Empowering Student Innovation and Experiential Learning through the Vertically Integrated Projects Model in a Conservative Higher Education Ecosystem

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Abstract: The Vertically Integrated Project (VIP) model, originally developed at Georgia Tech, provides a sustainable structure for experiential, long-term, and multidisciplinary learning. It enables undergraduate and graduate students to collaborate on ongoing research and innovation projects guided by faculty members, often in partnership with industry and community stakeholders. The expansion and adaptation of the VIP model within a conservative higher education ecosystem characterized by rigid curricular structures and limited undergraduate research opportunities can be a challenging task. The implementation of such process involves aligning VIP projects with existing academic' teaching and accreditation requirements, fostering faculty buy-in, and cultivating a culture of research-based learning among undergraduates. Case studies from non-US institutions, including the Lebanese American University (LAU) and the American University of Beirut (AUB), which are, to the author's knowledge, the only institutions in the Middle East currently adopting this novel program, demonstrate how project-based learning and vertical team integration can thrive even within traditionally structured higher education frameworks. At LAU, the VIP+ program emphasizes entrepreneurship and real-world problem solving, while promoting teamwork and innovation across disciplines and academic levels. Similarly, AUB's VIP implementation nurtures continuity in research and leadership development through multi-year student engagement. Together, these initiatives demonstrate how long-term, credit-bearing projects can bridge academic learning with industrial and societal needs, cultivating leadership, creativity, and professional competencies in engineering education. This paper shares lessons learned from establishing and scaling the VIP model in international and regional university settings, showcasing how sustained, multidisciplinary teamwork transforms traditional teaching into an innovation-driven experiential learning environment aligned with global educational trends.

Keywords: Vertically Integrated Projects, Experiential learning, Multidisciplinary project-based learning, Engineering curriculum innovation, Higher education.

1. Introduction

Engineering education worldwide is undergoing a paradigm shift driven by the need to better prepare graduates for complex, real-world challenges that demand not only strong technical

foundations, but also teamwork, innovation, and leadership skills. Traditional lecture-based curricula, particularly within conservative higher education ecosystems characterized by rigid program structures and limited flexibility, often struggle to provide students with sustained exposure to authentic research and innovation experiences. As a result, there has been growing interest in experiential and project-based learning models that promote long-term engagement, interdisciplinary collaboration, and closer alignment between academia, industry, and society to help tackle contemporary challenging problems.

Among these models, the Vertically Integrated Projects (VIP) framework has emerged as a robust and scalable approach to experiential learning. Initially created at Purdue in 2001 and later expanded by Georgia Institute of Technology in 2014 to constitute a VIP consortium of more than 50 universities worldwide. The VIP model integrates undergraduate and graduate students into long-term, faculty-led research and innovation teams that span multiple academic years and levels of study. Unlike short, course-bound projects, VIP teams emphasize continuity, knowledge transfer, and increasing student responsibility over time, enabling participants to develop both technical depth and professional competencies [1],[4]. Previous studies have shown that VIP participation enhances student retention, motivation, and self-efficacy, while also contributing to faculty research productivity and institutional research capacity [5],[6]. The pedagogical foundations of VIP are closely aligned with established theories of experiential learning and constructivism, which emphasize learning through active engagement and reflection [7]. Project-based learning (PBL) approaches have been widely adopted across engineering education to foster problem-solving skills and interdisciplinary thinking [8]. However, many PBL implementations remain limited in duration and scope, often constrained to a single semester. This limitation reduces opportunities for deep technical exploration and long-term innovation. The VIP model addresses this gap by embedding projects within the curriculum as credit-bearing courses that students can join for multiple semesters, allowing projects to evolve organically and achieve greater technical and societal impact [9].

While the VIP model has been extensively documented in North American contexts, its transferability to conservative or non-US higher education systems presents distinct challenges. Such systems often feature centralized curricula, strict accreditation requirements, and limited traditions of undergraduate research engagement [10]. Faculty workload models and assessment practices may also hinder the adoption of long-term, open-ended projects. Recent literature highlights that successful implementation in these environments requires careful alignment with existing academic structures, institutional leadership support, and clear value propositions for both students and faculty [11],[12]. Emerging case studies from international institutions demonstrate that these challenges can be effectively addressed through localized adaptation of the VIP framework. Outside the United States, the VIP model has expanded to Europe, Australia, and Asia. However, to the author’s knowledge, the American University of Beirut (AUB) and the Lebanese American University (LAU) in Lebanon remain the only two institutions in Western Asia, including the Levant and GCC countries, that have successfully adopted the VIP model. At LAU,

the VIP+ initiative extends the original model by placing a stronger emphasis on entrepreneurship, innovation, and industry-relevant problem solving. The program integrates VIP projects within accredited curricula while encouraging interdisciplinary collaboration across engineering, business, and design programs. Similarly, the American University of Beirut (AUB) has implemented VIP to promote multi-year student engagement in research-driven projects, fostering leadership development and continuity in traditionally structured academic programs [13],[14]. These experiences align with broader findings that vertically integrated, credit-bearing projects can serve as effective bridges between theoretical instruction and societal or industrial needs [15].

Despite these promising developments, there remains limited scholarly work that systematically examines how the VIP model can be scaled and sustained within conservative higher education ecosystems, particularly in regions where undergraduate research culture is still emerging. There is a need to document implementation strategies, governance structures, and pedagogical outcomes to inform institutions seeking to adopt similar models. The novelty of this paper lies in its comparative and practice-oriented analysis of adapting and scaling the VIP model within conservative, non-US higher education contexts. By drawing on institutional experiences and lessons learned, this work contributes new insights into aligning long-term experiential learning with rigid curricular systems while maintaining academic rigor and innovation. The remainder of the paper is organized as follows. The next section presents the structure and governance of the VIP program, detailing its integration within existing curricula and institutional frameworks. This is followed by a results and discussion section analyzing educational outcomes, student engagement, and implementation challenges. Finally, the paper concludes with key lessons learned, implications for engineering education, and recommendations for future adoption of vertically integrated experiential learning models.

2. VIP Program Structure and Institutional Integration

The VIP-based initiatives examined in this study are implemented through two institutionally aligned yet pedagogically distinct models: the VIP+ program at Lebanese American University (LAU), which is oriented toward entrepreneurship and innovation-driven experiential learning, and the VIP program at American University of Beirut (AUB), which primarily emphasizes applied research and long-term scholarly continuity. Both institutions follow the American higher education system and are registered with the New York State Education Department (NYSED), providing a common academic and regulatory foundation. Together, these implementations demonstrate how the core principles of the Vertically Integrated Projects framework can be adapted to different institutional missions within conservative higher education ecosystems.

2.1. Governance and Program Organization

Both programs are grounded in the Vertically Integrated Projects model originally created at Purdue and developed at Georgia Institute of Technology, which emphasizes long-term, faculty-led project teams, vertical student integration, and sustained multidisciplinary engagement. At

LAU, the VIP+ program is centrally coordinated through an innovation-focused academic structure that interfaces with engineering departments and entrepreneurship-related units, and is offered across all seven schools of the university on its two campuses. This governance model supports project continuity while enabling flexibility in project scope, particularly for innovation and venture-oriented outcomes. In contrast, AUB's VIP program is housed in the Maroun Semaan Faculty of Engineering and Architecture, emphasizing stability, research alignment, and continuity with faculty research agendas. Students work in multidisciplinary projects run in various departments: Architecture and Graphic design, Biomedical, Chemical, Civil, Electrical, Mechanical and Industrial Engineering with some projects having industrial partners.

Community engagement is embedded in the design and execution of VIP projects at both institutions. At LAU, many VIP+ teams interact with external stakeholders such as startups, community organizations, and potential end users to identify real needs, test early prototypes, and improve solutions based on feedback. At AUB, community engagement is reflected in applied research projects that address local industrial and societal challenges through sustained collaboration with external partners. In both cases, community engagement is not limited to outreach activities; it is integrated into problem definition, project development, and validation of outcomes over multiple semesters.

2.2. Curricular Integration and Credit-Bearing Structure

A defining feature of both implementations is the integration of VIP projects as credit-bearing courses, a critical requirement for adoption in conservative academic systems. Projects are mapped to existing elective or technical course slots approved through standard curriculum governance processes, ensuring compliance with accreditation and institutional regulations. At LAU, VIP+ courses are mapped primarily to elective and signature course slots, with a maximum of 6 credits counting toward the degree requirements, allowing participation across multiple schools while formally embedding innovation and entrepreneurship outcomes within academic programs. At AUB, VIP courses are mapped to technical electives and, in selected cases, to final-year (capstone) project requirements, with up to 12 credits applicable toward the curriculum, reinforcing the program's emphasis on applied research and disciplinary depth. At LAU, the VIP+ credit-bearing structure explicitly incorporates learning outcomes related to the entrepreneurial mindset, including opportunity recognition, solution validation, and real-world problem solving. At AUB, learning outcomes are more strongly aligned with applied research competencies, such as experimental design, data analysis, and technical documentation. In both cases, students may enroll in the same VIP project across multiple semesters, with performance expectations scaled to academic level.

2.3.Comparative Summary of Institutional Implementations

Table 1 summarizes the key structural and pedagogical differences between the VIP+ program at LAU and the VIP program at AUB, highlighting how a common experiential learning framework can be adapted to distinct institutional priorities within conservative higher education systems.

Table 1. Comparison of VIP+ (LAU) and VIP (AUB) Program Implementations

Dimension	**VIP+ at LAU**	**VIP at AUB**
Primary orientation	Entrepreneurship and innovation	Applied research
Governance structure	Centralized, innovation-oriented coordination	School of engineering and research-center based
Curricular status	Credit-bearing, curriculum-integrated	Credit-bearing, curriculum-integrated
Learning outcomes focus	Entrepreneurial mindset, problem solving, prototyping	Research skills, experimentation, technical depth
Team composition	Multidisciplinary (engineering, business, …)	Primarily engineering and applied sciences
Vertical integration	Sophomore to graduate level	Sophomore to graduate level
External engagement	Industry, startups, community stakeholders	Industry, applied research partners, community-facing stakeholders
Typical project outputs	Prototypes, validation studies, venture concepts	Experimental results, reports, publications
Offered courses	VIP201, VIP202, VIP301, VIP302, VIP303, VIP401, VIP402, VIP403, VIP701, VIP702, VIP703	VIPP201, VIPP202, VIPP301, VIPP401, VIPP501, VIPP502, VIPP601

3. Results and discussion

This section presents and discusses the results of student perception surveys administered to 199 students enrolled in the VIP program at American University of Beirut (AUB) and 110 students enrolled in the VIP+ program at Lebanese American University (LAU). Both surveys used an identical instrument consisting of ten Likert-scale statements evaluated on a five-point scale (1 = Strongly Disagree, 5 = Strongly Agree). The results enable a direct comparison between an applied-research-oriented VIP implementation (AUB) and an entrepreneurship-oriented VIP+ implementation (LAU).

The survey included the following ten statements:

1) Q1: I am satisfied with my overall experience in the VIP program.
2) Q2: Participation in VIP helped me improve my technical knowledge in the project domain.
3) Q3: I developed important transferable skills (e.g., teamwork, communication, leadership, problem-solving).
4) Q4: I feel that my participation in VIP has enhanced my readiness for future academic or professional opportunities.

5) Q5: The faculty advisor(s) provided helpful guidance and support throughout the project.
6) Q6: Graduate or senior students effectively mentored and supported my learning and integration into the team.
7) Q7: The workload required for VIP was appropriate and manageable alongside my other coursework.
8) Q8: Project roles and expectations were clearly defined, and the team was well organized.
9) Q9: I believe my contribution had a meaningful impact on the progress of the project.
10) Q10: I would recommend participating in the VIP program to other students.

Mean Likert scores [16] were computed for each question. Figure 1 shows the mean Likert scores for all ten questions for both institutions. Overall, both curves lie well above the neutral midpoint, indicating strongly positive student perceptions of the VIP experience at both AUB and LAU. Mean values typically exceed 4.2, confirming that vertically integrated, credit-bearing project experiences are well received even within conservative higher education ecosystems.

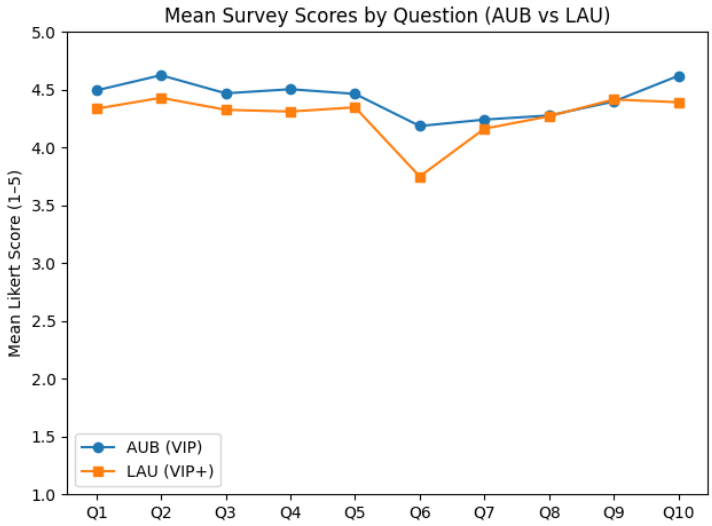

Figure 1. Mean survey Likert scores by question for both institutions.

Although the overall trends are similar, some systematic differences appear between the two implementations, reflecting their distinct institutional orientations. In most items, AUB shows slightly higher mean scores, while LAU shows comparable or stronger results in selected areas related to perceived impact and engagement.

Both cohorts expressed strong overall satisfaction with their VIP experience (Q1), with AUB scoring slightly higher. This indicates that both implementations provide a meaningful experiential learning environment despite their different structures and priorities.

Scores for Q10, which measures willingness to recommend the program to peers, were among the highest for both institutions. This strong endorsement suggests that students recognize the

educational value of the VIP and VIP+ programs and that the programs have good potential for long-term sustainability through positive peer recommendation.

Questions Q2–Q4 address core educational outcomes. Both groups agreed that participation improved technical knowledge, transferable skills, and readiness for future academic or professional pathways. AUB scored consistently higher on these items, especially in technical knowledge (Q2) and readiness (Q4), which is consistent with the applied research orientation of its VIP model. LAU also performed strongly, particularly in transferable skills (Q3), which aligns with the entrepreneurship and innovation focus of VIP+, where multidisciplinary collaboration, communication, and problem framing are central.

Faculty support (Q5) was rated very positively at both institutions, confirming that faculty mentorship is a key strength of both models. The largest gap appears in Q6, which evaluates peer and graduate-student mentorship, where AUB scored clearly higher. This difference is also reflected in Figure 2, where AUB responses are more concentrated in the highest Likert categories. This pattern suggests that AUB benefits from stronger graduate-student involvement and a more established vertical mentoring structure, while LAU VIP+ teams may benefit from further formalization of peer mentoring roles.

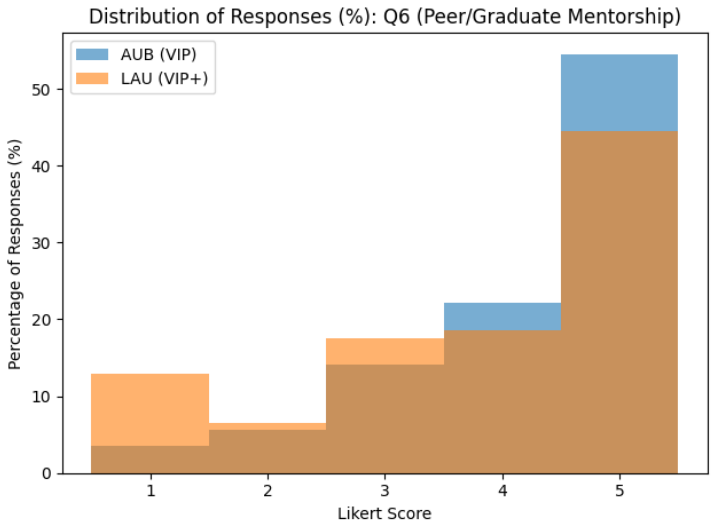

Figure 2. Percentage distribution of student responses to Q6 for both institutions.

Both cohorts generally agreed that the workload was manageable (Q7) and that project roles and expectations were clearly defined (Q8). Mean scores for these questions are comparable across institutions, with only minor differences. The workload question shows slightly greater variability at LAU, as illustrated in Figure 3. This variation may be attributed to the open-ended nature of entrepreneurship-oriented projects, where workload intensity can fluctuate depending on project phase, prototyping cycles, or external stakeholder engagement. Nevertheless, the overall positive response indicates that the VIP+ workload remains compatible with traditional course demands.

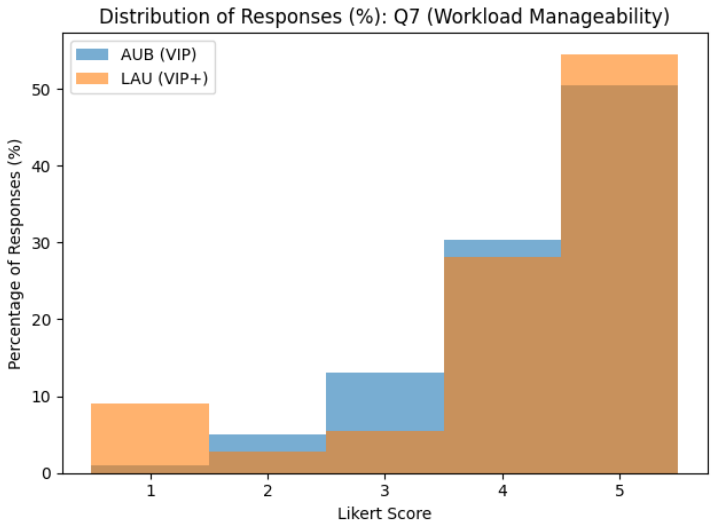

Figure 3. Percentage distribution of student responses to Q7 for both institutions.

Both AUB and LAU students strongly agreed that their contributions had a meaningful impact on project progress (Q9). This item received one of the highest mean scores across both cohorts, highlighting a key strength of the VIP model: sustained student ownership of authentic, long-term projects. Interestingly, LAU students reported a marginally higher mean score for perceived impact. This may reflect the tangible nature of entrepreneurship-driven outputs, such as prototypes, demonstrations, or validated solutions, which can make individual contributions more visible and personally meaningful.

Overall, the results demonstrate that both the applied-research-oriented VIP model at AUB (see program information at https://www.aub.edu.lb/msfea/verticalintegratedprojects/projects.html) and the entrepreneurship-oriented VIP+ model at LAU see https://soe.lau.edu.lb/degree-programs/vip/) effectively support student satisfaction, learning, and engagement. While AUB shows stronger outcomes in technical depth, readiness, and vertical mentorship, LAU matches or exceeds AUB in perceived impact and maintains strong performance across all other dimensions. These findings confirm that the VIP framework is highly adaptable and that its educational impact can be shaped by institutional priorities without compromising core learning outcomes. The results also suggest that targeted refinements, such as strengthening peer mentorship structures in entrepreneurship-focused teams, can further enhance program effectiveness.

4. Conclusion

This study examined the implementation and impact of the Vertically Integrated Projects (VIP) model within conservative higher education ecosystems through a comparative analysis of two institutional adaptations: the applied-research-oriented VIP program at American University of Beirut (AUB) and the entrepreneurship-oriented VIP+ program at Lebanese American University (LAU). Survey results from more than 300 participating students demonstrate that both

implementations achieve consistently high levels of student satisfaction, perceived learning gains, and program endorsement, confirming the robustness and transferability of the VIP framework beyond its original context.

Across both institutions, students reported strong improvements in technical knowledge, transferable skills, and readiness for future academic or professional pathways. These outcomes highlight the value of long-term, credit-bearing, faculty-led project teams in fostering deep learning and professional competency development. While overall trends were similar, the comparative analysis revealed meaningful differences aligned with institutional orientation. The applied research focus at AUB was associated with higher perceptions of technical depth and structured vertical mentoring, whereas the entrepreneurship-driven VIP+ model at LAU emphasized student ownership and perceived impact through tangible, innovation-focused deliverables. Importantly, the results show that vertically integrated experiential learning can be successfully embedded within traditionally structured curricula when institutional alignment, faculty engagement, and appropriate governance mechanisms are in place.

Beyond the VIP model itself, the findings highlight three transferable lessons for community-engaged programs in conservative academic systems. First, a credit-bearing multi-semester structure supports continuity and stronger partner relationships. Second, clear mentoring roles improve student integration, knowledge transfer, and project stability. Third, alignment with existing curricular rules is essential for long-term institutional adoption. For community partners, these features provide more reliable collaboration, more time for testing and feedback, and a better chance for project outcomes to mature over time.

This work contributes empirical evidence that the VIP model is a flexible and scalable pedagogical framework capable of supporting diverse educational objectives. Future work will focus on longitudinal assessment of student outcomes, integration of qualitative feedback, and exploration of how targeted program refinements can further enhance learning experiences in entrepreneurship- and research-oriented VIP environments.

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