Experiential Learning as a Tool for Deep Collaboration Between Business and Engineering Majors

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Abstract

Collaboration in higher education has seen many improvements in recent years. Programs that used to operate in silos incorporate some form of collaboration in their curriculum. However, there is still the need to expand interdisciplinary collaborations through experiential learning. The University of Dayton received a generous donation from an alumnus to support multidisciplinary collaboration between engineering and business majors through experiential learning. Consequently, the Stitt Scholars Program (SSP) was instituted to allow students to engage in multidisciplinary collaborations. The focus was to acquire and enhance their entrepreneurial and innovation skills. Through the Stitt Scholars Program, startup companies provide projects for multidisciplinary teams of students to execute. Each student puts in ten hours of work each week. The startup companies have no financial obligation as the students are paid from the Stitt Scholars Program fund. The students also take a 2-credit hour course which incorporates lecture series and other weekly academic engagements. This course's goal is to help the students understand the engineering and business needs of bringing out a product and starting and running a company. From his experience in managing a family-owned business, the donor was convinced that supporting such deep collaborative efforts may help break the silos and create value for startup companies in the community. This paper discusses the Stitt Scholars experiential learning program at the University of Dayton. We will present a narrative of the framework used in developing the Program, initial assessment, and feedback from various stakeholders, which may be helpful for institutions that may want to start a similar program. Generally, the experience has been positive and impactful for the students, the donor, and the industrial clients. The initial feedback from the clients shows that the program is creating value for their startup companies. Consequently, the program received an additional donation of $100,000.

1. Introduction

Experiential learning enables students to engage in a substantial experience and reflect on that experience "until they can create abstract conceptualizations that link the experience to previous experiences, which ultimately results in active experimentation when the student determines how they will put the experience into future actions" [1]. Experiential learning thus is a very active method of learning, contrary to the typically passive classroom environment where students listen to lectures and do not participate in reflective activities on the material presented. Experiential learning commonly incorporates an out-of-the-classroom experience (or an atypical in-classroom experience) and individual or group reflection to emphasize the significance of the experience.

Experiential learning aims to address the students' lack of engagement in traditional classroom settings. Typically, courses in higher education are taught in such a manner that for students to be successful, they have to engage in concept memorization and repetition to transfer new information into long-term knowledge [1]. The addition of experiential learning to the classroom could help

students significantly as "students are given the opportunity to develop their own associations between new material and previous knowledge" [1]. Forming these associations is imperative for the complete understanding and application of newly learned material. Additionally, experiential learning programs focus on "cognitive, social, and personal outcomes" [1] that can help to educate and improve the whole person, not simply the aspect of a student regarding their performance within the classroom [1]. Experiential learning is multifaceted and helps improve student interactions with new material, which increases their overall level of engagement in their education.

Experiential learning benefits students during their educational careers and after entering the workforce. According to Wurdinger and Allison [2], employers prefer hiring students who are "adept in life skills such as problem solving and creativity" [2], which are critical points of focus within experiential learning programs [2]. Thus, students who have learned experientially have advantages over those who have not when applying and interviewing for jobs post-graduation [2]. These students get the opportunity to "enhance skills such as problem-solving, critical thinking, and interpersonal relationships." A study at Elon University reports that "students that only had one experience were 33 percent less likely to have a job at graduation and 26 percent less likely to be accepted to graduate or professional school than similar graduates with more experiences" [3].

Although there are numerous benefits of experiential learning, the challenges cannot be overlooked. One such challenge is winning faculty support to integrate experiential learning into their programs. Wurdinger and Allison [2] observed that "while 97% of faculty survey respondents agree that experiential learning approaches enhance students' development of necessary life skills, there still exist many barriers to fully implementing this teaching pedagogy [2]. Such barriers include the time and energy required to develop and integrate experiential learning into the curriculum. In addition, the commitment to allowing students to have more control over their learning and the need to let go of traditional lecture styles in favor of more active teaching methods [2]. Other reasons include "workload, time constraints, and class size" [4]. Generally, educators embrace the benefits of experiential learning.

Perusso et al. [5] identify other significant challenges of experiential learning. It is not enough for students to participate in experiential learning activities and then move on to the next class or project [5]. Instead, they must fully engage with the experience and the material they have learned. "Reflective dialogue is central for ensuring that impressions from experience translate into better-defined learning outcomes" [5]. If experiential learning programs do not offer an opportunity for students to reflect on and discuss what they learned in a group environment, there is a greater risk of students not accurately understanding the learning objectives and thus not taking away any benefits from the program [5]. The discussions are more beneficial if well facilitated by the educator [5]. Therefore, educators must balance giving students some control of their learning and guiding them through the experience to help increase their understanding [5]. Experiential learning may also offer opportunities for students to engage in multidisciplinary collaborations. If the experience is deliberately designed, elements of multidisciplinary collaboration can be included to enrich the learning experience.

2. What is Multidisciplinary Collaboration?

Multidisciplinary collaboration "is concerned with the study of a topic across multiple disciplines, and with the transfer of methods from one discipline to another" [6]. In its most effective form, multidisciplinary collaboration does not solely mix students with different educational backgrounds with the single purpose of having them all learn a new concept or topic. Instead, this type of collaboration should enforce the application of the students' backgrounds and experiences in new ways they can learn new material while also learning from each other's method of learning [6].

Multidisciplinary collaboration within higher education courses "represents an opportunity for curricular innovation" as students from different backgrounds come together to apply their previous knowledge and learn new concepts [7]. Combining multiple educational disciplines allows for a more robust learning experience for students and faculty alike, who all benefit from hearing new ideas and taking new approaches to teaching and learning. Additionally, this type of teaching results in "improved affective and cognitive learning and critical thinking, offering learners/students the opportunity to obtain a broad general knowledge base" [8]. Participation in multidisciplinary courses also assists students in developing many skills that are highly valued in the workforce. Among these are hard skills such as management skills, reporting and writing skills, problem-solving skills, and soft skills such as communication, curiosity, empathy, and teamwork [8]. This is why the Stitt Scholars Program was instituted. It provides profound collaborative opportunities through experiential learning in a multidisciplinary academic and professional environment. A multidisciplinary approach to education highlights the inherent differences among students and how those differences can be applied in a constructive way for all involved [9]. This has greatly benefited the Stitt Scholars Program community partners who serve as project sponsors. The multidisciplinary teams have been able to help them come up with solutions that would have otherwise remained uncharted.

Dederichs et al. [10] implemented multidisciplinary collaboration in an engineering building design course. They observed that "52 percent of the students and 50 percent of the professors experienced an improved collaboration in their teams" [10]. The authors also reported that "a majority of the students felt activated during the course" and "the traditional role distribution was disbanded" in favor of a flatter team structure [10]. Multidisciplinary collaboration promotes the learning of collaborative skills necessary in any professional setting. It encourages students to break down any predefined barriers that may deter them from taking specific roles on a project.

Despite the benefits of multidisciplinary collaboration, some challenges may prevent universities from employing such teaching strategies. For example, this type of teaching and learning environment requires a "larger investment of university resources" [7], which can be challenging to acquire [7]. As with experiential learning, multidisciplinary collaboration takes extensive time and effort to implement. An important point brought up by J.G. Hardy et al. [8] is that providing adequate resources, motivation, training, and effective articulation of the benefits to students and

faculty members are essential to getting faculty members to engage in multidisciplinary collaboration [8]. Without these, faculty members may likely remain in their silos [8]. Therefore, experiences gained from multidisciplinary collaborations such as the Stitt Scholars Program must be shared among the broader academic community. The following section presents the main components of the Stitt Scholars Program at the University of Dayton.

3. The Stitt Scholars Program

The Stitt Scholars Program at the University of Dayton was instituted with a generous donation from an engineering technology alumnus who wanted students from the School of Engineering (SoE) to deeply engage with students from different academic units through experiential learning. The goal is to create multidisciplinary teams and provide them with opportunities to gain and enhance their innovation and entrepreneurship skills through value creation for community partners. The program aimed to equip the student with the skills and other business acumen required to start and run a company. From his experience in the corporate world of manufacturing, the donor had observed that engineering and business professionals typically do not *understand* the language of each other's profession, which leads to delays in product release and unmet or mismatched customer needs. Hence, the donation was meant to create an opportunity for multidisciplinary students to collaborate through experiential learning. Consequently, the first cohort was selected in the late spring (2021) semester to start the program in the fall of 2021. The program consists of a mini-course (Elements of Innovation and Entrepreneurship) and an experiential learning course (Stitt Experiential Internship). In the fall and spring semesters, the students enroll in these courses in addition to their regular courses. Details about the courses will be presented later.

3.1. Cohort Recruitment

The program's steering team designed recruitment flyers with application information such as required academic level, technical experience, and the required application materials. Applicants must be sophomores or juniors who can commit to one academic year (fall 2021 and spring 2022) with the potential for consideration for another year. In addition to sharing the flyer with academic advisors, some of the steering committee members also attended seminar courses at the school of engineering and the college of business administration in spring 2021 to share the application information with qualified students. After receiving applications, the team identified the eligible applicants and interviewed to select five engineering and five business students. When they accepted the program's offer, they were officially hired for the paid internship component through the Stitt Scholars Program student employment system.

3.2. Stitt Scholars Program Components

In the fall of 2021, the students participated in the mini-course and an experiential learning course. The director of the program developed weekly content for the courses. The mini-course consisted of a weekly lecture series with innovation and entrepreneurship topics. About two-thirds of the topics covered in fall 2021 were adopted from *Engineering Entrepreneurship from Idea to Business Plan: A Guide for Innovative Engineers and Scientists by Paul M Swamidass*. A total of

11 lecture series were hosted with 14 different speakers. After each lecture series, the director leads a 15 to 20 minutes reflection session for the student to reflect and also submit a half-page reflection paper later.

As part of the mini-course, the students also read a book (Steve Jobs - by Walter Isaacson) throughout the semester. Unlike traditional academic texts, which are typically discipline-focused, this book provided everyday examples of engineering and business challenges faced when starting a company. It presents excellent lessons about the product realization process, business acumen, and general personnel management practices related to innovation and entrepreneurship. In addition to weekly reading assignments, the students completed weekly quizzes (about ten questions per quiz) per chapter. Also, the students participated in a forum discussion to share what they found engrossing in each chapter. When time permitted, the director facilitated reading reflection sessions. However, most of the reflection and discussions occurred at the forum, where each student was required to start a thread and comment on (at least) two other posts from other students. The student had to post to the forum before seeing other posts. This constraint was deliberately instituted through the learning management systems to prevent their initial forum post from being influenced by what other students shared. The program director also engaged in the forum discussions by commenting on some students' posts and asking follow-up questions. The students read the first fourteen chapters of the book in fall 2021.

The experiential learning component was the main piece of the program. The students engaged in a paid 10 hours of work each week, also referred to as the internship. As part of the program (experiential component), they worked with startup companies at the HUB (powered by the PNC Bank). The HUB, a business incubator, has a rich ecosystem of startup companies and an entrepreneurship center that supports startup companies. It also has offices and shared workspaces for startups and other well-established corporations to work and grow their businesses. Situated in downtown Dayton and one of the historical buildings with rich architecture, the renovated arcade (the HUB) is revitalizing the area by bringing in startup companies and providing the resources they need to grow. The ecosystem and the energy at the HUB make it an ideal location for the Stitt Scholars Program. Thus, the cohort (referred to as interns) gets the opportunity to collide with young and experienced entrepreneurs at the HUB.

To secure projects from the startup companies, the program director meets at the HUB with the potential clients to understand their needs, scope them and determine if they will be appropriate for the interns. After the initial meeting, if the project is a good fit, the potential clients are provided with a project description form (in the appendix) to provide additional information about the projects. As seen in the appendix, the details include a timeline (expected completion date), problem description, goals/deliverables, client contact, and opportunities for student learning. If the client cannot put together the problem description, the director, after the initial meeting, generates it and sends it to the client for review.

Once projects are selected, they are presented to the interns to rank them in the order of their interest. The projects are then assigned by considering student interests, skill match, and discipline diversity. In fall 2021, the interns worked on ten projects in three phases. Eight of the projects were completed. Team members were reshuffled during each phase to ensure that the interns could

learn and work with different groups of people. Phase one had four projects with teams of two or three students. Phases two and three each had three projects. Each project lasted for about four to six weeks, with occasional overlaps. All the projects were executed outside of standard class times.

After project assignments, the interns sign a non-disclosure form and select a team leader who contacts the client to set up a kickoff meeting. Before each kickoff meeting, teams prepare a project charter and schedule. A template of the project charter can be found in the appendix. The teams also provide weekly written and oral project updates to the program director and the clients. At the end of the project, the interns typically submit written reports, final presentations, prototypes (if applicable), and any other technical or administrative deliverables to the client and the director. They complete two peer reviews (in the appendix) to assess their peers' performance. The next section presents the feedback received from the various stakeholders after the initial implementation of the SSP.

3.3. Feedback and Assessment

Client Survey

After every project, the clients complete a brief survey to share their experiences. Since our clients are all startup companies or entrepreneurs, it is vital to ensure that providing an educational value to the students leads to value creation. So, the client survey focused on whether their expectations were met. The eight clients whose projects were completed indicated that their project goals and deliverables were met or exceeded.

Donor Feedback

The donor was integral in shaping the vision of the Program. In fall 2021, two written reports were submitted to the donor and other university stakeholders. The first report was sent midway through the semester. This report chronicled the program's status, challenges, principal components, and a brief student experience. A written report was also submitted at the end of the semester, followed by a presentation. These chronicled the semester's experience and highlighted the interns' projects and the impact on clients and the community. One of the students was invited to the presentation to share his experience with the donor. The student spoke about the components and how the program has impacted him. This led to an additional donation from the donor to expand the program a year-long beyond the initial three years.

Student Assessment and Feedback

The program director met with each intern in a one-on-one meeting two weeks into the semester to learn about their initial impression of the program. For the remainder of the semester, collective student feedback was sought after every other lecture series. At the end of the semester, the students completed a comprehensive survey to share their experience in the program. The survey focused on the three main components of the program (the lecture series, book-read, and the internship). A summary of the main survey components is discussed below.

3.4. Analysis of Fall 2021 Program Components and Impact

The students submitted written reports and gave presentations for each project. They also participated in reflections and submitted reflection papers for every lecture series. They completed weekly quizzes and participated in weekly forum discussions for the book read. These were all graded, and students received feedback.

Project Work

The clients indicated that the interns met or exceeded their expectations and delivered all project deliverables. Most of them highlighted the interns' communication skills and ability to maintain ethical and professional communication. A client used one of the deliverables to secure $15,000 from the PNC Bank to support minority-owned businesses in greater west Dayton.

The interns also completed an end-of-semester anonymous survey in fall 2021. All ten students indicated that they got the opportunity to demonstrate their leadership skills. While two students were neutral, eight agreed or strongly agreed that the projects they worked on provided value to the client. Similarly, nine agreed that the projects were good learning tools. Generally, the students enjoyed interacting with the clients and collaborating with their peers from the different majors. Below are some direct comments from the student survey.

"I think that I gained the skill of "beginning-with-the-end-in-mind," which was highly stressed throughout the Program. Typically, I am good at looking at the big picture, but I am not a big planner, so doing Gantt charts and project charters isn't something I have used before. I usually make more up as I go, but with this Program, you have to be more upfront about your processes from the beginning. I learned this through the project I worked on".

"I think I had a decent amount of the elements of entrepreneurship coming into the internship, but I definitely learned a decent amount from the clients I am working with. They are creating a new way to help people with cancer or with a family history of cancer. They found a need in the insurance benefits industry and are filling it".

The word cloud below (figure 1) shows the words the students used to describe their experience in the program. As can be seen, when asked: "what skill(s) did you learn or enhance by working on the projects with your team and the client?" Most of the students mentioned communication and team skills as the skills they learned or enhanced. This was one of the goals of the Stitt Scholars Program. The students also mentioned that they learned or enhanced their marketing skills, how to think differently, project management, and working with students from different majors.

Figure 1: Word Cloud of Skills Learned or Enhanced from the Projects

Book Read

Figure 2 presents the results of the question "briefly describe what you learned from the textbook." The students spoke about learning things such as how to "create a business," learning a lot about "life," seeing different things from an "interesting perspective," creating a successful company, bringing ideas into life, and managing personalities and different people.

Figure 2: Word Cloud of Skills Learned from the Book Read

Lecture Series

The students submitted weekly reflection papers elaborating the main things they learned from each lecture series. As seen in figure 3, when asked about their perception of the lecture series", most of the students indicated it mainly was "interesting" seeing the speakers share valuable experiences. They appreciated the opportunity to ask questions and the different innovation and entrepreneurship topics that the speakers spoke about. The interns also went on a facility tour at the University of Dayton Research Institute (UDRI) for one lecture series to learn about additive manufacturing. This was well-received, and they expressed interest in more facility tours in the future.

Figure 3: Word Cloud of Students' Perception About the Lecture Series

4. Conclusions/Recommendations

The University of Dayton received a generous donation from an alumnus to support multidisciplinary collaboration between engineering and business majors through experiential learning. Consequently, the Stitt Scholars Program was instituted to allow students to engage in multidisciplinary collaborations. The focus was to provide students the opportunity to acquire and enhance their entrepreneurial and innovation skills. Through the Stitt Scholars Program, startup companies offer projects for multidisciplinary teams of students to execute.

The goal of the Stitt Scholars Program was to support deep collaboration between students from different majors by having them collaborate on projects with startup companies. As part of this program, an experiential learning course was integrated with a lecture series and scheduled reading assignments. The students worked on ten projects in fall 2021 and met all of the clients' project

goals. The students collaborated with peers from different majors, enhanced their communication skills, and prepared project charters and written reports. They also conducted formal presentations to share their project outcomes.

The students enhanced their communication skills, were exposed to innovation and entrepreneurship, and created value for their clients. Through the program, students utilize their talents to create value for the companies, build connections, acquire and enhance employable skills, and participate effectively in multidisciplinary teams as team leaders or members. The clients acknowledge that they enjoyed providing an educational value to the students and getting value for their projects. The program's success led to an additional donation of $100,000 to support the program.

5. References

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6. Appendix

Project Description Form

Title of Project:
Type of Project:
Description of Project/ Problem:
Deliverables (Desired Result):
Requirements:
Opportunities for Student Learning:
Key Words:
Client's Name:
Client's contact (email/phone number):
Client Address:
Target completion date:

Project Charter Form

General Information
Project Title: Date:
Project Manager/Team Leader: Phone: Email:
Project Sponsor/Client: Phone: Email:
Document Version: Date updated:

Project Scope
High-Level Problem Statement:
In-Scope: Out of Scope:

Objectives, Deliverables, Requirements and Benefits
Objectives:
Major Deliverables:
      Administrative: Technical:

Requirements: Benefits:

Project Assumptions

Risks and Constraints

Resource Requirements
People:
Time:
Other:

Budget Estimate
Funding Source:
Estimate ($):

Schedule (High-Level Milestone and Timeline)
Project Charter Approved On: Kickoff Meeting:
Requirement Documentation: Finalize Requirement:
Design and Development: Testing Date:
Closing Date:
Detailed Gantt chart (insert below)

Project Team Roles and Responsibilities
Team Member   Roles   Responsibilities

Communication Strategy
What   Who   When   How
Description Provider | Recipient   Frequency   Format | Distribution Method

Stakeholders
Internal:
External:

The charter must be reviewed and signed by the project sponsors/client and the project manager
Executive Sponsor/Client: Project Manager:
Reviewed by: Reviewed by:
Date: Date:
Signature: Signature:

Peer Review

Team
Date: _____

In order to determine the progress and team characteristics of each group, we need to conduct peer evaluations. Please grade each of the individuals (including you) on the following performance criteria. Each **row** …*not column* must total 100.

Team Members:	1. (Your Name)	2. (Team Member's)	3. (Team Member's)	4. (Team Member's)	5. (Team Member's)	6. (Team Member's)	Percentage of Total Work Completed (Row must total 100%)
1. Quality of Individual Work (Neat, Accuracy, Well Documented)							100%
2. Quantity of Individual Work (Equitable Load)							100%
3. Professionalism (Attendance, Attitude, Communications)							100%
4. Productivity (Efficient use of Time)							100%
5. Dependability (Timeliness of Work)							100%
6. Communications (Written, Oral, Presentation)							100%
7. Initiative (Self-motivated, Direction)							100%
8. Contribution to Morale (Positive Criticism, Cooperation)							100%
9. Contribution to Written Documentation							100%
10. Team Player (Attitude, Avoiding Important Issues, Work for the Good of the Group)							100%
Add up the TOTAL Points							
List three attribute codes that apply							

Code	Attribute		Code	Attribute
10	Poor Attendance		50	Good Team Leader
11	Late for Meeting w/ Client		51	Motivates Team
12	Late for Meetings w/ Team		52	Keeps Project on Track
			53	Direct/Straightforward
20	Poor Performance		54	Self Motivated/Directed
21	Not Prepared for Team Meetings			
22	Lack of Initiative		60	Accomplishes Tasks on Time
23	Avoiding Important Issues		61	Positive Attitude
24	Output is of poor quality		62	Performance is above expectation
25	Unorganized/sloppy		63	Motivated
			64	Excellent Team Member
30	Not a Team Player		65	Positive Contributions
31	Difficult to Get Along With			
32	Negative Attitude		70	High Quality Work
33	Untrustworthy		71	Technically Savvy
34	Poor Work Ethic		72	Intelligent Approaches to Solutions
			73	Valuable Previous Experience
40	Quiet			
41	Does Not Share Ideas		80	Communicates Effectively
42	Does not Communicate Status		81	Shares Ideas Well
43	Monopolizes Conversation			