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INVESTIGATING FACTORS CONTRIBUTING TO STUDENT DISENGAGEMENT AND OWNERSHIP IN LEARNING: A CASE STUDY OF UNDERGRADUATE ENGINEERING STUDENTS

Ruth Z Hauzel*	GITAM (Deemed to be University), Hyderabad, India	rhauzel@gitam.edu
Tanuja Pattnaik	The English and Foreign Languages University, Hyderabad, India	tanuja.4294@gmail.com
Vara Ranjani	GITAM (Deemed to be University), Hyderabad, India	rvara@gitam.edu
Surya Prabha Mandela	GITAM (Deemed to be University), Hyderabad, India	smandela@gitam.in

* Corresponding author

ABSTRACT

Aim/Purpose	Despite playing a critical role in shaping the future, 70% of undergraduate engineers report low levels of motivation. Student disengagement and a lack of ownership of their learning are significant challenges in higher education, specifically engineering students in the computer science department. This study investigates the various causes of these problems among first-year undergraduate engineers.
Background	Student disengagement has become a significant problem, especially in higher education, leading to reduced academic performance, lower graduation rates, and less satisfaction with learning. The study intends to develop approaches that encourage a more interesting and learner-motivated educational environment.
Methodology	This research uses a mixed methods approach by combining quantitative data from a survey-based questionnaire with qualitative insights from focus groups to explore intrinsic and extrinsic motivators, instructional practices, and student perceptions of relevance and application of course content. The aim of this method is to make an all-inclusive exploration into undergraduate engineering

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	students' perspectives on factors contributing to this disengagement and the need for more ownership.
Contribution	Inculcating passion for engineering among learners seems demanding, with numerous educational programs struggling with issues such as a lack of interest by students and no personal investment in learning. Understanding the causes is of paramount importance. The study gives suggestions to help teachers or institutions create a more engaged and ownership-based learning environment for engineering students.
Findings	The findings revealed a tangled web influencing monotonous teaching styles, limited opportunities and applications, and a perceived gap between theoretical knowledge and real-world engineering problems. It emphasized the need to implement more active learning strategies that could increase autonomy and a stronger sense of purpose in their learning journey. It also highlights the potential use of technology in promoting student engagement and ownership. Further research is needed to explore optimal implementation strategies for online simulations, interactive learning platforms, and gamification elements in the engineering curriculum.
Recommendations for Practitioners	It highlights the complex interplay of intrinsic and extrinsic motivation factors and the need to re-look at instructional practice and emphasize faculty training to develop a more student-centered approach. It also stresses the need to look into the relevance and application of the course content.
Recommendations for Researchers	More work needs to be done with a larger, more diverse sample population across multiple institutions and varied sociocultural and economic backgrounds.
Impact on Society	Enhancing learners' educational experience can result in creating a passionate and competent team of engineers who can face future obstacles fearlessly and reduce the production of half-baked graduates unprepared for the profession's challenges.
Future Research	Conduct long-term studies to assess the impact of active learning and technology use on student outcomes and career readiness. Investigate scaling up successful strategies across diverse engineering programs. See if promising practices work well everywhere.
Keywords	disengagement, ownership of learning, engineering education, intrinsic motivation, extrinsic motivation, instructional practices

INTRODUCTION

Today, engineering is a lively and ever-changing occupation that necessitates inventiveness, problem-solving aptitude, and a deep understanding of complex ideas. However, inculcating passion for engineering among learners seems demanding, with numerous educational programs struggling with issues such as a lack of interest by students and no personal investment in learning. The dangers here are far-reaching since universities can produce half-baked graduates unprepared for the profession's challenges. Student disengagement in engineering education is a pressing concern. A recent study linked it to higher dropout rates and lower industry preparedness among graduates (Freeman & Sukunthasurie, 2018). Understanding and addressing the factors that influence student motivation and ownership of learning is crucial for improving educational outcomes and preparing future engineers. Thus, this study explores the factors influencing student disengagement in engineering education. Disengagement can manifest in several different ways in a classroom, including but not limited

to low attendance, decreased classroom participation, and poor performance on tests and assignments. The study intends to develop approaches that encourage a more interesting and learner-motivated educational environment. Consequently, this can enhance learners' educational experience, resulting in a passionate and competent team of engineers who can face future obstacles fearlessly.

Student disengagement has become a significant problem, especially in higher education, leading to reduced academic performance, lower graduation rates, and less satisfaction with learning. This issue has become even more paramount in fields where a strong foundation and perpetual commitment to learning are required. One such field is engineering. In contrast to that, students who take ownership of their learning should be given the opportunity to decide their learning objectives, select suitable learning approaches, and reflect on how well they are doing. Furthermore, developing ownership also enables the learners to take responsibility for the direction of their learning, thereby increasing understanding and retention. Keeping all these in mind, this research uses a mixed methods approach by combining quantitative data from a survey-based questionnaire with qualitative insights from focus groups to make an all-inclusive exploration into undergraduate engineering students' perspectives on factors contributing to this disengagement and the need for more ownership.

Student engagement is a crucial aspect of education that involves the active participation of students in meaningful learning activities. Student engagement constitutes more than just attending classes; it also includes how much time and effort students dedicate to their educational pursuits (Kuh & Hu, 2001). Fredricks et al. (2004) provided a comprehensive way of categorizing engagement – behavioral, emotional, and cognitive dimensions – thus offering a multifaceted understanding of the concept. Engagement is widely recognized as one of the most critical factors in academic performance. Wang and Eccles (2012a, 2012b) stressed its positive association with improved grades and enhanced learning experiences. There have been several studies that have focused on understanding what impact factors such as teacher-student relationships (Pianta et al., 2012), classroom environment (Cooper & Fry, 2020), and instructional methods have on student engagement in the classroom (Canales, 2020). Garrison et al. (2010) established the Community of Inquiry framework. This framework emphasizes the significance of interaction and collaboration in online learning. Tinto (1997) suggests interventions that promote engagement through learning communities and high-impact practices.

Samuels (2018) highlighted the significance of cultural and contextual factors impacting engagement, focusing on implementing culturally responsive teaching practices. In summary, student engagement is a complex concept that significantly impacts academic achievements and the overall quality of education. This paper begins by outlining the challenges of student disengagement in engineering education, followed by a discussion on the negative consequences of disengagement. Next, the existing literature on motivational factors and instructional practices that can influence student engagement is reviewed. This is followed by the research objectives, which aim to identify factors influencing student disengagement and explore strategies to promote ownership and motivation in engineering education. Finally, the analyzed data is presented, conclusions are drawn from the analysis, and suggestions and recommendations for teachers to increase student engagement and motivation.

NEED FOR THE STUDY

The persistent lack of engagement and low ownership of learning among engineering students remains a concern. These barriers hamper student motivation, academic results, and readiness for engineering practice. Students who are less involved with learning tend to show lower information retention, underdevelopment of critical capabilities, and inconvenience in applying the knowledge obtained to real-world situations. Consequently, such tendencies lead to students underestimating their competency in engineering and even developing a feeling of not belonging to the engineering field.

Overcoming these challenges is inevitable in improving the quality of engineering education and raising a set of professionally ready and enthusiastic engineers. This research is pivotal as it highlights

the factors that lead to demotivation and failure to take control of the learning process among students. However, this study further explores the effectiveness of different inclusive approaches, including active learning methods, real-world examples, and technology-supported tools. These approaches could eventually lead to the emergence of a learning environment that is more interesting and student-centered for engineering educators.

The results of this research will have positive implications for learners, engineering educators, and higher learning institutions. The study can make a difference by measuring the effects of strategies that heighten student learning, increase retention, and make the engineering education experience a more satisfying experience through its findings. Such results could help design curricula and instructional techniques and improve engineering education.

RESEARCH QUESTIONS

Based on the objectives of the study, the following research questions have been formulated:

1. What are the intrinsic and extrinsic motivators that influence undergraduate engineering students' engagement in learning?
2. How do current instructional practices employed in engineering programs contribute to or hinder student engagement and ownership of learning?
3. What are students' perceptions regarding the relevance and application of course content to their future careers in engineering?

METHODOLOGY

This study employed a mixed-methods approach, utilizing quantitative and qualitative data collection methods. While the quantitative methods provide a broad picture through numerical and statistical data, the qualitative methods bring forth more in-depth insights into the various aspects of this research, including students' experiences, perceptions, and expectations. Triangulation of data from both these methods strengthens the validity of the findings. All procedures used in the study adhered to ethical research protocols, including obtaining informed consent from participants and ensuring the confidentiality of their data.

- **Survey:** A self-administered online survey was distributed to undergraduate engineering students across various year levels. The survey consisted of validated scales measuring intrinsic and extrinsic motivation and open-ended questions addressing the relevance of instructional practices and course content.

  Instrument: Validated scales measuring intrinsic and extrinsic motivation and open-ended questions.

  - *Strengths:*
    - *Quantitative data:* Provides a broad picture through numerical data for statistical analysis.
    - *Validated scales:* Ensure the survey measures intrinsic and extrinsic motivation accurately and reliably.
    - *Open-ended questions:* Allow students to elaborate on their experiences and perceptions beyond pre-defined options.
  - *Weaknesses:*
    - *Open-ended questions:* May require additional coding and analysis, potentially introducing researcher bias.
    - *Self-reported data:* Students' responses might be influenced by social desirability or memory limitations.
- **Focus Groups:** Two focus groups, each comprising 8-10 students, were conducted to gain deeper insights into student experiences. Semi-structured interview questions explored

themes related to motivation, engagement, instructional practices, and student perceptions of course content.

Instrument: Semi-structured interview questions.

- *Strengths:*
  - *Qualitative data:* Provides in-depth insights into student experiences, motivations, and perceptions.
  - *Group interaction:* Encourages students to build on each other's ideas and reveal diverse perspectives.
  - *Flexibility:* Allows the moderator to probe deeper into emerging themes.
- Weaknesses:
  - *Small sample size:* Focus groups don't represent the entire population.
  - *Group dynamics:* Dominant personalities might influence discussions.
  - *Social desirability:* Students might tailor their responses to fit the group dynamic.

Validity and reliability in the mixed-methods approach: The study employs triangulation, which strengthens the overall validity of the findings.

- **Validity:**
  - The survey uses validated scales, enhancing the accuracy of intrinsic and extrinsic motivation measurement.
  - Focus group discussions can help refine survey questions for better clarity in future studies.
  - Combining these methods provides a more complete picture of student experiences, leading to more valid conclusions.
- **Reliability:**
  - Consistency in administering the survey across all participants contributes to reliability.
  - Using a standardized interview guide for focus groups ensures questions are asked consistently across both groups.
  - Reporting detailed methods and procedures allows for replication of the study, promoting reliability.

LITERATURE REVIEW

Today, one of the most significant problems in engineering education is persistent student disengagement and a severe lack of ownership in their learning. Addressing these challenges is imperative to cultivate a more fulfilling and successful learning journey for aspiring engineers. This literature review investigates recent research findings to understand more about the factors conducive to these issues, offer probable solutions, and pinpoint promising enhancement strategies.

The academic involvement of college students increases dramatically based on the combination of the course factors. On the flip side, internal motivation, which springs from a student's curiosity, interest, and conscious effort to learn, can determine the student's approach to learning. Conversely, external judgment or sustaining motivation, which comes from outside and centers on external rewards or punishments, can somehow be the extrinsic motivation type that affects engagement abilities but not all along and cannot continue the commitment indefinitely. Empirical studies have proved a link between internal and external motivation, produced mainly through teacher-centered approaches. Moreover, the perceived relevance and practical application of course content significantly impact student engagement, with a precise alignment to real-world challenges enhancing student investment in learning.

Curiosity, interest, and the desire to master the subject are at the core of intrinsic motivation, which plays a vital role in maintaining student engagement. Deci and Ryan's (2000) Self-Determination Theory distills this intrinsic motivation into the needs for autonomy, competence, and relatedness, which also determine engagement. For this reason, works by Pascarella and Terenzini (2023) emphasize the importance of meeting these needs within an engineering classroom. According to their research, the best ways to meet the needs of the learners are to give them more choices in their assignments, create an educational structure that ensures mastery and feedback, and establish communities around learning through collaboration.

Students are believed to be more inclined to be invested in learning when they perceive a direct link between the theoretical knowledge they learn in the classroom and real-world challenges and experiences. Recent research by Jamieson and Hake (2023) emphasizes the importance of integrating real-world case studies, industry guest lectures, and design challenges into the engineering curriculum. Their study underscores the effectiveness of such strategies in strengthening student motivation, refining problem-solving skills, and deepening comprehension of the practical applications of engineering principles. This aligns with the current study's investigation into how incorporating real-world applications can influence student engagement and ownership in a first-year computer science program.

Technology may have an evolutionary impact on fostering student engagement and ownership in engineering education. Existing evidence indicates that online simulations, interactive learning toolkits, and gamification elements can help significantly increase student motivation and participation in engineering courses. Landers and Bailenson (2022) demonstrated in their recent study that integrating personalized avatar experience in an online platform benefitted participants of an engineering ethics course compared to students enrolled in the traditional lecture-based format. These outcomes indicate the potential of technology-based learning tools, although additional research is necessary to comprehensively assess the long-term effects, benefits, and the most appropriate integration methods.

Self-Determination Theory (SDT), proposed by Deci and Ryan (2000), offers a valuable framework for understanding intrinsic motivation. The theory suggests that three core psychological needs – autonomy, competence, and relatedness – significantly influence student motivation. Autonomy refers to the desire for students to have control over their learning experience. Competence refers to the feeling of success and mastery students experience when they learn effectively. Relatedness refers to the sense of connection and belonging students feel within the learning environment. Fulfilling these needs fosters intrinsic motivation, which is driven by a genuine interest in learning rather than external pressures.

Facilitating student curiosity and interest and enabling them to strive towards excellence and intrinsic motivation may be particularly important for promoting student engagement. Deci and Ryan's (2000) Self-Determination Theory (SDT) identifies autonomy, competence, and relatedness as indispensable psychological needs that affect intrinsic motivation. Furthermore, some recent heuristic studies, such as those by Pascarella and Terenzini (2023) and Hullett et al. (2022), suggest that fulfilling the needs of the students lies at the core of a successful engineering classroom. According to these studies, giving students the freedom to choose their activities, providing opportunities for mastery experiences, and promoting a sense of community through collaborative learning is pivotal in enhancing intrinsic motivation and student engagement. This study aims at understanding the different classroom activities that can be incorporated to develop student engagement and motivation.

Traditional teacher-centered classrooms are less effective in provoking interest among students today and may lead to disengagement. Several studies have emphasized the importance of project-based learning (PBL) or collaborative learning concepts and how they are significantly better for promoting involvement and understanding in engineering education. PBL aims to promote positive student engagement by resolving standard engineering issues through teamwork projects. Felder et al. (2020),

who examined the effect of PBL in an engineering mechanics course, found that the students who learned via PBL were more engaged, comprehended the concepts better, and had a sense of more ownership of their learning process than those compared to the traditional lecture group. An increasing body of evidence indicates that learning methodologies, including PBL, prove highly influential in engendering student engagement and receptivity in engineering education as they actively engage students in resolving real-world engineering problems through group project work.

Another aspect to consider is that students exhibit greater involvement in learning when they discern a clear connection between theoretical knowledge and real-world challenges. Therefore, as Jamieson and Hake (2023) argue in their recent research, allowing more real-world case studies and on-the-job presentations, including numerous guest speakers from among industry stakeholders, and incorporating design challenges could help engender high levels of motivation and help with their problem-solving skills while stimulating better understanding long-term outcomes of the engineering principles studied. New digital tools offer exciting ways to get students more involved in engineering studies. Studies show that fun online games, active learning websites, and game-like features make learning more engaging. Landers and Bailenson (2022) researched using a gamified online platform in an engineering ethics class. It found that game elements like leaderboards and badges made students more motivated and participative than traditional lectures. However, more research is needed on the long-term benefits of these technology-based learning tools and the best ways to use them in engineering education. This research aims to be a pivotal step towards understanding these benefits.

Student disengagement and a lack of ownership in learning pose significant challenges in engineering education. This review highlights the multifaceted nature of these issues, emphasizing intrinsic motivation, instructional practices, and the relevance of course content. Self-Determination Theory offers a valuable framework for fostering intrinsic motivation by addressing student autonomy, competence, and relatedness. Active learning approaches, integration of real-world applications, and technological advancements hold promise in creating engaging learning environments. Ongoing research is essential to explore the effectiveness of these strategies across diverse educational contexts. By adopting evidence-based practices, engineering educators can cultivate a cohort of passionate and well-prepared engineers equipped to tackle future challenges.

While this review highlights the importance of fostering intrinsic motivation and utilizing active learning strategies, it is crucial to acknowledge the limitations of a one-size-fits-all approach. Sociocultural factors like race, gender, and socioeconomic background significantly influence student experiences in engineering education. These factors can impact students' prior knowledge, learning styles, and even their perceptions of autonomy or collaboration within the classroom. Intersectionality, the interconnectedness of these social identities, further emphasizes the need for diverse instructional practices. Addressing these gaps in our understanding is essential for developing inclusive and effective engineering education practices that cater to all students' unique needs and experiences.

DATA ANALYSIS

This section focuses on the analysis of the data collected from 109 respondents. The analysis aims to answer the research questions and hypotheses outlined and provide insights into the phenomenon under investigation.

PARTICIPANTS

The research study included 109 first-year computer science students from GITAM (Deemed to be University), Hyderabad (Figure 1). The study focused on a single engineering discipline, computer science, to minimize the variations in student experiences due to different curricula. Computer science programs typically emphasize strong foundations in theoretical concepts alongside practical applications, which can provide insights into student perceptions of autonomy, competence, and relevance in their coursework. Focusing on a single discipline also allows more targeted comparisons to

future studies investigating student engagement and ownership within computer science programs. The participants belonged to Telangana and were selected at random so that the results of the study could be generalized to a greater extent.

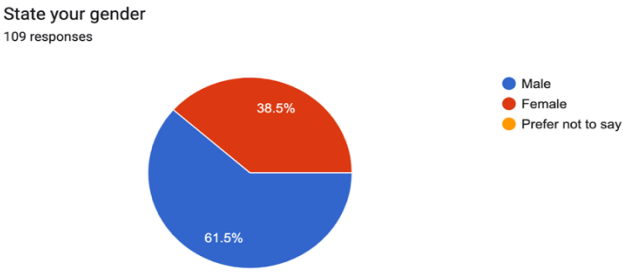

Figure 1. Gender of the participants

Motivation for Taking Engineering Courses

This questionnaire section depicts student responses to what motivates them to take the course. Based on the student's responses in Figure 2, motivations for engineering courses revealed a mix of intrinsic and extrinsic factors. Nearly half (49.6%) found the courses enjoyable and interesting, suggesting strong intrinsic motivation. A neutral group (34.9%) may have a blend of motivations. While over 65% recognized the value of these courses, some (21%) took them solely because their program required it. This highlights a potential disconnect between perceived value and personal interest. A smaller group (15.6%) seemed unsure about the courses' relevance to their goals, suggesting a need for improved clarity. Finally, a very small group (5.5%) took them due to external pressure, indicating the potentially negative impacts of extrinsic motivators on student engagement.

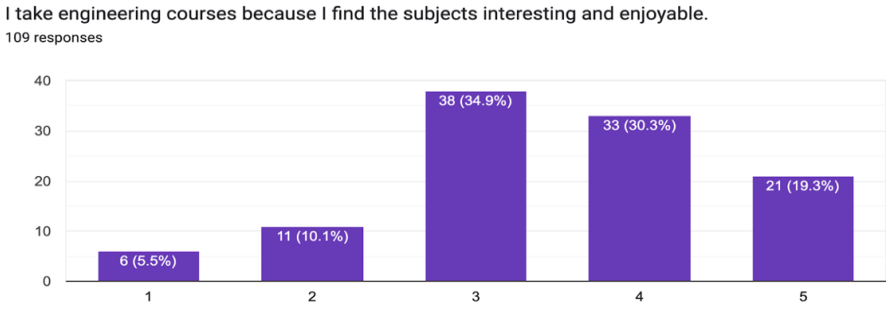

Figure 2. Student Motivations for Enrolling in Engineering Courses

The responses depicted in Figure 3 found that most students (62.7%) have some intrinsic motivation for engineering, meaning they enjoy learning new things in the field. This bodes well for their academic success and future interest. Over a third of students (34%) strongly agreed, indicating a high level of enjoyment, while another third (38.5%) found it moderately interesting. The remaining students (37.3%) may require additional efforts to cultivate their intrinsic motivation, as some showed potential disinterest (6.4%).

Figure 4 revealed that grades are a significant motivator for engineering students, with nearly 68% (34% strongly agree and 38.5% somewhat agree) prioritizing good grades. This points towards a reliance on extrinsic motivators in this group. Only a tiny portion (less than 1%) indicated low intrinsic motivation, meaning they don't find the coursework inherently enjoyable. While grades are essential, overemphasizing them can lead to shallow learning and hinder long-term interest in engineering.

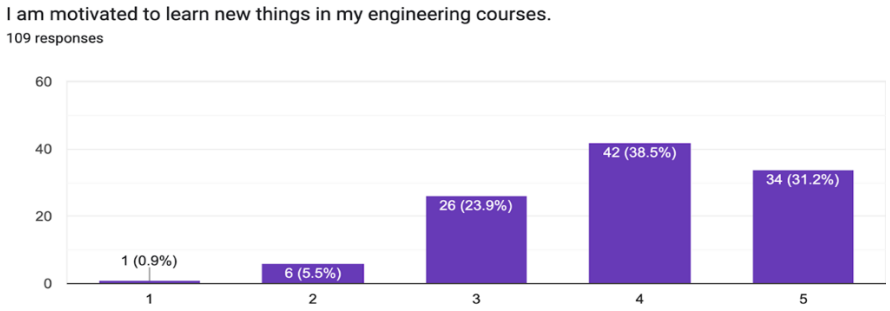

Figure 3. Levels of Intrinsic Motivation

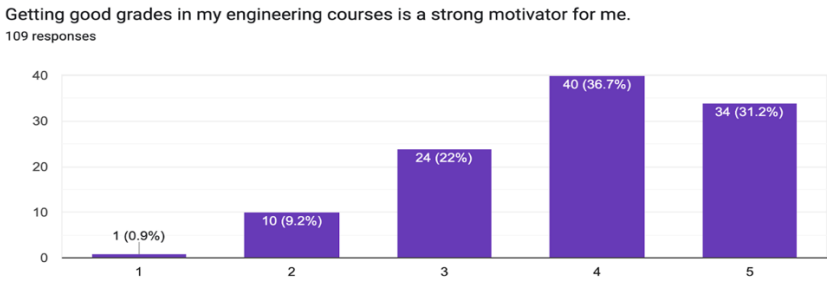

Figure 4. Impact of Grades as a Motivator

Based on the responses in Figure 5, the data gauged students' understanding of how grades translate to future jobs. Nearly 90% of students (45.9% strongly agreed and 24.8% somewhat agreed) believe good grades enhance job prospects, reflecting a perceived value in their engineering education. However, a small group (13%) expressed uncertainty or doubt about this link, suggesting a need for improved clarity on how coursework translates to career opportunities.

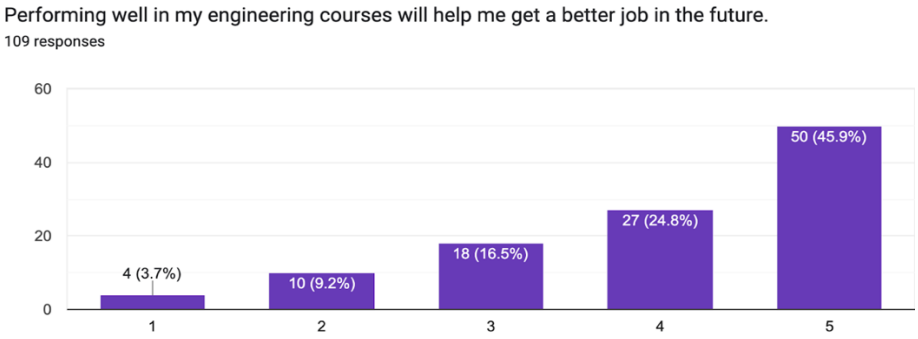

Figure 5. Student Perceptions of the Link Between Grades and Job Prospects

Engagement: Participation in Engineering Discussions

This section depicts student responses to engagement and participation in their course. A significant portion of the students, as shown in Figure 6, participate in class discussions (53.2%), with 19.3% strongly agreeing and 33.9% agreeing. This suggests that many students find class discussions stimulating and actively contribute their thoughts and ideas. However, a smaller portion (12%) rarely participate, with 9.2% somewhat disagreeing and 2.8% strongly disagreeing. This highlights the need for strategies to promote active learning and encourage student participation. Some possible strategies include incorporating more small group discussions, using think-pair-share activities, and providing prompts or questions to guide student participation.

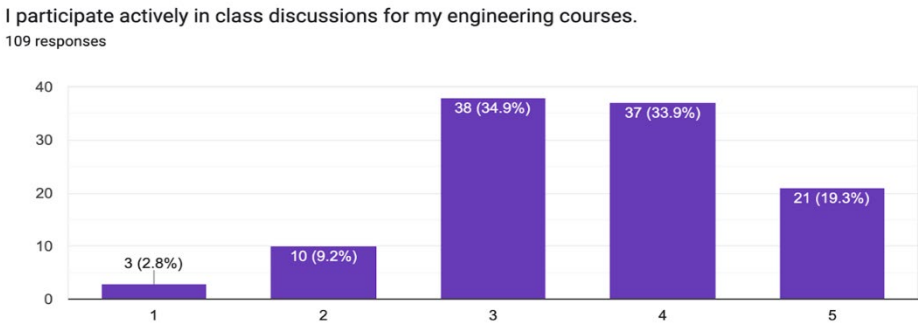

Figure 6. Student Participation in Class Discussions

The data in Figure 7 revealed that a majority of students (77%) find the engineering course material clear and easy to understand. Nearly half (44%) strongly agreed, indicating effective course design and instructor communication. Another third (33%) found the material somewhat clear, suggesting occasional difficulty. A small group (around 5%) needed clarification and might need additional support. These findings highlight the importance of clear explanations and exploring strategies to address areas of confusion for all students.

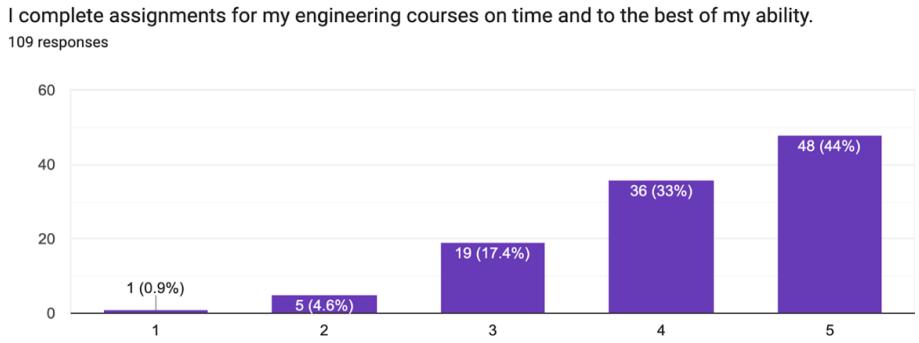

Figure 7. Student Perceptions of Clarity and Comprehensibility of Course Material

The data on help-seeking behavior among engineering students revealed positive trends in Figure 8.

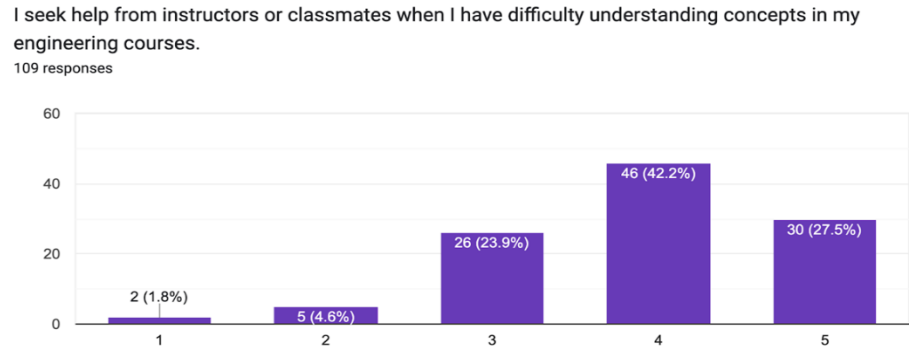

Figure 8. Help-Seeking Behaviour: Proactivity and Areas for Improvement

Nearly 70% of students (27.5% strongly agree and 42.2% somewhat agree) actively seek help from instructors or classmates when facing challenges. This indicates a proactive approach to learning and a willingness to ask for clarification. However, a smaller group (around 30%) may be less likely to seek help, with some students feeling hesitant or unaware of available resources. These findings highlight the importance of fostering a learning environment that encourages help-seeking behavior and ensures students are aware of the support available to them.

The data examining student interest in engineering courses yielded encouraging results, as shown in Figure 9. Over half of the students (56.9%) expressed at least some interest, with 15.6% finding the courses very interesting. Another third (30.3%) fell into a neutral zone, potentially finding the coursework somewhat engaging. However, a small group (12.8%) indicated a lack of interest, with some students even finding the material uninteresting. This information highlights the need for strategies to cultivate and sustain student interest in engineering, potentially through incorporating real-world applications or fostering connections between coursework and their future careers.

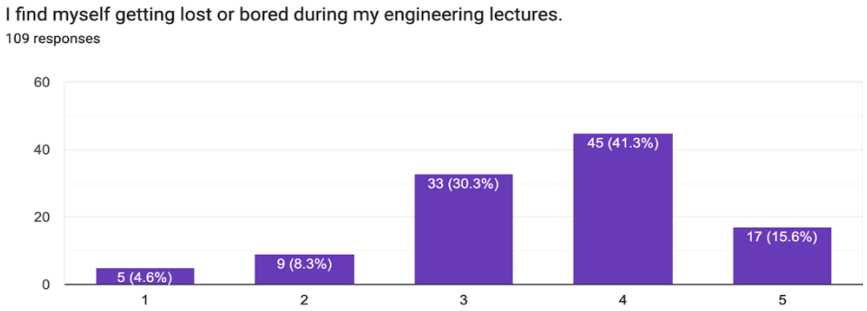

Figure 9. Levels of Student Interest in Engineering Courses

The responses in Figure 10 on student motivation in engineering courses revealed positive signs. Most students (62.4%) demonstrated intrinsic motivation, meaning they find the coursework enjoyable and are driven by a desire to learn. Nearly a quarter (23.9%) strongly agreed, indicating a high level of intrinsic interest. However, a smaller group (11%) showed lower intrinsic motivation. For these students, exploring strategies to cultivate their inherent interest in engineering, such as connecting coursework to real-world applications, could be beneficial. The findings suggest a solid foundation for student engagement and highlight areas where fostering intrinsic motivation could further enhance learning.

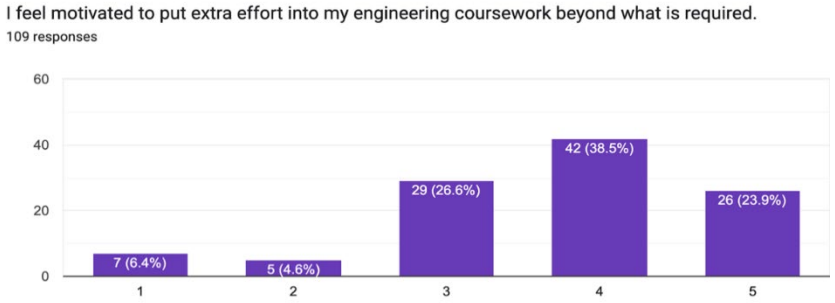

Figure 10. Intrinsic Motivation Among Engineering Students

As shown in Figure 11, the use of interactive activities in engineering courses yielded positive results. Most students (72.7%) reported that teachers use these activities at least occasionally, with 19.3% indicating they are always used. This suggests teachers recognize the value of interactive learning, which can foster communication, critical thinking, and a deeper understanding of the material. While a smaller group of students (27.3%) reported that they rarely experience the use of interactive activities, the overall trend highlights their prevalence and potential to enhance student engagement and motivation in engineering courses.

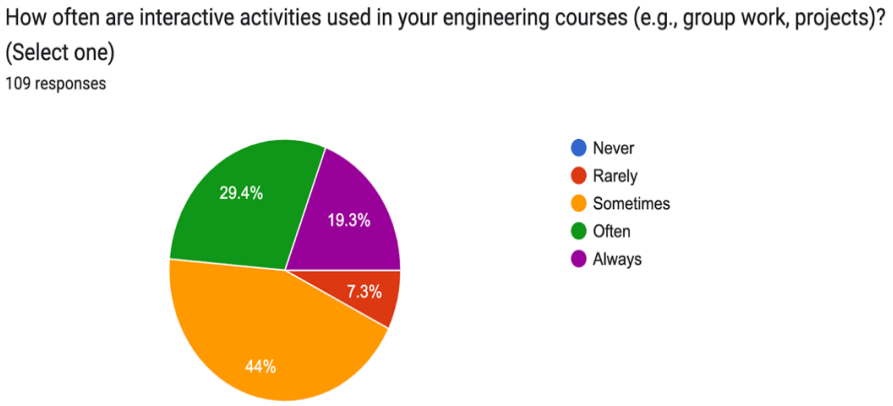

Figure 11. Frequency of Interactive Activities

As shown in Figure 12, a large majority of students (72.5%) felt comfortable sharing their views on how courses are taught, suggesting a positive learning environment that encourages student input. However, a minority (27.5%) did not feel they had a voice. This highlights the need for strategies to ensure all students feel comfortable participating. Some such strategies could be: creating opportunities for feedback, fostering a welcoming classroom atmosphere, and being mindful of cultural factors influencing participation styles. Encouraging students to voice their opinions is crucial as it can boost engagement, improve teaching through diverse perspectives, and give students a sense of ownership over their learning.

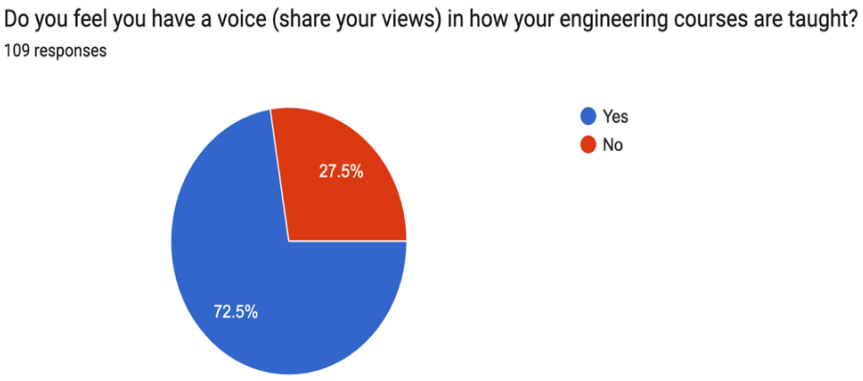

Figure 12. Student Comfort in Sharing Feedback on Course Teaching

As depicted in Figure 13, the responses on how well engineering courses provide opportunities to apply theoretical knowledge to real-world problems revealed positive trends. An unsurprisingly large majority (90.5%) of students perceived at least some connection between theory and real-world applications, with 20.2% indicating a great extent of connection. This suggests that engineering programs incorporate real-world applications into the curriculum, potentially enhancing understanding, problem-solving skills, and student engagement. A small minority (6.4%) reported no opportunities to apply theory in real-world contexts, highlighting the potential for further improvement in some programs. The findings emphasize the value of incorporating real-world applications into engineering curricula.

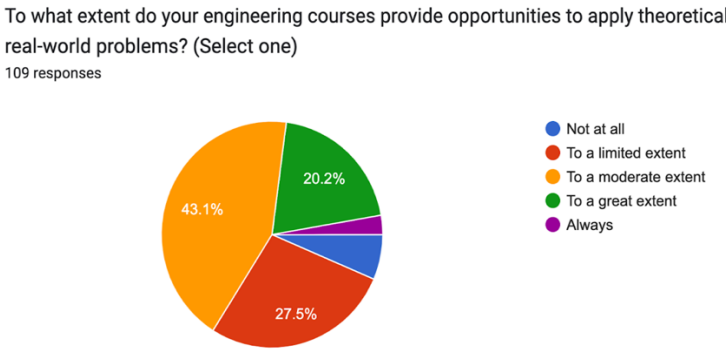

Figure 13. Student Perceptions of the Connection Between Theory and Real-World Applications

As shown in Figure 14, how well engineering courses prepare students for careers revealed mixed perceptions. Over two-thirds of students (65.1%) perceived at least some benefit, with 22% strongly agreeing that the coursework is beneficial. However, a significant portion (34.9%) were unsure or unconvinced, including 25.7% who agreed with the statement and 9.2% who disagreed or somewhat disagreed. This suggests that some curriculum improvements might be necessary to strengthen the perceived connection between coursework and career preparation for a sizeable portion of engineering students.

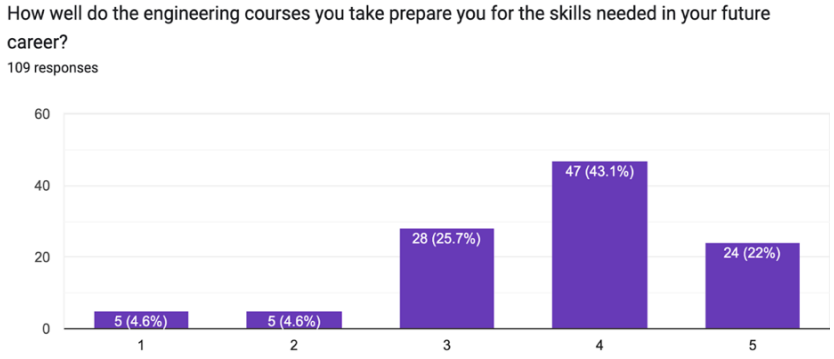

Figure 14. Student Perceptions of Engineering Courses' Preparation for Careers

The responses shown in Figure 15 on using real-world examples in engineering courses revealed a call for more practical applications.

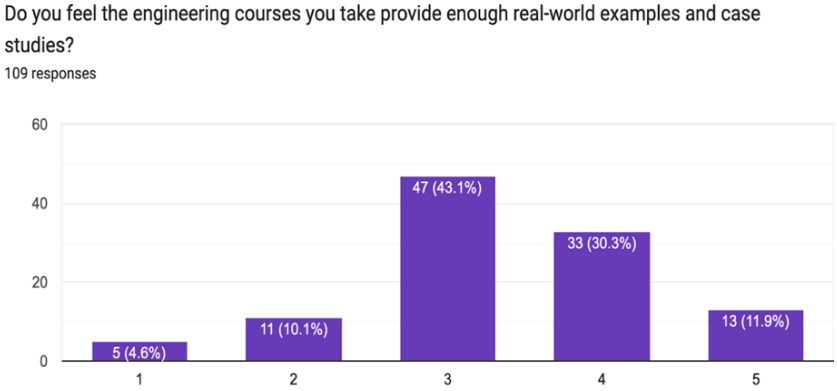

Figure 15. Student Demand for More Real-World Examples

Over half of the students (55%) desired more real-world content, with 11.9% strongly agreeing. This suggests that while some students find the current level sufficient (43.1%), a sizeable portion (14.7% somewhat disagreed and 4.6% strongly disagreed) believe the curriculum could benefit from incorporating more real-world examples and case studies. This could potentially improve understanding, problem-solving skills, and student engagement by making the coursework more relatable and relevant.

The responses examining how often engineering courses offer project-based learning yielded positive results. As shown in Figure 16, most students (72.5%) indicated they have opportunities to apply classroom concepts through projects, with 14.7% reporting frequent opportunities. This suggests focusing on project-based learning, enhancing understanding, problem-solving skills, and student engagement. However, a minority (27.5%) reported a less frequent use of projects, highlighting the potential for some programs to incorporate project-based learning more extensively.

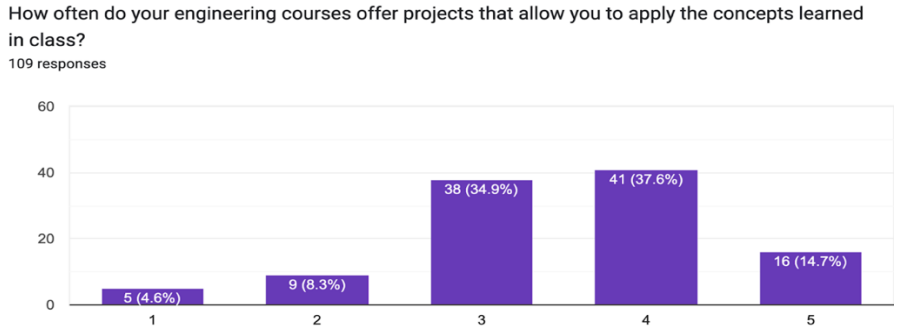

Figure 16. Frequency of Project-Based Learning

The responses to this question that explores the teaching practices that students found most engaging reveal that the most popular teaching practice is hands-on/practical experience (17.43%), closely followed by interactive classes/workshops and collaborative learning, with 16.51% of students preferring each practice. These are closely followed by blended learning and multimedia incorporation (11.93%). From this, we can deduce that students prefer to learn through practical experience, interactive classes, and collaborative learning. The use of blended learning methods and multimedia incorporation also aids in their engagement in the classroom. However, 8.26% of the students find nothing engaging about their classes. This leads to the possibility of students needing to be able to fulfill their learning goals due to disengagement.

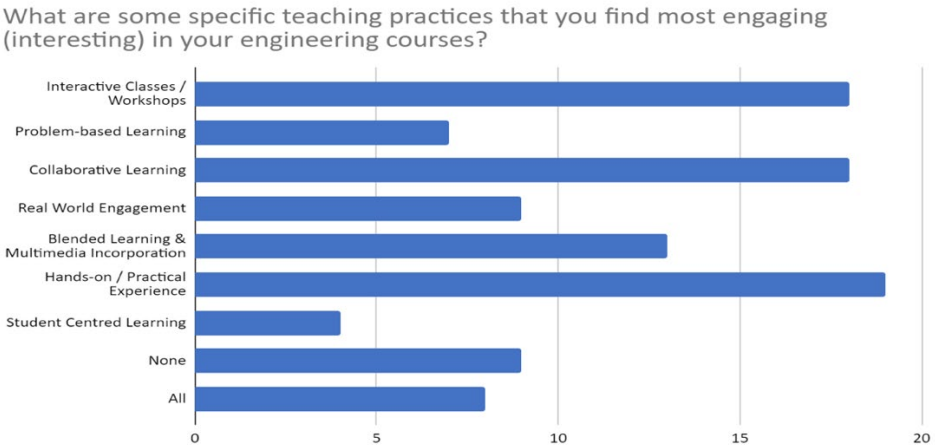

Figure 17. Most Engaging Teaching Practices

While there are several aspects of classroom teaching that students find disengaging, a majority of students (33.95%) were most critical about teachers just lecturing in the classroom. This can be associated with the students (9.17%) who find the lack of interaction in a classroom a hindrance to learning. Apart from this, students dislike the lack of practical or hands-on learning and the absence of real-world relevance in what is being taught. These students (18.35%) feel that a theory-based teaching method does not fulfill their learning requirements. Another factor that students believe to be impacting their learning is using outdated or redundant materials (5.51%). Taking these factors into consideration, we can infer that students learn better when there is sufficient classroom interaction, teachers use adequate real-world examples and practical activities, and an updated set of materials.

Figure 18. Student Criticisms of Disengaging Classroom Practices

Of the 109 responses received for this study, 41 students did not offer suggestions. The above graph is charted based on the suggestions provided by the remaining 68 responses. Most students (33.82%) believe that hands-on or practical experience relevant to their course will aid in the learning process. Another significant suggestion (25%) provided by the students was to have more interactive classes. Minimizing a lecture mode of teaching and focusing on interactive and collaborative activities in the classroom will lead to more student engagement and, consequently, better learning. Further, 20.59% of the students suggest incorporating more real-world projects to better understand the subject matter in terms of its relevance in the real world and provide them with experience for their future careers. Another major factor impeding the learning process is the use of outdated materials. 14.71% of the students suggest updating the learning materials used, which indicates that institutions must work towards regularly updating the curriculum and materials.

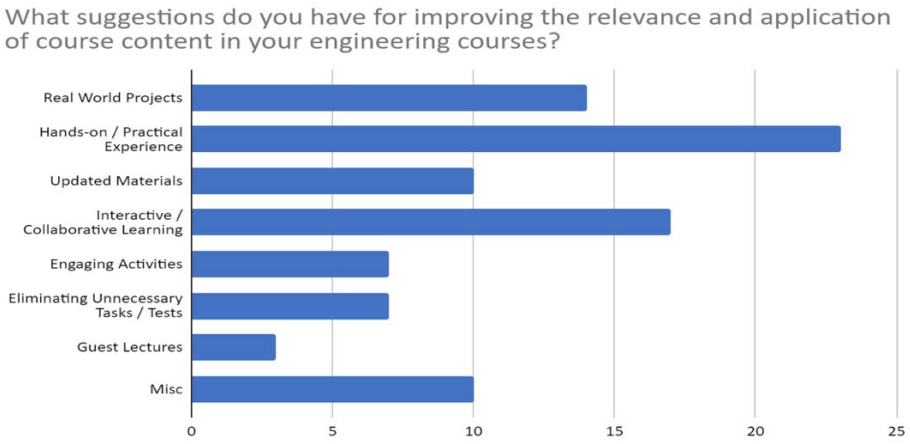

Figure 19. Student Suggestions for Enhancing Learning

DISCUSSIONS AND FINDINGS

The study provided an overview of the current state of engineering education, highlighting the importance of student motivation and engagement and noting that 70% of undergraduate engineers reported low motivation. This research investigated the causes of these issues among first-year undergraduate engineers using surveys and focus groups to explore motivators, teaching practices, and student perceptions of course content relevance. It then identified significant challenges, such as student disengagement and a lack of ownership over learning, particularly among computer science students. It discussed how these issues affected students' retention, critical skills, ability to apply knowledge to real-world problems, and sense of competency and belonging in the field.

The study employed a robust methodology to gather data on student motivation in engineering education. A survey was used to collect quantitative data, which included validated scales measuring intrinsic and extrinsic motivation, providing a reliable foundation for analysis. Descriptive statistics were then used to understand the central tendencies and variability of motivation scores across the student population. In addition, content analysis, a qualitative technique, was employed to categorize student responses from the open-ended survey questions. This approach aimed to gain deeper insights into the 'what' and 'why' behind the quantitative data from the validated scales. The qualitative analysis revealed student experiences and perceptions that numerical data alone might not have captured, providing a richer understanding of student motivation in engineering education by going beyond the numbers and exploring the participants' subjective experiences.

The study revealed that monotonous teaching styles, limited practical opportunities, and a perceived gap between theory and real-world application were key factors, with students emphasizing the need to better connect coursework to real-world challenges. Recommendations included incorporating project-based learning and industry case studies to boost engagement and motivation. The study stressed the importance of tackling these issues to improve academic outcomes and readiness for engineering practice, suggesting active learning methods, real-world examples, and technology tools as potential solutions. These changes were expected to benefit students, educators, and institutions alike. The research questions focused on understanding what motivates students, how current teaching practices impact engagement, and how students perceive the relevance of their coursework to their future careers.

The findings of this study, as presented in this section, not only contribute to the existing literature but also validate the complex interplay of factors influencing student disengagement and ownership in learning among undergraduate engineering students. Intrinsic motivation, combined with curiosity and a desire for mastery, emerged as a significant stimulator of student engagement, reinforcing the importance of Self-Determination Theory (SDT). However, extrinsic factors like grades and future careers also played a significant role, underscoring the need to address both intrinsic and extrinsic motivators in curriculum design.

INTRINSIC AND EXTRINSIC MOTIVATION

Research Question 1: What are the intrinsic and extrinsic motivators that influence undergraduate engineering students' engagement in learning?

The results of this research indicate that the primary motivations of students are intrinsic factors such as intellectual curiosity, the desire to learn things they can apply to the real world, and a sense of accomplishment. However, extrinsic factors such as good scores and career advancement also influenced student motivation. Further, a positive correlation was found between intrinsic motivation and student engagement.

INSTRUCTIONAL PRACTICE

Research Question 2: How do current instructional practices employed in engineering programs contribute to or hinder student engagement and ownership of learning?

The focus group discussions revealed dissatisfaction among students with the traditional and lecture-heavy teaching methods. Students expressed a desire to have more interactive learning experiences, such as project-based learning, hands-on activities, and collaborative problem-solving tasks. Students believed that these approaches could promote deeper understanding and ownership of the learning process. Additionally, students felt that limited opportunities for choice and student input in the classroom also hindered their engagement.

Relevance and Application of Course Content

Research Question 3: What are students' perceptions regarding the relevance and application of course content to their future careers in engineering?

A central theme that emerged was the perceived disconnect between theoretical knowledge and its practical application in the real world of engineering. Frustration was common among students with courses lacking real-world examples, case studies, or projects that demonstrate the practical use of the learned information. This lack of perceived relevance significantly hampered student motivation and engagement.

These findings align with the research by Felder et al. (2021), who demonstrated the effectiveness of project-based learning (PBL) in fostering a deeper understanding and ownership in engineering education. Students long to study real cases, hear from industry experts, and tackle design challenges. These align with Jamieson and Hake's (2023) recommendations. Merging theories and applications would motivate learners, build problem-solving abilities, and deepen an appreciation for engineering principles.

This study reveals that implementing more active learning strategies could increase autonomy and a stronger sense of purpose in their learning journey. The study also highlights the potential use of technology in promoting student engagement and ownership. However, as Landers and Bailenson (2022) demonstrated, further research is needed to explore optimal implementation strategies for online simulations, interactive learning platforms, and gamification elements in the engineering curriculum.

Limitations of the Study

By shedding light on various aspects of the teaching and learning system that require re-evaluation and modernization, this research underscores its relevance and significance. However, it's crucial to acknowledge the presence of certain limitations.

- The scope of this research is limited to a single university and may only be generalizable to computer science programs.
- The sample size may also need to be larger to capture the full spectrum of student experiences.
- The study could involve a larger, more diverse sample population across multiple institutions and varied sociocultural and economic backgrounds.

Recommendations of the Study

Teachers can help students understand course material better by improving course clarity. They can do that by:

- *Utilizing clear and concise language:* Use plain words. Avoid confusing language or complex terms without explanations.
- *Incorporating multiple learning styles:* Combine different teaching styles like lectures, visuals, hands-on activities, and real-life examples. People learn in various ways.
- *Providing opportunities for questions and feedback:* Allow students to ask questions in class. Let them share feedback on how clear the lessons are. This ensures understanding.

- *Holding office hours and offer additional support:* Have regular office hours. Give extra help to students who find the content challenging.

Often, students avoid seeking help from teachers due to various reasons. Here are some ways in which teachers can encourage help-seeking behavior among students:

- *Destigmatize help-seeking:* Create a classroom environment where asking questions is encouraged and viewed as a sign of engagement, not weakness.
- *Promote help-seeking resources:* Clearly communicate the availability of help resources such as office hours, tutoring services, or online forums.
- *Normalize help-seeking:* Share success stories of students who overcame challenges by seeking help and emphasize the importance of asking questions for better understanding.

While there is a lot of responsibility on the teachers to make learning more engaging, there are certain things that can be incorporated at the institutional level to aid in this, such as:

- *Highlight career relevance:* Students need to understand the practical uses of computer science. Show how classwork teaches skills companies seek. This helps students see the career relevance.
- *Showcase alumni success stories:* Invite engineers and alumni to share their journeys. Let them explain how computer science education aided career success. These success stories showcase paths students can take.
- *Offer internship or co-op opportunities:* Provide students with internships or co-ops. Let them apply classroom knowledge to real work. This bridges the gap between learning and careers.

CONCLUSION AND FURTHER RESEARCH

Students lose interest in learning if they do not feel in control or connected to what they are being taught. It is crucial to understand the factors contributing to student disengagement and a lack of ownership in learning to improve computer science education. Computer science teachers must strive to make students more responsible for their learning. By fostering intrinsic motivation through strategies that address student autonomy, competence, and relatedness, employing active learning approaches like PBL, and integrating real-world applications into coursework, computer science educators can create a more engaging and ownership-driven learning environment for future engineers. Therefore, by implementing the findings of this study, educators can create a more engaging learning environment that caters to diverse student motivations and fosters a love for lifelong learning in computer science.

In conclusion, the following key areas need more research to promote student engagement and agency in computer science education.

- Conduct long-term studies to assess the impact of active learning and technology use on student outcomes and career readiness.
- Investigate scaling up successful strategies across diverse engineering programs. See if promising practices work well everywhere.
- Focus on faculty training. Develop programs to help instructors teach using student-centered methods effectively.
- Understand diversity's role. Explore tailoring active learning and tech to meet engineering students' varied needs and learning preferences.

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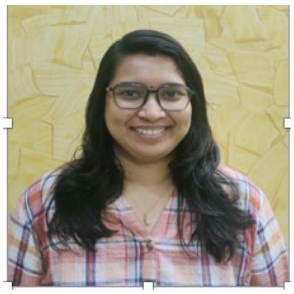
AUTHORS

Dr. Ruth Z. Hauzel is an Associate Professor in the Department of English and Other Languages at GITAM (Deemed to be University), Hyderabad. She has over ten years of teaching experience and three years of training experience with a multinational company. Her research interests include bi/multilingual education, language and culture, and English Language Teaching.



Tanuja Pattnaik is a Research Scholar at the Department of English Language Education at The English and Foreign Languages University, Hyderabad. She holds a Master's in English from GITAM (Deemed to be University) and is UGC-NET qualified. Her research focuses on improving the writing skills of students through reading.

Dr. Vara Ranjani is an Assistant Professor in the Department of English and Other Languages at GITAM (Deemed to be University), Hyderabad. She has more than 15 years of teaching experience. Her research area is Diaspora literature. She has made significant contributions to her field through both her teaching and research endeavors.

Surya Prabha Vallae is a Research Scholar in the Department of English and Other Languages, GITAM (Deemed to be University), Hyderabad. She is a communications professional in the IT sector. Her research focuses on corpus-based analysis of English textbooks at the school level. She aims to enhance the quality of English education through her scholarly work.