Evaluating the Impact of Participation in the SAEINDIA Collegiate Club Activities on Engineering Education

[1] Rolvin D'Silva, [2]Binu K G, [3]Glenson Toney, [4]Sathyendra Bhat, [5]Yathish Kumar, [6]Vinoothan Kaliveer, [7]Roopesh K, [8]Ashwin Shetty, [9]Vijay V S

[1,2,5,6,8,9]Department of Mechanical Engineering, St Joseph Engineering College, Mangaluru
[3]Department of Electronics & Communication Engineering, St Joseph Engineering College, Mangaluru
[4]Department of Computer Applications, St Joseph Engineering College, Mangaluru
[7]Department of Business Administration, St Joseph Engineering College, Mangaluru
[1] rolvind@sjec.ac.in , [2] binuk@sjec.ac.in, [3] glensont@sjec.ac.in, [4] sathyendrab@sjec.ac.in, [5] yathishk@sjec.ac.in, [6] vinoothank@sjec.ac.in, [7]roopesh@sjec.ac.in, [8]ashwins@sjec.ac.in, [9] vijayv@sjec.ac.in

Abstract— **The paper assesses the impact the involvement of Engineering students has on the academics, employability and personal development in SAEIndia Club. The study discusses the skill gap in engineering education and the degree of impact of extracurricular activities in promoting holistic development of engineering graduates through a thorough review of literature. Using a mixed approach of multiple statistical analysis which include correlation analysis, paired t-Tests and Chi-Sqaure tests, the paper evaluates the viable outcomes that the candidates have experienced in terms of their leadership development, career advancement, academic performance and alignment of the activities of the club towards curriculum. The outcomes indicate significant implications on the candidates who involve in the club activities for a longer period with improvements evident on lines of improved communication skills, project management abilities, and at large leadership skills The influence is found to be uniform across demography: both male and female though a considerable difference is found in leadership positions held with male candidates holding higher positions. This difference is attributed to the factors like travel, physical exertions and limited facilities at the competition sites which is detrimental and also refers to creation of a conducive environment across the competitions at various stages to make it apt for female participants as well. While the impact is evident and promising, the study also refers to the fact that the activities and objectives need to be streamline to cater to a larger audience and hence help building the essential skills both technical and life skills. The data backed study points at the difference that the club has made to the candidates who were part of it. This refers to the need for more technical clubs that can drive skilling and aid in preparing engineers who are future-ready. This will also enable institutions to bridge the gap between knowledge delivered in classrooms and the practical skill sets that the industry looks to help graduates build a career in the contemporary world.**

***Keywords*—Academic Performance, Employability, Engineering Education, Extracurricular Activities, Leadership development, SAEIndia Collegiate Club, Skill Development.**

ICTIEE* Track*: Pedagogy of Teaching and learning

ICTIEE Sub-Track: The art and science of Teaching-Pedagogical Insights for educators aligning with NEP 2020.

I. INTRODUCTION

ENGINEERING education in India has historically fostered an orientation to understanding the theory without limited inclination to the application and development of skills (Gayathri, 2024). Though the model is very good at making significant numbers of graduates, it has been criticized for failing to make the students develop practical skills and competencies relevant to a contemporary workforce (Ayshan et al 2023). As India marches aggressively to be a global technology and innovation leader, its engineering education system is being now increasingly realized that it needs to shift from an entirely knowledge-based frame to a system stressing on building the necessary skills of problem-solving, communication, and team working capability (Thanikachalam, communicating in 2023). Though work has been done recently to make the Indian engineering curriculum current by updating content and including modern theories, this approach has also not beeneffective in seeing these graduates develop essential skills needed for succeeding in the current workplace. Even with such curriculum upgradations, the curriculum is still devoid of variation, and emphasis is not being given to some essential skills like problem-solving, communication, leadership, teamwork — which are the most important skills in the overall fast-changing technology-driven world (Kapoor, communications 2023, Marco, 2023).

This is a serious issue where the output generated through classroom teaching and imparting to the students does not match the needs at work, thus defeating the whole purpose of engineering education. While students pass out with a good theoretical base, most often they fail to implement such theories in action, where team effort, innovation, and practical solution implementation are vital (Ruşen, M, 2004). This gap in the education has serious implications, not just for the employability issues of engineering graduates, but for the competitiveness of the Indian engineering sector globally

Rolvin D'Silva
Department of Mechanical Engineering, St Joseph Engineering College, Mangaluru
rolvind@sjec.ac.in

(Toney et al., 2024). Also, most of the engineering colleges, especially in rural and semi-urban areas, lack funds and infrastructure for effective practice-oriented teaching, which worsens the situation even more (Hiwarekar, 2023). Although the curriculum is based on the most advanced theories, research shows that the traditional ways of relaying this knowledge, predicated to a large extent on lectures and written examinations, leave very little room for active learning or for learning how to handle complex problems relative to real-life situations. For this reason, many graduates are not well-prepared to serve their place in today's workforce, where adaptability, creativity, and the ability to work in multidisciplinary teams are a must.

In addition, a big challenge is also seen to the fact that in most of the cases many faculties serving in engineering institutions are not practical enough or rich in industrial exposure themselves, that is actually necessary to reduce gaps between the curriculum theory and practice. Such faculty members further widen the gap between the competencies inculcated through engineering degree programs and relevant industry requirements of job markets (Kulkarni et al., 2023). This emphasis on the theoretical nature of education is also represented in the assessment and evaluation systems used in Indian engineering education. The traditional modes of examination have aspects that test more on the memory and understanding of theoretical knowledge than being able to elicit the levels of development that would enable the same students to apply such knowledge in practical terms. The model of assessment is not founded on any incentives for the acquisition of practical skills, in addition to the fortifications it creates for a narrow definition of academic success that is increasingly divergent with the modern economy's demands. The changing scenario of engineering education in India needs a serious rethink on how some of the most important skills of the 21st century in the present scenario—namely, problem-solving, communication, leadership, and teamwork—can be effectively developed. It is believed that such competencies cannot be learned totally through classroom-based education and need to be specifically developed elsewhere with real, professionally guided technical challenges, which not only engage students but give educational institutions a compelling reason to invest in these important developmental skills.

Participation in such extracurricular activities as technical clubs and various contests is related to better performance and employability afterward. The SAEINDIA Collegiate Club works in the direction of providing students with exposure to in-depth engineering projects that provide a symbiotic exposure of theoretical learning with practical hands-on skills. Such co-curricular interventions gain importance in the context of demand-increasing towards engineers who are technically sound and who, at the same time, are equipped to handle the complexities occurring in today's engineering practices. In this background, low employability of the engineering graduates in India results in a crying demand for educational strategies that definitely feature skill development exercises along with the traditional academic learning. Co-curricular interventions such as the SAEINDIA Collegiate Club for vehicle design and development provide a great opportunity for students to work with others in a team on complex engineering projects related to the design, development, and testing of vehicles that simulate as much as possible the challenges posed in real work. These projects apply theoretical knowledge to real-world problems, and through that exercise, students acquire a wide range of technical and soft skills which are going to be relevant to future learners (Underdahl et al. (2023).

SAEINDIA Collegiate Clubs are a platform for students to try out hands-on learning activities that have an impact beyond the class curriculum. By designing a project and developing the vehicle, the student undertakes managing project dynamics, functioning within real-world constraints, and communicating the ideas correctly. Such experiences bequeath them golden opportunities to develop critical competencies for problem-solving, leadership, and teamwork—skills often underemphasized in traditional engineering programs (Gadola, 2019). What is more, the professional challenges created by these co-curricular activities incentivize students and educational institutions to invest in skill development. This way, high-achieving students are in a position to strive for excellence not only by managing to apply classroom knowledge practically but also by gaining a marketplace advantage through such projects. It will, in turn, call on educational institutions to support these efforts, realizing the role they play in preparing students for demands of the modern workforce.

The huge potential for co-curricular interventions, like the SAEINDIA Collegiate Club, demands that their contribution toward development in students' needs to be rigorously examined. There is considerable anecdotal evidence that participation in these sorts of activities leads to improvement in both academic and professional competencies, but hard empirical evidence on both quantification of improvement and its optimization is missing so far. This research will try to fill that gap by assessing the impact of participation in the SAEINDIA Collegiate Club on academic performance, employability, and overall skill development for engineering students. This study attempts to explore an outcome for those students who undergo the cocurricular activities in order to come out with substantial insights of how the engineering education in India could be restructured based on the modern workforce needs. The potential of this research, therefore, indicates a chance to inform educational strategies by ensuring that future engineers are technically competent and competent in the varied skill set demanded to perform in the dynamic and collaborative work environment today. If India is to realize its global leadership ambitions in technology and innovation, no better time could be appropriate for a more skill-oriented approach in the world of engineering education.

II. SAEINDIA COLLEGIATE CLUB ANNUAL PROCESS

The SAEINDIA Collegiate Club through its standardized operations functions as an important co-curricular initiative in many engineering education institutions across the country. The experiential learning process envisaged in this initiative provides students with an opportunity to apply the theoretical knowledge gained during the course of their education in

designing and developing All-Terrain Vehicles. The developed vehicles are then taken for the national level SAEINDIA BAJA competitions that offer students to assess their vehicles and understand the strengths and weaknesses of their designs. The multidisciplinary nature of the work allows students to engage with peers from different disciplines and skill sets, thereby making them industry ready. The operational process of the club allows students to encounter engineering and managerial complexities that simulate real-world product development challenges. The primary objectives of the Club is to design and develop All-Terrain Vehicles that are either IC Engine powered for competing in mBAJA SAEINDIA competitions or that are electric powered for taking part in eBAJA competitions (Alajmi et al., 2015). The annual process followed by the SAEINDIA Collegiate Club is illustrated in figure 1. The annual commencement of activities of the club follows the release of the annual calendar of events by SAEINDIA (Rao M, 2015). The schedule of activities leading to the virtual and main BAJAcompetitions acts as the roadmap for the participating teams. The release of the calendar of events signals the commencement of the project with the members engaging in drawing up the strategic plans for the expected season's performances. This is followed by the recruitment of members for various teams and setting of project goals and scope of work. A notable factor in the operations of the SAEINDIA Collegiate Club, being studied in this work, is the degree of autonomy provided for the students by the institutional management and the faculty mentors. This autonomy is especially evident in the selection of members through interview processes that are conducted by the student leaders based on the needs of each team. The autonomy, therefore forms a cornerstone of the experiential learning built into the operations of the club. Students brainstorm to arrive at the various requirements of the teams, that range from roll-cage design to brakes, suspensions, transmissions and other subassemblies of the ATVs. The students of Department of Mechanical, Electricals, Electronics and Computer Science Engineering are allowed for the interviews. Roles and responsibilities are also envisaged for website development, documentations, marketing and branding. The student leadership team is also formed through internal elections. This allows the participating students a live experience in leadership dynamics and project management principles (Lacey et al., 2020). The overall structure of the BAJA events forces the students to engage in workmanship that is real-world and allows them to experience the impact of leadership on qualityof work and effectiveness of teamwork. The process therefore allows natural leaders to flourish and others to imbibe leadership traits.

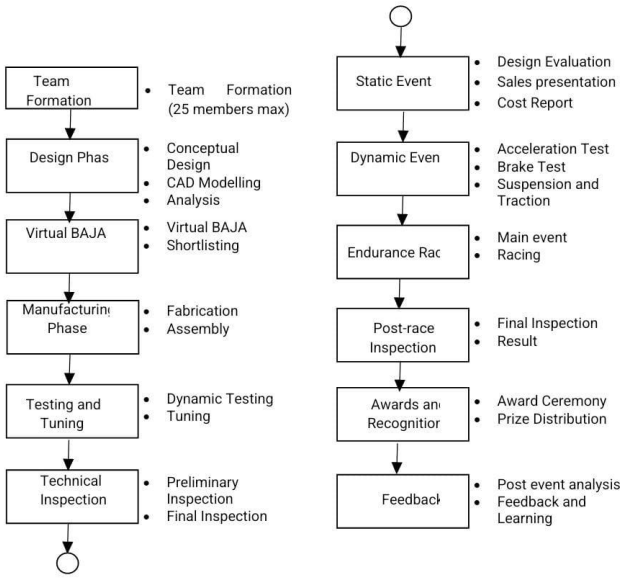

Fig 1. Annual Process of SAEINDIA Collegiate Club

Unlike the other academic projects of the students, the SAEINDIA projects offers the students an opportunity to handle a significantly higher budget that usually amounts to 10 Lacs INR and more. Students have the responsibility of carrying out estimates, preparing the budget for considerations of materials, equipment, and other critical purchases and expenses. This component of the SAEINDIA BAJA project teaches students the importance of financial prudence and the impact of financial decisions on the success of the project. Time management is another aspect that students learn during the process. They take the ownership of balancing their academic responsibilities with the demands of the project. The pressure to meet the strict SAEINDIA deadlines resembles the high-stakes environment of professional engineering, where delays and overrunning the deadlines can lead to elimination and loss of capital. One more aspect of importance is the experiences gained by students in conflict management and conflict resolutions. Differences of opinions arising out of technical disagreements or interpersonal issues, needs to be addressed in-house and necessitates the application of strategies to maintain team harmony and ensure that the project stays on track. The students also work towards raising sponsorship for their activities within the guidelines of SAEINDIA and the institutional norms. This allows for significant outside world interactions. The process involves preparing and delivering presentations to industry representatives. Students learn how to present their project in a professional manner, highlighting its value to potential sponsors and the broader community. This contributes to their communication and negotiation skills. The students will also realize the need to market their work and build brand awareness for their clubs ATVs.

As illustrated in Figure 1, the annual process of the SAEINDIA Collegiate Club begins with the formation of a team, limited to 25 members as per the SAEINDIA guidelines, where students with diverse skills and strengths are selected to fill necessary roles such as project management, design, fabrication, and testing. Following team formation, the process moves into the design phase, where the team engages in

conceptual design, followed by CAD modeling using industry standard tools such as Solidworks. The modeling is followed by analysis, typically using ANSYS and other industry standard platforms to develop the vehicle's overall architecture. The design phase is important as it provides students with two main aspects: a) the opportunity to apply theoretical knowledge to develop the designs and b) the opportunity to innovate within the guidelines. The students have to balance innovation with feasibility. After completing the design phase, the team participates in the Virtual BAJA event, a preliminary round where their designs are presented to a panel of experts. This event simulates real-world design reviews and emphasizes the importance of effective communication and presentation skills. Successful teams are shortlisted to advance to the manufacturing phase, where the vehicle is physically built through the fabrication of components and assembly. During this phase, students apply their technical skills and learn about the challenges of prototyping and product development. The manufacturing and assembly phase is followed by the important state of static and dynamic performance testing. The testing phase is used to evaluate the key performance parameters such as acceleration, braking, and overall handling of the ATV. Based on the results, the vehicle is tuned to optimize its performance. This iterative testing and refinement process is critical for improving the vehicle's reliability and efficiency. Before the competition, the vehicle must pass a series of technical inspections, ensuring compliance with safety and design standards. These inspections mirror real-world regulatory compliance processes, teaching students the importance of adhering to industry standards (Kumar et al., 2021). The competition itself begins with the static event, where the team's design is evaluated by judges through presentations that include design rationale and cost reports. This event tests the team's ability to justify their design choices and manage project costs, simulating scenarios where engineers must present their projects to stakeholders. The dynamic event follows, where the vehicle's performance is rigorously tested in areas such as acceleration, braking, and suspension. The main event of the competition is the endurance race, which tests the vehicle's durability and performance over an extended period under challenging conditions. This race simulates real-world conditions where vehicles must perform reliably over long distances.

The endurance race is followed up with a post-race inspection to assess the deterioration and damage of the components and the vehicle as a whole. The results of the competition are then announced based on the vehicle's performance across all events, emphasizing the importance of durability and reliability in engineering design. The teams that perform well are awarded and allotted with All India Rankings that showcase the standings of the teams on the national level. This recognition is valuable for students' professional careers. The BAJA events also offer placement opportunities. Top mobility companies attend the BAJA competitions and conduct interviews to select students for different roles. The project is completed with proper documentations, review meetings, and feedback sharing that forms the basis for the next season.

The club through its operations offer students the opportunities to take on leadership roles and manage the various aspects of vehicle development for mBAJA (IC Engine based) and eBAJA (Electric ATV. The hands-on experience gained through participation in the SAEINDIA Collegiate Club equips students with practical skills that are highly valued by employers. The ability to apply theoretical knowledge to develop engineering systems and also manage projects within constraints makes these students more industry ready. Owing to the struct deadlines, it is often observed that the students are forced to deliver results under pressure, thus making them significantly resilient and equipped to face industry challenges. Students find direct relevance of the core aspects of engineering, especially those related to material properties, design of machine elements, structural designs, transmission systems, brakes and clutches, etc., that are discussed in the curriculum. The activities within the SAEINDIA Collegiate Club are designed to complement the engineering curriculum, ensuring that students gain practical experience that aligns with their academic studies. The impact of the SAEINDIA Collegiate Club activities on the above four competencies is the subject matter of this study and is discussed in the subsequent sections.

III. METHODOLOGY

The paper evaluates the impact of the SAEIndia Collegiate Club on the student members. The survey included alumni who graduated between 2020 through 2024 and were involved in the activities of the club during their course of graduation. The survey covered their demographic details which included age, gender and their year of graduation, their involvement in the club activities, leadership roles (if any) they have held, their perception on the impact of the club on their academics, projects, technical skills, placements, employability, networking and career progression. It also included the duration for which the alumni was part of the club. The survey also had qualitative questions on the impact of club in career and personal development. The structured approach followed to determine the impact of the club on the alumni in this research encompasses the following:

A. Survey Design and Data Collection

The research includes responses from 97 alumni, including 36 females and statistical analysis mentioned in the step B were performed. The respondents included candidates who graduated between 2020 to 2024.

B. Statistical Analysis and Hypotheses

The following statistical tests were conducted to evaluate the survey responses.

- Correlation Analysis
- T-Test for Gender-Based Impact and impact of Leadership Roles
- Chi-Square Test of Independence

Correlation analysis is performed to determine the direction and strength of the relationships between the factors under consideration: leadership positions held, years of association,

impact on academics, employability and personality development.

H_1: There is a significant correlation between the factors.

The correlation coefficient r is calculated using equation 1, where n refers to the number of pairs of scores, and x, y are the individual sample points. T-Test for Gender-Based Impact is performed to determine the possibility of statistically significant difference in the impact on the male and female participants based on their involvement in the club.

$$r=\frac{n\sum(xy)-\sum x\sum y}{\sqrt{(n\sum x^2-(\sum x)^2)(n\sum y^2-(\sum y)^2)}} \quad (1)$$

H_2: There is a significant difference between the impact on male and female participants.

T-Test for leadership based impact is evaluated to check if a leadership role in the SAEIndia Collegiate club has had a distinctive impact on the factors, such as academic performance, employability, and the candidate's personality development.

H_3: Leadership roles have a significant impact on the outcomes.

The t stats is calculated using equation 2,

$$t=\frac{Mean(X_1)-Mean(X_2)}{\sqrt{\frac{s_1^2}{n_1}+\frac{s_2^2}{n_2}}} \quad (2)$$

where s_1 and s_2 are the corresponding variances of Mean(X_1) and Mean(X_2) respectively, while n_1 and n_2 refer to the sample sizes. To determine the significant relationship between the categorical variables like leadership positions held, impact on academics and employability, a Chi-Square Test of Independence is performed.

H_4: There is a significant relationship between the categorical variables.

$$\chi^2=\sum\frac{(O_i-E_i)^2}{E_i} \quad (3)$$

The Chi-square value for significance is calculated using equation 3, where Oi represents the observed frequency and Ei the expected.

C. Interpretation of Results

The results of these tests are interpreted to determine the statistical significance and study the impact of the club in the all round development of the candidates and acts as a robust framework to deduce conducive conclusions from the survey responses and plan for measures to improve and elevate the impact of the beyond academics initiatives like the SAEIndia Student Club.

IV. RESULTS AND DISCUSSION

The correlation heatmap represented in Figure 2 provides insights into the relationship between various factors considered to make an impact in the candidates profile. A moderately positive correlation of about 0.56 is obtained between the duration a student has been a member of the club and the leadership positions that were held. This indicates that longer involvement in the club leads to holding positions of responsibilities as well. A moderate correlation of 0.53 between the membership period and the personality development of the candidate is also found which hints that extended engagement contributes to personality development which is a positive impact. Another appreciating impact is found on academic performance with a correlation of 0.32 which refers to the fact that assuming leadership role has aided candidates improved academic performance (based on individuals perception). This

TABLE I
JUSTIFICATION AND SEQUENCING OF STATISTICAL TESTS FOR ANALYZING SAE BAJA CLUB IMPACT

Statistical Test	Objective	Statistical Justification	Rationale for Sequential Order
Correlation Analysis	Assess the strength and direction of linear relationships between continuous variables (e.g., years of academic performance).	Serves as an exploratory analysis to identify significant pairwise correlations, informing the structure and focus of subsequent inferential tests.	Conducted first to identify foundational correlations that guide further hypothesis testing and analysis.
Independent Samples T-Test (Gender-Based)	Evaluate whether there are statistically significant mean differences in outcomes between male and female participants.	The T-test is optimal for comparing means between two independent groups, ensuring gender-based variations are identified prior to further analysis. It also assesses differences between two groups (leaders vs. non-leaders) providing a comprehensive analysis of role-based effects.	Positioned early to control for potential gender confounding effects, ensuring accurate interpretation of subsequent analyses. Follows gender analysis to explore the distinct influence of leadership roles, building on identified gender differences.
	Investigate the impact of leadership roles on outcome variables, comparing both binary and multi-level leadership involvement.	Follows gender analysis to explore the distinct influence of leadership roles, building on identified gender differences.	Placed last to synthesize and confirm the influence of leadership roles, integrating findings from prior analyses.
Chi-Square Test of Independence	Examine the association between categorical variables (e.g., leadership roles, membership duration) and categorical outcomes.	The Chi-Square test is robust for testing independence between categorical variables, determining whether observed associations are statistically significant.	Placed last to synthesize and confirm relationships between categorical variables, integrating findings from prior continuous and categorical analyses.

may be due to the essential life skills candidates imbibe as leaders: taking responsibilities and managing time effectively. Also, a positive correlation of 0.46 is found between the factors, academic curriculum and personality development. This points that the activities of the SAEIndia Collegiate Club has relevance to the academic goals of the graduating candidates and contributes to their overall personality development.

Fig 2: Correlation Heatmap between the different factors of the SAE BAJA Survey Data. a) Years of Association, b) Leadership Position in the Club, c) Effect on Academics, d) Effect on Academic Project, e) Effect on Employability, f) Aided in Networking, g) Personality Development.

TABLE II
T TEST BASED ON GENDER

Variable	T-Statistic	P-Value	Interpretation
Years of Association	0.340624701	0.735068308	No significant difference
Leadership position in the club	3.090799401	0.002809772	Significant difference: Males more likely to hold leadership positions.
Effect on Academics	0.300999817	0.764562848	No significant difference
Effect on Academic Project	-0.226444107	0.821403333	No significant difference

An evaluation of between employability and networking effectiveness factors results in a positive correlation of 0.33. This acknowledges that the effective networking opportunities in the club contributes to improved internships and placements. Majority of the participants rated the impact of the club on job placement and career advancement on a higher scale. Since the data hinted at the higher scale and lacked variability, correlation on those factors could not be deduced. But the responses acknowledge the positive impact the club had on these variables as well. Hence we reject the null hypothesis and conclude that there is significant correlation between factors and their impact on the candidates, especially leadership roles leading to improved academic and personality development vehicle club activities in line with curriculum and the networking opportunities impacted employability and personal growth positively. The T-test on leadership, membership duration,

TABLE III
T TEST RESULTS (LEADERSHIP VS. OTHER FACTORS)

T-Statistic	P-Value	Interpretation	T-Statistic
Years of Association	4.93519027	0.0000146	Significant difference: Leaders have longer membership duration.
Effect on Academics	3.437848233	0.000901208	Significant difference: Leaders report better academic outcomes.
Effect on Academic Project	1.945940698	0.054688032	Near significant difference: Leaders perceive better alignment.

academic performance and alignment with curriculum in the Collegiate club shown in Table 1 highlights distinct perspectives. With a t-stats of 3.09 and a corresponding p-value of 0.0028, a statistically significant difference on the leadership positions held between male and female suggests that more male candidates have held positions of responsibilities involved and has to be investigated. Qualitative analysis also indicates that this disparity arises from the extended working hours required by the team, coupled with the extensive travel and suboptimal conditions at numerous competitions held nationwide. Also, the demanding physical tasks associated with these events contribute to the challenges faced by female candidates in pursuing leadership roles.

However, the duration that a male or female candidate has had as members of the Club showed no statistically significant difference with a t-stats of 0.34 and a p-value of 0.735 which points that the gender has no implications on the membership duration which is a positive indicator. Another interesting observation is that the academic impact of the club has been uniform across gender with both male and female showing positive impact, supported by a t-stats of 0.30 and a p-value of 0.76 accepting the hypothesis that there is no significant difference in impact between male and female candidates. This is a favorable indication. The club's technical projects alignment with the academic curriculum shows no statistically different significance. The t-statistics of -0.23 and the p-value of 0.821 refers that the impact has no implication based on the candidate's gender. Other factors with responses positively inclined to higher scale and showed little or no variability in the scale were not considered for the test as they indicated positive impact with identical responses. Another major factor that the research explored was the impact of the candidates holding leadership roles on academic performance and also if this had a significance based on the duration a candidate has been a member of the club. Table 2 shows the significance of these factors and highlights the insights drawn. The study clearly points at the statistical significance between the membership duration and the leadership positions held by the candidates. As indicated in the correlation analysis, the t-test also finds a strong positive impact of the leadership positions on the academic performance when compared to the candidates who held no roles of responsibility. Between leaders and non-leaders there is also a near significant difference in how they perceive the

degree of alignment between club technical projects and their academic curriculum, which leaders generally view as better. shaping these results. Leadership positions within the club yield important links to academic success (χ^2 = 12.66397, p =

TABLE IV
CHI SQUARE TO DETERMINE SIGNIFICANCE IN CATEGORICAL VARIABLES

Variable 1	Variable 2	Chi-square	p-value	DOF	Interpretation
Gender	Membership duration	7,85195341	0,54913199	2	No significance
	Leadership Positions	7,16568273	0,00743114	1	Significant Association
	Academic Performance	4,00536696	0,1349726	1	No significance
	Alignment with Curriculum	4,43659889	0,10879413	2	No significance
	Career Advancement	0	1	1	No significance
Membership duration	Leadership Positions	34,3744389	0,0000768	2	Significant Association
	Academic Performance	33,3802897	0,01500614	1	Significant Association
	Alignment with Curriculum	48,24858868	0,00018389	4	Significant Association
	Career Advancement	0	1	2	No significance
Leadership Positions	Academic Performance	12,6639711	0,0017785	2	Significant Association
	Alignment with Curriculum	3,57432295	0,1674324	2	No significance
	Career Advancement	0	1	2	No significance
Academic Performance	Alignment with Curriculum	15,1201288	0,0044584	4	Significant Association
	Career Advancement	0	1	2	No significance

This could indicate that they have a deeper link with and understanding of both the organization's activities as well as the educational purpose. Nevertheless; lack of variability in responses meant this analysis faced data challenges when examining the impact of leadership on technical skills which aid in coursework or job placement. Carrying out leadership roles in the club offers opportunities for personal growth, academic enhancement and possibly closer connection to academic and career goals hence significance of differences noticed regarding time spent as membership period and academic performance. To sum up, leadership positions held by individuals within SAE BAJA Student Club are associated with longer membership duration and higher grades thus almost significantly affecting alignment to the curriculum so it can be concluded that people holding such positions influence their overall experiences within the group positively thus leading them towards success. By examining Chi-square analysis presented in table 5, it can be observed that these dependencies denote the information of different variables related to the SAE BAJA Student Club. The analysis reveals that there is no significant association between gender and years of association (χ^2 = 7.851953, p = 0.549132), effect on academic performance (χ^2 = 4.005367, p = 0.134973), influence on project work for academics (χ^2 = 4.436596, p = 0.108794), career enhancement (χ^2 = 0, p = 1) or personal development (χ^2 = 1.886865, p = 0.596217). However, a significant association was found between gender and holding a leadership position within the club (χ^2 = 7.165683, p = 0.007431), suggesting that gender may influence leadership roles. Further analysis highlights several outcomes with strong associations to years of affiliation including leadership positions (χ^2 = 34.37444, p=7.68E-05), impact on academics (χ^2 = 33.38029, p=0.015006), impact on academic projects (χ^2=48.24589 P=0.000138) among others such as personality development (χ^2=190.4911 P=1.58E-26). This means duration in the club is paramount when it comes to 0.001778) as well as for personality growth (χ^2 = 17.84929, p = 0.000472), however, no notable associations were observed with either academic projects or career progression. Further analysis indicated that there is a significant relationship between academics and academic projects (χ^2 = 15.12013, p=0.004458) as well as between academics and personal development (χ^2 = 16.52634, p = 0.011191) thereby reiterating how interconnected personal growth and academic achievement are when it comes to clubs. On the other hand, there were no major correlations between the effect on academic projects and career advancements or between aiding in career advancements' impact on personality traits. Therefore, some aspects of club experiences may be connected while others may act separately reflecting several-sided effects of membership in the club.

CONCLUSION

This research brings out valuable insights into the multidimensional impact of SAEINDIA's collegiate club on the academic performance, employability, and holistic development of engineering students. The present study emphasizes co-curricular activities as a supplement to traditional engineering education by providing hands-on experiences that bridge gaps between theoretical classes and the requirements of today's industrial world. The data clearly shows that the more the time spent in SAEINDIA Collegiate Club, the more is the development in leadership skills, improvement in academics, and personality traits. Students who held leadership positions in the club showed better academic performance and strong alignment of activities in the club with the curriculum. These findings support that leadership roles, as a means of providing critical life skills such as time management, responsibility, and teamwork, contribute to students' overall academic success. It, however, dwells on many challenges, the

most predominant being gender inequality in participation to leadership. Qualitative analysis portrays that it could be the physically demanding nature of activities at the club, apart from the extensive travelling and suboptimal conditions at competitions, which may discourage female students from participating in leadership roles. This points to a finding: the need for institutional support to create an atmosphere that allows for more inclusivity to foster equal participation between genders. The Chi-Square analysis helped to shed more light on the relationships between various factors within the framework of the club. Of importance, it is noted that in most instances, the length of time one is involved in the club is related to positive outcomes in leadership, academic performance, and personal development. Results imply that continued exposure to the activities of the club deepens the integration between academic and practical knowledge in a manner that eventually leads to the production of more holistic and industry-ready graduates.

Though generally positive, there were areas within this study that revealed participation in clubs came out weaker. Specifically, no relationship was found to be significant with regard to career-related effect and academic projects. This perhaps would point out that while the club supports academic and personal growth, its influence on direct career outcomes may need additional focus. This finding calls for a much more effective way to align the activities of the club with those on career development, such that students gain not just academic insights but clear pathways into employment. Therefore, the contribution this research can make to the existing debate around reform in engineering education in India is immense. The findings make a case for a curriculum in which co-curricular activities are integral to programs in engineering, much like the SAEINDIA Collegiate Club. This will go a long way in enhancing the equipping of students with the varied skill set needed for survival in the complexities encountered in modern engineering landscape. Tailored intervention is needed to meet unique needs of different student demographics, so as to ensure that the benefits from participation are open to all. Looking ahead, the following points to some further areas of research and development: first, the need to investigate how these barriers to leadership participation by female students could be mitigated, either through policy changes or the enhancement of its support systems; second, that future research could continue with this group of participants to further define the career paths over time in order to explain with clarity how experiences associated with these co-curricular clubs are translated into professional success. Further, expanding the scope of the study to a wide array of institutions and other engineering disciplines would give an all-inclusive understanding of the impact of the clubs on the students' development. Conclusion: The SAEINDIA Collegiate Club is one of the most important platforms for all-rounded development of engineering students, building up not just technical but also the necessary soft skills like leadership, teamwork, and communication. When India is trying to emerge as a leader in technology and innovation, such co-curricular initiatives in the engineering curriculum would become imperative if the country is to produce the next line of engineers who are not only academically brilliant but also industry-ready. Such insights provide impetus educational institutions need to fine-tune their efforts toward producing engineers such that graduates coming out from these schools are competent enough to face all modern workforce challenges.

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