engineering (CSE) discipline, and the rest 3% in Electronics and Communication Engineering (ECE), 2% in Mechanical Engineering (ME), and 1% in Civil Engineering (CE). The number of female participants is 213, representing 24% of the overall strength. In contrast, the count for the male participant is 673, representing 76% of the total strength. The average age of all the participants is 18.2 years.

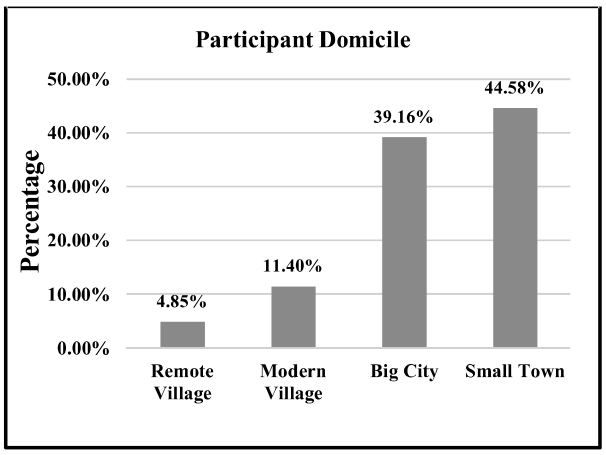

Fig. 7: Distribution of Participants According to Their Domicile

The distribution of participants as per their domicile areas is represented in figure 7. It is inferred from the data that 83.74% of students belong to big cities and towns, reflecting the access to modern resources and facilities such as high-speed internet for self-learning, which helps in making a clear vision to pursue higher education compared to the students belonging to remote villages.

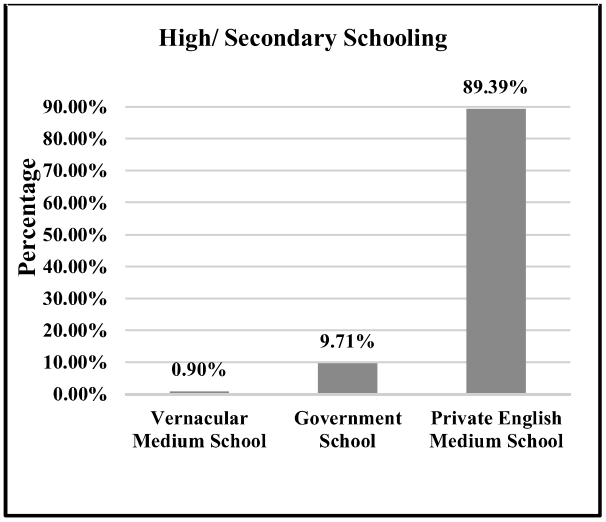

Fig. 8: Distribution of Participants Schooling Background

Figure 8 shows that 89.39% of students have done their schooling in private English medium schools, which means that language or medium of instruction deeply influences the choice of taking engineering course. These responses further helped the academic mentors to identify the students who may need help in writing the reports or may feel cautious about expressing their thoughts. Further, figure 9 shows the distribution of participants' vision towards professional goal attainment. From the responses, the prime reason to opt for Engineering as a professional Career is to get a job in a multinational company, whereas 27.31% of students like to serve society through the skills they attain. 24.72% have goal orientation towards ruining their own start-up venture through.

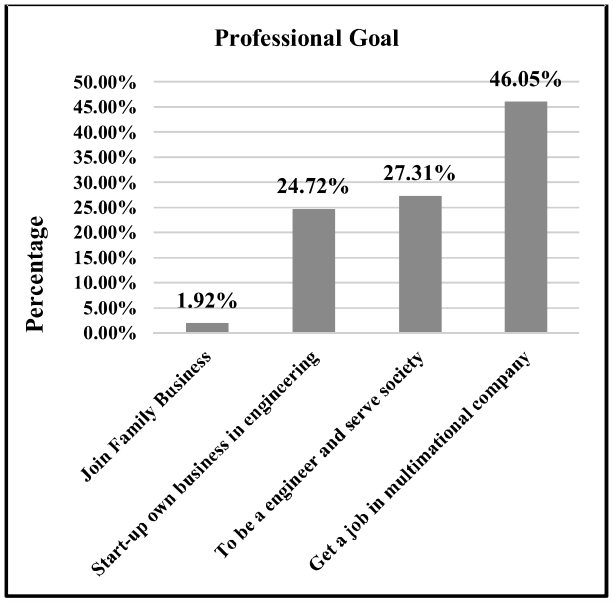

Fig. 9: Distribution of Participants Vision towards Professional Goal

Engineering and being an entrepreneur. Rest 1.92% of students are willing to carry forward their family business. These responses helped in the alignment of the overall execution of the course based on the topics and interests of the students.

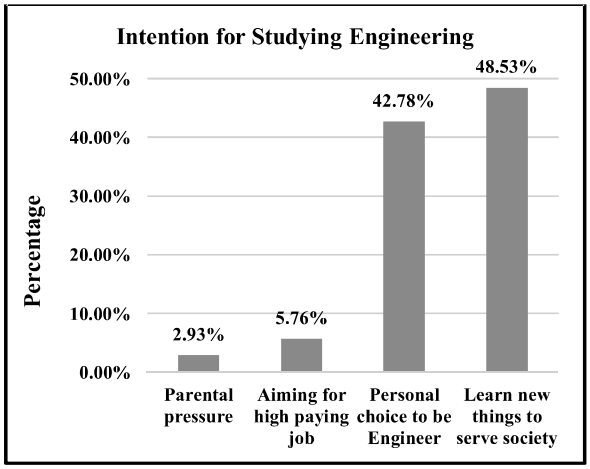

Fig. 10: Distribution of Participants intention to Pursue Engineering Course

Figure 9 shows the purpose of the student towards pursuing engineering education and zeal towards being a lifelong learner. It is evident from the data that student 48.53% of students intend to learn new things, like to innovate, and solve real-time problems to serve society, and 42.78% of students show their personal choice to become an engineer. Hence, more than 97% of the target population was initially motivated to explore the emerging trends and technologies. Only 2.93% of students reported pursuing engineering courses under parental pressure, and proper handholding and guidance were required to be given.

B. Reliability Analysis

The post-course survey aims to estimate student satisfaction with the proposed course on emerging technology. It has three sub-components: Teaching-learning Experience (TE), Generic Skills (GS), and Learning Experience (LE). The questionnaire was shared with 1000 engineering students using Google Forms (https://forms.gle/siChCg8XJfE1K3m7A), and 886 responses were collected and analyzed using IBM Statistical tool SPSS V14. A reliability analysis test was carried out on the sample data collected to measure the internal consistency of the test items represented through the Cronbach alpha value. Table 3 represents the Reliability statistical results for overall test items, and Table 4 represents descriptive statistics of the same items.

Table 3: Reliability Statistics of Post-Course Survey

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
0.957	0.959	15

Table 4: Test Items Descriptive Statistics

Test Items Statements		Mean	S.D.	Cronbach's Alpha if Item Deleted	Cronbach's Alpha
TE1	*Industry experts communicated the topic content effectively*	4.0677	0.85960	0.954	0.811
TE2	*Experts made the topic as interesting as possible*	3.9549	0.96854	0.953	
TE3	*The information about the conduct of the session was given well before the time*	3.9831	1.09480	0.958	
TE4	*I was allowed to ask questions during the session.*	3.7675	1.18088	0.958	
GS1	*These sessions develop my problem-solving skills.*	3.7799	1.08408	0.953	0.885
GS2	*Report writing helps me in improving my skills in written communication.*	4.0237	1.01096	0.954	
GS3	*As a result of these sessions, I knew about the latest trends and technology in engineering.*	4.0011	1.01570	0.953	
GS4	*These sessions made me more confident about my ability to learn.*	4.2280	0.90069	0.954	
LE1	*These sessions have helped me think about new opportunities in engineering.*	4.2257	0.90126	0.954	0.915
LE2	*The sessions helped me understand the requirement of the industry*	4.1332	0.92808	0.953	
LE3	*The sessions improved my perspective on professional Career*	4.0011	0.98060	0.953	
LE4	*I am clearer and more confident about the technology I must focus on*	4.0372	0.96713	0.954	
LE5	*I can identify the skills I need to acquire in the next 3 years of engineering*	3.9729	1.01478	0.953	
LE6	*My motivation to do engineering as a career increased after attending these sessions*	4.2698	0.89476	0.955	
OS	*Overall Satisfaction: Overall, I was satisfied with the quality of this course on Emerging Technologies.*	4.0034	0.96550	0.952	0.952

The internal consistency of the test items observed from statistical results represented by Cronbach's Alpha coefficient is: $\alpha = 0.957$, which infers that the Reliability of the data is excellent and fit for analysis. Table 4 shows the mean and standard deviation (S.D.) values for test items ranging from 3.7675 to 4.2698 and 0.85960 to 1.01570, respectively. TE4 has the lowest mean, and LE6 has the maximum mean score, which concludes that the student feels that they received less time and opportunity to interact with industry experts. As the sessions were conducted in online mode, due to the comprehensive class strength of participants and time constraints, it was the limitation of the course which is very well represented by the mean score of items TE4 in table 4. On the other hand, the LE6 item scored the highest mean score, which infers that the students feel more motivated towards pursuing engineering as a career after undergoing a course on "Introduction to Emerging Technologies." The students got the chance to see, listen and interact with top leaders of the industry and understand the current role of engineers in the industry closely under their guidance. This is further supported by the mean score value of the overall satisfaction test item (OS), which is 4.0034, showing a positive inclination towards acceptance of the course by most of the participants. The inter-item correlation (r) between test items was observed as $r = 1$, representing a good correlation amongst the items put under test. Further, Cronbach's Alpha coefficient (α) for TE is 0.811, GS is 0.885, and LE is 0.915, showing that all components have good internal consistency between themselves.

5. Conclusion & Future Scope

The extent to which technology pervades our daily lives is unparalleled. It is impractical to think of ourselves without the aid of technology in this modern era. The constant rise of technology trends has increased the importance of acquiring and comprehending the industry-required abilities well before beginning a career. In the past and currently, HEIs have laid the groundwork for a variety of technology-focused courses for students. With the launch of NEP2020, the freedom to opt for more holistic and multidisciplinary approaches in technical and non-technical courses has been allowed to the contemporary learners. Also, with the rise of the Covid-19 pandemic, the boom in online teaching rose manifolds. This allowed student to learn from anywhere and at any time. Engineering students in their first year may find it helpful to discover their skill set if courses like "Introduction to Emerging Technologies" are introduced. The inclusion of this course provided students an opportunity to interact with industry experts and understand technological trends directly from industry mentors. The course outcome was designed in such a way that on successful completion of the course, the student would be able to choose his/her technology specialization with more ease than the present. This course will equip students with the most up-to-date skills necessary to enter the industry upon graduation. The pre-course survey results show majority of students are from urban areas and willing to pursue engineering education to serve for society and solve societal issues. To assess student satisfaction with the prescribed course, a post-course survey was conducted. The Cronbach's Alpha coefficient for the test items came to be 0.957, representing excellent Reliability amongst the data. After successfully completing the course, students report higher levels of motivation to pursue a career in engineering. In the future, a hybrid model for teaching-learning can be employed to deliver this course. Live interaction in physical space can add more weight to their motivation and offers them added privilege to interact with industry mentors.

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