Entering the First Year of a Multi-disciplinary, Hands-on, Competency-Based Learning Experience: Hopes and concerns of students, parents and faculty

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Abstract

When first year students enter a new program that fundamentally differs from their past educational experiences, new types of pressures may impact both students and their families. To identify some of the pressures that should be anticipated when introducing a new program, this exploratory case study focused on the hopes, concerns, and fears of the first cohort of students enrolled in the first semester of a pilot program at the Purdue Polytechnic Institute – a new multi-disciplinary, hands-on, competency-based program. Since students do not act in isolation, additional considerations are given to expectations and concerns of their parents, and faculty response to those concerns. Students and parents were surveyed, and in-depth interviews were conducted with both students and faculty. Qualitative and quantitative analyses found that while the majority of students and parents were excited about the hands-on, student-centered approach, concerns were raised about employability, the ability to seamlessly transfer back to traditional programs, and ability to develop the same skills and knowledge as students in traditional technology programs would. The use of badges instead of grades caused further confusion and distress among students, especially during the first few weeks of the program. Program faculty attempted to ameliorate these concerns through transparency and by providing additional structure, with mixed success. Along with the findings, potential implications for similar programs and areas for future research are discussed.

Introduction

This exploratory case study offers insights into the excitement and challenges of implementing the first year in an experimental pilot program. As part of a set of initiatives to transform higher education at Purdue University, the Polytechnic Institute (PI) was designed to be a multi-disciplinary, hands-on, competency-based experience for undergraduate students in technology programs. In Spring 2014, the PI began recruiting students, and in Fall 2014, the program opened its doors to its first cohort. The faculty who had taken a year to design and develop the first year curriculum eagerly awaited their new mentees. However, students came in with their own hopes and concerns, which impacted their desire to join and remain in the program. Students were not alone in their decision-making. They were guided and supported by parents who themselves had both expectations and concerns about their children entering an experimental pilot program. This paper explores those hopes and concerns, and faculty members' responses to them.

Literature Review

Transition to college life holds many promises of independence, new friends, experiences, and career prospects. However, along with the excitement comes anxiety and fear that may undermine positive feelings and, if left unchecked, may make it difficult for some students to continue their academic career. After all, the freshman year is the toughest one students face in their lifetime [1]. If these fears are not recognized and addressed in a timely manner, they may lead to a student dropping out of the program they are enrolled in, or even out of college entirely [2].

However, it would be a mistake to consider students' hopes and concerns without taking into account their immediate network. Research shows that the generation of students who are currently entering college, also known as "Millennials", have particularly strong ties with their parents [3]. Parents are often the ones who help make decisions not only before their child selects a major but throughout their academic career and even beyond [4, 5, 6].

To better understand the spectrum of concerns and emotions resulting from being enrolled in a novel college program, we first need to understand typical first-year student concerns and expectations.

Overview of First Year Students' Concerns and Expectations

The topic of concerns and expectations is an important one in higher education. Previous research shows the following common areas of emotional struggle among freshman students, namely:

Social and relational: Starting college means for many students moving out of home and to a new location, and therefore experiencing a separation from family and friends. Even students who continue staying with their families and commute to school still face a considerable degree of change in their relationships and time spent together. Without emotional preparation, students may need to undergo significant adjustment during their first year [7]. Such adjustment may be even harder for the Millennial generation, whose connectedness with their families is stronger than in prior generations [3]. While all students go through the renegotiation of family relationships and development of their own networks, many millennials may not be as ready to sever family ties, allowing or even expecting their parents to remain continually involved in their educational decisions and campus life [3, 8]. Feeling protected, special, and sheltered from many troubles throughout their previous years of schooling, they may expect the same level of support and care at college and may go back to parents in need of comfort at harder times, while missing opportunities to develop their own coping techniques [9].

Relationship with peers: Socialization brings another important point of the transition to college life, namely the establishment of relationships with new peers and by extension a change in their social identity. Research shows that the development and support of the social network of freshmen help incoming students better adjust to new life at college [8, 10].

Academic engagement and performance can be another factor that brings up concerns among students entering college [8]. The current generation of students is characterized as high-achieving and pressured; "they want a structure enforced to ensure that compliance will lead to achievement" [9, 11]. However, they may find that the quantity and quality of work required at college is significantly different than what they were used to in high school, resulting in stressful relationships with the faculty.

Gender and racial concerns may emerge, particularly for female and minority students entering engineering majors, which have long been dominated by white and Asian males and as such may be considered unattainable [11, 13]. Yet, Millennials are one of the most diverse groups in the history of the nation and have seen their own mothers, or mothers of their peers, being gainfully employed. Thus, they have developed certain expectations about their own professional future [9].

While the aforementioned factors impact students' overall transition to and adjustment in college, another significant factor for a newly created program would be *program expectations*. Expectations about a college, a program, or even a course serve as a prism through which students see their educational environment. However, such expectations are not stagnant and may change with access to new information about, or experience with, the environment [14]. Millennials are often confident that they will be able to meet all expectations and requirements, as long as their own expectations are met [9]. Yet, if what they see is not congruent with their expectations, this would not only create a dissonance but also serve as a catalyst of less desirable behaviors inside and outside the classroom [15].

The aforementioned concerns, fears, and expectations are often considered when a student is enrolled in a traditional classroom with already somewhat known outcomes, like mechanical engineering or biology. Being the first cohort in a newly created program that differs from traditional education on both systemic and individual levels may create additional fears and concerns about both the immediate, and the distant future.

Changing Expectations for Preparing Engineering Professionals

Employers overwhelmingly demand that graduates be innovators; proficient at written and oral communication; have the ability to solve complex problems in a real-world setting; have a broad skill-set; and that they demonstrate ethical judgment and integrity, intercultural skills, and the capacity for continued new learning [16]. Many of these skills can be gained through meaningful incorporation of liberal arts into higher education [16]. However, current engineering education has not yet embraced the notion of the "cooperation among the previously separate disciplines to attack problems that have no recognizable boundaries" (p.17) [17] to enable students to quickly adapt to the consistent shifts in directions taken by technology and engineering in the real world where the globalization, the development of a knowledge economy, and rapid changes in technology make skills of recent graduates obsolete in as little as 18 months [12, 18, 19].

However, changes in curriculum should also take into account the particular challenges of working with Millennial students, who are often characterized as learners that prefer group/collaborative activity, are fascinated by new technologies, prefer experiential activities and structured coursework, and may not be well prepared by their previous schooling to tackle complex self-guided learning or problems without a clear "right" answer [20, 21, 22, 23].

Study Setting

A multi-disciplinary team of 15 faculty members at Purdue, a large Midwestern, land-grant, R1 university, were tasked to develop the PI, a new learning experience that will provide students with a personalized pathway to develop diverse, cross-disciplinary competencies.

To ensure the success of the PI towards meeting its overarching goal of raising a new generation of global engineers, the following values were developed to guide the team efforts [24, 25]:

- *Student as a whole person* to help students develop individual talents, deepen understanding of the world, and develop skills to be a productive member of society.
- *Diversity of thinking, knowing, and learning* to support divergent and convergent thinking, cognitive and embodied knowing, and theoretical and experiential learning.
- *Openness, collaboration, and cooperation* through collaborative learning, production, and consumption of knowledge to embrace the creative powers of the community.
- *Access* to all students to nurture and support all talents and sensibilities from diverse backgrounds, means, preparation, and experiences.
- Students' *autonomy* to make learning a personal act of discovery fueled by strong motivations and commitment.
- *Risk taking* to support open-ended inquiries, encourage learning from failure, and develop courage, creativity, and competence.

The program aims to achieve these goals with a seamless merge of technical and liberal arts to allow students to experience the interconnectivity that is seen in the work world but generally not reflected in academia. Students are required to tackle ill-formed problems by analyzing and deconstructing the problems, assessing the needs, researching options, and offering well-rounded solutions. The environment in which students operate starting with their very first semester in college would cater to the development of such skills through hands-on learning by doing, determining their own learning path and focusing on topics they are drawn to, and support from instructors who act as guides on the selected path. To avoid the rigidity of traditional credit hours, assessments, and grades, the faculty elected to incorporate interwoven competencies across multiple learning experiences, and to use an electronic badge portfolio to mark the development of skills and knowledge. This portfolio will be used to provide hard evidence to potential employers of the specific skills students possess.

To provide multiple points-of-view and introduce students to different areas and experiences, the intent is for each cohort to include students with diverse professional interests. This would allow students to explore and develop new areas of interest that may not be otherwise available for them. In this first exploratory year, a PI degree had not yet been established. Therefore, students

entered the program with one of the traditional COT majors and were expected to pursue competencies equivalent to those they would gain in courses within the major area, in addition to the more general PI competencies.

The first semester experience of the PI was built around two major components. A Seminar course was designed and taught by faculty from across the COT and the College of Liberal Arts. The goal of this 10-hour/week course was to develop creativity, empathy, critical thinking, and written, oral, visual and auditory communication skills, through use of a variety of instructional methods. A Design Studio course (eight hours per week) was co-taught by a professor from the COT and a professor from the Theater department in the College of Liberal Arts who specializes in scenery technology and engineering. The Design Studio was intended to foster design thinking, critical thinking, and domain-specific skills through engagement with a series of real-world, ill-structured problems. Students were given the opportunity to gain other skills through traditional courses, close work with mentors from their desired discipline, or self-study. By the end of the semester, students were able to earn up to 33 badges, including optional badges that allowed them to focus on their interest in specific skills or topics.

The team was aware that adapting Signature Pedagogies [26] from other fields, such as seminar and studio models, would require that both faculty and students become accustomed to a new way of teaching and learning. They were also aware that there were trade-offs to be made between adding significant Liberal Arts content and cross-disciplinary experiences, and maintaining the strengths of the traditional programs in the COT, specifically the development of domain-specific competencies. Therefore, it was expected that students and parents would have a range of fears and concerns, as well as hopes about the possibilities offered by this program.

Research Questions

This paper explores these topics, by addressing the following research questions:

1. What did parents and students hope for from this new program?
2. What concerns did parents and students express about the new program?
3. What concerns were alleviated or did they continue after the first weeks of the semester? What new concerns emerged?

Methods

Participants

Students

The first cohort started with 36 freshman students. However, by Week 5 of the fall semester, 3 students dropped the program. Twenty students participated in a survey conducted during the fifth week of the semester, and seventeen participated in interviews the following week.

The composition of the group (N=36) in comparison with the overall indicators for the COT in the beginning of the Fall 2014 semester was as follows:

Students' mean age was 18.14 (17-21 years old). Females represented 16.67% of the group, whereas the average admission of females into the University's COT was 16.5%.

The distribution of majors was similar to the overall COT indicators (see Table 1).

Table 1

Distribution by Major of PI students in comparison with COT freshman student population for 2014/2015 academic year

Majors	PI (N=36), %	COT (N=3,257), %
Mechanical Engineering and Technology	33.3	30.4
Computer Graphics and Technology	11.1	11.2
Computer and Information Technology	16.7	14.3
Aviation	8.3	17.9
Business and Construction Management	5.6	11.2
Exploratory Studies	19.4	--
Other (Industrial distribution, MFET)	5.6	--

Additionally, 52.8% students reported that they considered themselves an "A" student while 44.4% considered themselves "B" students (one person did not provide a clear answer). In comparison, the high school GPA for the COT for 2014-2015 academic year was similar with an average GPA being 3.58/4.0.

Parents

Eighteen parents participated in the survey. One person from each household was asked to respond, and mothers represented 83.33% of the group. When asked for their education level, the distribution was as follows:

Table 2

Self-reported distribution of educational levels among parents of the PI students

Educational level	Percentage of parents (N=168), %
High School Diploma	11.1
Some college	16.7
Associate degree	16.7
Bachelor's	38.9
Master's	5.6
Doctoral or professional degree	11.1

Faculty

Of the fifteen faculty involved in the design of the program, seven were actively involved in teaching during the first semester (while others developed spring courses or participated as liaisons to other departments and university offices, evaluators, and other roles). The seven teaching faculty came from a range of disciplines, including Communications, Computer

Graphics Technology, Electrical and Computer Engineering Technology, English, Libraries, and Theatre (with specialty in scenery technology and engineering). All seven teaching faculty were interviewed mid-semester, and the majority of the faculty group participated in regular reflection meetings.

Data Sources

Students were surveyed at the beginning of the first week of class, and again at week 5. The survey instruments were designed as part of a larger evaluation study. The portions relevant to this paper in the week 1 survey included demographics; the role parents played in decision-making about this program; a set of items that required students to indicate the traits they expected from the program, and whether these traits were important to them; and open-ended questions about students' expectations, what appealed to them most, and what they were most concerned about (Appendix A). The week 5 survey included Likert questions about their transition experience and their satisfaction with various aspects of the program and open-ended questions about what they liked and disliked in the program (Appendix B).

Interviews were conducted with students in week 6 by a team of five interviewers. These interviews addressed students' experiences within the program, what they believed was working well, and what they believed was not working well. We used a semi-structured interview approach; an interview guide was created including high level questions that should be addressed during each interview. Each of these questions was addressed in each interview, but interviewers allowed participants to stray from the guide and introduce relevant topics that may not have been foreseen by researchers.

A parent survey was mailed to the household of each student in the second week of the semester (Appendix C). One parent responded in each household. The questionnaire was matched to the student survey instrument, and collected demographics; the role parents played in decision-making about this program; a set of items that required parents to indicate the traits they expected from the program, and whether these traits were important to them; and open-ended questions about parents' expectations, what appealed to them most, and what they were most concerned about.

Semi-structured interviews were conducted with faculty at mid-semester. These interviews addressed faculty's experience with students and other faculty, and their beliefs about what was going well and what could be improved for next time. Researchers also attended and took notes at faculty reflection sessions. Finally, class observations were conducted to inform our understanding of the other data sources.

Data Analysis

Descriptive statistics were used to summarize closed-ended survey data. Qualitative data from interviews and open-ended survey items were analyzed using the constant comparative method for naturalistic inquiry [27], to discover themes related to hopes and concerns within and across stakeholder groups.

Results

Student Career Goals

As shown in Table 1, students entered the program with a number of different intended majors. There were also a number of Exploratory Studies students who had not yet determined a major. Some of these already had firm ideas about which major they would like to pursue, while others indicated they were still very open. Forty-seven percent indicated they intended to pursue advanced degrees.

When asked in the Week 1 survey what their intended career path was, 25% indicated a specific field, such as biometrics or mechanical engineering, and a few even targeted a specific employer, such as Google or Disney. Others had broader goals, such as "inventing and discovering and innovating technology." Three indicated they wanted to make a difference in the world. One Exploratory Studies major stated "I did not want to choose between art school and computer science" and was hopeful that "[the] Polytechnic Institute [will] combine art with technology."

Parental Involvement

Students and parents surveyed at the beginning of the semester were asked to indicate the level of parents' involvement in student decision making. As can be seen in Figure 1a and 1b, parents were very much involved– perhaps to a greater extent than they themselves realized in many cases.

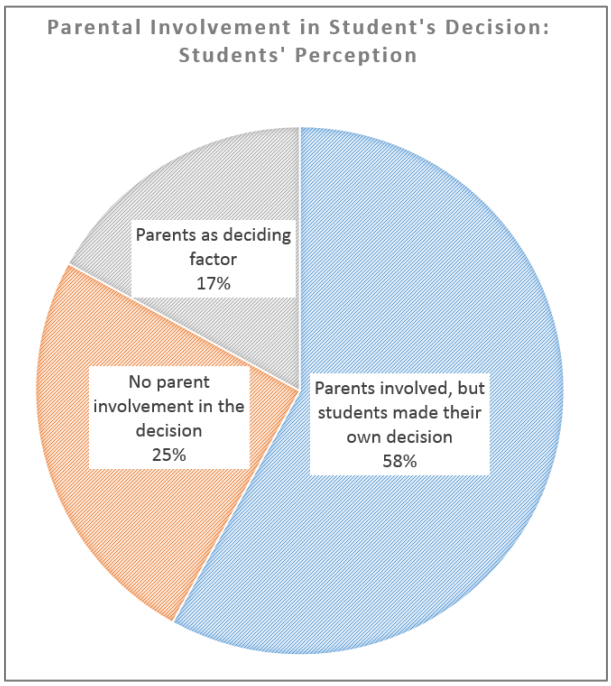

Figure 1a: Students' perceptions of their parents' involvement in their decision to join PI (N=36)

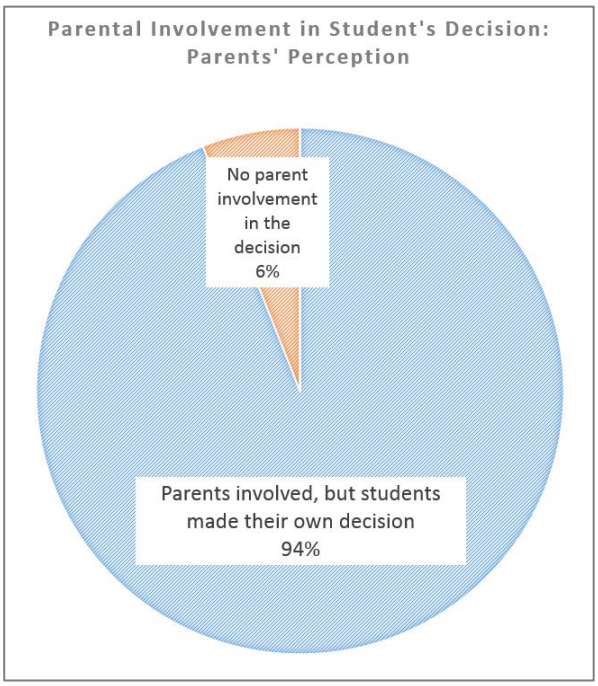

Figure 1b: Parents' perceptions of their involvement in students' decision to join PI (N=18)

New Program Expectations

Both students and parents were asked to indicate the importance of various program traits, as well as their expectations for the new PI experience. Three parents did not respond to the prompt for perceived importance, therefore the results were adjusted to consider reports of 15 parents. Table 3 contains the comparison of student and parent responses. Neither parents nor students were certain what to expect from the program, as evidenced by the many "Do not know" responses (in parentheses). Parents and students were also asked open-ended questions about their expectations. Their responses are discussed in the sub-sections below.

Table 3

Comparison of student and parent responses about aspects of program that are important for them and what they expect from PI

Categories	Perceived Overall Importance, %		Expectations about PI, %	
	Student (N=36)	Parent (N=15)	Student (N=36)	Parent (N=18)
Focus on learning				
Focus on mastery over memorization	86.1	86.7	83.3 (16.7)	100.0 (0)
Ability to work with faculty mentors	83.3	93.3	100.0 (0)	83.3 (11.1)
Hands-on opportunities	80.6	93.3	91.7 (5.6)	100.0 (0)
Good fit for student's learning style	77.8	93.3	72.2 (25.0)	66.7 (22.2)
Offer of a responsibility for own learning	75.0	86.7	80.6 (16.7)	83.3 (5.6)
Combination of liberal arts and technical subjects	61.1	80.0	80.6 (16.7)	77.8 (22.2)
Less work than a traditional degree	30.6	33.3	5.6 (61.1)	5.6 (55.6)
More work than a traditional degree	27.8	40.0	19.4 (75.0)	11.1 (61.1)
Focus on social relationships				
Teamwork	75.0	100.0	91.7 (8.3)	94.4 (5.6)
Way to meet friends	66.7	60.0	83.3 (11.1)	55.6 (33.3)
Excludes current friends	50.0	33.3	22.2 (33.3)	11.1 (16.7)
Focus on post-graduation career				
Good fit for student's career expectations	83.3	86.7	61.1 (36.1)	72.2 (22.2)
Popular with employers	80.6	86.7	41.7 (58.3)	61.1 (38.9)
Helpful for graduate school	66.7	73.3	30.6 (69.4)	27.8 (66.7)
Focus on Overall Program Qualities				
Interesting program	83.3	93.3	94.4 (5.6)	88.9 (11.1)
Good place to learn	80.6	100.0	80.6 (19.4)	77.8 (22.2)
Fun program	77.8	73.3	72.2 (25.0)	77.8 (16.7)
Parental Influence				
Encouraged by parents	50.0	--	69.4 (27.8)	--
Encouraged by other parents or teachers	--	60.0	--	22.2 (55.6)

Note: Numbers show percent who responded "yes". "Do not know" responses given in parenthesis.

Appealing program traits

Students had high expectations for the program, reflected both in their responses to the questions shown in Table 3, and in their open-ended comments, where many students stressed their excitement about participating in a very different type of college experience. As one explained, "[PI] appealed to me, because the way it was described to me, made it seem like it was about revolutionizing the way technology is taught". The vast majority of students indicated that a focus on mastery was important. As one student stated, "I expect there to be a higher emphasis on knowledge and understanding than on memorization." When asked what appealed to them most about the program, over half of students mentioned hands-on learning. However, only a handful of students specifically discussed the multi-disciplinary approach, and, as is show in Table 3, about 40% placed no value on experiencing a "combination of liberal arts and technical subjects", contrary to the expectations of program designers.

Both students and parents stressed the value of hands-on learning. As one parent who was herself a teacher explained, "My son gets more out of hands on learning than he does strictly lectures. I like the fact that they are learning to apply skills and knowledge learned. This will give him a giant step up in the business world. I see it daily kids have the skills and knowledge but do not know how to apply it." Parents hoped that the experience would provide their children a safe place to think outside of the box, be creative, and become excited to learn.

Meeting future goals

In their open-ended responses, about a third of parents indicated they hoped that the program would "[teach] them the skills to be successful in their choice of profession". Parental expectations that their own child would "be prepared to be successful in the chosen field, and to get her first job" were similar to those expressed by students. However, about a quarter of parents feared that PI students would have fewer opportunities than their peers in traditional degrees. As one parent explained, "Do not get me wrong, I understand there is place for growth but this is their future and I would hate for my son to complete college with a degree that employers do not see as a complete degree." In contrast, only a handful of students indicated that they were concerned about employers understanding or accepting the new degree at the time they took the beginning-of-year survey – although this would change as the semester progressed.

Excitement of joining a new program

The newness of the program was itself a major draw for students, with 36% indicating that they expected the experience to be unique or different. As one student responded when asked for expectations of the PI program, "the opportunity to be involved in something new, something uncommon, and something unexplored" was at the top of the list. In contrast to students' enthusiasm, a number of parents saw the fact that this would be an initial pilot year for the program as a risk.

Lack of certainty about program.

Despite their enthusiasm, students did not have a very clear idea of what the new program would be like. As can be seen in Figure 2, the vast majority of students asked to think back to their initial experiences at week five indicated they did not know what to expect when they started this

program, and most were “confused at how to be successful at PI”, and uncertain whether the program would prepare them for their future career.

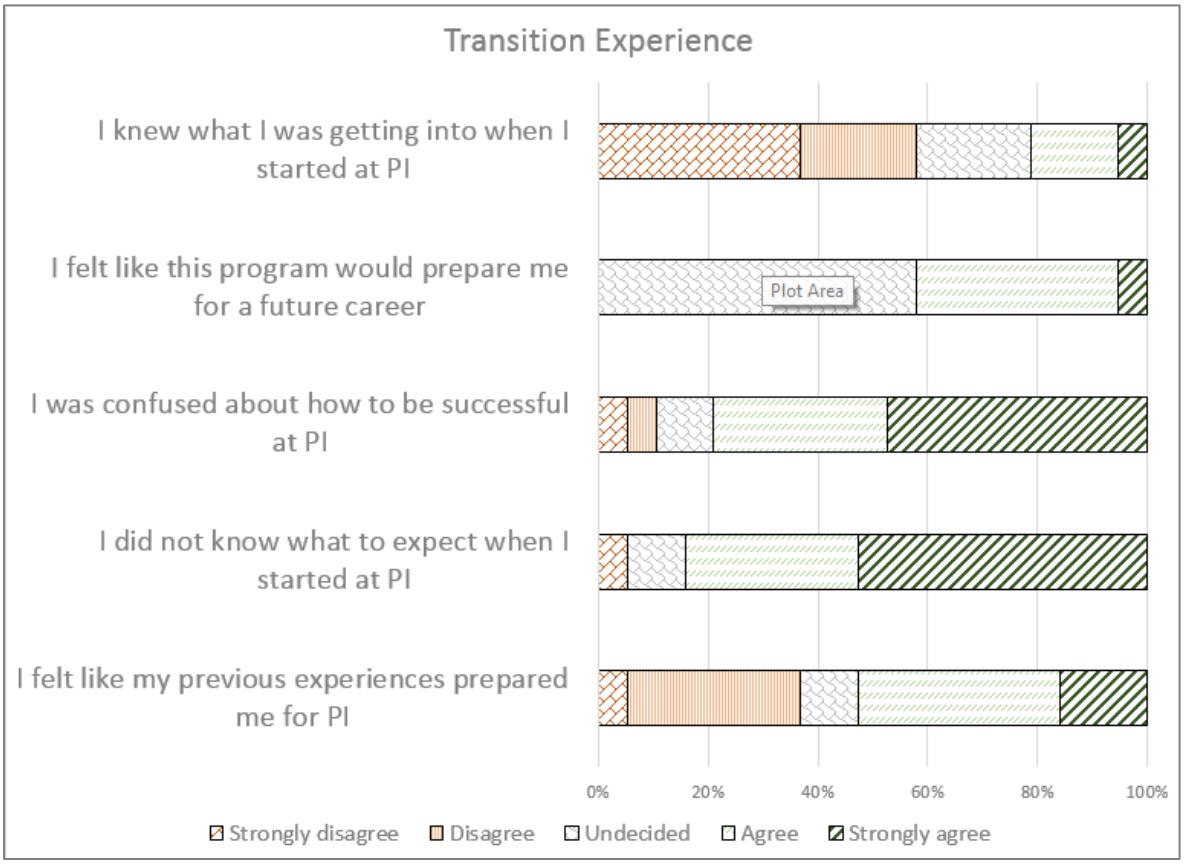

Figure 2. Students’ week 5 responses when asked to think back to how they felt at the beginning of the semester (N=20).

Early Experiences in the Program

Students’ first impressions

As they arrived for their first day of class, students were excited and jumped in to their first projects. As one explained in an interview conducted at week six, “The first week, [I was] very stoked. I was pumped up, we got to play with Legos the first day. It sounded like it was going to be a load of fun.” Students indicated that they were overwhelmed at first, but soon adapted.

> *I like being here a lot more than I thought I would. That first week of class, I was kind of intimidated by the entire thing. I didn't really know what to expect out of it. Now that I'm more adjusted and into everything, I know more of what to expect and such.*

Only a few students described insights into what they had learned by being thrown into a project-based learning environment form the first day in the program. As one explained:

> *So [the lack of structure] frustrated me a lot. That they were expecting me to do something they knew I didn't know how to do. And that was actually the point, it turns*

out. But the first two days of class, two days of Design Lab or two days of ethnography research, I didn't know that. But then they break it out a few days later that they wanted us to get to this point of frustration before they came in and helped us out.

Student confusion about program expectations and transferability

Students struggled with difficulties that arose out of systemic issues in integrating this alternative program into the university. Although all students attended the same learning experiences at the same time, behind-the-scenes work done to align these experiences with traditional courses and requirements for programs of study caused difficulties with scheduling and advising. One student was accidentally enrolled in three extra classes beyond what was expected by PI and his major area, and spent several days "freaking out because I thought this was like the regular program…I had a bad experience because I didn't have really much time to do homework, didn't have much time to do anything because I signed up for too many classes."

Lack of clarity about the competency-model and how it aligned with traditional transcripts was a cause for anxiety among many of the students. As an international student explained, "Starts to get confuse. Because I don't know how they calculate my grade and I want to make sure I have good grade because that's the reason why I came here." Exploratory studies students (who had yet to declare a formal major) expressed concerns about the ability to transfer to traditional programs, while another student expressed concerns about his eligibility for scholarships if he did not receive an interim GPA.

By mid-semester, confusion about the competency model continued, at a more detailed level. This included confusion about how to interact with the badge system, with only 16% indicating they understood how to earn badges. Forty-two percent indicated they were uncertain whether badges accurately represented the work they had done, and 5% disagreeing that they did. In addition to being uncertain whether they had met the criteria for earning badges, students indicated they did not understand the relationships among the badges. A number recommended solutions, such as "A flow chart showing more explicitly how to earn the badges (i.e., what needs to be done in what order, etc.)"

Responses to the PI learning environment

As shown in Figure 3, by week five, students had begun settling into their new environment. Students interviewed indicated they enjoyed engaging in projects, and compared this experience favorable with traditional courses, which they found "boring". Students also enjoyed gaining experience beyond their declared majors within the project-based Design Lab course. "Projects and everything, that's all going really well. It gives us a lot of hands-on work with specific stuff with electronics and programming and all the stuff that kind of covers all of our majors".

Although students enjoyed the projects themselves, the majority of students surveyed indicated in an open-ended suggestion box that the program should provide more structure or guidance. Several frustrated students stated that "they do not really teach us". Others indicated a small

amount of additional scaffolding could make a big difference. As one student suggested, “I think we should start from smaller or simpler things then become harder, harder, harder, step-by-step.”

Others were quite concerned that the hands-on learning style would be insufficient to gain theoretical knowledge. One remarked:

> *I think we should have more traditional classes, like more lectures and things like that. And after the class, we need homework, to finish that, and then we should do the things we are doing right now… but first we need to learn theory. Without theory, no, it's not going to work.*

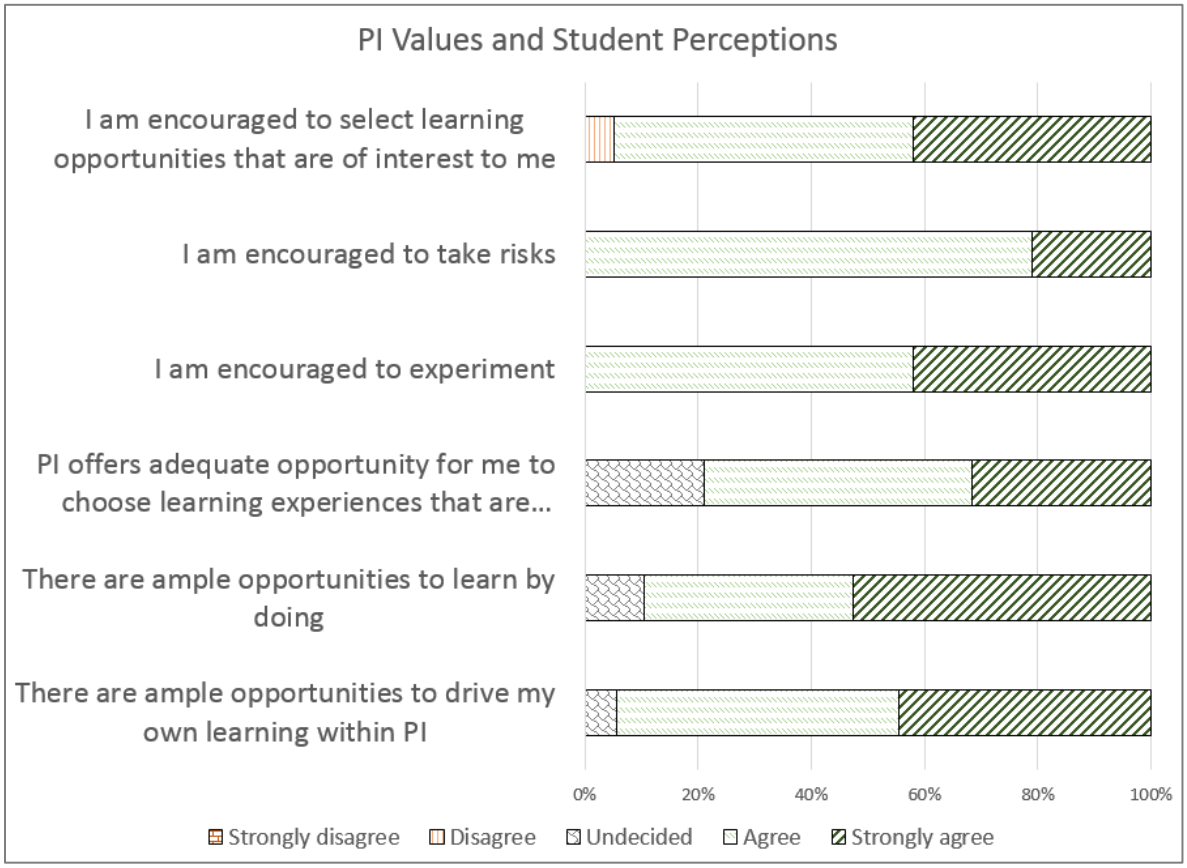

Figure 3. Students’ week 5 responses when asked to reflect on their experiences that represented PI values (N=20).

The competency-based model required students to resubmit work until faculty mentors felt evidence of mastery was provided. Some felt that this offered them an opportunity they would not have in traditional classes; “we always have the opportunity to go back and make it better and actually get it right.” However, other students did not see this as a benefit, explaining that they would prefer to get a low grade and “be done with it” over having to resubmit multiple times.

Having to manage their own time was another aspect many students were unprepared for. Students recognized that their own procrastination added to their concerns and feeling of falling behind, but many requested that soft or hard deadlines be set. Seventeen percent of surveyed students' responses when asked what was not working well indicated that the workload was too high. Students suggested that this was due in part to lack of coordination of the schedule, and unexpected requests to re-work projects already handed in.

Relationships

The unique nature of this program, which required the student cohort to be together in class about twenty hours per week as well as a high level of interaction between students and faculty, quickly led to a closely bonded group. "I think we're all really close together in PI. We all are pretty... It's 33 students who are spending a lot of time together. We're all pretty close knit right now and we all get along really well." They also supported one another on their individual work. "People who have knowledge already are, just out of the kindness of their heart, helping other people. If everybody is helping everybody then everybody is going to be doing better, and so I think that's a really awesome thing."

Students also stressed their satisfaction with their relationships with faculty mentors. "I feel like you guys should know that some of the professors are really great, fun to be around, you can tell that they care." This was often contrasted to faculty in outside courses. As one described an outside professor: "She's used to just so many students where she's just 'I'm a teacher. You're a student. I'll give you this information. I don't have to bother about catering to you anyway.' So it's either boring or it's uninformative."

Dealing with the newness of the program

Finally, as the semester progressed, students began to recognize some of the drawbacks of entering a pilot program.

> *I understand that's a big part of being the first people in a class. It's a new class, so they don't necessarily know what works and what doesn't yet.*

They discussed their experiences with projects and teaching approaches being re-designed on the fly. Students were generally understanding in cases in which the rationale for the change was provided.

> *I guess the restructuring [of the Design Lab assignments] was really nice, and again, it comes with the program is really early in inception. I guess as being a guinea pig, I'm open-minded at this. It hasn't really influenced my opinion of PI quite yet and the fact that we had to restart on something or that everything looks like it's chaotic and a mess.*

However, in other cases (such as modifications to the Seminar course) students expressed frustration about what they perceived as lack of coordination between instructors, and constantly shifting deadlines and expectations.

Students indicated that resolving some of the gaps that existed could alleviate many of the issues they had had this semester – especially the lack of historical experience in the program that often left them feeling like they did not have enough foundation to build upon in their project-based learning.

> *When [PI is] mature, there'll be a big project base. There'll be a nice, dedicated level of resources that the students can go to. They'll have an idea of how the best way to teach something is. I guess it takes time to teach something quickly.*

Faculty Reactions and Future Plans

Many surprises were encountered as the language of "competencies" was coordinated with the university administration of "grades". The degree of concern expressed by students, especially regarding the competency-based model and how it would fit within the traditional university structure, was not anticipated by faculty. As the faculty became aware of students' concerns they attempted to ameliorate them through transparency and ongoing discussions. In some cases adjustments were made through administrative structures or in course design to ease the transition.

Another area of faculty vision that required adjustment was student autonomy. Faculty worked from an understanding of the benefits of students centered learning in which learners benefit from being given a great deal of autonomy and being encouraged to take risks in the process. They found that the first year student cohort was not prepared for the high level of freedom given within the PI learning environment. Many of the key components of the PI teaching and learning model, such as competencies, just-in-time learning, and flexible deadlines, were in stark contrast to the highly-structured way students had been used to learning in high school. Yet, faculty expected students to thrive in this environment from the very first day. Many students became confused and distraught. The faculty's response was not always unified, and in some cases discussion between faculty members in front of students added to students' sense that the environment was chaotic rather than well planned. The transition to student autonomy may have occurred too rapidly for these students.

Most students seemed to better understand why the PI learning experience was designed as it was by mid-semester, suggesting that some of the initial faculty concerns about student confusion may have been exaggerated. The time and pace required for this transition will be an obvious area of research moving forward.

Nevertheless, it became clear that a full four year curriculum design was needed to help students conceptualize how they would move through the program and how their current work would tie to long-term academic and professional goals. Implementing the long-term vision required a fully developed set of competency descriptions for each disciplinary area included within the degree. Without a selection of competencies, students would continue to have good reason to wonder what they can expect in the years that follow and their potential for career preparation from the PI.

Discussion & Implications

Students entering the PI had high, but vague, hopes and expectations for the program. Parents were perhaps more realistic in both their expectations and their concerns. Parent and student exposure to the program design was generally limited to an informational invitation letter sent to all students. Some parents and students reached out to the program to learn more or attended summer events. However, more should have been done to help match student and parent expectations to the reality of the programs characteristics. The PI experience demonstrates that institutions attempting to create unique undergraduate educational environments should understand both student and parent attitudes and provide as much information as possible to new students before classes begin in order to recruit and maintain students who will be successful.

Interviews with students also revealed that they often sought their parents' comfort and assistance in difficult times. For example, a student who had enrolled in too many courses discussed his heavy course-load with his mother, who proceeded to contact the program administrator – after which the issue was quickly resolved. While faculty hope to build student autonomy more quickly than commonly found in traditional programs, this type of close parent / student relationship is the norm for many Millennial students [28]. It may be wise for those attempting to create unique undergraduate educational environments to consider ways to leverage strong family ties, while at the same time encouraging students to reach out in new and exciting directions.

Both students and parents expressed concerns about credentialing, including transfer of credits to traditional degree programs or other universities, and the way transcripts would be perceived by employers. Once again, parents were more likely to recognize these issues early-on, while students began to express concerns only after the semester had begun, possibly after they had learned more about the college environment from non-PI peers. In addition, both student and parent concern came from confusion about the degree of discipline specific content to be provided by the multidisciplinary PI program. Students and parents have come to expect the narrowly defined disciplinary content typically embodied in a "major". Although students were offered a broader exposure to disciplinary learning in the PI, parents and students wondered whether they would receive adequate preparation to compete with graduates from more discipline specific majors in their chosen career path. Industry representatives have recently been invited to speak with the PI students to alleviate this concern. This process will be implemented before students enter the program in future years and should be considered a very important step for any multidisciplinary program.

The competency-based system proved to be more difficult for students to understand and adapt to than faculty had anticipated. Students struggled with pacing themselves, and with understanding the overall structure of the program. Although faculty explained the model numerous times, students continued to be confused and concerned. Anyone contemplating a competency-based degree should carefully examine the experiences of several universities who have instituted competency based programs. Having a detailed set of competency descriptions

and procedures as well as examples from successful implementation of competency-based programs elsewhere will help minimize confusion in this complex area.

Although students were nearly universally satisfied with the idea of hands-on learning, they frequently discussed feeling lost. Students responded to this in varying ways. Some felt the program had failed them and wished for a more traditional teaching approach. Others adapted and learned to ask questions of faculty and peers when they needed help. Most interestingly, a number of students offered insightful suggestions for providing additional scaffolding and learning resources. While some degree of "surprise" shortcomings in scaffolding material is to be expected in an experimental educational offering, the PI experience provides evidence to "expect the unexpected". It is better to provide more support resources than you think will be necessary if at all possible.

Despite their concerns, students were generally very positive about their relationships with faculty and with their peers. The low number of students in this pilot allowed for a high teacher to student ratio, and a tight-knit student community. It will be challenging to retain this strength as the program grows, but it appears that non-traditional programs can retain student enthusiasm by building strong trust relationships between students and all levels of program staff.

The findings from the ongoing formative evaluation (which this paper reports on, in part) have informed continuous improvements in the program, as has direct feedback from students to teaching faculty. Although many expressed fears and concerns as the semester progressed, students could also be surprisingly understanding when unexpected issues arose , especially when faculty were transparent about the reasons for adjustments being made. Many students envisioned how the learning experience would change once assignments and resources had been more fully developed and faculty had learned from their early experiences. The PI students have further expressed appreciation for the regular presence of the PI program evaluation team from the first day. They have come to expect the positive outcomes that have resulted as the team supplied formative feedback to faculty and the program administrators. We strongly recommend implementing a formal formative evaluation process for new programs, including the use of in-depth interviews and frequent check-ins through survey or similar techniques to allow for student and teaching faculty voices to be heard. Although at times student complaints or faculty concerns may be a "normal" part of the process, understanding the experience of each group and the underlying causes of dissatisfaction as well as more positive reactions is crucial to fine-tuning a program before scaling up.

Limitations & Areas for Future Research

This study addresses the experiences of students, parents, and faculty in one particular program. Findings of this case study cannot be generalized to other programs, although the lessons we have learned may be of value to those considering developing programs with similar features. We were also limited in our ability to collect data from all stakeholders. Although we had a 100% response rate on the initial student survey, only half of parents participated in the parent survey, and about half of students participated in mid-semester interviews. While this level of

response rate may be expected (especially in mailed questionnaires as in the case of the parent survey), we are not able to guarantee that these responses are fully representative of the entire group. However, we did receive a range of responses, from those who were extremely satisfied with the program to those who had deep concerns. Finally, because we did not collect personally identifiable data, we were not able to link student responses over time or link student and parent responses. In future years, we plan to track individuals, allowing for more sophisticated longitudinal studies.

Potential areas for future research include:

- Methods for improving the introduction of a competency-based model to students
- Exploration of the mentoring relationship between faculty and students in a highly self-directed program
- Limits on faculty-student ratio for offering project-based, student-centered experiences in our design
- Development of learning resources to support highly self-directed, project-based student learning
- Faculty coordination across learning environments and domains
- Adaptation of Millennials to this type of learning environment
- Change in student perceptions about the learning environment across the duration of an undergraduate program
- Comparison of attitudes, learning outcomes, and eventual employment for PI students compared with students in traditional COT programs

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Appendix A: Beginning-of-Semester Student Questionnaire

This survey is part of an evaluation study to determine how students make decisions about which Purdue program to apply. In addition to being used for evaluation purposes, aggregate anonymous responses may also be used as part of a research study. You will not be identified in any way.

1. Based on what you learned about the Purdue Polytechnic Institute (PPI) over the summer, how would you describe PPI, and are those characteristics important to you?

	Would you describe PPI as_____?			Is this important to you?	
	Yes	No	Don't Know	Yes	No
Fun					
Interesting					
Less work than a typical degree					
More work than a typical degree					
A good place to learn a lot					
Popular with employers					
A good fit with my learning style					
Helpful to get accepted into a graduate school					
A good fit with my career expectations					
Popular with my parents					
A good way to meet friends					
Excluding my current friends					
Engaging me in hands-on projects					
Letting me work in a team					
Combining liberal arts and technical subjects					
Encouraging me to be responsible for my own learning					
Focused on mastery rather than on memorization					
Allowing me to work closely with faculty mentors					

2. What appealed to you the most about the Purdue Polytechnic program?

3. What are your expectations for the Purdue Polytechnic program?

4. Is there anything you are concerned about in applying for the Purdue Polytechnic Institute?

5. To what extent were your parents involved in your decision to attend PPI?

- ☐ They were the deciding factor
- ☐ We talked it over together but I made the final decision
- ☐ They played no part in the decision making process
- ☐ Other: _____

6. To what extent were your friends involved in your decision to attend PPI?

- ☐ They were the deciding factor
- ☐ We talked it over together but I made the final decision
- ☐ They played no part in the decision making process
- ☐ Other: _____

7. For what major will you will enroll?

- ☐ Building Construction Management
- ☐ Computer and Information Technology
- ☐ Computer Graphic Technology
- ☐ Engineering Technology (Electrical or Mechanical Engineering Technology)
- ☐ Aviation Technology
- ☐ Technology Leadership and Innovation
- ☐ Exploratory studies – please specify major interest:
  _____
- ☐ Theatre
- ☐ Other: _____

8. What is your age? _____

9. What is your gender?

- ☐ Male
- ☐ Female
- ☐ Other: _____
- ☐ Refuse to answer

10. What is your ethnic origin?

- ☐ White
- ☐ Hispanic or Latino
- ☐ Black or African American
- ☐ Native American or American Indian
- ☐ Asian / Pacific Islander
- ☐ Other: _____
- ☐ Refuse to answer

11. Are you generally…:

- ☐ An *A* student
- ☐ A *B* student
- ☐ A *C* student
- ☐ A *D* student

12. How many AP courses do you plan to transfer in?

- ☐ 0
- ☐ 1
- ☐ 2
- ☐ 3
- ☐ 4
- ☐ 5+

13. As best you can remember, what was your SAT score? _____

- ☐ Can't remember/prefer not to answer

14. As best you can remember, what was your ACT score? _____

- ☐ Can't remember/prefer not to answer

15. What is your professional goal?

16. Do you plan to obtain an advanced/professional degree (e.g., Master's, PhD):

- ☐ Yes
- ☐ No
- ☐ Not sure

17. How do you believe your preparation at Purdue will help you reach that goal?

18. What is your parents' highest level of education?

- ☐ High School Diploma/GED
- ☐ Some college
- ☐ Associates degree
- ☐ Bachelor's degree
- ☐ Master's Degree
- ☐ Doctoral or professional degree

Thank you!

Appendix B: Student 5-week Questionnaire

This survey is part of an evaluation study which aims to determine what is working well and what could be improved within the Purdue Polytechnic Institute. In addition to being used for evaluation purposes, the data you provide may also be used as part of a research study, and therefore could be shared at academic conferences or as part of a publication. You will not be identified by name – all data will be reported in aggregate.

Design Lab Experience

	Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
1. I enjoy my experiences in design lab.	☐	☐	☐	☐	☐
2. I feel I have learned a lot in the design lab.	☐	☐	☐	☐	☐
3. I have had the opportunity to practice skills multiple times while working on projects in design lab.	☐	☐	☐	☐	☐
4. I have had the opportunity to master skills while working on projects in design lab.	☐	☐	☐	☐	☐
5. What I learned in the design lab will be valuable to me in the future.	☐	☐	☐	☐	☐
6. I intend to earn additional badge(s) outside of the requirement.	☐	☐	☐	☐	☐
7. I have a good relationship with my mentors in design lab.	☐	☐	☐	☐	☐
8. My mentors in design lab are fair with awarding badge(s) for the work I have completed.	☐	☐	☐	☐	☐
9. The physical space used for design lab is conducive to my learning.	☐	☐	☐	☐	☐
10. I am interested in the topics of the projects in design lab.	☐	☐	☐	☐	☐

11. Things I like most about design lab:

12. Things I like least about design lab:

13. Ways design lab could be improved:

Seminar Experience *("Digital Narratives")*

	Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
1. I enjoy my experiences in seminar.	☐	☐	☐	☐	☐
2. The seminar is developing my critical thinking skills.	☐	☐	☐	☐	☐
3. The seminar is helping me to become a more critical user of information.	☐	☐	☐	☐	☐
4. The seminar is helping me to become a better communicator.	☐	☐	☐	☐	☐
5. The seminar is helping me learn more about technology.	☐	☐	☐	☐	☐
6. I have a good relationship with my mentors in the seminar.	☐	☐	☐	☐	☐
7. I intend to earn additional badge(s) outside of the requirement.	☐	☐	☐	☐	☐
8. My mentors in seminar are fair with awarding badge(s) for the work I have completed.	☐	☐	☐	☐	☐
9. The physical space used for seminar is conducive to my learning.	☐	☐	☐	☐	☐
10. I am interested in the topics of the projects in seminar.	☐	☐	☐	☐	☐

11. Things I like most about seminar:

12. Things I like least about seminar:

13. Ways seminar could be improved:

Disciplinary Learning & Practice Experience (DLP)

Work or learning activities that are specific to a discipline, done in small groups or individually with a faculty member from that discipline. For instance, those who are CGT majors or interested in graphics design discuss discipline-specific topics and badges with faculty with expertise in CGT. Other students may work with faculty with expertise in programing, mechanical engineering, etc.

1. I have participated in _____ DLP experiences.
2. DLPs I have participated in include:

	Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
3. I have enjoyed my experiences with DLPs.	☐	☐	☐	☐	☐
4. I feel that I learned what I needed to from the DLPs.	☐	☐	☐	☐	☐
5. What I learned in DLPs connected with what I am doing in Seminar/Design Lab.	☐	☐	☐	☐	☐
6. What I learned in DLPs will be useful to me in the future.	☐	☐	☐	☐	☐

7. **Things I like most about DLPs:**

8. **Things I like least about DLPs:**

9. **Ways these DLPs could be improved:**

Independent Learning Modules (ILMs)

These experiences include face-to-face or online "modules" designed to help you master a particular topic or skill. For example, you might have been pulled out with a small group of other students to learn particular Communications skills.

10. I have participated in _____ ILM experiences.
11. ILMs I have participated in include:

	Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
12. I have enjoyed my experiences with ILMs.	☐	☐	☐	☐	☐
13. I feel that I learned what I needed to from the ILMs.	☐	☐	☐	☐	☐
14. What I learned in ILMs connected with what I am doing in Seminar/Studio.	☐	☐	☐	☐	☐
15. What I learned in ILMs will be useful to me in the future.	☐	☐	☐	☐	☐

16. Things I like most about ILMs:

17. Things I like least about ILMs:

18. Ways these ILMs could be improved:

Transition Experience

Think back to the way you felt at the beginning of this semester.

During the first weeks of class...	Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
1. I felt like my previous experiences prepared me for PPI.	☐	☐	☐	☐	☐
2. I didn't know what to expect when I started at PPI.	☐	☐	☐	☐	☐
3. I was confused about how to be successful at PPI.	☐	☐	☐	☐	☐
4. I felt like this program would prepare me for a future career.	☐	☐	☐	☐	☐
5. I knew what I was getting into when I started at PPI.	☐	☐	☐	☐	☐

Overall Purdue Polytechnic Experience

Student as whole person

	Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
6. My mentors respect me as a person.	☐	☐	☐	☐	☐
7. There are ample opportunities to drive my own learning within PPI.	☐	☐	☐	☐	☐
8. I like the balance between technical and non-technical content.	☐	☐	☐	☐	☐

Diversity in thinking, knowing, and learning

	Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
9. Different types of thinking are respected in PPI.	☐	☐	☐	☐	☐
10. Different types of people are respected in PPI.	☐	☐	☐	☐	☐
11. There are ample opportunities to learn by doing.	☐	☐	☐	☐	☐
12. Many forms of learning are valued within the program (including formal instruction, just-in-time learning, learning on my own, etc.)	☐	☐	☐	☐	☐
13. I am encouraged to select learning	☐	☐	☐	☐	☐

opportunities that are of interest to me.	

Openness, Collaboration, and Cooperation

	Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
14. I feel welcome to approach my mentors at any time	☐	☐	☐	☐	☐
15. Collaboration is encouraged in PPI.	☐	☐	☐	☐	☐
16. Teamwork is encouraged in PPI.	☐	☐	☐	☐	☐

Autonomy

	Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
17. I can choose <u>how</u> to learn with PPI.	☐	☐	☐	☐	☐
18. I can choose <u>when</u> to learn with PPI.	☐	☐	☐	☐	☐
19. I can choose <u>where</u> to learn with PPI.	☐	☐	☐	☐	☐
20. I can choose an instructor/mentor with PPI to help with my learning.	☐	☐	☐	☐	☐
21. PPI offers adequate opportunity for me to choose learning experiences that are meaningful to me.	☐	☐	☐	☐	☐
22. I understand how to earn badges.	☐	☐	☐	☐	☐
23. Badges accurately represent the work I have done.	☐	☐	☐	☐	☐

Risk Taking

	Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
24. I am encouraged to experiment.	☐	☐	☐	☐	☐
25. I am encouraged to take risks.	☐	☐	☐	☐	☐
26. I am rewarded for experimentation.	☐	☐	☐	☐	☐
27. I am rewarded for taking risks.	☐	☐	☐	☐	☐

28. Comments on your overall experience:

29. Anything else you would like to tell us:

About You

1. Age: _____

2. Gender:

☐ Male ☐ Other: _____

☐ Female ☐ Refuse to answer

3. For what major are you enrolled?

☐ Building Construction Management

☐ Computer and Information Technology

☐ Computer Graphic Technology

☐ Engineering Technology (Electrical or Mechanical Engineering Technology)

☐ Aviation Technology

☐ Technology Leadership and Innovation

☐ Exploratory studies – please specify major interest:

_____

☐ Theatre

☐ Other: _____

4. What is your ethnic origin?

☐ White

☐ Hispanic or Latino

☐ Black or African American

☐ Native American or American Indian

☐ Asian / Pacific Islander

☐ Other: _____

☐ Refuse to answer

5. Are you generally…:

☐ An *A* student ☐ A *C* student

☐ A *B* student ☐ A *D* student

Thank you!

Appendix C: Parent Survey

This survey is part of an evaluation study to determine how students and parents make decisions about which Purdue program to apply. In addition to being used for evaluation purposes, aggregate anonymous responses may also be used as part of a research study. You will not be identified in any way.

1. Did you encourage your child to apply to the Purdue Polytechnic Institute (PPI)?

- ☐ Yes
- ☐ No
- ☐ Not sure

2. To what extent do you think your opinion was a factor in your child's decision to attend the Purdue Polytechnic Institute?

- ☐ It was the deciding factor
- ☐ We talked it over together but my child made the final decision
- ☐ I played no part in the decision making process
- ☐ Other: _____

3. How would you describe PPI and are those characteristics important to you?

	Would you describe PPI as _____?			Is this important to you?	
	Yes	**No**	**Don't Know**	**Yes**	**No**
Fun					
Interesting					
Less work than a typical degree					
More work than a typical degree					
A good place to learn a lot					
Popular with employers					
A good fit with my child's learning style					
Helpful for my child to get accepted into a graduate school					
A good fit with my child's career expectations					
Encouraged by other parents or teachers					
A good way to meet friends					
Excluding my child's current friends					
Engaging my child in hands-on projects					
Letting my child work in a team					
Combining liberal arts and technical subjects					
Encouraging my child to be responsible for his/her own learning					
Focused on mastery rather than on					

memorization					
Allowing my child to work closely with faculty mentors					

4. What are your expectations for the Purdue Polytechnic Institute program? *(please, be specific)*

5. Is there anything you are concerned about related to the Purdue Polytechnic Institute? *(please, be specific)*

6. For what major will your child enroll?

- ☐ Building Construction Management
- ☐ Computer and Information Technology
- ☐ Computer Graphic Technology
- ☐ Engineering Technology (Electrical or Mechanical Engineering Technology)
- ☐ Aviation Technology
- ☐ Technology Leadership and Innovation
- ☐ Exploratory studies – please specify major interest:_____
- ☐ Theatre
- ☐ Other: _____

7. What is your gender?

- ☐ Male
- ☐ Female
- ☐ Other: _____
- ☐ Refuse to answer

8. What is your ethnic origin?

- ☐ White
- ☐ Hispanic or Latino
- ☐ Black or African American
- ☐ Native American or American Indian
- ☐ Asian / Pacific Islander
- ☐ Other: _____
- ☐ Refuse to answer

9. What is your highest level of education?

- ☐ High School Diploma/GED
- ☐ Some college
- ☐ Associates degree: Major: _____
- ☐ Bachelor's degree: Major: _____
- ☐ Master's Degree: Major: _____
- ☐ Doctoral or professional degree: Major: _____

10. Comments/Suggestions?

Thank you for your responses.