

# Living Learning Communities: A Transformative Approach for Diploma Automobile Engineering Students

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**Abstract**— Collaborative learning has increasingly been recognized as an effective approach for enhancing student engagement and academic outcomes in engineering education. This study investigates the implementation of structured group-based learning within diploma automobile engineering programs, with a focus on student-centered pedagogical practices. The proposed framework emphasizes active participation, critical thinking, problem-solving, and the development of interpersonal skills through sustained collaborative engagement.

A mixed-methods research design was adopted, combining quantitative analysis of academic performance with qualitative feedback to evaluate the effectiveness of the approach. The instructional model incorporated a range of structured activities, including brainstorming exercises, real-world exploration, guided web-based research, and group-based assessments, enabling students to engage more actively with technical concepts. The findings indicate a consistent improvement in student performance, conceptual understanding, and confidence levels when compared with conventional instructional methods.

The study further explores the role of Living-Learning Communities (LLCs), defined as structured environments that integrate academic and peer interaction beyond the traditional classroom setting. From the students' perspective, continuous participation in LLC-based activities contributed to improved engagement, collaborative learning behaviour, and greater ease in understanding complex subject matter. Overall, the results suggest that the LLC framework supports not only academic achievement but also social integration and holistic student development. These findings offer practical insights for the adoption of collaborative, student-centered strategies in technical and workforce-oriented education.

**Keywords**— Collaborative Learning, Critical Thinking, Curriculum Design, Interpersonal Skills, Living-Learning Communities, Mixed-Methods Approach, Problem Solving, Technical Education

## I. INTRODUCTION

Collaborative learning and group-based instructional approaches have gained considerable importance in contemporary education due to their potential to enhance student engagement and academic performance. Grounded in constructivist learning theory, these approaches emphasize the role of social interaction in cognitive development, encouraging learners to actively participate in the process of knowledge

construction. As a result, student-centered teaching practices increasingly promote critical thinking, active involvement, and shared learning experiences within the classroom.

In technical education, particularly in diploma automobile engineering, the adoption of such approaches is especially relevant from the students' perspective. The discipline requires learners to integrate theoretical understanding with practical application while developing essential competencies such as problem-solving, teamwork, and communication. However, traditional instructor-centered methods often provide limited opportunities for sustained interaction and experiential learning, which may affect students' engagement and confidence in handling complex technical concepts.

Collaborative learning environments offer a viable alternative by facilitating peer interaction, collective problem-solving, and continuous engagement with subject matter. Within this context, Living-Learning Communities (LLCs) represent a structured approach in which academic learning is extended beyond formal classroom settings through ongoing interaction among students. In such environments, learners participate in regular group activities, discussions, and shared academic tasks, enabling them to reinforce their understanding through collaboration, reflection, and peer support.

While prior studies have established the effectiveness of LLCs in undergraduate engineering education, there is limited research exploring their systematic implementation in diploma-level automobile engineering programs, particularly in contexts where structured collaborative activities are integrated consistently across multiple courses and throughout the academic year. Furthermore, there is a need to examine how such frameworks influence students' learning experiences, engagement patterns, and confidence in addressing real-world technical challenges.

This study addresses these gaps by examining the structured implementation of an LLC-based collaborative learning framework in diploma automobile engineering education. The primary objective is to evaluate its impact on academic performance, conceptual understanding, and the development of interpersonal skills in comparison with conventional teaching approaches. By combining analysis of academic outcomes with insights into student experiences, the study aims to provide a more comprehensive and systematic understanding

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of the pedagogical value of LLCs in supporting holistic learning and preparing diploma-level students for the evolving demands of the automobile engineering profession.

## II. RELEVANCE

Understanding how students learn within collaborative group environments is essential for strengthening pedagogical practices in diploma automobile engineering education, where applied problem-solving, teamwork, and practical decision-making are integral to professional competence. From a student perspective, learning is more effective when opportunities are provided for active participation, peer interaction, and engagement with real-world contexts, rather than relying solely on instructor-centered delivery.

In this context, the present study examines the effectiveness of structured group-based activities implemented within a Living–Learning Community (LLC) framework. The approach emphasizes continuous and systematic integration of collaborative learning across multiple courses, enabling students to engage with technical concepts through discussion, shared problem-solving, and experiential tasks. Such structured interaction supports deeper conceptual understanding and encourages students to take an active role in their own learning process.

Compared to traditional instructional methods, the LLC-based approach provides a more interactive and supportive learning environment, which contributes to improved engagement, better retention of concepts, and increased confidence in handling complex subject matter. The findings of this study indicate consistent improvements in academic performance and learner participation, suggesting that collaborative strategies can effectively enhance both cognitive and behavioural aspects of learning.

Beyond academic outcomes, the LLC framework also supports the development of essential interpersonal skills, including communication, collaboration, and collective decision-making, which are critical in engineering practice. By linking academic learning with peer-supported environments, the approach contributes to holistic student development.

The study offers practical insights for educators and curriculum designers seeking to implement structured, student-centered instructional strategies in diploma-level engineering programs. Additionally, it establishes a foundation for further research on the long-term impact, scalability, and applicability of LLC-based learning models across diverse technical education contexts.

## III. LITERATURE REVIEW

Collaborative learning has been widely recognized as an effective pedagogical approach for enhancing student engagement and academic performance across diverse educational contexts. Foundational studies by Johnson, Johnson, and Stanne (2000) and Slavin (2011) provide strong empirical evidence that cooperative learning environments promote positive interdependence, improve academic achievement, and support cognitive development through structured peer interaction. These studies establish that learning is more effective when students actively participate in shared tasks and construct knowledge collaboratively rather than individually.

In the context of engineering education, Living–Learning Communities (LLCs) have emerged as a structured extension of collaborative learning, integrating academic and social environments to support continuous student engagement. Prior research has shown that participation in LLCs contributes to improved academic performance, stronger sense of belonging, and enhanced student retention. For instance, studies have reported that students engaged in LLCs demonstrate higher levels of academic involvement and satisfaction, particularly during critical transition phases in engineering programs.

Further research has emphasized that the effectiveness of LLCs is closely linked to their design and implementation. Variations in program structure, level of student interaction, and integration of academic activities significantly influence learning outcomes. Studies have highlighted that well-coordinated LLC frameworks, which incorporate structured collaborative activities and continuous peer engagement, are more likely to produce positive academic and social outcomes. Additionally, sustained participation in such environments has been associated with improved engagement, deeper conceptual understanding, and better academic performance among engineering students.

Despite these contributions, existing literature primarily focuses on undergraduate engineering education, with limited attention to diploma-level technical programs. In particular, there is a lack of research examining the systematic and continuous implementation of LLC-based collaborative learning within diploma automobile engineering contexts. Furthermore, few studies have explored how structured group activities, when integrated across multiple courses over an extended period, influence both academic outcomes and students' learning experiences.

The present study addresses these gaps by investigating the impact of a systematically implemented LLC-based framework in diploma automobile engineering education. By combining analysis of academic performance with insights into student engagement and learning behaviour, the study aims to extend the current understanding of collaborative learning and LLCs within practice-oriented technical education environments.

## IV. ASSUMPTIONS

1. The design and implementation of the collaborative learning framework are guided by a set of pedagogical assumptions related to student learning behaviour, engagement, and interaction within group environments:
2. Students in diploma-level technical education may initially experience psychological barriers—such as hesitation, lack of confidence, or fear of making errors—which can limit their participation and active involvement in collaborative learning settings.
3. Immediate or critical evaluation of ideas during group activities may reinforce these barriers, reducing students' willingness to contribute and engage openly in discussions.
4. The use of structured yet low-stakes collaborative activities, such as brainstorming and guided group tasks, can help create a supportive learning environment that reduces anxiety and encourages participation.
5. As these initial barriers are gradually minimized, students are more likely to demonstrate active cognitive

engagement, reflected in improved idea generation, critical thinking, and problem-solving abilities.

6. A learning environment that promotes open expression and values diverse perspectives can enhance students' confidence, motivation, and sustained interest in the learning process.
7. Contributions made during collaborative activities, including preliminary or partially developed ideas, are considered valuable to the learning process, as they support exploration, discussion, and progressive refinement of understanding.
8. These assumptions form the basis for structuring collaborative activities within the Living-Learning Community framework, with an emphasis on fostering a positive, inclusive, and student-centered learning experience.

## V. METHODOLOGY

The study adopts a Living-Learning Community (LLC) framework that integrates collaborative academic activities with students' shared learning environments. The methodology is designed to examine the impact of sustained group-based learning on academic performance, engagement, and interpersonal skill development among diploma automobile engineering students.

### A. Participants and Group Formation

The study involved fifty second- and third-year diploma automobile engineering students, organized into 16 groups of three to four members. Groups were formed heterogeneously based on academic performance, geographical background, and gender diversity to promote peer-assisted learning, balanced participation, and exposure to diverse perspectives.

### B. Courses and Duration

The LLC approach was implemented across three core courses—Automobile Engines (AEN), Automobile Systems and Body Engineering (ASB), and Automobile Body Engineering and Safety (ABE)—over one academic year. Collaborative activities were integrated into lectures, laboratory sessions, and selected co-curricular activities to ensure continuous student engagement.

### C. Research Design

A mixed-methods approach was used to evaluate the effectiveness of the framework. This included:

- Quantitative analysis of academic performance through course-wise pass percentages and comparisons with other subjects
- Qualitative observations of student participation, interaction, and engagement during activities

This combination enabled a more comprehensive understanding of both academic outcomes and student learning experiences.

### D. Implementation Process

The instructional process was carried out in structured phases:

1. Understanding Phase: Identification of initial student perceptions and participation barriers through brainstorming activities.
2. Preparation Phase: Alignment of teaching strategies with student needs based on prior performance and assessment patterns.

3. Group Formation Phase: Creation of heterogeneous groups to support collaborative learning.

4. Activity Implementation Phase: Integration of structured activities such as recall exercises, real-world exploration, web-based research, and group assessments.

5. Monitoring Phase: Continuous observation, feedback, and revision to ensure conceptual clarity and engagement.

### E. Instructional Focus

The approach emphasized a supportive and student-centered learning environment, encouraging participation while minimizing performance pressure. The focus remained on conceptual understanding, collaborative engagement, and the development of confidence in applying technical knowledge.

## VI. DETAILS OF ACTIVITIES

Fifty second- and third-year diploma automobile engineering students were organized into 16 groups of three to four members. The Living-Learning Community (LLC) framework was implemented across three core courses—Automobile Engines (AEN), Automobile Systems and Body Engineering (ASB), and Automobile Body Engineering and Safety (ABE)—throughout the academic year. The activities were integrated into lectures, practical sessions, and selected co-curricular settings, enabling continuous evaluation of both academic performance and collaborative learning.

1. Quick Check: This activity focused on improving recall and attentiveness during lectures. Students were shown images of automobile components or systems and asked to identify them within a limited time. From a student perspective, this activity supported rapid recall, reinforced technical terminology, and encouraged active participation.



Fig. 1. illustrates identification of automobile body shapes.

2. Make a Note: Students were encouraged to prepare concise, structured notes in the form of comparison tables after completing key topics. This helped in organizing theoretical concepts and supported better revision. The activity improved clarity of understanding and assisted students in articulating differences between related concepts.



Fig. 2. Comparative table for four-stroke SI and CI engines

3. Real-World Search: This activity extended learning beyond the classroom by requiring students to identify and document

real automobile components, specifications, and system layouts. Visits to workshops and service stations were encouraged. This approach enhanced observation skills, practical understanding, and communication abilities.



Fig. 3. Identification of vehicle specifications within the campus.

4. Web-Based Search: Students used digital resources under guided supervision to explore technical topics and discuss findings within their groups. This facilitated immediate clarification of concepts and promoted collaborative digital learning.



Fig. 4. Web-based exploration of automobile body testing methods

5. Group-based Assessment: Conducted during revision sessions, this activity involved group preparation followed by structured question-and-answer interactions. Immediate feedback was provided to reinforce learning. The activity promoted collective responsibility, engagement, and healthy academic competition.



Fig. 5. Group-based assessment and outcomes

6. Brake the barrier: This activity aimed to bridge the gap between theory and practice by integrating concept revision within laboratory sessions. Real components and demonstrations were used to reinforce theoretical understanding. Students reported improved confidence in applying concepts in practical contexts.



Fig .6. Integration of theory revision during practical sessions

7. Group Calls: Students conducted group discussions through conference calls to revise previously learned topics. The flexible and informal nature of these interactions allowed students to express doubts freely. Recorded discussions were shared on a common platform, supporting peer learning and continuous engagement.

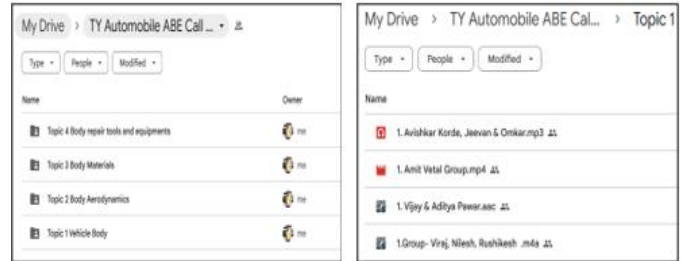


Fig .7. Uploaded group call recordings

8. Group Effect Assessment: This activity evaluated group interaction and conceptual clarity through a structured communication task. One student described a concept without naming it, while another identified it based on the explanation. This improved communication skills, conceptual understanding, and collaborative problem-solving.



Fig .8. Group effect assessment technique

VII. OUTCOMES

The implementation of structured group-based activities within the Living-Learning Community (LLC) framework resulted in noticeable improvements in students’ academic performance and engagement. These outcomes were assessed by comparing semester examination results of LLC-supported courses with other courses conducted during the same academic period.

The LLC approach was applied continuously across three core courses—Automobile Engines (AEN – AE3I), Automobile Systems and Body Engineering (ASB – AE4I), and Automobile Body Engineering and Safety (ABE – AE5I). As shown in Fig. 9, all three courses demonstrated higher pass percentages compared to other subjects, indicating a consistent positive trend associated with the use of collaborative learning strategies.

From a student perspective, participation in LLC-based activities contributed to improved confidence in handling complex concepts. Regular engagement in recall exercises, real-world exploration, group discussions, and collaborative assessments supported better conceptual understanding and application of knowledge.

The observed improvements can be attributed to sustained peer interaction, active participation, and shared responsibility for learning. Although the analysis is based on comparative performance trends, the findings suggest that structured and

continuous collaborative learning can positively influence both academic outcomes and student engagement.

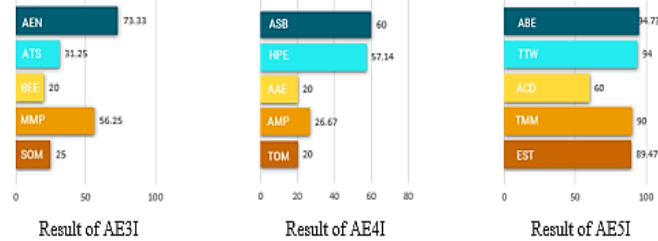


Fig. 9: illustrates the comparative course results across semesters, highlighting the improved pass percentages achieved in LLC-supported courses.

### VIII. FEEDBACK

The feedback phase served as an important mechanism to evaluate students' learning experiences within the Living-Learning Community (LLC) framework. Through structured questionnaires and discussions, students reflected on their participation, engagement, and understanding of concepts.

TABLE I  
PARTICIPATION AND ACTIVITY DATA

Activity	Number of Participants	Positive Feedback (%)
Quick Check	50	85
Make a Note	50	82
Real world search	50	88
Web based search	50	80
Group-based Assessment	50	90
Brake the Barrier	50	86
Group Calls	50	75
Group Effect Assessment	50	87

The data in Table I indicate consistently high levels of positive feedback across all activities, ranging from 75% to 90%. Activities involving direct application and interaction, such as group-based assessment and real-world search, received comparatively higher responses, suggesting stronger student engagement in experiential learning tasks.

TABLE II  
FEEDBACK QUESTIONNAIRES AND ANALYSIS

Sr. No.	Question	Responses (in %)		
		Yes	No	May be
1	Is Activity implemented successfully?	87	5	8
2	Did you observe any positive changes in learning style?	79	5	16
3	Did you motivate for study or learn something new?	76	8	16
4	Did you feel this approach help you to learn in depth?	82	8	10

5	Will you recommend to continue same activity in coming AY?	74	5	21		
6	Rate the overall activity	1	2	3	4	5
		0	0	8	21	71

Table II reflects a positive perception of the LLC-based approach among students. A majority of respondents reported successful implementation (87%) and improved learning experiences (79%). Notably, 82% of students indicated better conceptual understanding, and most students rated the activities highly, with 71% assigning the highest rating.

From a student perspective, qualitative feedback further highlighted improved engagement and clearer understanding of concepts. Students reported that collaborative discussions made complex topics easier to grasp and helped connect theoretical knowledge with real-world applications.

Overall, the feedback suggests that structured collaborative activities within the LLC framework contribute positively to student engagement, conceptual clarity, and motivation. While the findings are based on self-reported responses, the consistent trends across activities indicate the effectiveness of the approach in enhancing both learning experience and participation.

### IX. NOVELTY

The study presents several distinctive contributions in the context of diploma-level technical education:

- Application of LLC in Diploma Education:

The implementation of the Living-Learning Community (LLC) framework in diploma automobile engineering represents a context that has received limited attention in existing literature, which predominantly focuses on undergraduate programs. This study extends the applicability of LLCs to a practice-oriented diploma setting, addressing the specific learning needs of such students.

- Integration of Structured Collaborative Activities:

The framework incorporates a diverse set of structured activities, including real-world exploration, guided web-based learning, and group-based assessments. The systematic integration of these activities across multiple courses enables continuous engagement and supports the connection between theoretical concepts and practical applications.

- Continuous Feedback-Oriented Implementation:

The approach includes an iterative feedback mechanism, where student responses and participation patterns inform ongoing refinement of activities. This adaptive process contributes to a more responsive learning environment and supports sustained student engagement.

These contributions highlight the potential of structured and continuous collaborative learning models in enhancing both academic outcomes and student learning experiences within diploma-level engineering education.

### CONCLUSION

The implementation of the Living-Learning Community (LLC) framework in diploma automobile engineering education contributed to the creation of a collaborative and supportive learning environment that extended beyond traditional classroom instruction. The integration of structured group

activities enabled continuous peer interaction, promoting active engagement and improved conceptual understanding of technical subjects.

The findings indicate that sustained participation in LLC-based activities positively influenced students' academic performance and learning behaviour. Students demonstrated increased confidence in handling complex concepts through regular engagement in recall exercises, real-world exploration, group discussions, and collaborative assessments. Comparative analysis of course results further showed that LLC-supported courses achieved higher pass percentages than other subjects, indicating a consistent positive trend.

In addition to academic improvement, the framework supported the development of interpersonal skills such as communication, teamwork, and shared responsibility. From a student perspective, collaborative learning environments contributed to greater participation, improved confidence, and a stronger sense of academic involvement.

However, certain limitations must be acknowledged. The study was conducted within a single institution and focused on a specific discipline, which may limit the generalizability of the findings. Furthermore, the evaluation was primarily based on short-term academic performance and observational insights, without consideration of long-term outcomes.

Future research may explore the long-term impact of LLC-based learning on academic progression, skill development, and professional readiness. Extending the framework to other technical disciplines and institutional contexts, along with incorporating longitudinal data, would provide a more comprehensive understanding of its effectiveness.

Overall, the results suggest that the LLC framework offers a practical and effective approach for enhancing both academic outcomes and student development in diploma-level engineering education. The study provides useful insights for educators seeking to adopt structured, collaborative, and student-centered teaching practices.

#### REFERENCES

- David W. Johnson, Roger T. Johnson, and Mary Beth Stanne, "Cooperative Learning Methods: A Meta-Analysis", ResearchGate, Article January 2000
- Robert E. Slavin, "Instruction Based on Cooperative Learning". ResearchGate, Article January 2011
- J. Micomonaco, "Living-Learning Communities as a Potential Intervention to Increase the Retention of First-Year Engineers", ASEE, 2011.
- J. Hodge, M. Lagoudas, A. Harris, J. Froyd, M. Hobson and J. Pope, "Influencing the Academic Success of Undergraduate First-Year Engineering Students Through a Living Learning Community", ASEE, 2011.
- K. Inkelas, M. Soldner, S. Longerbeam and J. Leonard, "Differences in Student Outcomes by Types of Living-Learning Programs: The Development of an Empirical Typology", *Research in Higher Education*, vol. 49, no. 6, pp. 495-512, 2008. Available: 10.1007/s11162-008-9087-6 [Accessed 28 December 2018].
- S. Ciston, M. Carnasciali, J. Nocito-Gobel and C. Carr, "Impacts of Living Learning Communities on

Engineering Student Engagement and Sense of Affiliation", ASEE, 2011.

- K. Buell, V. Love and C. Yao, "Living-Learning Programs Through the Years: A Reflection on Partnerships Between Students, Faculty, and Student Affairs", *The Journal of College and University Student Housing*, vol. 44, no. 1, pp. 86-100, 2017. [Accessed 29 December 2018].
- S. Schauer, K. Pakala, Kim M.B. Tucker," Review of Living Learning Communities and Their Impact on First Year Engineering College Students", American Society for Engineering Education, Proceedings of ASEE PNW Section Conference (Corvallis, Oregon). @2020