Navigating Institutional Opportunities and Challenges: Interdisciplinary Program Development for Product Design and Entrepreneurship

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Introduction

This paper presents a case study of the development of an interdisciplinary program in design, innovation, and entrepreneurship – a Bachelor of Science in Product Design and Entrepreneurship (PDEP) - at University of the Pacific. University of the Pacific is a medium-size, private, student-centered university with three campuses in California. We are a minority serving institution (MSI) with Asian American and Native American Pacific Islander-Serving Institution (AANAPISI) and Hispanic-Serving Institution (HSI) designations. The goal of this new program is for students to cultivate an entrepreneurial mindset by integrating diverse ideas and concepts across disciplines to generate innovative solutions to complex problems. Students will engage in user-centered design thinking, storytelling to communicate the value of their ideas, and collaborative teamwork to develop high-quality prototypes through iterative processes. They will also gain essential skills in market research, financial forecasting, and innovation, ensuring they can connect theory to practice in ways that benefit both society and the economy.

The development of this program required collaboration across a variety of disciplines in three academic units: (i) engineering and computer science; (ii) arts, humanities, and sciences, and (iii) business. It was led by a Faculty Advisory Board and coordinated with the Office of Enrollment Strategy, as well as the Curriculum Committees and Deans of each of the three academic units. While there have been recent efforts at University of the Pacific to develop interdisciplinary programs, including in data science and sustainability, it has historically maintained a strong focus on traditional, discipline-specific structures within its academic programs and thus does not have a historical tradition of interdisciplinary efforts. This mirrors broader challenges and organizational barriers faced by universities attempting to bridge disciplinary divides.

In this paper, we begin by describing the historical context for the institutional structure in higher education and incentives influencing a shift toward interdisciplinary. Undergraduates are drawn to problem solving in interdisciplinary spaces [1] and universities need to adapt their structures to be able to train students to address complex issues and topics. We also outline features of strong interdisciplinary programs, recommendations for developing programs, and the impact on student outcomes that have been shared in the literature. Additionally, we summarize strategies for shifting academic culture to support interdisciplinarity and the factors that lead to sustainable programs.

The remainder of the paper will focus on the process we followed in the development of the Bachelor of Science in Product Design and Entrepreneurship (PDEP) and compare our experience to the recommendations found in the literature. We reflect on the institutional opportunities and challenges of creating such an interdisciplinary curriculum.

Challenges in the Structure of Higher Education

There are structural challenges that prevent interdisciplinarity in the Academy. American higher education is organized as a disciplinary framework. The disciplines are compartmentalized into

academic departments that define the processes and evaluation of knowledge production. The organization of universities into disciplines began in the early 1900s to train students with skills needed for the growing industrial workforce. Courses of study in areas like engineering, nursing, and education emerged [2]. This movement toward specialization led to concerns about student's overall education and interest in adding a general education that supported the integration of knowledge from a variety of disciplines alongside disciplinary training.

Additionally, following World War II, universities responded to the national need for applied scientific developments and devoted faculty resources to advancing knowledge with increased efforts on research. In the 1960s, government institutions such as the National Science Foundation (NSF) began to support applied research which further spurred interdisciplinary team formation in research. Continued funding for interdisciplinary research, centers, and trainee programs thus stimulates and reinforces interdisciplinary foci at research universities [2], [3]. Faculty with these shared interests can leverage their common research relationships and channel their passion for a topic into the development of interdisciplinary courses [4]. A cluster of related classes can then form a minor program [5] and, if desired, be combined with existing classes to form a major program [4].

While leveraging existing research partnerships may be a pragmatic path for interdisciplinary program development at research-focused institutions, it is important to recognize that alternate methods are required for conceiving and designing programs in less research-intensive or teaching-focused institutions. These institutions may have a stronger disciplinary identity with more siloed departments that reinforce rigid curricular structures and ways of measuring productivity.

The Benefits of Interdisciplinarity

Interdisciplinary programs impart processes to address broad or complex topics where a single discipline is insufficient. These processes require integrating concepts and methodologies from two or more related disciplines to develop a fuller understanding of the complex topic [6]. This is different from double majors where the two disciplines are studied independently, as any connections between them are not explicitly required and would need to be made by the student [7]. Degrees in Interdisciplinary Studies have offered a way for students to design integrated customized curricula to address complex issues at institutions where a formal degree on that particular topic is unavailable [2], [7], [8].

Lattuca et al. found that students with self-designed interdisciplinary majors scored higher on Positive Attitudes Toward Literacy, a measure of the enjoyment to read various genres and express themselves in writing, and Need For Cognition, a measure of interest to engage in many learning behaviors, compared to students in other interdisciplinary program structures [9]. They posit this is likely due to the high motivation of students selecting a self-designed major and that these are available at institutions where faculty and students work closely to design their customized academic program [9]. This type of program would be feasible at institutions with smaller student populations and a teaching focus.

Changing the Culture

Institutional embrace of interdisciplinary programs requires a shift in academic culture. Typically change occurs incrementally and slowly in academia. Rapid transformation is unlikely, however movement toward interdisciplinarity can be enabled with small changes that allow for flexibility institutionally and with individual faculty development. Review of case studies indicated that over time, if supported by careful planning, implementation, and self-assessment efforts, beliefs move [10].

Institutions should use combined approaches of strategic targeting of selective initiatives and identifying and addressing barriers such as promotion criteria, budget control, and unit reporting [10]. Strategic targeting can be top down to align with state and federal priorities and university strengths [2], [10] or faculty led bottom-up efforts [4], [10]. Efforts succeed with both substantial faculty buy-in and administrative sponsorship [11].

Challenges and Opportunities

Klein and Schneider (2010) summarize barriers and disincentives to interdisciplinarity into these themes: (i) organizational structure and administration; (ii) procedures and policies; (iii) resources and infrastructure; and (iv) recognition, reward, and incentives. Table 1 contains a subset of these barriers. Relaxing these barriers promotes the flexibility and culture change that may be needed.

Table 1. Barriers and Disincentives to Interdisciplinarity. *Adapted from [10, pp. 72–73].*

Theme	Barrier or Disincentive
Organizational Structure and Administration	• Rigid one-size-fits-all model of organizational structure • Territoriality and turf battles over budget, ownership of curriculum and research • Resistance to innovation and risk • Lack of experienced leaders • No clear and authoritative report lines for interdisciplinary units
Procedures and Policies	• Inflexible guidelines that inhibit approval of new programs and courses • Lack of guidelines for hiring, tenure and promotion, and salary • Unfavorable policies for allocation of workload credit for interdisciplinary teaching
Resources and Infrastructure	• Inadequate funding and ongoing support for interdisciplinary units • Inadequate space and equipment and inflexible allotments of use • Weak or no faculty development system • Insufficient time for planning and implementing program and project infrastructure • Insufficient time to develop collaborative relationships in team teaching and research
Recognition, Reward, and Incentives	• Invisibility and marginality of interdisciplinary research, teaching, service, advising, and mentoring • Reliance on volunteerism and overload • Negative bias against interdisciplinary work

Klein and Schneider [10] also summarize factors that are essential to develop sustainable interdisciplinary programs. These are listed in Table 2.

Table 2. Essential Factors for Sustainable Interdisciplinary Programs. *Adapted from [10, p. 106].*

- Being an autonomous unit
- Having a voice in unit policies and procedures
- Has a visible and secure location in the organizational hierarchy
- Structural coherence
- Sequence of core interdisciplinary courses
- Clearly defined interdisciplinary mission
- Shared intellectual agenda
- Adequate personnel (faculty and staff)
- Strong and experienced leaders
- A sense of community and shared experiences
- Faculty development
- Incorporation of best practices and pertinent literatures
- Proactive attention to integrative and collaborative processes
- Adequate financial resources and control of budget
- Adequate common space and equipment
- Appropriate criteria of evaluation and assessment
- Equal access to institutional reward system and incentives
- Affiliations with other units and external communities

Chieh recommends programs avoid trying to make every course in the program interdisciplinary when designing a curriculum [12]. The curriculum needs to include courses that build essential competencies in areas such as quantitative thinking, critical thinking, written communication, problem solving, etc. in addition to highly interdisciplinary courses that require that foundation. A way to develop well integrated courses covering complex topics is to collaboratively create and teach them in interdisciplinary teams [6], [12].

Preston & Fletcher recommend workshops with cross-department teams in the early stages of program ideation [4]. This will enable themes to emerge that leverage the university's areas of strength. It is also critical to review similar programs to understand the competitive landscape. While Preston & Fletcher advise drawing from the enthusiasm of faculty champions, they also recommend seeking input from current students and potential future employers about the program [4].

Development of Product Design and Entrepreneurship Program (PDEP)

Following the successful approval of the first interdisciplinary program at University of the Pacific in data science, the Academic Council in coordination with the Provost's office hosted a Curriculum Innovation Day, a voluntary event intended to provide faculty from different schools within the university with the opportunity to generate ideas for new interdisciplinary programs in a workshop style setting. The event was held in a neutral space with tables and seating organized to promote discussion and complemented with refreshments. Dialogue was seeded with structured networking components and there was also time for unstructured conversations. At the start of the session, the Provost addressed participants, inviting them to be creative and

unconstrained in idea generation. The procedural logistics, organizational structures, funding needs, etc. would be handled later by a Faculty Advisory Board (FAB) and the relevant Deans. From this session, programming related to design, innovation, and entrepreneurship emerged as one common area of interest. Bolstering entrepreneurship through curricular partnerships with other schools was viewed as an opportunity for the business school whose strength in entrepreneurship had waned in recent years due to staffing constraints. Following the Curriculum Innovation Day, the Academic Council followed up with all faculty and invited volunteers to join FABs related to the interdisciplinary areas of interest. The Faculty Governance office offered support in navigating the subsequent development and approval processes for proposed programs.

A FAB with a total of nine representatives from three schools (engineering and computer science, liberal arts and sciences, and business) was formed. One faculty member from engineering and one from business co-led the FAB. The FAB met regularly during the spring semester, as well as five times over the summer. Our initial meeting was spent learning about each other's thoughts and ideas for programming for design, innovation, and entrepreneurship. The following options arose:

- 1-year Master program at both professional and graduate levels
- 2-year undergraduate degree focusing on Applied Design, Innovation, and Entrepreneurship for transfer students
- 4-year undergraduate degree focusing on building an entrepreneurial mindset
- 4-year undergraduate degree focusing on entrepreneurial practical experience
- 4-year undergraduate degree focusing on core Design, Innovation, and Entrepreneurship foundational skills and different tracks (e.g., Tech, Art & Media, Social Sustainability, Web3/Blockchain, etc.).

Following this, the FAB decided to conduct an environmental scan to understand the status and potential opportunities for programming. Activities included: (i) gathering benchmarking data from universities with similar programs; (ii) listing existing classes offerings that are relevant to the program and housed in the three schools, and (iii) together with Office of Enrollment Strategy Strategic Enrollment, identifying the gaps and needs in the market related to design, innovation, and entrepreneurship.

The information gathered with Enrollment Strategy was critical at this time in the development process. Using a commercially available labor market data and analytics tool designed for education, data on the job market as well as landscape of existing educational programs emphasizing design, innovation, and entrepreneurship were obtained. The job market analysis identified numbers of job postings regionally and nationally, in demand skills, education level required, and average salaries across the occupations searched. Because of the interdisciplinary nature of the program, a range of related occupations were evaluated. The program analysis identified similar academic programs offered at other institutions and their Integrated Postsecondary Education Data System (IPED) tuition and fees, completion information, and program growth. Additionally, Enrollment Strategy encouraged the FAB to focus on the main institutional aim, which is to attract new undergraduate students to enroll at University of the Pacific. They indicated a preference for a Bachelor of Science degree as that would be attractive to international students. They also recommended a curricular design with a core set of courses

and a limited number of tracks. Finally, they emphasized leveraging our existing infrastructure, such as the library and makerspace, and our existing faculty expertise.

This feedback guided us to design a 4-year undergraduate degree focusing on core design, innovation, and entrepreneurship foundational skills and different options for tracks. In future meetings of the FAB during that semester, we discussed vision and goals as well as came to agreement on utilizing project-based learning in newly designed courses. The FAB agreed that many of the core courses should be interdisciplinary in nature, not emphasizing a single discipline in the content of the course. All existing related classes offerings in the three schools were reviewed for inclusion in the program. We also identified commonality between existing offerings and areas that would need to be addressed in new courses. Some FAB participants also shared lessons learned from previous newly launched programs that we should avoid, such as a lack of sufficient depth in technical content and the absence of a structured pipeline to deliver complex technical concepts effectively. Additionally, it was emphasized that aligning course skills with job market demands is crucial to ensure student success post-graduation. Establishing a clear program identity was also highlighted as essential for creating a sense of belonging and fostering strong student cohorts. Lastly, participants stressed the importance of focusing on niche areas to attract new students and grow enrollment, rather than simply reallocating students from existing programs.

Academic programs at other institutions typically emphasize physical design or digital experience. Our aim was to create a curriculum that integrates both. To address this, we developed two options for tracks: (i) Physical Design + Manufacturing, and (ii) Digital User Experience + AI.

We reached this point by the start of summer term and then stalled due to the FAB consisting of 9-month faculty. University leadership and the Deans wanted the program to launch in Fall 2025 and so it needed to be approved by our Board of Regents in their November 2024 meeting. This required an accelerated timeline to develop the curricular details of the program and to seek feedback so that it would be ready for approval by the curriculum committees in each of the units in early September. To accomplish this, the Deans provided modest stipends to those who could participate in a few days of summer workshops.

The summer workshop team consisted of five of the FAB members, but unfortunately no one from the liberal arts and sciences could participate. The team started by defining a program mission statement (one that aligned with the institution's mission statement), program learning outcomes (PLOs), program curriculum including new course proposals. The program curriculum consists of the following topics and subtopics:

- Fundamentals in math, business, economics, and artificial intelligence
- Design Core
  - Principles of Design
  - Communication through Media and Technology
  - Research Methods
  - Cognitive and Learning Processes
- Business Core

- o New Product Development
- o Management
- o Marketing
- o Finance
- o Entrepreneurship
- Tracks (select one)
  - o Physical Design + Manufacturing
    - – Computer-Aided Design (CAD)
    - – Materials
    - – Manufacturing
  - o Digital User Experience + AI
    - – UX Design
    - – App & Web Development
- Capstone (two semesters)

More details on the curriculum can be found in [13].

Another activity for the summer team was developing a multi-year budget to include with the proposal. This included funds for a Program Director, Associate Faculty Director, adjunct faculty/course buyouts for existing faculty to teach in the program, Marketing Manager, Administrative Assistant, start-up marketing expenses and an operating budget. We planned for a modest initial enrollment that would grow to a steady state over a few years.

To ensure that a student could complete this curriculum in a four-year timeframe, negotiating flexibility on pre-requisite courses for some existing courses with their corresponding programs was required. The business school in particular was limited in options for pre-requisite changes for existing courses to stay compliant with their accreditation body. A unique and challenging aspect of this effort was garnering endorsements from a diverse range of more than 15 academic programs in order to include their courses in the program. Some of the concerns departmental leaders raised included the potential increases in class sizes, frequency of courses offerings, faculty resources, and whether some courses needed significant realignment or had overlapping content with the PDEP program (which could be a concern for programs that may view PDEP as internal competition). Concerns were also raised in the engineering school that the program was not sufficiently technical, did not have a direct path to engineering practice, and could not be accredited by ABET in its current form. This was an example where the disciplinary lens on student learning and outcomes was deeply held. Advisory board leaders discussed the wide variety of possible career paths for students with faculty in order to highlight the value of the PDEP program. Gaining program and school buy-in was an iterative process. Each school's curriculum committee had to approve the proposal. The university does not have a process in place for simultaneous review of interdisciplinary programs by these committees, so we received feedback one by one.   If any committee raised questions or requested modifications, there was a chance it would need to be revisited by another committee that had already approved the proposal. For example, the business school felt strongly that the second course in the capstone sequence should be an existing course, Entrepreneurial Management Practicum, rather than a new course as originally proposed. They were the last to provide feedback and so it required revisiting this change to the curriculum with the two other committees.

Following the schools' approval, university faculty governance committees reviewed and approved the proposal. And finally, it was sent to the Board of Regents for approval.

Our process contained many of the recommendations from the literature. Table 3 compares the development of the PDEP program with the recommendations from [4], [10], [12].

Table 3. Alignment with the recommendations from the literature for interdisciplinary program development and sustainability

Author	Recommendation	Status	Comments
Klein & Schneider [10]	Being an autonomous unit	No	The program is housed together with other interdisciplinary programs under the Provost's office, but program oversight is assigned to one of the Deans.
	Having a voice in unit policies and procedures	No	The faculty will retain their membership in the given school, but there is no mechanism for PDEP.
	Has a visible and secure location in the organizational hierarchy	Ongoing	Not yet finalized.
	Structural coherence	Yes	The business core and design core classes build on each other. The capstone will bring together content in a culminating interdisciplinary experience.
	Sequence of core interdisciplinary courses	Yes	There is at least one interdisciplinary class per year for both tracks.
	Clearly defined interdisciplinary mission	Yes	The mission was developed collaboratively with representatives from each school.
	Shared intellectual agenda	Ongoing	Faculty Affiliates will be selected. They will provide guidance on the priorities of the program along with the Director and Faculty Director.
	Adequate personnel (faculty and staff)	Ongoing	As planned in the budget, there is a ramp up planned for personnel. It is hoped that we will follow this plan.
	Strong and experienced leaders	Ongoing	An Interim Faculty Director has been appointed, and the Director will be hired in Fall.
	A sense of community and shared experiences	Yes	Students will take a series of courses as a cohort. There is an opportunity to grow the sense of community with a physical home.
	Faculty development	Yes	The schools and the university have funds for faculty development
	Incorporation of best practices and pertinent literatures	Ongoing	The first set of PDEP courses will begin in fall. The instructor is expected to consider best practices
	Proactive attention to integrative and collaborative processes	No	Not yet defined.

	Adequate financial resources and control of budget	Ongoing	The approved budget will provide adequate resources. Control of the budget is uncertain; it may reside in the Provost's office or the Dean's office.
	Adequate common space and equipment	Ongoing	The proposal requested a physical administrative home for the program. It is hoped that this will occur.
	Appropriate criteria of evaluation and assessment	No	Not yet defined.
	Equal access to institutional reward system and incentives	No	Not yet defined.
	Affiliations with other units and external communities	Yes	While the program will be overseen by one Dean, there will be regular meetings with all the Deans.
Chieh [12]	The curriculum that builds essential competencies in addition to highly interdisciplinary courses	Yes	Foundational competencies are built in the business and design cores, and cohort classes will be interdisciplinary.
	Collaborate in developing and teaching well-integrated courses covering complex topics	Ongoing	The Director and Faculty Director will be collaborating on content development for the cohort classes.
Preston & Fletcher [4]	Conduct cross-department workshops during ideation	Yes	The Faculty Innovation Day was a cross-department workshop intended for program ideation.
	Understand the competitive landscape	Yes	Conduct an environmental scan early in the development process
	Seek input from current students and potential future employers	Ongoing	We have spoken with current students informally about the program. We will be forming an industrial advisory board to solicit feedback from potential employers.

Conclusions

In this paper, we discussed the development of a new interdisciplinary Bachelor of Science in Product Design and Entrepreneurship (PDEP) at University of the Pacific. While institutional hurdles such as faculty buy-in, budget management, and curriculum alignment required significant effort, these challenges also led to opportunities for enhanced interdisciplinary collaboration, the creation of innovative courses, and the reinvigoration of the entrepreneurship area in the business school.

We reviewed the alignment of the development process with existing recommendations for interdisciplinary programs from the literature [4], [10], [12]. In particular, effective communication, strategic coordination, and shared ownership among stakeholders along with establishing independence, visibility, and governance structures emerged as success factors that need to be prioritized as we establish the program. The lessons learned from this effort provide a valuable blueprint for similarly structured institutions aiming to establish interdisciplinary programs that bridge academic units.

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