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”What’s in it for me?” A Look into First-Year Students’ Perceptions of a Digital Badge System

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Abstract

In Fall 2014, the Purdue Polytechnic Incubator – a new undergraduate program with the focus on competency-based interdisciplinary skills – welcomed its initial cohort of first-year students. During the first semester, students were involved in a number of holistic educational experiences intended to develop interdisciplinary competencies, the mastery of which was evaluated by awarding digital badges. The individualized approach and benefits of a wider exploration of skills created interest and support among the freshmen enrolled in the new program. However, the novelty and the deviation from the traditional path of specific, graded assignments and tests also created a fair degree of anxiety. This paper will explore the benefits and hurdles of using the digital badge system to evaluate and credential learned skills within this innovative program from a first-year student's point of view and within the context of the program development and foundational principles. Data were gathered through both student interviews and surveys collected at the mid- and end-of-semester points to allow for both qualitative and quantitative representation of their opinions. Implications and transferability of our findings and lessons learned to other courses or programs in the field will be discussed.

Introduction

The globalization, knowledge economy, and rapid technology evolution of today threaten the complacency of narrow professional fields. In today's world, for business and even nations to stay competitive, engineers need to adapt quickly to the change and be first to advance [1, 2, 3]. Baccalaureate engineering education often struggles to keep up with this change. According to Hewlett Packard's estimations, technical knowledge and skills gained at school are outdated as early as 18 months after receiving a diploma, or about a quarter of the time needed to gain those skills [4]. At the same time, businesses have expectations that employees will come in with skills that will allow them to compete, and recent graduates are not equipped with competencies to meet those expectations [5, 6, 7], leaving many students with loan debts and dismal prospects for the future.

How can current and future students be prepared for "jobs that do not yet exist, to use technologies that have not yet been invented, and to solve problems that we don't even know are problems yet" (p.2) [8]? Researchers and practitioners suggest that rapid changes in an engineering world require a new prospective on the profession, and particularly education. It is during their undergraduate education that students should learn to merge and make connections between "previously separate disciplines to attack problems that have no recognizable boundaries" (p.17) [9]. Today's engineers need strong analytical skills, the ability to demonstrate skills in planning and adapting (or "practical ingenuity," p. 24 [2]); creativity, communication, as well as business and management. But even more so, they need to be flexible, resilient, mobile, dynamic thinkers, change managers, and self-regulated lifelong learners, who can work in teams

and alone and use technology proactively [2, 6, 9, 10, 11]. While some of these competencies, such as analytical skills, are effectively acquired in college, other competencies needed for today's and tomorrow's engineers are lagging behind [10, 12].

Cross-disciplinary Competencies and Self-Directed Lifelong Learning

To date, there is a strong move across many nations to include multi-disciplinary competencies and soft skills into the engineering curriculum (e.g., [13, 14, 15]). Skills developed in humanities classes help boost awareness of the need for multi-faceted requirements faced by professionals in the real-world working on ill-structured issues or questions. However, this is only one of the aspects that would help professionals adapt and grow after college.

Students enter and often leave college as dependent learners who used to rely on faculty and textbooks to tell them what to do [9]. To transition towards independence and interdependence in their learning and as a result in their ability to advance in their professional field, students need to gain such skills as persistence, positive attitude towards learning, ability to organize and manage time effectively, seek resources and help with their learning, collaborate with peers to gain new knowledge, assess their own work and work done by others, as well as develop and use effective strategies to conquer new topics or deepen knowledge of familiar topics [16]. In other words, they need to develop self-directed lifelong learning skills.

It is challenging to teach these types of competencies and skills in a classroom, and becoming proficient in them may require inculcation throughout a student's academic career. It may be instructional for students to experience interdisciplinary courses and even projects for which students could take full responsibility: from assessing requirements, designing an initial plan, assigning and managing workload, to creating a prototype and collaboration with other students and faculty.

Badges as Competency Credentialing and Life-Long Learning

The challenges that emerge with teaching competencies required for the 21st century are also aligned with challenges of evaluating and credentialing those competencies in the classroom setting and "selling" them to a potential employer. Recently, digital badges or microcredentials have gained attention in the world of education as a way to capture, showcase, and legitimize competencies within individualized learning paths; validate a wider variety of experiences, knowledge and/or achievements; and aid students in building a stronger professional identity [17]. They allow a more granular breakdown of achievements and accomplishments in learning, but also a wider and richer tapestry of skills than a traditional program would [17, 18, 19, 20].

In a traditional educational system, competency is considered gained after a set number of credit hours and standardized knowledge assessment, generally in the form of examinations. A passing score would generally indicate that students have been able to answer a majority of questions on a topic, but cannot indicate on its own areas of strength or weakness. Competency credentialing is more targeted and specific, focusing on the deeper acquisition of knowledge and ability to apply competency-specific skills to projects. Additionally, a learner can be encouraged to look beyond a class for other means to gain knowledge, including other institutions or independent self-regulated learning [18].

Figure 1: Information Literacy Badge

While many associate badge with a graphic representation of a skill that could be displayed on a website (e.g., Mozilla's Backpack; see Fig. 1), the ecosystem behind it is much more complex. It has the capacity to include extensive metadata to verify credentials, criteria, relationship with other skills, badges, or a program, issuers, evidence (an artifact), date of issuance and the duration until it is valid, standards, as well as tags. The hosting platform has the ability to allow users organize stack, show, or hide any of the badges to show the range of skills they find salient for their careers [17, 18].

While at the systems level, badges can be used as a way to provide a framework for competency attainment and representation (e.g., [20, 21]), we know little of student perception of using badges as an inclusive system for not only project assignment but also the confirmation of mastery attainment in the content of the competency-based program. In this study, we will look at the profile of engineering students engaged in a novel competency-based program and how these findings can be applied to future program development.

Polytechnic Incubator and New Experiences in Engineering and Technology Education

PI program design: In an attempt to prepare its students for the challenges of a professional career in the ever-changing domains of engineering and technology, Purdue Polytechnic Incubator (PI), a new, trans-disciplinary, competency-based initiative, was created at the College of Technology (CoT) of a large Midwestern, land-grant, R1 university. Started as an initiative formed by a multidisciplinary faculty and industrial partners, this pilot program provided the grounds for the university to explore a new educational model as a foundation for the undergraduate engineering and technology curriculum. To support the notion of the continuity of learning, the program combines not only cross-disciplinary training, in which students are exposed to technology/engineering and humanities content to develop both professional and soft skills and general competencies, but also to cross-course/subject training where students are able to make connections of the topics and how they apply to cross-course projects they need to complete.

PI overall digital badge ecosystem design: Instead of a set number of credit hours, students would need to prove the attainment of a number of competencies represented by earned badges.

Each badge consists of several levels/projects that would allow a student to go from basic level to a more advanced one (see Fig. 2).

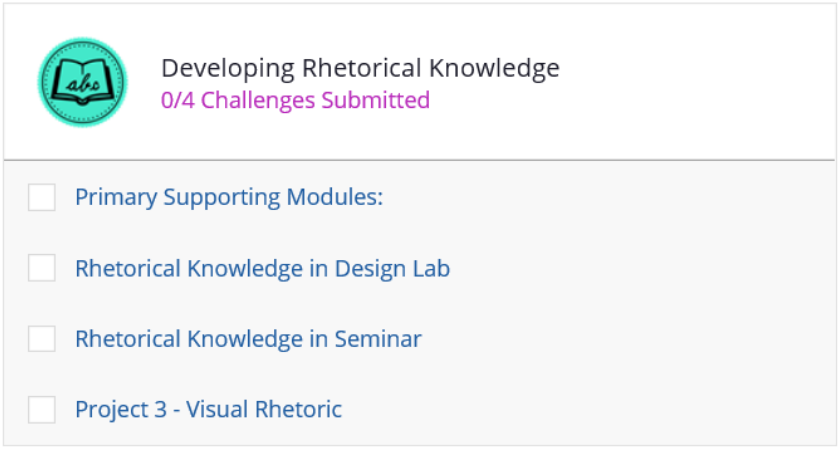

Figure 2: Sample badge entry that includes the graphic representation of the project/competency and the challenges needed to be completed by students

Students would earn badges in a number of disciplines within and outside of their immediate range of interests. Badges can be earned through the coursework offered within the university or outside of it. The badging system is a learning and e-portfolio system developed by and available within the university. The badges earned are compatible with Mozilla's Backpack and can be shared with social networking sites, like LinkedIn or Facebook to allow learners to display their achievements publicly. One of the benefits of the system is that it is designed as a Learning Management System (LMS), where learners have access to an assignment page with the information about the badge, requirements, and any supplemental materials, as well as a multilevel assignment submission page (see Fig. 3).

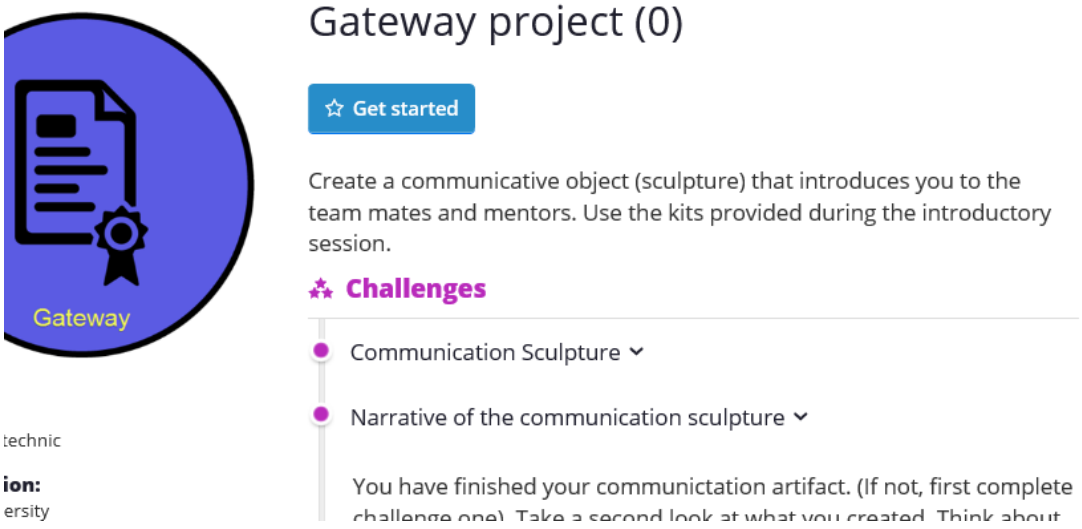

Figure 3: Badging System as an LMS

PI first semester implementation: In Fall 2014, the PI welcomed its first freshman cohort of multi-disciplinary students with a broad range of technical and engineering interests, including aviation, mechanical engineering, computer information technology, computer graphics technology, and others. During their first semester, students experienced two major learning environments: Design Studio and Seminar. The Design Studio course was rooted in the idea of a

seamless integration of direct teaching and learning-by-doing while working on real-world ill-structured problems with ongoing feedback and critique from both an instructor and peers. The diverse academic interests of the freshman cohort allowed them to form teams with a range of skills and abilities to mimic a team approach to design and innovations at a workplace. The Seminar course embraced a range of topics rooted in technology and liberal arts to develop and advance creative and critical thinking, oral, written, and design skills with a heavy focus on the use of technology to transmit the message. Similarly to the Design Lab, it utilized a combination of teaching and learning strategies, teamwork, and peer critique.

Overall, students within the program had access to 33 badges during Fall 2014 semester. Twenty badges designed to satisfy the competency requirements across Design Studio and Seminar learning experiences with the focus on wide skills (e.g., critical thinking or rhetorical writing) and more specific experiences, like working with engineering equipment to complete a project. The rest were aimed to expand domain-specific knowledge (e.g., C language for students interested in programing, and the use of advanced Photoshop features for students interested in computer graphics). These badges were aimed at students with interests in specific majors, yet they were available to any student enrolled in the course.

While there were variations across projects and requirements, the process for obtaining each badge included at least the following: introduction to the new topic (e.g., participation and an impromptu classroom presentation or discussion, hands-on activity in class); reflections on the design and development of the project and on their own learning; application of new materials; and finally, the final project itself accompanied by the narrative/reflection and artifact(s). While some projects were to be completed independently, for others, students were encouraged or required to work with peers. In addition, some projects could be in part used to meet sub-competencies across multiple badges. Students completed projects on their own timeframe and in the order they preferred. While there were soft deadlines, student had an option to take as much time as they needed. Some of the projects were also presented in class for peer review and critique. Faculty were available to provide feedback at any stage of the project completion. The instructors held Q&A sessions about badges throughout the semester as needed by students.

Assignments completed as part of a badge were evaluated by two or more faculty members and/or teaching assistants involved in a particular learning experience, using a detailed rubric that was also available to learners. These evaluators would provide detailed feedback on each assignment and may require from students to revise and resubmit without penalty as many times as needed until the competency was attained. Students could not get “partial credit” – they must truly master the competency to be awarded the badge. However, even those students who were awarded a badge could still go back and resubmit at a later date if they felt that they gained new skills that could significantly improve their initial project that will be presented in their final e-portfolio.

Research Questions

In this paper, we will explore the perception of badges by the first PI freshman cohort by addressing the following questions:

1. What were the benefits of badges as perceived by students?

2. What concerns and/or challenges with badges did the PI students experience during their first semester?
3. How can the program be improved based on students' feedback?

Method

The data reported in this paper are part of a larger ongoing evaluation project, the goals of which are to conduct formative and summative evaluation of the new program. For the purpose of this particular study, we intend to focus on students' perception of badges within this context.

Participants and Courses

The PI first cohort included 36 students. These students were initially admitted to the CoT and then sent a letter inviting them to apply to the PI. The cohort mean age is 18.14 and females represented 16.67% of the group. The enrollment of females was similar to the College of Technology indicators of 16.5%. However, by Week 5 of the semester, three students dropped out. Of the remaining 33 students, 20 participated in a survey conducted during Week 5 of the semester and 25 students participated in the end-of-semester survey. Additionally, 17 students were interviewed at the mid-semester point, and 16 participated in end-of-semester interviews.

The distribution of majors was similar to the overall distribution of freshman students within the CoT for 2014-2015 academic year.

Table 1
Incoming Freshman Student Majors (PI and CoT), Fall 2014

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 Information and 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	--

The ethnic distribution was as follows: white – 58.33%; Asian/Pacific – 19.44%; African American – 8.33%; Hispanic/Latino – 2.78%, and the rest refused to identify.

Overall, PI students were similar in their previous academic success to the overall CoT freshman student population. PI students surveyed at the beginning of the semester reported that they were generally either "A" (52.8%) or "B" (44.4%) students. One student failed to provide a clear answer to the question. These results are consistent with the GPA listed by the CoT for the incoming freshman students for Fall 2014, which was 3.58 out of 4. Standardized test scores were also similar to those in the CoT as a whole (see Table 2).

Table 2
Self-reported results on standardized tests by PI students in comparison with overall CoT

Test	n	Mean	Median	SD	Min	Max
PI SAT	30	1719.83	1680	195.24	1400	2150
PI ACT	13	25.92	26	2.56	21	30
CoT SAT	--	1789	--	--	--	--
CoT ACT	--	28	--	--	--	--

Notes. While a portion of students did not take or did not list any or both test scores, 16.7 % students completed both tests. Due to the distinction of standardized tests, both scores were included.

Instruments and Procedures

Anonymous paper-based surveys were administered at the mid-semester and end-of-semester points. Survey instruments included Likert-scale and open-ended questions to clarify and provide an in-depth opinions, as well as basic demographic data. Due to the scope of the larger evaluation study, the survey instrument included questions aimed to investigate a range of opinions and learning skills. A portion of the questions concerned badges as part of individual course experience, as well as overall opinion of badge use. While the questions for the mid-semester asked for any current experience, the end-of-semester survey included questions where students could provide their feedback based on the whole semester. Surveys were collected at the end of a class period with no instructors present.

Additionally, individual semi-structured interviews were conducted at the mid-semester and end-of-semester points. The use of interviews allowed the researchers to gain a deeper understanding of trends observed in surveys as well as during classroom observation. Students were asked questions about their overall experience with the program, university, as well as individual aspects of the program, including badges. Students could also provide any additional information or experience they felt to be important but that may not have been covered by the interviewer. Interviews were conducted during free periods throughout the week with no instructor present.

Data Analysis

Descriptive statistics was used to summarize closed-ended survey data. Qualitative data from interviews and open-ended survey items was reviewed using a descriptive coding approach to discover topics or themes related to the use of badges in students' learning experience. The themes were then analyzed and grouped under categories [22].

Results

The discussions and surveys revealed the following six categories:

- badges as credentialing of meaningful experiences;
- badges as credentialing of learning paths and experiences;
- badges as credentialing of deeper learning;
- badges as an intersection of student extrinsic and intrinsic motivation;
- badges as experience to manage day-to-day learning; and

- need for alignment of badges as a credentialing mechanism.

- Badges as Credentialing of Meaningful Experiences

The tie-in of badges to specific and applied competencies rooted in real-life ill-structured problem experiences allowed students to feel that what they did was meaningful not only in their academic career but also to their future professional life.

> *In high school you have a lot of menial grades that mean something, but all you really care about is the test or the big project that's a large chunk of it. The badge system is a way of throwing out the menial grades…*

> *I like the fact that we get badges and competencies and not necessarily grades. I feel like because we have badges, we always have the opportunity to go back and make it better and actually get it right. … I feel like that's more applicable to real life.*

- Badges as Credentialing of Learning Paths and Experiences

This system allowed students to manage or curate their own learning paths and experiences, while working towards their college degree. It also allowed students to see and bridge gaps in their own individual learning paths.

> *The way I use the badge system is, I use it as a way to document my learning experience so far to see what I have learned.*

The optionality behind some badges also allowed students to explore areas that they would not be able to do otherwise without taking an entire course and without being "punished" with a bad grade should the student not like the experience or not continue to pursue the area due to other external or internal reasons:

> *If one comes up that has something I'm interested in, I definitely will, or at least do some of the activities in the badge. Maybe not complete the badge, but I will do the activities that are to the badge.*

Sixty-five percent of students intended to earn badges outside of competencies required for their major, and 36% indicated that they had done so in the end-of-semester survey (32% listed that they were not sure yet whether they earned them. Since the survey was conducted about a week before the end of the semester, not all the results were posted at that time).

> *So you can basically choose any badges you want, any field you are interested in.*

The process of adaptation to a badge system was not easy. By the end of the semester, about 28% of students still indicated that they were not sure how to earn badges.

> *The badges were a little weird, to be honest. I'm obviously not used to getting badges. A lot of people that I tell about PI, when I tell them we don't get grades or anything, we get badges, they always react like "huh?"*

At first, I was still kind of confused about exactly how we would show them what we've learned, because there are challenges and there are badges and they work together in some way. At first, it was kind of complicated. But now, at this point, I definitely feel more comfortable. The challenges work towards the badges and the badge shows I understand this concept.

Students could use the same project towards multiple badges, if it demonstrated multiple skills (for example, a design document might show written communication as well as design thinking skills). This proved to be a confusing notion for many students, who considered each project one single "assignment".

*There are still confusing parts to it [*badge system*], because some projects can go under different badges. They can be submitted to two different badges, so that's kind of confusing to me a little bit.*

- Badges as Credentialing of Deeper Learning

The specificity and applicability of badges to real life, the ability to explore each topic and see the gaps, as well as the built-in ability to focus on topics of interest and importance without worrying about the grade helped students focus on their projects in a more meaningful way.

It's not a memorization type of learning. It's actually applied.

They're not teaching you day-by-day to complete the 10-point assignment. You have a larger pool of things. You have a potential for multiple tries …, but you're not being taught excessive amounts of nothing.

Students gradually began to understand how the badges actually represented what they were able to do.

Each badge is supposed to represent a competency, a skill that I am supposed to earn through showing that I have that skill or I am capable… That badge represents a piece of knowledge that I understand.

Students also began to recognize the value behind the mastery-learning approach embedded in the badge system.

It shows what I've learned and what I can do. If I can't do it, then I won't get the badge. But I can always have the opportunity that I can do it. If I can't do it the first time, I can try and try and try again.

Such deeper learning would require the control or ownership of one's learning. However, for students with no prior experience with independent and proactive learning, this was not always clear:

Instead of getting a grade on whatever you're doing, you submit it through [badge LMS]. If **they** *think that you've mastered the material, then you gain the badge. If not, then* **they**

let you know and you have to go back and tweak it until **they** *think that you understand it* [emphasis added].

Additionally, for some students, deeper learning seemed to be associated with more work and the preference was towards grades as milestone markers towards the completion of the course.

The only thing nice about the old schooling system is that once you turned something in, even if you got a good or bad grade on it, it's was done, and you didn't have to redo it.

- Badge as an Intersection of Student Extrinsic and Intrinsic Motivation

Student interview responses showed evidence that students were intrinsically motivated, and contrasted this with their previous experience in working towards a grade.

I think for everyone, and that was what the first week was mainly spent on was helping us understand that, it's really a de-programming. I heard someone say that. It's very true. I've spent 12 years of prior education getting a grade back on anything I turn in. So it's definitely hard, a hard transition, and you really have to catch yourself when you start thinking about it as a grade because it's not.

Many badges were designed to allow students to select their own topics, format, or project role to pursue, or choose a project from a list of suggestions. Students indicated this was intrinsically motivating.

I think I warmed up to the idea of individualized learning a lot faster than some of my peers. I think they got concerned that they weren't going to be learning enough and that kind of thing. So the only thing I would have changed is I wish I would have spoken out more and I would have tried to convince them more that this is a really exciting prospect in that you get to choose what you learn. You don't have to be told what to learn.

I feel like they've shown me a lot more that my passions are worth pursuing. And that I need to learn to motivate myself as well. Self-motivation is a big key especially for higher education. If I'm not doing something that I'm passionate about or that I care about, I'm not going to do a good job on it or I'm not going to my best on it, I should say. I feel like PI really emphasizes that. And it's been slightly eye opening.

However, while getting a badge was motivational for students, it was also challenging for some to maintain a positive attitude when they were asked to revise projects until they were able to provide evidence that the competency was mastered.

It's really hard to balance your time and to actually get things right the first time. Because you do something and you get a rejection, it's really discouraging. And you have to redo something, it's really discouraging to keep redoing something until you finally get it right.

- Badges as Experience to Manage Day-to-Day Learning

Self-regulated learning requires a set of skills that are not taught in most traditional classroom environments, namely goal setting, planning of both times to learn and the path to take to learn the materials, perseverance, breaking larger topics into smaller chunks, self-reflection, and so on. The infrastructure behind the badges in the PI competency-based system was intended to allow students to develop those skills. Students were aware that they could pace themselves.

> *You have a few little or smaller components that you get done first, and then you put it all together into the big final section of the badge, and then all that has like a recommended due date, but you don't have to get it done by that time. You can get it done on your own time, as long as it gets done before the end of the semester.*

Yet, this very day-to-day management of learning was the toughest experience for the majority of students. A lot of students expected strict course syllabi with hard deadlines and step-by-step instructions as to what to do next. So when being exposed to a more self-regulated environment, students felt at a loss.

> *Time management [*is an issue*], definitely, because I know a lot of people don't have any badges… I feel if there were more concrete deadlines for badges, especially since we're freshman, you can kind of teach us time management.*

Students shared feeling overwhelmed with the number of badges they had and because of the lack of hard due dates, the worked seemed to pile up for them:

> *I just feel like there might have been a lot badges to get done in a short amount of time. But that might have just been because I'm disorganized or the whole not understanding what to do in the beginning, the first five weeks.*

Indeed, by the end of the semester many students had not submitted all of their badges, and received incompletes for the course.

- Need for Alignment of Badges as a Credentialing Mechanism

While most students indicated that they liked at least some aspects of the badging system and enjoyed the associated projects, many students were concerned that they did not understand the alignment of badges to more traditional credentialing, e.g., grades and credit hours. This was a big concern throughout the semester, and particularly at the end for students who decided to leave the program.

> *I don't know. Starts to get confusing. 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. But I just don't know what I am supposed to do to have good grades I guess.*

> *If you, guys, do end up letting people come in but also going out, transferring out, it would be a lot easier for the students and PI to know to make kind of a bridge, to just let them [*students*] know what you can do if you do leave PI. Because obviously it's not going to be comforting to someone if they don't know what they are going to get for their work. So as long as it keeps the badge based system and it links it with the credit system*

that the school has right now, it's probably a little easier for students to grasp what they are doing.

When asked to reflect at the end of the semester if the competencies attained and badges earned across both experiences were relevant for their future profession, 64% of students agreed that Design Lab competencies were relevant and 60% of students agreed that competencies and badges gained at the cross-disciplinary humanities seminar experience were salient to their future careers. However, students were concerned that employers would not understand and accept their credentials.

I am concerned that since the program is so new, employers will not accept the new grading system of PI.

Finally, even though students had positive attitude towards badges, only 56% agreed that they liked badges and preferred to continue earning them in the future.

Discussion

Overall, student opinions about their experience with badges clustered around six categories that reflect the benefits and challenges in use, namely: badges as credentialing of meaningful experiences; badges as credentialing of learning paths and experiences; badges as credentialing of deeper learning; badge as an intersection of student extrinsic and intrinsic motivation; badges as experience to manage day-to-day learning; and need for alignment of badges as a credential mechanism.

Unlike traditional grading that serves as milestones towards the completion of the course, badges are meant to transcend individual courses and provide a mastery-based system that is more similar to what is expected in the work world. The ability to curate their skills and experiences, be responsible for the direction of learning, trying new areas without a punishment of failing, engage with learning materials in a more meaningful way to truly understand, and the opportunity to take risks with different directions or trials/attempts resonated with the PI students. Ultimately, it is hoped that such lifelong learning skills inculcated throughout the academic career will result in more diverse and engaged specialists who know how to acquire knowledge as an independent and interdependent learner.

Yet, the responsibility for proactive learning management was too much for some students. Such a reluctance may potentially be explained students' K-12 school experiences, through which they have developed the habit of being dependent learners and allowing the system keep track of projects, grades, and learning directions [9]. Indeed, some PI students felt quite at a loss in guiding themselves through the process of working towards and receiving badges. This uneasiness may be explained by the non-linearity of badges (i.e. the order of badges is suggested but not required) and the number and complexity of activities or challenges within each badge. Students appear to also have been confused by the process by which badges were denied or the reasoning behind denials, and the need to revise and resubmit their work.

Badges possess a motivational value as well. A badge as a graphical representation of the learned material can certainly be considered as a representation of external motivation, similar to tokens or stars students used to get at an elementary school. Yet, the learning infrastructure behind a badge is focused on mastering the topic and using the final project as a showcase of the skills developed. This affords students flexibility in their learning approaches and the control over the steps and depth beyond what is required to meet the competency, and thus provides a basis for intrinsic motivation. However, transitioning from a system that rewards only performance-oriented goals to one focused on mastery-oriented goals may take time. As a result, students may become demoralized when they were not being recognized for competency on the first try. For some, not being able "to get it" was caused by not understanding the badge ecosystem. For others, the effort put into each project made them feel that evaluation of the competency was not reflective of that effort.

Not seeing clear connections between the competencies/badges earned and the bigger goal (e.g., applicability to a potential job) may also decrease student engagement and proactiveness towards exploring and gaining new skills suggested by the program. This gap may be explained by the lack of overall experience in the industry or the dissonance between the ideal profession and what the current world needs today. For example, it is common for technology students to believe that communication skills are not important in technical jobs, although employers consistently indicate that these skills are crucial in industry. Also, it may be due to the lack of clear alignment of competencies with job specifications that could have helped students create better connections.

It is important to note though that while some of the opinions may reflect relative naivety in terms of self-regulated lifelong learning towards a more meaningful career, the majority of students had recently left the highly structured educational environment of a high school. We are hopeful that with the progression in their studies and in the program, they are on the path to active learning and ownership of the learning process.

Limitations and Recommendations for Future Research

There are a number of limitations to the study, including a relatively small initial population, limited number of questions on diverse aspects of badges and their use in students' learning experience. However, these limitations in combination with obtained results outline a number of potential research opportunities, namely:

- While we have created overarching categories of perceptions about badges, more detailed research into each of the categories would allow for better understanding of perceptions and their implications.
- The consideration of generational characteristics may help explain both positive and negative opinions about the use of badges in education.
- Comparing students' self-reported experiences to faculty perceptions and independent observations would help to triangulate data and answer some of the lingering questions about why some students continued to show misunderstandings or had difficulty completing the requirements for their badges by the end of the semester.

Implications for Educators and Program Designers

A number of implications can be drawn on systemic, program design, and student levels:

1. The acculturation into the new program can be challenging for students, particularly if all the components, including assessment of knowledge and skills through badges, are completely new. Therefore, it is salient that both students and the wider population are educated about the purpose and benefits of badges. This would help remove the stress students may experience from the dissonance between the traditional educational grading and the use of badges as credentials.
2. Students that have control over their learning path and are personally invested in their learning will be more intrinsically motivated to continue with it and get deeper into the subject. The non-linear badging system and the progression of easier projects to more complex ones to attain a competency will allow students stay motivated.
3. Students enjoy learning experiences that mimic real-life experience, yet they may be challenged at times of making clear connections between the skills represented and assessed by within the badge system, and how these skills can be applied to the real world. Forming the connections or letting students reflect on them would allow for better engagement and more personal responsibility in learning.
4. Day-to-day management of learning requires a number of self-regulatory skills that students do not always possess. For example, a number of students waited until the last minute to turn in the majority of their badges, resulting in much stress. While students enjoy the soft deadlines, supports or scaffolding (e.g., having suggested learning plans or using student presentations as a type of soft deadline) are needed both in terms of effective learning and strategies to support lifelong learning. Additionally, faculty should consider an individualized approach in working with students who struggle with technical side or requirements of badges to develop initial understanding of the new system.

Conclusion

The study examined the perceptions of the very first cohort of students in a new program that focuses not only on inter-disciplinary approaches to engineering and technology education, but also promotes the development of self-regulated lifelong learning skills. The results indicate that the majority of students are ready and willing to engage in experiences that are approximated to real world processes. They want to partake in being responsible for their learning and can sense the importance of making their work count from the first days of school. They enjoy gaining new knowledge without worrying about grades or being able to grasp everything on the first try.

Yet, their first steps are very cautious, since these new experiences are not only different from what they may have been used to but also from what they have expected or observe their peers to be going through. As a result, there seems to be a dissonance, even polarity of opinions between liking attaining badges while working within their own timeframe, but yet wanting more structure and hard deadlines; or looking forward to an alternative to the traditional means to earning grades but yet wanting the structure of the grade as a familiar foundation to evaluate one's standing.

We believe that our findings represent a salient first step towards understanding of student perceptions of benefits and challenges behind badge system of credentialing competencies at a college level. Being able to understand and program around these challenges would allow for a better and more responsive educational system that would meet needs of students and demands of the today's world.

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