

## **Integrating Innovation and Entrepreneurship Development through the Vertically Integrated Projects Plus Program**

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# **Integrating Innovation and Entrepreneurship Development through the Vertically Integrated Projects Plus Program**

**Abstract:** The Vertically Integrated Projects Plus (VIP+) program introduces an innovative educational model that integrates project-based learning with entrepreneurial development to empower the next generation of innovators and leaders. More specifically, the program combines six credits of multi-semester project work with three credits of entrepreneurship or leadership coursework to develop technical skills, teamwork, opportunity recognition, and market awareness. Designed to bridge gaps in traditional higher education, the program fosters both disciplinary expertise and innovation-driven thinking, cultivating students capable of transforming ideas into impactful solutions across diverse fields. Students pursuing the VIP+ Certificate complete nine credits, comprising six credits earned through sustained engagement in multidisciplinary VIP+ projects and three credits through a leadership or entrepreneurship course. At the core of the program are long-term, innovation-centered projects that unite students and faculty from various disciplines to collaborate on real-world challenges. This structure enhances critical thinking, creativity, problem-solving, and project management skills while promoting interdisciplinary teamwork and sustained mentorship. The entrepreneurship component complements this experiential framework by introducing students to the principles of innovation, business strategy, and market-oriented design, enabling them to identify opportunities for technological, social, and economic advancement. By merging academic rigor with entrepreneurial mindset development, the VIP+ program serves as a catalyst for cultivating innovators and changemakers who can navigate and shape the evolving landscape of global industry and society. This approach enriches university education as a whole and provides a research-driven platform for exploring how the integration of innovation and entrepreneurship can redefine student learning and prepare graduates to lead in dynamic, technology-driven environments.

**Keywords:** Innovation and Entrepreneurship, Sustainable Development Goals, Research-Based Education for Sustainable Development, Vertically Integrated Projects

## **1. Introduction**

Innovation and entrepreneurship have become central priorities for higher education institutions (HEIs) seeking to prepare graduates for increasingly complex, technology-driven economies. Entrepreneurship education is widely recognized as a driver of opportunity recognition, job creation, and economic resilience. HEIs are urged to embed entrepreneurial mindsets across disciplines rather than confining them to business schools [1]-[2]. At the same time, there is growing consensus that traditional lecture-based approaches are insufficient; instead, experiential, project-based, and problem-based pedagogies are advocated to connect theory with real-world practice and to foster transversal skills such as creativity, leadership, and resilience [3]-[7].

Project-based learning (PBL) has emerged as a particularly powerful pedagogy for entrepreneurship and innovation education. PBL emphasizes student-centered, experiential engagement with authentic problems, promoting creativity, opportunity identification, teamwork, and decision-making under uncertainty, competencies closely aligned with entrepreneurial action [3],[7],[8]. Studies in engineering, management, and STEM (Science, Technology, Engineering, and Mathematics) contexts show that project- and problem-based curricula enhance students' creativity, critical thinking, collaboration, and communication, while also improving their readiness for the future workforce and capacity for innovation [7]-[8]. Competency-based models of entrepreneurial development in PBL environments underscore the importance of autonomy, reflective learning, self-efficacy, and collaborative learning for cultivating adaptable, opportunity-oriented graduates [9]. In parallel, research on integrating entrepreneurship into STEM and technical education highlights several models of curricular integration, ranging from embedding entrepreneurial elements in existing courses to fully project-driven, whole-process designs where innovation and venture creation are central learning vehicles [10]-[12]. Design thinking and other action-oriented methods have been shown to help science and engineering students translate technological ideas into value-creating solutions, though students often find such courses challenging and institutions must address issues of faculty readiness, assessment, and resource support [3],[4],[12]. Case studies from China, India, and Europe further stress the need for institutional ecosystems, incubators, innovation hubs, and industry partnerships, that complement coursework and support entrepreneurial intentions and outcomes [1],[2],[13].

Within this broader shift, Vertically Integrated Projects (VIP) represent a novel approach to research-based, problem-centered education. Originating in engineering, VIP programs organize long-term, large-scale projects around active faculty research, engaging multidisciplinary and “vertically” mixed teams of students from different academic years, and often including graduate students [14]-[18]. Evidence from multiple institutions shows that VIP participation enhances research skills, communication, project management, and “work readiness,” while providing sustained mentoring relationships and opportunities to address ambitious, real-world challenges [14]-[18]. Recent adaptations also align VIPs with strategic agendas such as the Sustainable Development Goals and expand participation across faculties, demonstrating the scalability and flexibility of the model [18]. Despite these advances, several gaps remain. First, much of the VIP literature focuses on integrating research and undergraduate education, with limited explicit attention to structured entrepreneurial development (e.g., business strategy, market validation, venture creation) within VIP frameworks [14]-[18]. Second, while numerous studies document the benefits of PBL, design thinking, and interdisciplinary innovation courses for entrepreneurial skills, these initiatives are often short-term or course-bounded rather than embedded in sustained, multi-semester project ecosystems [3],[4],[7],[19]. Third, recent reviews of entrepreneurial STEM education call for deeper, project-driven integration of entrepreneurial processes into students' technical work, but concrete models that connect long-term multidisciplinary projects with formal entrepreneurship coursework are still emerging [10],[12].

Traditional VIP mainly focuses on long-term, faculty-led project participation and research skill development in vertically mixed teams. VIP models aligned with the Sustainable Development Goals keep this long-term structure but frame projects around sustainability and societal impact.

VIP+ builds on these approaches by adding a formal entrepreneurship certificate, linked business or leadership coursework, and project activities that encourage students to consider value creation, implementation, and market relevance. Addressing these gaps, the Vertically Integrated Projects Plus (VIP+) program integrates long-term, multidisciplinary VIP projects with a structured entrepreneurship or leadership course to create a coherent pathway that couples disciplinary depth, research-based project work, and explicit entrepreneurial mindset development. The main novelty of VIP+ is that it moves from short, course-level entrepreneurship exposure to a certificate-based, multi-semester model that links research projects with formal business learning. The program extends the VIP model by formally embedding innovation-centered projects within an entrepreneurship-oriented certificate structure, thereby linking experiential learning, innovation, and venture-oriented competencies in a single educational framework. VIP+ responds directly to major engineering education priorities by combining student learning, multidisciplinary collaboration, faculty mentoring, and innovation-oriented project work in one scalable program model. Unlike many short project-based interventions, VIP+ links entrepreneurship learning to sustained project participation across multiple semesters. The remainder of this paper is organized as follows. Section 2 presents the methodological framework of the study, beginning with a description of the VIP+ Program at the Lebanese American University, followed by an overview of the VIP project structure and the student recruitment process. This section further details the evaluation method used to assess student learning experiences and program effectiveness, as well as the requirements and implementation of the Entrepreneurship Certificate of Completion. Section 3 discusses the program outcomes, with particular emphasis on student enrollment trends, perceived educational impact, and the initial adoption of the entrepreneurship certificate. Finally, Section 4 concludes the paper by summarizing the main findings, discussing implications for higher education institutions seeking to integrate innovation and entrepreneurship through vertically integrated, project-based learning models, and outlining directions for future research and program development.

## **2. Methods**

### **2.1. Description of the VIP+ Program at the Lebanese American University**

The Vertically Integrated Projects Plus (VIP+) Program at the Lebanese American University (LAU) is an innovative, experiential education framework that embeds students in long-term, multidisciplinary project teams addressing real-world technical and societal challenges. VIP+ engages undergraduate and graduate students in sustained, faculty-led research and development initiatives that are co-mentored by industry partners, fostering collaboration across academic levels and disciplines. Through involvement in VIP+ projects, students acquire both professional competencies, such as leadership, teamwork, technical communication, project management, and documentation, and domain-specific technical skills directly relevant to contemporary engineering practice. A defining feature of VIP+ is its integration of entrepreneurial confidence building, providing students opportunities for internships, workshops, presentations by distinguished leaders, and pathways toward venture creation. Entrepreneurship is not treated only as a separate course in VIP+. Within the projects, students are asked to connect technical progress with user

needs, value creation, and possible implementation pathways. Project milestones may include problem definition, stakeholder identification, prototype demonstration, and a short discussion of feasibility or market relevance. Faculty mentors reinforce this perspective during project meetings by asking students to explain the practical value of their solutions, identify possible beneficiaries, and reflect on implementation constraints. The program operates across multiple semesters, thereby enabling deep engagement with complex problems and reinforcing a bridge between academic learning and industry needs. Moreover, VIP+ credits are integrated into the LAU curriculum, counting toward elective or signature course requirements, which further aligns academic progress with impactful research experience. Collectively, these elements position VIP+ as a transformative model that enhances student readiness for professional careers and contributes tangible solutions to real-world challenges.

## **2.2. Overview of the VIP Projects and recruitment**

As part of the methodological framework for implementing the Vertically Integrated Projects Plus (VIP+) Program at the Lebanese American University (LAU), this subsection describes the structure of the projects offered and the recruitment process used to populate student teams. The VIP+ model at LAU is organized around a portfolio of long-term, faculty-led projects that address engineering, scientific, and societal challenges relevant to the institution's strategic priorities and the regional context. Projects operate continuously across multiple semesters and span a wide spectrum of themes, including renewable energy and sustainability, intelligent manufacturing, robotics and autonomous systems, biomedical engineering, smart agriculture, advanced materials, digital transformation, and community-oriented innovation. Each project team consists of undergraduate and graduate students working under the guidance of one or more faculty mentors, with additional input from industry or community partners when applicable. The structure of the projects supports cumulative learning and knowledge transfer between students of different academic levels, enabling vertically integrated teams to sustain progress over time while simultaneously developing professional competencies such as teamwork, experimentation, problem-solving, and ethical responsibility.

The recruitment process is an essential methodological component in ensuring that the VIP+ Program attracts and retains students capable of contributing effectively to multi-semester project work. Recruitment is conducted at the beginning of each academic fall and spring semesters through a structured procedure coordinated by the VIP Office. Faculty mentors submit updated project briefs that include objectives, scope, required prerequisites, and anticipated deliverables. These briefs are disseminated through the School of Engineering's communication channels, including email announcements, the VIP+ website, and information and pitch sessions. Students submit a formal application specifying their three project preferences by priority, relevant coursework, prior experience, and motivation for joining. Applications are reviewed jointly by the VIP Office and the supervising faculty namely the team leader, who may conduct interviews for projects requiring specific technical competencies. Selection emphasizes academic performance, commitment to long-term engagement, and alignment between student skills and project needs. Accepted students are enrolled in VIP course credits and integrated into project teams through an orientation process that outlines expectations, reporting procedures, assessment criteria, and

semester milestones. When the student is not accepted for the first choice, the application is forwarded to the team leader of the second-choice project. Also, when the application for the second choice is not retained, the last recruitment goes to the team leader of the third-choice project. This systematic recruitment and onboarding approach constitutes a foundational methodological element of the VIP+ implementation at LAU, ensuring consistency, continuity, and quality across diverse multidisciplinary project teams.

### **2.3.Evaluation method**

The effectiveness of the VIP+ Program at the Lebanese American University (LAU) is assessed using the institutional student course evaluation instrument administered at the end of each academic semester. This standardized evaluation tool is centrally managed by the university and is applied consistently across all courses, including VIP-designated courses, thereby ensuring reliability and comparability of results. The instrument is designed to capture students' perceptions of both the instructional quality and the overall learning experience, which is particularly relevant for experiential and project-based learning models such as VIP+. Responses are collected anonymously using a Likert-type scale ranging from strong disagreement to strong agreement (i.e, 1 for Strongly Disagree, 2 for Disagree, 3 for Agree, and 4 for Strongly Agree), and quantitative results are reported as mean scores at the course, school, and university levels.

The evaluation form is structured around multiple assessment dimensions that align well with the learning objectives of the VIP+ Program. These dimensions include: (i) course design and organization, (ii) instructional quality and learning impact, (iii) assessment and feedback, (iv) student support and professionalism, and (v) student self-evaluation. The course design and organization section evaluates the clarity of project objectives, alignment between activities and learning outcomes, relevance and currency of project materials, and workload management. This dimension is particularly important in VIP+ courses, where project scope evolves over multiple semesters and requires clear communication of expectations. Instructional quality and learning impact focus on the extent to which the learning experience is perceived as beneficial, the encouragement of student participation, critical thinking, creativity, and the effective use of instructional and digital tools. These indicators directly reflect the pedagogical goals of VIP+, which emphasize active learning, innovation, and student ownership of project outcomes. The assessment and feedback dimension evaluates the relevance of graded deliverables, such as reports, presentations, prototypes, and project milestones, to the course objectives, as well as the timeliness and constructiveness of feedback provided by faculty mentors. In the context of VIP+ projects, assessment emphasizes continuous performance evaluation rather than traditional examinations, making this dimension essential for capturing the quality of mentoring and formative feedback. Student support and professionalism assess faculty accessibility, responsiveness, and professional conduct, which are critical factors in sustaining long-term project engagement and mentoring relationships. Finally, the student self-evaluation section provides complementary insight into student workload, engagement level, and self-perceived academic performance, offering contextual data that supports interpretation of the quantitative results. The collected evaluation data are analyzed descriptively and used as an indirect assessment measure of student satisfaction, perceived learning gains, and instructional effectiveness within the VIP+

framework. Results are reviewed by faculty mentors and program coordinators to identify strengths, areas for improvement, and actionable feedback for subsequent iterations of the program. By leveraging an institutionally validated evaluation instrument, the VIP+ Program ensures methodological rigor while capturing dimensions of learning that are particularly relevant to experiential, multidisciplinary, and vertically integrated project-based education. In addition to student satisfaction data, the VIP+ Program defines three entrepreneurship-related learning outcomes for certificate participants: (i) identify and evaluate real problems as potential opportunities, (ii) develop and communicate a basic value proposition supported by preliminary market awareness, and (iii) demonstrate leadership and teamwork while advancing a technical solution toward practical use. These outcomes can be examined through project artifacts such as presentations, prototypes, short business concept notes, and mentor feedback rubrics. At this stage, the present study reports indirect evidence from course evaluations and early program indicators, while direct artifact-based assessment will be implemented in future cohorts.

## **2.4. Entrepreneurship Certificate of Completion**

The Entrepreneurship Certificate of Completion offered through the Vertically Integrated Projects Plus (VIP+) Program at the Lebanese American University (LAU) is a formal recognition designed to encourage and validate students' development of entrepreneurial knowledge and competencies alongside their long-term project engagement. This certificate complements the technical and research-oriented objectives of the VIP+ framework by explicitly integrating entrepreneurship education, thereby equipping students with foundational business, innovation, and market-oriented skills that are essential for transforming technical solutions into viable products, services, and ventures.

Students become eligible for the Entrepreneurship Certificate of Completion once they satisfy a defined set of academic and experiential criteria that extend beyond the regular VIP+ project requirements. Specifically, students must successfully complete a minimum of six (6) credits of interdisciplinary VIP+ projects, which ensures sustained engagement in team-based research and innovation, and demonstrate commitment to entrepreneurial development through additional academic coursework focused on entrepreneurship topics. These courses include offerings such as Entrepreneurship and Small Business Management (FEM301), Entrepreneurial Marketing (FEM322), and Digital Entrepreneurship (FEM312), each of which provides students with theoretical foundations and practical frameworks in areas such as opportunity identification, business planning, customer analysis, digital business strategy, and marketing practices. Completion of one or more of these courses, totaling at least three (3) credits, is required for certification. The certification process is initiated by students who are active participants in the VIP+ Program and have fulfilled the credit requirements. Students must formally apply for the certificate, submitting documentation of completed VIP+ project credits and the entrepreneurship coursework they have undertaken. The program coordinator verifies eligibility, ensuring that both project involvement and entrepreneurship coursework meet the prescribed criteria. Where applicable, substitutions may be considered for equivalent courses that align with the certificate's learning outcomes, subject to approval by the program coordinator. The combination of substantial project experience and targeted entrepreneurship education is intended to foster an integrative

learning experience in which students not only innovate technically but also critically engage with market viability, value creation, and business model development. By formalizing recognition of entrepreneurial engagement through the certificate, the VIP+ Program at LAU reinforces a culture of innovation that bridges academic research and real-world application. The certificate serves as a credential that enhances students' academic portfolios and strengthens their preparedness for career pathways involving technology ventures, startup leadership, industry innovation roles, and interdisciplinary problem solving. Its design reflects an intentional blending of experiential research and entrepreneurship education, positioning graduating engineers to contribute meaningfully to knowledge economies and socio-economic development contexts both regionally and globally.

### **3. Discussion**

The following discussion presents early implementation evidence focused on program growth, student perceptions, and initial certificate uptake rather than long-term venture outcomes. The enrollment trends illustrated in Figure 1 provide clear evidence of the sustained growth and increasing institutional integration of the VIP+ Program at the Lebanese American University (LAU) over the period from Fall 2021 to Spring 2026. Starting with an initial cohort of 53 students in Fall 2021, the program demonstrates a consistent upward trajectory in student participation, reaching 182 enrolled students by Spring 2026. This more than threefold increase reflects both rising student demand for experiential, project-based learning opportunities and the gradual maturation of the VIP+ framework within a conservative higher education ecosystem characterized by rigid curricula and limited flexibility for nontraditional instructional models. The observed enrollment pattern reveals several noteworthy features. First, the overall trend is strongly positive despite minor semester-to-semester fluctuations. For instance, modest declines are observed between Spring 2023 and Fall 2023, and again between Spring 2025 and Fall 2025. These variations can be attributed to typical academic cycle effects, including graduation of senior students, shifts in course scheduling, and variations in project capacity across semesters. Importantly, each temporary decline is followed by a subsequent increase, suggesting that the program has developed sufficient structural resilience and institutional support to sustain long-term growth. The sharp rise observed in Spring 2025, followed by continued high enrollment in subsequent semesters, coincides with the expansion of the project portfolio, increased faculty participation, and stronger alignment of VIP+ credits with degree requirements.

Beyond numerical growth, the enrollment data indicate a qualitative shift in how students perceive the value of VIP+ participation. As projects mature and deliver tangible outcomes, such as prototypes, industry collaborations, and research outputs, student interest appears to be increasingly driven by the program's reputation and peer-to-peer dissemination rather than solely by administrative promotion. This phenomenon aligns with the vertically integrated nature of the VIP model, where experienced students mentor newcomers, contributing to continuity, institutional memory, and sustained engagement across academic levels.

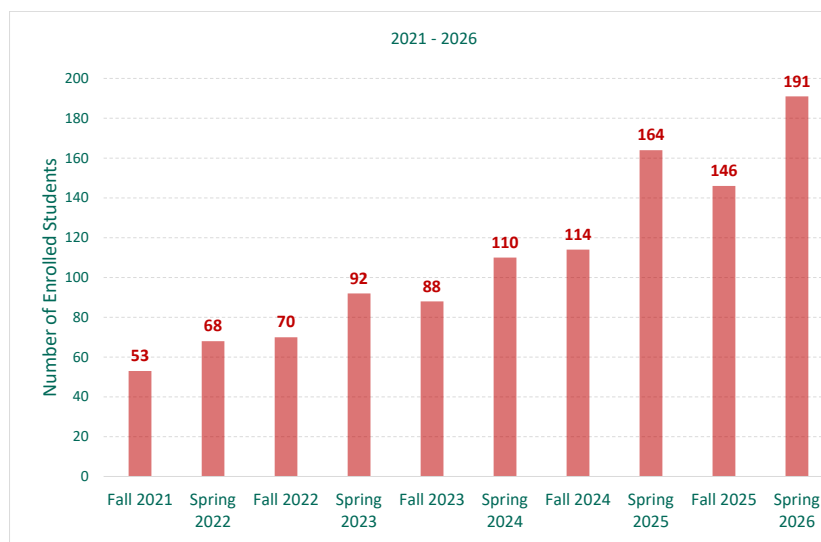


Figure 1. Students' enrollment in the VIP+ Program from Fall 2021 to Spring 2026.

The introduction of the Entrepreneurship Certificate of Completion represents an important complementary development within this growth trajectory. Although the certificate was formally launched relatively late in the program's evolution, its early uptake is noteworthy. The first certificate was awarded in Spring 2025, followed by three additional certificates in Fall 2025. While these numbers remain modest relative to total enrollment, they reflect the initial phase of adoption of a new credential that requires additional academic and experiential commitments beyond standard VIP+ participation. The gradual uptake suggests that students are beginning to recognize the added value of formal entrepreneurship recognition, particularly as VIP+ projects increasingly emphasize innovation, commercialization potential, and engagement with external stakeholders. As awareness of the certificate increases and more projects progress toward market-oriented outcomes, a corresponding rise in certificate participation is anticipated.

Taken together, the enrollment trends and early certification outcomes suggest that the VIP+ Program at LAU is transitioning from a pilot initiative to a scalable and sustainable educational model. The steady growth in participation demonstrates the feasibility of implementing a vertically integrated, experiential learning framework within a traditionally structured academic environment. Moreover, the emergence of the Entrepreneurship Certificate of Completion highlights the program's capacity to evolve beyond technical education and support broader institutional goals related to innovation, employability, and entrepreneurial mindset development. These findings provide empirical support for the adaptability of the VIP model in conservative higher education contexts and underscore its potential for long-term impact on engineering education.

The continued expansion of VIP+ depends not only on student demand but also on faculty capacity. Faculty mentors must supervise multidisciplinary teams over several semesters and guide students in both technical and innovation-oriented thinking. At LAU, this work is supported by the VIP Office, shared recruitment and reporting procedures, and the integration of VIP+ credits into the formal curriculum. For long-term scalability, faculty mentoring should be recognized, supported, and regularly coordinated across teams.

#### 4. Conclusion

This paper presented the design, implementation, and early outcomes of the Vertically Integrated Projects Plus (VIP+) Program at the Lebanese American University, highlighting its adaptation within a conservative higher education ecosystem. The results demonstrate that a vertically integrated, project-based learning model can be successfully embedded within rigid curricular structures when supported by institutional alignment, structured recruitment, and validated evaluation mechanisms. The sustained growth in student enrollment over multiple academic years provides quantitative evidence of increasing student engagement and acceptance of the VIP+ framework, while qualitative indicators suggest meaningful development of professional, technical, and collaborative skills. The introduction of the Entrepreneurship Certificate of Completion further extends the impact of the program by formally integrating entrepreneurship education with long-term project engagement. Although still in its early stages, the initial uptake of the certificate indicates growing student interest in translating technical innovation into market-relevant outcomes. Together, these findings suggest that VIP+ serves not only as an effective experiential learning platform but also as a scalable model for fostering innovation, employability, and entrepreneurial mindset development. Some features of the model are context-dependent, especially curriculum approval pathways, local administrative processes, and the pace of adoption in a conservative institutional environment. However, the core design is broadly transferable: long-term multidisciplinary teams, credit-bearing project participation, staged recruitment, faculty-led mentoring, and structured entrepreneurship learning. These elements can be adapted by public or private universities, including engineering programs in the United States, if local credit rules and faculty support systems are clearly defined.

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