

## **AC 2010-1351: STUDENTS AS THE KEY TO UNLEASHING STUDENT ENGAGEMENT: THE THEORY, DESIGN, & LAUNCH OF A SCALABLE, STUDENT-RUN LEARNING COMMUNITY AT XX**

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# Students as the Key to Unleashing Student Engagement: The Theory, Design, & Launch of a Scalable, Student-Run Learning Community at XX

## Introduction

Improving engineering education has been a recurring theme throughout the past century. Over the last two decades, calls for reform have intensified from many stakeholders at the global and local levels—including the National Academies, policy makers, faculty, employers, and students.<sup>1,2,3</sup> Heroic faculty efforts have been broadly mounted and large amounts of money have been spent, but truly transformative change in engineering education remains an elusive goal. For example, a recent volume examines the many efforts made in the creation and execution of the National Science Foundation (NSF) Coalitions and finds that many useful curriculum modifications and pedagogical innovations were implemented, but those efforts, even when successful, remained largely local, failing to diffuse broadly to other institutions.<sup>4</sup> Worse, many of the innovations that appeared to be working well reverted to prior form following the expenditure of NSF-provided funds.

Engineering education is a complex system, and the difficulty in transforming it should, in one sense, come as no surprise; however, calls for reform largely prescribe similar solutions such as better emphasis on communications skills and teamwork in classrooms taught with greater pedagogical skill. It is a bit of a puzzle that such widespread agreement has not resulted in more effective and sustainable change and better diffusion and pace of change.

This paper takes the position that an important, largely unrecognized, reason behind the failure for transformation efforts to take hold is that much of the effort—even much of the effort that claims to be student centered—remains inexorably *faculty centered*. Indeed there is a large literature of student-centered pedagogy, but the fundamental assumption behind much of it is that *teachers must behave differently to engage the student*. On one level such an assertion is unassailable in that if we wish something to be different, something different must be done, and the faculty member is the natural actor to initiate change; however, it is interesting to note that the move from the expression “sage on the stage” to that of “guide on the side,” a move that is supported by the overwhelming mass of educational literature, continues to treat the faculty member as the primary actor.

The view taken herein is that a key to effective, sustainable, and scalable change is to move firmly from faculty behavioral change to student behavioral change as the primary focus of effort, thereby treating the student as the primary actor in that student’s education. In other words, the view promoted here is that *students must behave differently to engage themselves*. In particular, the paper considers the theory, design, and launch of a student-run learning community called the *iCommunity* as part of the XX Foundry for Innovation in Engineering Education initiative at the University of XX. Although that effort is in its opening moments,

early returns are promising, and activities and assessment to date support the idea that truly student-centered efforts can work, scale, and, more importantly, unleash a powerful kind of student engagement that is rarely seen on engineering campuses today.

The paper starts by briefly reviewing the XX Foundry for Innovation in Engineering Education (iFoundry), discussing its emphasis on organizational and conceptual change as fundamental to effective transformation. The paper continues by discussing some of the theory of student engagement and socialization, connecting that theory with important principles used in the design of the iCommunity effort. It continues by discussing the structural, temporal, and functional elements of the iCommunity design and then reviews the results with the Fall 2009 entering freshmen class followed by conclusions and implications for engineering education.

### **Background on the XX Foundry for Innovation in Engineering Education**

iFoundry began in 2007 as a grassroots effort among five departments to transform engineering education at the University of XX. The effort started by recognizing that a primary reason why curriculum is difficult to change is because voting procedures induce a kind of academic NIMBY (not in my backyard) problem.<sup>5</sup> Simply put, faculty members agree that curriculum reform is a good idea except they exclaim “don’t change my course,” and subsequent *logrolling* prevents anything more than modest incremental changes from being made. iFoundry sought to overcome this fundamental difficulty by creating a pilot incubator in which change was permitted, but faculty governance was respected.

Another particularly important idea to these early efforts was Watkins’s STaRS model and the concept of *realignment*.<sup>6</sup> In the STaRS model, organizations can be (1) startups, (2) turnarounds, in need of (3) realignment, and (4) sustaining success. Startups and turnarounds need to *act* and organizations in need of realignment and those sustaining success need to *learn*. Simply put, an organization in need of realignment needs to change, but doesn’t know it, so a key idea is that such organizations need to have a good bit of *mind changing* (learning) going on, and this means that the pace of change needs to be a better match to the pace of mind changing to avoid the rejection of the change effort by the analog of an *immune system response*.<sup>7</sup> Sometimes university administrators talk of leading faculty members as “herding cats,” and Watkins’s advice would seem to indicate that there needs to be a good match between adapting speed of change to the volume and distribution of faculty “meowing.” Further details of the original incubator design principles are available in the original whitepaper.<sup>8</sup>

Another idea that was important to iFoundry efforts from the early days was the need to critically examine engineering’s conception of itself. Although many engineering programs take pride in their commitment to math and science, engineering faculty are frequently at a loss for words when articulating (if they try to articulate) a coherent vision of what engineering is, its place in the world, its method, its knowledge and practices, and its values. Thus engineering faculty are comfortably rigorous when it comes to math and science, but they are less so when it comes to conceptual matters.<sup>9</sup> Of course, there is a discipline devoted to conceptual rigor. It is called *philosophy* and early efforts in iFoundry were devoted to (and continue in) better connecting philosophy and engineering in ways that help change engineering faculty minds through the making of better arguments.

Together, the need for appropriate *organizational* and *conceptual* change efforts have played a role in iFoundry's development from the beginning. However, the coming of the first freshmen in Fall 2009 necessitated more focused thinking about students, their engagement, and how to create an experience that would be maximally impactful with modest resources and a relatively small footprint in the curriculum. The paper continues by discussing some key theories underlying our design efforts and it continues by extracting key design principles and by reviewing key design elements.

## **Theoretical & Practical Frameworks Underpinning the iCommunity**

The Copernican revolution espoused at the beginning of the paper—putting students at the center of their learning universe—is not simply monadic in the sense that a student is merely expected to learn from him or herself and no one else. No, just as the sage-on-the-stage view challenged at the beginning is dyadic (faculty-student), and the guide-on-the-side is also pairwise (student-faculty), the primary student-centered relationship left underexplored in engineering education is also dyadic (student-student). This places a premium on understanding the theory and practice of student socialization. In this section, we approach socialization through three perspectives: social cognitive theory, social exchange theory, and learning community pedagogy and practice. Many theoretical models of socialization describe stages through which newcomers pass, as they become members.<sup>10</sup> Learning is the common thread throughout these models as newcomers learn specific tasks and responsibilities, as well as the values and mission of the institution.<sup>10, 11, 12</sup> For the freshmen in this program, we attempted to help them learn about the interrelationships among the work of engineering, life-long learning, and university and professional communities.

### *Social cognitive theory*

A perspective recently emerging in learning theory is the integration of narrowly focused theories into broader views of learning. These more inclusive views of learning incorporate cognitive, emotional, and social factors into a more integrated system of interdependent factors.<sup>13, 14</sup> There is also a correspondence between these broader views of learning and the requirements of learning in the socialization process as described as learning what to do, how to do it, and why it is done this way.<sup>15</sup>

Social cognition provides a useful theoretical lens for explaining the learning process of freshman (as newcomers) entering college. Encountering a novel situation prompts newcomers to search for information to make sense of the situation.<sup>16</sup> This search can involve social and personal sources of information. Social cognition helps explain the development of a personal frame of reference based on the collective frame of reference of the social group.<sup>16, 17, 18</sup> In the case of freshman beginning their engineering studies, their existing aspirations and experiences form their personal frames of reference that then interact with the collective frame of reference of the institution. As the face of the institution for iFoundry students, we sought to build on their incoming aspirations and enthusiasm for engineering, learning, and community.

Viewing the socialization process strictly from a perspective of the newcomer learning to fit in often overlooked important social and systemic influences on the newcomer's learning process. Socialization is a complex process comprising multiple actors and interactions.<sup>19, 20, 21, 22, 23</sup>

Wanous also noted that the interactions among newcomers, insiders (peers and faculty), and the situation (context) are important sets of factors influencing the socialization process. He found that increasing the level of interactions between the newcomer and his or her environment increased the success of socialization.<sup>10</sup> However, it seems reasonable that the quality of the interactivity is important—not just the frequency of activity. Increasing the wrong kind of interactivity may promote the wrong kind of learning, thereby decreasing the success of socialization. Social exchange theory addresses the quality of social interactions between members of social groups.

### *Social exchange theory*

A major premise in the literature on student engagement indicates that the level of social connectedness students achieve affects their satisfaction, learning, and persistence in their educational endeavors. Social exchange theory (SET) describes a type of evolving relationship between people as a series of interactions in which they exchange resources guided by rules of exchange or social norms.<sup>24</sup> Recent theorizing has begun to move social exchange theory beyond its behavioral and economic roots to include cognitive and affective constructs. Recently, Lawler proposed an affective theory of social exchange that directly links emotions and sentiments to actors' perceptions of fairness, satisfaction, solidarity, trust, leniency, and commitment to their exchange relationships.<sup>25</sup>

A more specific focus of social exchange involves the formation of individuals' roles and identities. A premise of role-making behavior is that institutional roles are typically ill-defined, and individuals negotiate and clarify their roles through interactions (exchanges) between leaders and members.<sup>26</sup> Through these processes, a newcomer acquires information about the behavioral constraints and demands of the institution, negotiates alternatives, accepts a pattern of behavior, and gradually modifies this pattern of behavior.<sup>27</sup> Of particular interest regarding the experiences of entering freshman in higher education is the initiation and development of exchange relationships between the individual and others (peers, faculty, administrators, teaching assistants). Additionally, research indicates that relationships are unique to each individual and may develop into high-quality relationships based on trust and respect or degenerate into low-quality relationships merely fulfilling the rudimentary requirements of the institution.<sup>28</sup> Another key characteristic of social exchange is that high- or low-quality relationships form quickly and tend to endure.<sup>30</sup> Thus, the initial interactions (experiences) are extremely important, because they affect attitudes, satisfaction, and performance. Several insights gleaned from theorizing about social exchange informed our development of the iFoundry learning community, such as the importance of first experiences and the quality of relationships formed as a result of shared power, high levels of trust and respect, and attention to reciprocity with students. While the concept of learning communities is quite varied, research indicates that learning communities help foster social exchange and connectedness that leads to higher achievement in academic studies.

### *Pedagogy and learning communities*

From a longitudinal study of 27,064 at 309 baccalaureate-granting institutions, Astin identified two environmental factors that made the most difference in student educational outcomes. The first was the frequency and quality of student-to-student interaction closely followed by the frequency and quality of student-to-faculty interaction. In addition, Astin found that the structure

of the educational curriculum had little effect on educational outcomes.<sup>29</sup> In his study of Harvard undergraduate students, Light found similar correlations between social interactions and academic achievement.<sup>30</sup> And their study of persistence of science, math, and engineering majors, Seymour and Hewitt found that a defining difference between students who stayed or quit their majors was whether they received help from others at a critical time in their studies.<sup>31</sup> These findings reinforce other research on transitions that highlight the importance of social connectedness on engagement and outcomes.<sup>32, 33</sup> This realization of the critical importance of social connections drove much of the development of learning communities over the past few decades.

Research supporting the effectiveness of learning communities has typically followed three conceptual themes: developmental, cognitive science, and learning outcomes.<sup>34</sup> The developmental literature states that students develop intellectually and psychologically through exposure and interaction with experiences that challenge and disrupt their current understandings and worldviews. Ideally, community experiences introduce students to complex, diverse perspectives, as well as promoting critical thinking and contextual learning. Cognitive science highlights the importance of context in learning, stressing the effects of the environment and links to past experience on individual learning. Thus, rich interactive environments that are integrated and coordinated to support and enrich learning lead to deeper, more complex learning and knowing. Furthermore, research indicates that learning outcomes improve from the experiences of learning communities by fostering greater student support for and engagement in purposeful academic activity that leads to improved success.<sup>34</sup>

It was because of this work that our vision included the importance of fostering a sense of community among students. We believed that the traditional experiences afforded to freshmen in engineering programs missed a crucial driver of learning, that is the importance of the community experience for students. This change in view was exemplified by the statement contrasting the traditional educational experience with what we endeavored to create for iFoundry. For example, at the first meeting we told students that traditionally, professors would ask freshmen to look to their right and look to their left, and that one or two of the three would not be there next year. We proposed a variation on this tradition by asking students to look to their left and look to their right, and realize that these were the people that would help them become successful in their academic and career efforts. This example illustrated the importance of community to the learning experience.

### **Design Principles for iCommunity and the Freshmen Experience**

The theory of the previous section lays the groundwork for assembling a set of design principles for the community structure and freshmen experience. Specifically, the key design principles guiding the formation of iFoundry are as follows:

- **Transitions.** Transitions from high school to college are difficult, but opportunity laden.
- **Magic moments.** Meeting expectations of change, especially at transitions, can be very powerful.
- **Student Aspirations.** Student aspirations as prospective engineers differ, but alignment of aspirations with opportunities can be powerful.

- **Passion.** Engineering can be a passionate way of life.
- **Social.** Engineering is usually a social way of life.
- **Choice.** Student freedom and choice foster creativity and engagement.
- **Intellectually appropriate.** Educational objectives grounded in the real fundamentals of engineering practice resonate with students and those who hire them.

In a moment, we will examine detailed structural, temporal, and functional elements that come together to create a system that follows these principles, but in communicating many of these things to students and stakeholders we developed two locutions that were helpful in conveying the tone of the effort quickly: the *missing basics* and the *three joys*. Each is discussed briefly:

**The missing basics.** Engineering faculty members often defend the status quo against encroachment by “soft” subjects (teamwork, leadership, communications, etc.) by expressing opposition to the dilution of “the basics,” by which they usually mean math, science, and engineering science. Elsewhere an argument has been made suggesting that students in industrially sponsored senior design courses are deficient in seven qualitative thinking skills: questioning, labeling, qualitative modeling, decomposing, experimenting, visualizing and ideating, and communicating.<sup>35, 36</sup> These seven critical and creative thinking skills are arguably some of the greatest gifts of the Western intellectual tradition; they are also essential to being a great engineer, and are thus called the “missing basics” of engineering.

**The three joys.** When students first come to campus, they face a daunting gauntlet of math and science courses—the math-science death march—from which they infer that (1) engineering is applied math and science and (2) a kind of drudgery. To counteract these misconceptions, we talked to students about the joy of engineering from the perspective of practice. We talked to them about the joy of learning from the perspective of a fast-paced world in which today’s learning will not be adequate for tomorrow’s challenges, and finally we talked to them about the joy of community in the sense that engineering is an activity performed with others for others.

An interesting side benefit of using these locutions is that they are interrelated in that the missing basics form a uniform tool kit for exercising the three joys. Thus, in a short presentation, the intellectual coherence of the overall program can be quickly and effectively conveyed.

### **iCommunity as Part of a Larger System: Overall Design Elements**

The focus of this paper is the student-run learning community, iCommunity, but to understand it well, it must be seen as part of a larger system (figure 1) of structural, temporal, and conceptual elements.

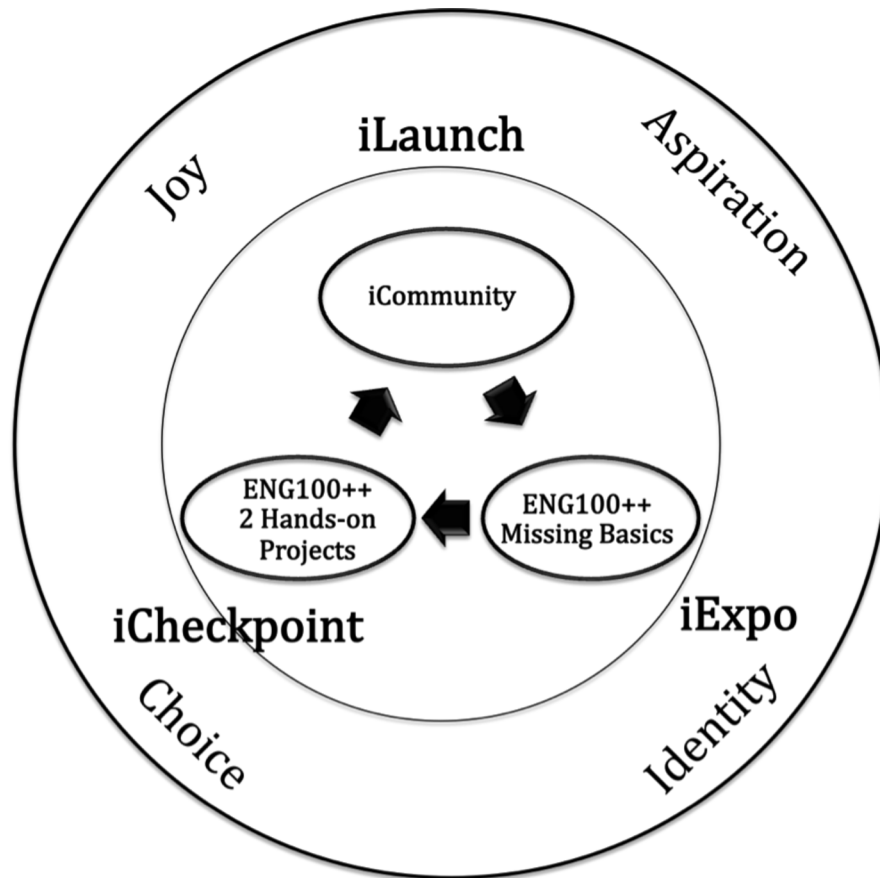


Figure 1. iCommunity as part of a larger system.

### Structural elements

The center of the diagram depicts the key structural elements of the student experience:

- ENG100++ - Introduction to the Missing Basics lectures/discussion
- ENG100++ - Hands-on projects
- iCommunity

A portion of the freshmen experience is a one-hour course called the *Introduction to the Missing Basics of Engineering* (ENG100++). The course is intended as an extended version of an existing zero-credit course (ENG100) that all XX freshmen take. ENG100 meets twice a week for half the semester, and is taught by *engineering learning assistants*, upperclass undergraduate students, and it covers key items about engineering, academic, and student life at XX as well as a number of professional issues. ENG100++ meets twice a week for the whole semester, covers the material of ENG 100, adds classroom material on the missing basics of engineering and two hands-on projects, and is taught by faculty. The ENG100++ syllabus for the course is available online ([www.ifoundry.XX.edu](http://www.ifoundry.XX.edu)).

On the first day of the week in ENG 100 ++ the missing basics material is taught in fairly traditional lecture/discussion sections. The second day of the week, ENG 100++ is devoted to two separate hands-on projects. Teams of approximately five students are formed and they start with a project to fabricate a small steam turbine driven car from a kit. The design and materials



are given to each team; they are simply asked to fabricate a working machine, but the fabrication challenge involves cutting thin sheet metal and soldering, and getting a machine to work is a non-trivial task. The midterm of the course ends with a steam car derby. The second project is more open ended. Teams are supplied with Arduino programmable controller kits with servos and sensors ([www.arduino.cc](http://www.arduino.cc)) and asked to devise an interesting project. Projects are judged on functionality, originality, and possible usage in the market.

The details of the iCommunity structure will be discussed in more detail in a moment, but a key distinction to make at this juncture is that ENG100++ is a course and iCommunity is an extracurricular activity. In thinking about engineering student life at XX we observed that many students get involved in a very large array of student and engineering student life activities, but oftentimes that involvement is delayed until late sophomore or early junior year. The iCommunity is designed as an accelerator that helps students become acclimated to student life quickly and then become part of the mainstream of it. More details of the iCommunity experience will be shared in a moment, but first the temporal and conceptual elements of figure 1 are briefly discussed.

#### *Temporal elements*

The semester has a beginning (iLaunch), a middle (iCheckpoint), and an end (iExpo). To treat the beginning of the semester (and the freshmen year) as special the semester is launched with a special retreat and team-building activities. The iCheckpoint at the middle of the semester helps the iCommunity get organized and focus by setting a deadline for presentations. The iExpo is a celebration of the semester. (Note: we branded many of the events and functions of iFoundry using the lower-case “i” in front of descriptive terms. This lower-case “i” is a common label at the University of XX).

#### *Conceptual elements*

The ring of conceptual terms (joy, choice, aspirations, and identity) convey many of the key concepts that are foci of the semester’s efforts. We believe that the positive language used to describe the activity is important to creating a positive culture within the iCommunity.

With this overview, we can proceed to a better understanding of the iCommunity activity itself.

### **A Student’s Eye View of the iCommunity**

Along with ENG 100++ (missing basics and the project work), the iCommunity launched with a diverse group of first-year engineering students in August 2009. Prior to the semester beginning, students applied to iFoundry in response to a letter from our Associate Dean upon acceptance to XX. 110 students applied to iFoundry. All were accepted. 93 accepted XX’s offer of admission. 88 actually came to campus, and 73 are still with us. In reviewing the credentials of these students, their tests scores and grades were not statistically different from normal students. We believe they are more venturesome as a group than normal, in part because they agreed to participate in a vaguely defined program, and we are independently verifying this belief by comparing the creativity and risk-taking profiles of the students compared to the norm.

This section presents the semester’s activity in rough chronological order, working from the

iLaunch to the iCheckpoint to the iExpo. Along the way the structural and functional elements of the effort are presented in the order in which students encountered them.

### *3-2-1 → iLaunch*

The weekend prior to the beginning of classes, we organized an orientation program for incoming iFoundry students dubbed the *iLaunch*. On Saturday morning (22 August) we presented the vision of iFoundry and our expectations for the program. We organized icebreakers and other activities to get the students acquainted with each other. After lunch, we bussed everyone out to a 4H camp where students participated in a low-ropes course to get acquainted and build community. That evening there was entertainment and a campfire. Students spent the night in cabins and the next day they joined one of four *iTeams* to discuss their aspirations and the objectives the teams for the coming semester.

### *Four iTeams aligned with student aspirations*

As part of the application process for iFoundry, students told us why they were interested in engineering and what they aspired to do as engineers. Reviewing these student aspirations we identified three broad categories. First, there were students who were motivated to come to engineering school to design cool technology. Second, there were students who wanted to be the next “Max Levchin,” the next great tech entrepreneur. Finally, there were students who wanted to “save the world” by tackling difficult social or environmental problems. Four teams were created in alignment with these aspirations:

1. Art & Engineering Design (AED).
2. Service & Systems Engineering (SSE)
3. Entrepreneurship & Innovation (EI)
4. Engineering in Service to Society (ESS).

These diverse iTeams provide a variety of emphases to accommodate the interests of students. At the iLaunch, students were presented with a list of the available teams, and the students were asked to rank their preferences. In Fall 2009, all students got their top choice.

### *First iTeam meetings and iChair elections*

Classes began on the Monday following iLaunch (24 August 2009) with the first session of ENG100++ meeting that day. On Wednesday (26 August 2009), the iCommunity gathered for a two-hour meeting. The iTeams were formally introduced to their various advisors as follows:

- iTeam Student Advisor (iSA), a graduate or undergraduate student to provide connections to student life and practical university advice.
- iTeam Faculty Advisor (iFA), a faculty member assigned to provide procedural advice and faculty contact.
- iTeam Corporate/Organizational Advisor (iCOA), a corporate or organizational friend aligned with the iTeam who can provide sporadic input from the real world of work.

iSAs and iFAs were present in person. iCOA contact information was distributed for subsequent interaction.

Following these introductions, each iTeam elected an iChair from among its ranks. The iChairs were told that they were free to organize their iTeam in any reasonable manner that would allow the iTeam to serve four functions:

**Identity and social interaction.** Each iTeam provides a sense of belonging and identity to its members in the same way that a fraternity or sorority or social club might, except that it is up to the iTeam to create its own identity and social activities.

**Academic support and advising.** Students are members of their home departments and iFoundry and primary responsibility for academic support and advice is with the home department; however, iTeams are an important source of informal academic support and advice. iSAs can provide information to students based on their own experience as students, and IFAs and iSAs can provide iFoundry-specific advice about university offerings and courses. In addition, iTeams can organize to help their members “survive” the challenges of the freshmen year.

**World of work.** A key to motivating students is to make sure they understand the way opportunities in the world of work align with their interests. Each iTeam is paired with one or more corporations or organizations and one or more iCOA representatives.

**Service and projects.** Just as many fraternities, sororities, and social organizations perform service activities in their communities, iTeams can choose to perform service to campus entities, the community, and beyond. Also, iTeams are encouraged to work on micro-projects with their corporate and organizational sponsors.

After the first meeting, iTeams met for the first month of the semester on a weekly basis to prepare for iCheckpoint and iExpo meetings at midterm and the end of the semester, respectively. At first, dates, times, and meeting places were predetermined by iFoundry administrators—usually around dinner time with pizza provided. Eventually, the iTeams met at a frequency and time determined by their members.

#### *iCheckpoint and iExpo*

The iCheckpoint meeting was held at midterm (14 October 2009). After a box-dinner meal, the whole community assembled briefly and then was broken into two breakout presentation sessions where the teams presented their organization, plans, and progress regarding (1) identity and social networking, academics and advising and (2) the world of work and service. The iTeams conducted various social and academic events. For example there were skating parties, movie nights, including a gathering to watch TED.com presentations, trips to corporate sponsors, travel to Silicon Valley conferences, international service projects, helping with Habitat for Humanity projects, and more.

The iExpo meeting was held at semester end (2 December 2009), and the teams made final presentations capturing their experience in a summative manner. Each team also provided background information on their activities with posters and booth displays. iCOAs, IFAs, departmental faculty, parents, and others were invited and many attended.

### *Other iCommunity gatherings*

Additionally, iCommunity gatherings were scheduled for social, intellectual, or organizational purposes as needed and were initiated by iFoundry staff, the iCouncil of iTeam chairs, or both. Some students took field trips to visit their corporate partners, attend conference meetings, or simply to socialize with other members of their team.

Within this community structure, students had a large amount of discretion and choice regarding their participation and the activities they pursued. While participation was not mandatory, most students participated in the regular meetings and special events. Camaraderie developed quickly.

### **Preliminary Results from Inaugural iCommunity in Fall 2009**

At the time of this writing, the iCommunity just completed its first semester. While study and evaluation of this program continues, preliminary findings indicate successful outcomes for many students. These outcomes tend to show high levels of student engagement, efficacy, and self esteem, along with increased enthusiasm for and identification with a career in engineering.

On November 11, 2009, we administered a survey asking students about their understanding of the iFoundry program and about their experiences socializing into college life. These results are summarized in Table 1. A series of assertions were made, asking the students for a five-point Likert-scale response. The questions were asked twice, once for the first two weeks (then) and once for the date of the survey (on November 11). In Table 1, the first three questions were about understanding and the last two questions were about whether the students believed the experience was valuable. The table shows an aggregate score of the Likert-scale four and five responses (agree and strongly agree).

*Table 1. Comparison of Positive Responses (Agree and Strongly Agree) Early and Midterm.*

<b>Topic</b>	<b>Then</b>	<b>Now</b>
Understand iFoundry vision	12%	76%
Understand iCommunity goals	29%	76%
Understand ENG 100++ objectives	57%	88%
Feel iFoundry is valuable academically and professionally	69%	80%
Feel iFoundry is valuable for making student connections	84%	88%

Many students did not understand the vision or the components of the experience (ENG100++ and iCommunity) well to begin with, but most understood it after midterm. Most students felt that the experience would be academically, professionally, and socially beneficial to begin with, and more felt that way after midterm.

Qualitatively, students reported a range of responses about the community experience. Most reported that the community experience helped them make friends and connections with faculty, as well as providing them with a rather unique perspective on engineering. For example, several students commented on the benefits of the social connections facilitated by their participation in the community:

- “It helped me meet a lot of people who I really enjoy.”
- “I’ve gained connections and opportunities through my iTeam that I believe will help me in the future.”
- “iFoundry has been amazing at connecting me with faculty and administrators!”
- “Not only does iFoundry help give me experience doing things rather than talking about them, but with the interest being shown in the program, it will probably look good on a resume too.”
- “It’s an excellent place to meet new friends and get a foothold on college life.”

Other students indicated that the time commitment to the community took away from their studies or interfered with other aspects of their lives. Some also reported that the community efforts at socializing were not needed—they perceived little value in the community. Some of the less enthusiastic comments indicated frustration with the time commitment or the perceived lack of value in the community efforts. For example,

- “It was actually worse because it gave me TONS more work than everyone else.”
- “I am an out-going person, so I feel I’d be making good connections either way.”

Overall, the most common benefits reported by students were the enhanced opportunities to make friends and build social connections, develop a broad view of engineering, and take initiative.

### **A Bumpy Beginning Followed by Aspirations Unleashed**

Generally, there was a sense during the first half of the semester that students struggled with their roles and understanding of the expectations of the iCommunity. As described by role-making theory, when roles are somewhat ambiguous, newcomers must negotiate and define their roles within the context of the organization. In the iCommunity, students encountered purposely ill-defined roles and expectations requiring them to negotiate what their role in this community was to be and what the community itself was to become. Allowing students to define their roles created some frustration as students expected their roles to be defined. This frustration was evident in some of the blog postings from students. For example,

At the beginning of this semester, I had no idea what iFoundry was. Due to a communications mix-up, I didn't even know whether I got in or not. Then came the iFoundry orientation (iLaunch) which, while it was a lot of fun, I left still somewhat confused as to what iFoundry really was. Sure, I learned that it was designed to create more well-rounded engineers by teaching something called the "missing basics", and that someone really likes affixing lowercase i's to the beginning of nouns, but I didn't know how we were going to do that. Actually, at that point, I doubt anyone really knew what we were doing--not even the professors--since the professors pretty much told us, "we'll do what you want to do."

To be clear, the professors were not saying what they wanted because they didn’t know what they wanted. They were biting their tongues in the hopes that the students would assert themselves. At the time, it was tempting to step in and tell the students to do what we thought they should do, but the whole idea of the iCommunity was to honor students, their aspirations, and their choices.

This is not to say that faculty were silent, and timing of critical messages appeared to be an important factor in the outcomes of this program. For example, the iLaunch immediately communicated the differences between iFoundry and traditional programs in engineering. We explained the differences between iFoundry's view of the missing basics and the socially embedded nature of engineering and the traditional "cold war curriculum" and its "math and science death march." Students adopted this view and we feel it helped many of them take charge of their education—especially in facing and succeeding in traditional curricula back in their home departments. That these efforts were important and largely successful is reflected in student blogs and the student presentations at iCheckpoint and iExpo; many of these student communications discussed the missing basics, the iCommunity, the iTeams, and other iFoundry concepts explicitly and favorably.

Still, prior to iCheckpoint there was a palpable rise in student frustration—and faculty concern. At the end of September and beginning of October, students complained about the classwork, the projects, the meetings, just about everything that was going on, but then something interesting happened. First, in ENG100++, the steam turbine cars started to work. Then, at roughly the same time, the students had to get their act together to present at iCheckpoint, and they did. Some of the student teams did an outstanding job at iCheckpoint, a job that rivaled the best senior design presentations. All teams did a satisfactory job, and all iTeams showed progress in organizing to enact activities in each of the four functional areas. At this point in the semester, it appeared in person and on the student blogs that the grumbling stopped or at least slowed dramatically. One of the clearest first signals that the students were "getting it" was at the *kaizen* (continual improvement discussion) at the end of iCheckpoint. A student in that session summarized the feeling of many in the community when she said, "We weren't sure you were serious about us doing what we wanted to do on our teams, but then realized you were, and it was very cool." At this point, we started to believe the combination of activities in the experience was working, and then more "cool" things started to happen.

The success of the mid-term presentations and the first projects seemed to give the students good social connections, a confidence boost, and a sense of engineering identity, but then students started to assert themselves in ways that were unexpected through a series of what we have come to call *aspirationally assertive acts* (AAAs). For example six students on their own volition went to a student entrepreneurship conference in Palo Alto. Another three applied and were admitted to a Technology Entrepreneurship Center (TEC) trip to Silicon Valley, something that is fairly unusual for freshmen. Eight students arranged on their own to visit their iCOA in Chicago at Skidmore, Owings, and Merrill. One student even rearranged with her instructors to take all her finals early so she could participate in an international project in Indonesia with civil engineering students from the National University of Singapore. We were hopeful for good socialization and adjustment to the first year, but we were somewhat surprised by these acts of aspirational assertion. Although engineering freshmen come in like puppies, they usually finish the year like zombies, and it is unusual to get them speaking and acting in such a can-do manner.

In trying to put this phenomenon in perspective, we thought back to an experience early in iFoundry's development. In February 2008, the second author traveled with two graduate students to Franklin W. Olin College to observe and investigate what that innovative school was doing. During that visit, there was some downtime in a second-semester freshmen course on

distributed systems and the Olin students were encouraged by their faculty members to talk with the visitors from XX. They did so, and the second author was struck by their boldness, their sense of engineering identity, and their confidence. It was a very moving experience, and at the time, it seemed that if iFoundry could simply bottle what Olin was producing in its freshmen and bring it to XX that 80% of the curriculum transformation battle would have been won. Although at the time, it wasn't clear what was causing what we now call the *Olin effect*, we were hopeful that with a lot of work over a long time, we would get something like it at XX.

Although we continue to assess and try to understand the Fall 2009 iCommunity experience more fully, preliminary results indicate that, not only did iFoundry students transition into college successfully as expected, they developed a strong voice, ambition, and identity toward their studies and the profession that is rare among incoming freshmen. Put another way, it appears that we may now be getting the Olin effect at XX in the iFoundry-iCommunity pilot.

On the one hand, it hardly seems possible that a one-hour freshmen course and a small footprint extracurricular experience could yield the kind of results we've observed. After all, we (the faculty) didn't do that much. The students had to organize themselves. The students had to do the project work. The students had to present what they did in a professional manner. On the other hand, maybe that's the big point—and what's missing from many reform efforts. Perhaps it isn't about what we do, but it's about what the students do. Much more work needs to be done, but we are now thinking of iCommunity and the larger experience that we've enabled as a minimally structured environment that promotes students' competent action, thereby leading to a strong unleashing of their aspirations, creativity, and initiative.

## Conclusions

This paper has discussed the background, theory, systemic framework, operation, and initial results with a student-run learning community called iCommunity as part of the iFoundry initiative at the University of XX. The backdrop of the paper is that effective engineering curriculum transformation is uncommon and that truly student-centered curriculum transformation is rare; most current student-centered pedagogy still views the faculty member's behavior as primary. The view adopted herein is that one key to effective and scalable educational transformation may be to systematically create learning environments in which student behavior is primary and organized along intellectual, social, and lifelong learning dimensions from the freshmen year forward.

More work needs to be done, but early results appear to have been successful because we carefully managed the timing, content, and structure of the coursework, project work, and community work. This combination appears to have made the difference between a traditional learning community that would largely have helped students form relationships with their peers and faculty, and the iCommunity, in which socialization and connectedness appeared to occur together with an additional burst of initiative, confidence, and engineering identity—the Olin effect—witnessed in students at XX. We can hardly wait to track this energized group of young people as they continue through their education. We are working now to provide new courses and experiences in the sophomore year for this year's iFoundry freshmen. We also are in the planning phase of a fourfold expansion of the program to an incoming cohort of 300 new

freshmen in 2010. Continued assessment of the current cohort and experience from the incoming larger cohort should help us understand the sustainability and scalability of this kind of undertaking.

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