A Living-Learning Community for Engineers Interested in Entrepreneurship: Looking Back at the First Year

Dr. Thomas P. James P.E., Rose-Hulman Institute of Technology

Thomas James received his PhD in Mechanical Engineering and an Executive MBA from Marquette University. He has a MS in Materials Science and Engineering from the University of Wisconsin – Milwaukee. Dr. James is a Fellow of the American Society of Mechanical Engineers and is a registered Professional Engineer (PE). His major interests are new product development and global business ventures. He teaches courses in management and entrepreneurial studies. In addition to teaching, Dr. James directs the ESCALATE program, a living-learning community focused on integrating entrepreneurship and technical disciplines. Dr. James is also an avid inventor with over a dozen patents and he has several publications in peer reviewed journals related to his research in biomechanical systems. Prior to joining academia, he worked in the consumer products industry for 13 years where he was the Director of Engineering at Milwaukee Electric Tool. Following an acquisition by Techtronic Industries, he became the Senior Vice President of Global Engineering for the power tools division, headquartered in Hong Kong, where he lived and worked.

A Living-Learning Community for Engineers Interested in Entrepreneurship: Looking Back at the First Year

Introduction

A general characteristic of campus learning communities (LC) is the promotion of a subset of courses and co-curricular events that is moored by a central interdisciplinary theme. In a living learning community (LLC), the taxonomy is similar to an LC, except that a group of pre-matriculation students are often self-identified through an application process with the intent to arrange common housing in a single residence hall. The purpose of combining living with learning is to provide a more intimate experience by amplifying the intersection between a student's pedagogical and personal spheres for greater achievement of learning objectives.

In practice, the typology of learning communities is quite varied. The Washington Center's Learning Communities Directory is continually being updated and today contains a catalog of at least 300 learning community programs[1]. There are also ample resources for exploring the history of learning communities and the creation of new ones. For example, N. S. Shapiro et al. provides a practical guide to creating learning communities, with a focus on putting administrative processes in place[2]. For a more comprehensive treatment of the subject, a recent book by O. T. Lenning et al. has several informative sections, particularly on achieving student success and assessment of learning objectives[3].

From a management perspective, LLC's are historically administered from the campus Office of Residence Life[4]. My situation is somewhat unusual in that I am a full time professor of engineering and a director of a living learning community. Hence, the purpose of this paper is to provide a unique perspective of an engineering faculty member when launching an entrepreneurship LLC at an institution that only offers engineering, math, and science degrees. The paper is written in narrative form, with the events unfolding chronologically, so as to immerse the reader in an environment that is likely to exist during the initial year of launching an LLC to an engineering community. The focus here is on specific challenges that are not generally covered in the broader contemporary literature on LLCs.

In general, there were three challenging and largely undocumented areas encountered during our initial implementation and management of the entrepreneurship LLC: (i) students enter the program with the expectation of a four year experience, regardless of marketing materials, but the practicality of living together and taking courses together beyond the freshmen residence year is problematic, (ii) scheduling a sequence of first-year courses is more difficult than expected due to an unequal AP credit distribution, remedial English requirements for foreign students, and engineering majors that require specific course sequencing, and (iii) each new cohort has no connection to the past or future cohorts, so rather than building a collective intelligence that gains momentum, there is the possibility of developing fractional cohorts that exhibit less than optimal tribal knowledge.

Freshman Recruitment

When notifying students of an LLC opportunity, it is recommended that program expectations are clearly communicated[2]. In June 2014, we sent an email to the incoming class of engineers notifying them of a new program whereby they could live and learn together about entrepreneurship as they participated in a diversity of technical degree programs. The specific month is given here to emphasize that the date of communication is an important decision to be made by the recruitment team. Recruitment can occur before or after students have committed to your institution. We chose to communicate to committed students. Essentially, we did not use the program as a means to entice a student to choose our university over another.

The student email briefly described the LLC, highlighted co-curricular activities, and specified a common core of three courses. Interested students were directed to a website where they could learn specifics and complete an application for the program. The application included an essay regarding interest in the program and a description of entrepreneurial experience and intent.

From the time of the initial email in June, students have approximately 3 to 4 weeks to complete the application. For the first two cohorts, we received 70-80 applications, which met our goal and represented approximately 15% of the incoming class of engineers. From this applicant pool, a team of faculty reviewers selected 45-50 students based on their application essay and a review of their initial application to the institute. The selection process included some effort to balance demographics, such as by gender, major, location, and interests.

A large advertising budget was not critical to our recruitment success. Given our modest effort through email, the recruitment process generated sufficient awareness and a pool of highly qualified applicants. After arrival of freshman on campus, they are asked to complete an institutional survey that covers a variety of topics. From an advertising perspective, a particular question of interest is "Prior to coming to our institution, what programs had you heard of?" In response to this question, students ranked the entrepreneurship LLC fifth (n = 141) among the top ten programs identified, Table 1.

Table 1 Response to freshman questionnaire: "Prior to coming to our institution, what programs had you heard of?

Rank	Campus Program	N	%
1	Fast Track Calculus	248	48.5%
2	Operation Catapult	244	47.7%
3	Homework Hotline	200	39.1%
4	Accelerated Math Physics	151	29.5%
5	Entrepreneurship LLC	141	27.6%
6	Ventures	121	23.7%
7	Environmentally Responsible Engineering LLC	101	19.8%
8	Robotics Minor	81	15.9%
9	PRISM - Math and Science	28	5.5%
10	Innovation Center/Competition Teams	53	10.4%
	None of the Above	91	17.8%

To amplify our in-person marketing effort, we plan to enlist current program participants as guides for tours with prospective students and parents. This may increase the eventual number of applications if more students join our institution specifically because we have this program. The freshman survey sought to address the issue of program attractiveness with the question, "Which of the following programs had an impact on your decision to attend our institution?" In this case, the entrepreneurship LLC ranked eighth (n = 24) when considering the top ten programs identified by students, Table 2.

Table 2 Response to freshman questionnaire, "Which of the following programs had an impact on your decision to attend our institution?

Rank	Campus Program	N	%
1	Operation Catapult	92	18.0%
2	Ventures	71	13.9%
3	Robotics Minor	44	8.6%
4	Innovation Center/Competition Teams	41	8.0%
5	Fast Track Calculus	36	7.0%
6	Accelerated Math Physics	28	5.5%
7	Homework Hotline	30	5.9%
8	Entrepreneurship LLC	24	4.7%
9	Environmentally Responsible Engineering LLC	11	2.2%
10	Leadership Academy	10	2.0%
	None of the Above	260	50.9%

Understandably, there is some trepidation related to over-marketing a scarce resource. In some situations, there may be buyer's remorse if admitted students are not selected for a program that influenced their choice to attend our institution over rivals. From the data in Table 2, it appears that approximately 24 of the 510 freshman respondents indicated that joining an entrepreneurship LLC impacted their college selection criteria. Given that we accept 45-50 students into the program from a pool of 70-80 applicants, it does not appear that we are "over-selling" the program with our current advertising efforts.

Demographics

Looking back at the first two cohorts, we achieved our goal of diversity by major. In general, the proportion of majors represented in the entrepreneurship LLC mirrors the distribution of majors in the full student body, Table 3. To provide some context for sample size and analysis, we have approximately 2,200 undergraduates and only offer degrees in engineering, math, and science. There are no liberal arts degrees offered. We have experience with only one other LLC, which is focused on environmentally minded engineering, and has been in existence for five years.

The demographic data illustrates an interesting result because it challenges a potential research hypothesis, "Entrepreneurial programs attract students from specific engineering majors." For example, given the popularity and publicity of Silicon Valley start-ups, one might surmise that

more students with a major in computer science and software engineering may join the entrepreneurship program. However, when looking at application data for the first two cohorts, there appears to be a lack of compelling evidence to support this hypothesis, albeit a small sample size.

There is one interesting data point that was lost in the "Other Majors" category as presented in Table 3. In particular, we noticed that in both cohort application pools there was an absence of students pursuing civil engineering. This sparked much conjecture that perhaps civil engineering students do not see themselves as entrepreneurs or perhaps they do not see the civil engineering profession as a place for entrepreneurial pursuits. To gain some insight, a survey was conducted for all freshman (n = 26) and sophomore (n = 36) civil engineering students.

Table 3 Comparison of engineering majors between overall student body and LLC cohorts

Major Degree	% of Student Body	% of LLC
Mechanical Engineering	52.1%	39.4%
Computer Science	12.5%	14.0%
Electrical Engineering	8.3%	10.8%
Biomedical Engineering	10.4%	9.7%
Chemical Engineering	13.4%	7.6%
Software Engineering	5.2%	7.5%
Other Majors*	16.7%	8.8%

* Physics and Computer, Optical, and Civil Engineeing

The civil engineering survey consisted of statements where students could check one box that indicated their level of agreement, for example: (i) Strongly Agree, (ii) Agree, (iii) Neither Agree or Disagree, (iv) Disagree, or (v) Strongly Disagree. In response to the statement, "The civil engineering profession provides opportunities to become an entrepreneur," nearly 60 percent of the students indicated "Strongly Agree" or "Agree." On the statement, "I consider myself to be an entrepreneur," approximately 25% of the students responded "Strongly Agree" or "Agree." From these responses, there was reasonable evidence of an ample supply of civil engineering students that could potentially apply to join an entrepreneurship LLC.

The number of students interested in an LLC, regardless of the theme, is only a fraction of the student body. Hence, the potential applicant pool consists of civil engineering students that are interested in entrepreneurial studies and are interested in a living learning community. We estimate this to be approximately 10% of the students in any given major based on the raw data that was used to create Table 3. Deductively, this means that approximately 6 of the 62 civil engineering students should have applied to the entrepreneurship LLC, but we had zero applications for the first two cohorts. Some light was shed on this mystery when we looked at the open response data in the civil engineering survey. Five civil engineering students decided to join a living learning community on campus, but the theme of that LLC was environmentally responsible engineering, not entrepreneurship. This small data set indicates that when civil engineering students are given an either/or choice of an LLC to join, they identify more closely

with environmental engineering than entrepreneurship. For us, the takeaway here was that one should not over-segment a small market if your goal is to create an interdisciplinary community.

Residence Hall

During the selection of sophomore assistants (SAs) for the LLC residence hall, we missed an opportunity by not taking advantage of SAs to organize co-curricular activities specific to the entrepreneurship theme. Rather, the SAs were trained in the traditional manner by the Office of Residence Life and therefore performed their duties similar to SAs that were not affiliated with the LLC. We realized too late that this was a lost opportunity to gain additional staffing to assist with planning and managing a plethora of co-curricular activities, such as attending Pitch Fests, Verge Events, StartUp Weekend competitions, hackathons, and entrepreneurial alumni speaker events, to name a few. In the future, we plan to create a list and schedule of activities to be organized by SAs and resident assistants (RAs) in the LLC, which will be communicated during the hiring process and special training will be provided as applicable. In addition, we plan to elicit help from students in the entrepreneurship club to organize co-curricular activities in coordination with SAs and RAs in the LLC.

Referring to the first of three challenges mentioned in the Introduction to this paper, the entrepreneurship LLC was originally intended to be a program for the freshman year, but the students have an expectation that it will continue for all four years. It was never advertised to be anything beyond one year, but each cohort is requesting specific programmatic activities for their current year. Fortunately, organizing students to live together on one floor or to occupy an entire residence hall is of no additional cost to the institution. However, after the freshman year, many students take advantage of lower cost opportunities by living off campus or by joining Greek Life to live at a fraternity or sorority house. To gage student interest in continuing the program beyond the freshman year, a survey was recently conducted. Specifically, we wanted to know if there was an interest among the freshman to live together as sophomores in a campus residence hall, thereby extending a subset of the community for one more year at no cost to the institution. To our surprise, approximately 25 of the 45 students in the current freshman cohort have requested to live together on one floor of a sophomore residence hall. The vast majority of the remaining students in the cohort are in the process of pledging a fraternity or sorority. From a leadership perspective, the plan is to have SAs in the freshman LLC become RAs in the newly formed sophomore LLC. We have yet to determine curriculum opportunities for the sophomore LLC, but we are leaning towards promoting the use of electives to earn a Minor in Entrepreneurial Studies rather than requiring additional courses.

With regard to residence life, a final lesson learned is that communication within the cohort is challenging as the effectiveness of email diminishes over the academic year. This realization has caused us to recently organize the cohorts with a more formal leadership structure. Two students from each cohort have agreed to be Class Representatives, with the primary responsibility to coordinate communication between the director of the LLC and the cohort participants. At times, Class Representatives literally go door-to-door in the residence hall to solicit feedback on ideas and to communicate the schedule of upcoming events. While this structure is relatively new, Class Representatives have been highly successful in their communication efforts. An

added benefit is that Class Representatives are exceptional candidates in training for future SA and RA positions.

Course Scheduling

A second challenge we underestimated when organizing an LLC is the complexity of course scheduling. For the entrepreneurship LLC, a three course series was developed. Since our institution follows a quarter system, all three courses were intended to be taken the first year. However, we quickly learned that scheduling conflicts required a more flexible system whereby some students are allowed to drop back one cohort and take a class in their sophomore year.

When launching the LLC, only one new course was developed, an Introduction to Entrepreneurship. The remaining two courses, Rhetoric & Composition and Introduction to Design, were revamped existing courses to include an entrepreneurial focus. For example, in the composition class students can be asked to develop the written materials required to launch an online Kickstarter campaign. In the design course, students can be asked to think about commercialization of their design and solicit customer feedback during iterative design cycles.

The first problems encountered in course scheduling occurred with students where English was a second language. Some of these students were not prepared to take the Introduction to Entrepreneurship course during their first quarter on campus, so we needed to start offering that course in both the spring and fall quarters. While initially this created some scheduling difficulty, it had an unintended benefit of providing an opportunity for non-LLC students to take an entry level course in entrepreneurship as an elective. Initial evidence suggests that the new course is in high demand and is likely an on-ramp to earning the Minor in Entrepreneurial Studies.

A second problem encountered with course scheduling was that regardless of how we arranged the three course series, we ran into specific situations where an overload of credits occurred in certain quarters. Specifically, this occurred when students needed to take a series of required courses for their degree program and the courses were only offered once per year. Hence, we underestimated the complexity and staffing needs during registration periods when each LLC student with a conflict needs personalized attention within a limited timeframe. In addition, the registrar's office was in their own learning pattern within the first year of the launch.

A final area of course scheduling difficulty has to do with unexpected student behavior. Although it makes perfect sense in hindsight, we learned that some students didn't like entrepreneurial studies after taking the first class and participating in some co-curricular activities. This became apparent on faculty evaluations were a bimodal distribution appeared, with the vast majority of students loving the course, but a couple of students absolutely hating the course. Under normal circumstances, if students really do not like a course, they drop it. The problem here was that LLC students felt trapped. They wrongly assumed, because we didn't make it clear, that they would be asked to leave the program if they dropped one of the core classes. In their mind, they thought they would potentially be asked to move out of the community to a different residence hall. While they didn't enjoy the courses and co-curricular

events, they had formed strong bonds with many of the community residents so they begrudgingly continued.

An additional problem encountered was that some students simply ignored the three course curriculum because there was nothing to lose by opting out and pursuing a second major or minor. To address the issue of a student feeling trapped in a curriculum or for those that simply chose different priorities, we have decided that we will award a Certificate of Entrepreneurship to students that have completed the recommended core curriculum and have participated in co-curricular activities. Going forward, we will need to communicate to a small number of students that it is acceptable to drop the courses and still remain in the community, but they will not receive the certificate. Finally, we need to establish metrics and communicate requirements related to "adequate" participation in co-curricular activities.

First Year Performance

The theoretical foundation of learning communities is steeped in the knowledge that academic performance and retention increases if students feel they have a social network to support their academic pursuits[5]. Research has consistently shown that students in learning communities show positive outcomes in terms of first-year grade point average and retention[6].

At the end of the academic year for our inaugural cohort, we were pleased to see that the entrepreneurship LLC made a positive contribution to academic success. The mean grade point average for the LLC cohort was 3.30/4.00, as compared to 3.10/4.00 for the comparative student body, Table 4. The difference was statistically significant ($p = 0.005$).

Grades for the LLC cohort were normally distributed according to the Anderson-Darling test, but the distribution of grades for the greater population was skewed toward the upper end and did not represent a normal distribution. However, given the large sample size and the assumption that the means are normally distributed, a two sample t test is still appropriate even though the distribution of the greater population is non-normal[7].

Table 4 Comparison of first-year grade point averages

Student Population	Mean Grade Point Average (4.00 scale)	Standard Deviation	90% Confidence Interval
LLC Cohort (n = 45)	3.30*	0.47	(3.18, 3.42)
Student Body (n = 491)	3.10	0.63	(3.05, 3.14)

*Significantly different ($p < 0.05$); 2-Sample t Test, Minitab

Table 5 Comparison of average incoming standardized test scores

Student Population	SATM	SATV	SATW	ACTC	ACTE	ACTM
LLC Cohort (n = 45)	690	595	593	29	28	31
Student Body (n = 491)	688	602	590	29	29	31

A difference in incoming standardized test scores (ACT and SAT) could be an explanation for the higher grade point averages among the LCC cohort as compared to the greater student body. However, student application data does not support this hypothesis as the scores were generally the same, Table 5. Hence, from our experience with the inaugural cohort, the entrepreneurship LLC had a significantly positive effect on grade point average.

Table 6 Comparison of first-year retention

Student Population	Number of Students	Returned for Second Year	Difference	% Leaving	% Retention
LLC Cohort	45	44	1	2.2%	97.8%
Student Body	491	452	39	7.9%	92.1%

In addition to grade point average, we analyzed first-term retention for the LLC cohort as compared to the greater student body. Here too we found a significant improvement. In the case of the LLC, only one student did not return for the fall quarter of sophomore year, whereas 39 students (7.9%) from the remaining class did not return, Table 6.

Cohort Integration

A final challenge was recently identified when we began to realize there was no compounding educational effect as an additional 50 students arrived on campus to join the first cohort of 45 students. Rather than having 95 students engaged in our program by combining two cohorts, we had two separate groups. In fact, some students in the inaugural cohort expressed in private a feeling of being "dumped" in favor of the new class. This feeling makes perfect sense if you examine what transpired. As the first year drew to a close, the inaugural cohort moved out of the LLC residence hall, with approximately half joining various fraternity and sorority housing and the balance split between two sophomore residence halls. Not only were they physically scattered upon returning to campus as sophomores, they were academically scattered as each student pursued more specialized courses in their major. Meanwhile, the freshman class arrived on campus and began to gel as they completed their Introduction to Entrepreneurship course, lived in a common residence hall, and participated in co-curricular activities. Attempts to schedule activities between the two cohorts, such as meet-and-greet dinners or participation in the entrepreneurship club, largely failed as the events were sparsely attended by sophomores.

The literature gives some guidance on a means to connect cohorts in a living learning community. In a recent issue of Learning Communities from Start to Finish, Mimi Benjamin and Laura Jo Rieske provide a template for a peer mentoring organization[5]. The authors describe the various roles and responsibilities of peer mentors and highlight several diverse programs at various colleges.

At our institution, we have recently embarked on the process of building a peer mentoring network. Rather than creating a new student organization, we decided to create a Director of Mentoring as a new positon within our entrepreneurship club on campus. Reporting to this student leader are 5-6 Mentoring Coordinators, which have been chosen from the first LLC cohort. In our structure, each of the sophomores will mentor 3-4 Peer Mentors. Peer Mentors are current freshman LLC participants. Our goal is to recruit approximately 18-20 Peer Mentors. The organizational structure of the peer mentoring network is shown in Figure 1.

Figure 1 Connecting the LLC cohorts with a peer mentoring organization

After forming the mentoring organization, we plan to use the remainder of 2015-2016 to train the mentoring team on their roles and responsibilities. Most of the training will be in coordination with our residence life team that presently trains SAs and RAs. The base of the pyramid will be complete when the new LLC cohort arrives on campus next fall. At that point, each Peer Mentor will be assigned approximately three freshman to personally call to inform them of acceptance into the program and to introduce themselves as their peer mentor. It is our hope that this mentoring organization will form a sustainable linkage between cohorts. This should strengthen and broaden our entrepreneurship LLC, with a running rate of nearly 200 students across all four years of their undergraduate experience. Ultimately, 75 of the 200 students will be involved in the peer mentoring program, within a structure that cross pollinates with our entrepreneurship club.

References

1. Washington Center's Learning Communities Directory, Available at http://evergreen.edu/washingtoncenter/lcdirectory/index.html
2. Shapiro, N. S. and Levine, J. H., 1999, Creating Learning Communities: A Practical Guide to Winning Support, Organizing for Change, and Implementing Programs, 1st Edition, Jossey-Bass, San Francisco, CA.
3. Lenning, O. T., Hill, D. M., Saunders, K. P., et al., 2013, Powerful Learning Communities: A Guide to Developing Student, Faculty, and Professional Learning Communities to Improve Student Success and Organizational Effectiveness, 1st Edition, Stylus Publishing, Sterling, VA.

4. Smith, B. L., MacGregor, R. S., Gabelnick, F., et al., 2004, Learning Communities: Reforming Undergraduate Education, 1st Edition, Jossey-Bass, San Francisco, CA.
5. Benjamin, M., 2015, Learning Communities from Start to Finish, No. 149, Jossey-Bass, San Francisco, CA.
6. Stassen M. L. A., 2003, "Student Outcomes: The Impact of Varying Living-Learning Community Models, Research in Higher Education," 44(5), 581-613.
7. Glass, G. V., Peckham, P. D., and Sanders, T. R., 1972, "Consequences of Failure to Meet Assumptions Underlying the Fixed Effects Analyses of Variance and Covariance," Review of Educational Research, 42(3), 237-288.