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The Mediating Role of University Entrepreneurial Ecosystem on Students' Entrepreneurial Self-Efficacy*

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The importance of developing entrepreneurial skills in students is increasingly getting recognized in engineering education. Several institutions have initiated informal and formal entrepreneurship education programs to expose undergraduate students to entrepreneurial training and practice. Using a wide range of pedagogical approaches and curricular emphasis, entrepreneurship education programs focus on developing an 'entrepreneurially-minded' workforce in addition to encouraging venture creation. As programs continue to grow, more students will be exposed to entrepreneurship education, which brings with it the opportunity to examine how students at different institutions or entrepreneurial ecosystems may differ in entrepreneurship-related skills and characteristics. In our presented exploratory work, we focus on how students' entrepreneurial self-efficacy differs based upon the entrepreneurial ecosystem within which students are situated. We use Mc Gee's Entrepreneurial Self-Efficacy scale to assess students' confidence in their ability to perform five entrepreneurship-related tasks – searching, planning, marshaling, implementing finance, and implementing people. Our findings note statistically significant differences in entrepreneurial self-efficacy for three of the five entrepreneurial self-efficacy measures (planning, marshalling, and implementing people). The implications of our work for engineering institutions interested in developing programs related to entrepreneurship are discussed.

Keywords: entrepreneurship education; entrepreneurial ecosystem; entrepreneurial self-efficacy

1. Introduction

The importance of fostering innovation and entrepreneurship in engineering undergraduates has been extensively noted in the research literature [1] and national reports [2, 3]. As a result, programs exposing students to entrepreneurship in a variety of academic settings are increasingly becoming popular among institutions of higher education [4, 5]. Evolving from the business school model of venture creation, engineering entrepreneurship education has broadened its focus to meeting skill-based demands of college graduates [6]. With an overarching intent to prepare graduates to succeed in a competitive, technology-driven workplace, entrepreneurship education programs (EEPs) typically use experiential and other student-centered pedagogies to actively engage students in performing different entrepreneurial practices (e.g., customer-discovery and business model development) in curricular and co-curricular formats [4, 7–9].

In the U.S., EEPs will continue to grow among universities and colleges in the near future [9]. This is largely due to the continued investment from the National Science Foundation (NSF) in programs imparting entrepreneurial training (e.g., NSF Epicenter Program: National Center for Engineering Pathways to Innovation and NSF I-Corps); and collaborative multi-institutional efforts through the Kern Entrepreneurial Engineering Network [10]. Furthermore, the case for entrepreneurship education has also been widely evident internationally in the form of inclusion of professional skills in accreditation standards [11], entrepreneurship in the list of key engineering competencies [12], and in frameworks related to engineering education curriculum and assessment [11]. These continued trends suggest that entrepreneurship education for engineering is deemed to increase in the future. This anticipated growth brings with it the opportunity to examine how students at different institutions or entrepreneurial ecosystems may differ in entrepreneurship-related skills and characteristics. In this study, we examine the research question: what are the differences in students' entrepreneurial self-efficacy located in two different entrepreneurial ecosystems and how does it vary across student's academic status and gender?

While the majority of literature in engineering entrepreneurship has focused on assessing entrepreneurship program offerings [13–15], research examining student attributes for effective entrepreneurship program engagement is beginning to emerge [16, 17]. Our presented work explores how

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entrepreneurial self-efficacy differs across students situated in different university entrepreneurial ecosystems. Although the growth of engineering entrepreneurship is evident across the academic spectrum, institutions vary in their approaches to educating engineers in entrepreneurship, which range from standalone engineering- focused entrepreneurship courses [18, 19] and interdisciplinary programs [20], to integration with the engineering curricula [21] and more specifically with engineering design courses [22–24]. The findings of our work provide implications for how entrepreneurship programming should be developed to cater to students in different institutional contexts.

In this paper, we first review the construct of entrepreneurial self-efficacy, its origins, and summarize relevant research and theoretical work presented in the literature. Next, we describe the work that has been performed on entrepreneurial ecosystems with a particular emphasis on institutional settings as that is the focus for our work in this study. The methods section of the paper provides more details on the specifics of our study. We describe the university entrepreneurial ecosystems in which the study took place, the measures that were used for our analysis of entrepreneurial self-efficacy, and the analysis performed to obtain the results outlining the reliability of the constructs that we applied. The results describe how the participants in each institutional setting differed in terms of the entrepreneurial self-efficacy five constructs – searching, planning, marshalling, implementing people, and implementing finance. This section also provides the correlation analysis that was performed between the five constructs and our independent variables – academic year, institution, and gender. The results demonstrate that academic year and institution had significant effects on particular constructs of entrepreneurial self-efficacy while gender did not. In the discussion section of the paper, we describe how the observations made pertaining to entrepreneurial self-efficacy may be related to the entrepreneurial ecosystems that exist at each of these institutions. We discuss how role models are known in literature to serve an important role in the development of entrepreneurial self-efficacy yet institutions that are just growing their programs in this field do not have access to as large a network of entrepreneurial role models. We also describe that the availability of curricular and co-curricular offerings could have served a role in the differences observed as growing programs do not have as many programs available to students as those programs that are well established. Finally, we describe the implications associated with our work and what this could mean to entrepreneurial programs in college-based settings. We discuss how the development of an entrepreneurial ecosystem at an institution that is interested in developing programs related to entrepreneurship is critical to providing students with the necessary exposure to increase their own entrepreneurial self-efficacy. This work hereby serves as an identification of the need for more research on the impacts of college entrepreneurial ecosystems on student entrepreneurial self-efficacy.

2. Background

2.1 Entrepreneurial Self-Efficacy

Entrepreneurial Self-Efficacy (ESE) ascribes to an individual's confidence in successfully performing different entrepreneurship-related tasks [25, 26]. ESE stems from Bandura's conception of self-efficacy and has been noted in the literature as an important predictor of one's performance [27, 28]. In simple words, the concept of self-efficacy posits that one's confidence in his/her ability to do a task has a positive impact on one's actual performance of the task and also one's willingness to engage in the task. In the context of entrepreneurship, this implies that individuals with high self-efficacy in performing entrepreneurial tasks or high ESE will have an influence on their willingness to engage in entrepreneurial behaviors and engage in them successfully.

Researchers have noted that ESE holds importance in predicting one's entrepreneurial intentions [26, 29–31]. For instance, in one such study, Pihie & Akmaliah [32] examined university students' perceptions of ESE and entrepreneurial intentions in light of entrepreneurial career preferences. Overall, the researchers found that students held a moderate level of entrepreneurial intentions and ESE. However, significant differences were noted based on students' entrepreneurial career aspirations. Students aspiring to pursue an entrepreneurial career reported higher levels of ESE and entrepreneurial intention in comparison to students who did not aspire to pursue an entrepreneurial career. Based on the findings, the author called for universities to incorporate targeted educational efforts to foster the enhancement of ESE and consequently promote the development of entrepreneurial intention and pursuance of entrepreneurial careers. In addition to intent to pursue entrepreneurial activity, researchers and theorists have noted that ESE is critical in predicting entrepreneurial behavior [33, 34]. Cumulatively, these studies underline that ESE is an important factor in the context of entrepreneurship and thus it is imperative to study it in educational contexts.

Acknowledging the centrality of ESE, studies have focused on examining ESE in different populations such as undergraduate and graduate business

students [35], MBA alumni [25], higher education management students [36], entrepreneurs and managers [37]. Furthermore, researchers are continuing to expand the understanding of ESE by examining it from a gender perspective [25, 26, 30, 38] and unpacking factors that may inform its development in individuals [16]. From an assessment perspective, ESE is becoming a commonly used metric to evaluate success in the entrepreneurship education literature [25, 26, 29, 39–41]. Furthermore, due to its inherent nature, ESE involves confidence in performing business related tasks such as searching for an opportunity to solve and planning to effectively pursue the identified opportunity; which are often similar to professional attributes needed in engineers to succeed in their careers. Considering the important position of ESE in entrepreneurship theory, practice, and research; its examination across different institutional entrepreneurial ecosystems offers insights for practitioners and program developers as entrepreneurship education grows in institutions of higher education, particularly outside the business school.

2.2 Entrepreneurial Ecosystem

The term entrepreneurial ecosystem has been gaining popularity within the entrepreneurship education literature. In most instances, entrepreneurial ecosystem has been used to define the "interdependent actors and factors coordinated in such a way that they enable productive entrepreneurship within a particular territory" [42, p. 1]. In this manner, it captures a variety of elements that could contribute to providing an environment that aids in the generation of new businesses. These elements can include networks, leadership, finance, talent, knowledge, support services, formal institutions, culture, and physical infrastructure [42]. Other models have proposed that an entrepreneurial ecosystem consists of a series of different types of attributes that support and reinforce one another. Spigel [42] describes an entrepreneurial ecosystem model as having cultural, social, and material attributes. Cultural attributes can include the culture and history of entrepreneurship that has taken place within the region. Social attributes are focused on people with an emphasis on networks, human capital, mentors, and investment capital. Finally, material attributes focus on the infrastructure associated with the region in the form of policies, markets, and support services [42]. Whereas Suresh & Ramraj [43] described an entrepreneurial ecosystem as providing moral, financial, network, government, technology, market, social, and environmental support.

Although these definitions are quite broad and cover many elements that could lead to an environment conducive to starting a business, they are not focused on the elements that would be relevant to an educational or academic environment. Brush [44] created a description of how an entrepreneurial ecosystem could exist within a higher education environment. Her definition consists of both domain and dimension related elements. The domain elements focus on specific offerings on the university campus and include curricular activities, co-curricular activities, and entrepreneurship research. Entrepreneurship research can focus on both theoretical as well as applied research elements. Dimensions that were important to the definition include stakeholders, resources, infrastructure, and culture. Stakeholders in a university setting include but are not limited to students, staff, faculty, and administrators. Resources focuses on the necessary skills, supplies (in the form of both technology and materials), funding, and partnerships that would lead to successful implementations of entrepreneurship-related activities. Infrastructure was broken down into both physical and non-physical elements depending on the type of activity. Finally, culture included the values and traditions associated with the institution [44]. Many of the elements that were outlined in Brush's model of an entrepreneurship education ecosystem have been used by other researchers when studying their own local context such as the work done by Carvalho, Costa, & Dominguinhos [45] when examining the entrepreneurial ecosystem of a university in Portugal.

Brush [44] found in her work that domains and dimensions could range in implementation from low to high, generating four general categories within which institutions could fall: broker, coordinator or facilitator, hub, or developer. A broker institution is one that is found to have a large amount of domain related activities but that may not necessarily have entrepreneurship as one of its main priorities leading to a lack of resources to continue to support these initiatives. A coordinator or facilitator institution is one that would have a very limited offering of entrepreneurship-related curricular and co-curricular activities. The institution itself wouldn't be focused on building its entrepreneurship programming and as such could only support a small number of activities on a yearly basis. Hub institutions would be universities where there is a significant breadth in the curricular and co-curricular offerings and the institution has shown a strong commitment to furthering its mission in this area. These institutions would be considered to be leaders within the field. Finally, an institution that is a 'developer' would have the leadership and support necessary for building out its entrepreneurial programs but wouldn't as of yet

developed entrepreneurship-related activities with a lot of breadth.

3. Methods

3.1 Participants and Setting

This study was conducted at two universities in the United States. Institution A is a mid-size public research university in the north Atlantic region. The institution has an undergraduate enrollment of approximately 15,000 students. The college of engineering (CoE) has an average enrollment of approximately 1,500 undergraduate students across its nine bachelor degree offerings. Institution B is a large research university located in the Midwest U.S. The institution has an enrollment of approximately 30,000 undergraduates across its nineteen schools and colleges. The College of Engineering in particular enrolls over 6,500 undergraduate students, out of which approximately 25% and 10% students are women and from underrepresented minorities respectively as of 2017. A summary of the different entrepreneurial ecosystems at each institution are shown in Table 1.

The participants in this study from Institution A represented undergraduates in both the colleges of business and engineering. Both business and engineering undergraduates were invited to participate in this study through a recruitment e-mail sent to all majors in the two colleges. In total 63 students participated in this study from Institution A. The breakdown across colleges was 36 from the college of engineering and 27 from the college of business. The participants from Institution B participating in this study were undergraduate students enrolled in one such entrepreneurship course offering an experiential learning opportunity to students in Fall 2017. In the total enrollment of 90, 55 students participated in our study yielding a response rate of 61%.

3.2 Measures

The validated Entrepreneurial Self-Efficacy (ESE) scale developed by McGee, Peterson, & Mueller [46] was used in our study. The scale assesses students' ESE by asking how much confidence they have in their ability to perform tasks associated with its five identified constructs – searching, planning, marshalling, implementing people and implementing finance. The *searching* construct assesses an individual's confidence in his/her ability to perform tasks involving the developing and/or identification of an opportunity. The *planning* construct assesses an individual's confidence in his/her ability to perform tasks that lead to the transformation of the identified opportunity in the searching phase into a business plan. The *marshalling* construct assesses an individual's confidence in his/her ability to perform tasks associated with gathering and organizing resources essential to launch a venture. The *implementing people* and *implementing finance* constructs assesses an individual's confidence in his/her ability to perform tasks associated with managing people and finance-related aspects needed to sustain the venture respectively.

The survey consists of a total of nineteen items and gathers participant response on a five-point Likert-Scale (not confident at all; a little confident; somewhat confident; confident; very confident). We also collected demographic data on student gender and academic status which were used in our analysis. Also, consistent with recommended approaches when using validated instruments, we tested the reliability of the items for our given sample using Cronbach alpha as a measure of internal consistency and conducted a confirmatory factor analysis. As presented in Table 2, high Cronbach alpha values and factor loadings for the five ESE constructs assured the reliability of the ESE instrument for our studied sample.

3.3 Data Analysis

We calculated the student scores for the five ESE constructs by averaging the student reported scores on the Likert-Scale (1–5) for the constituent survey items. The analysis of data was performed using these average scores with SPSS v24 statistical software. The data analysis included three main steps. In the first step, we examined overall differences and similarities in students' ESE scores for the five constructs using descriptive statistics. Mean and standard deviations of ESE scores were calculated across the two institutions and students' academic status. The second step involved examining how our independent variables (academic status and institution type) significantly correlated with our dependent variables (ESE constructs) using bivariate Pearson correlation analysis. While academic status and institution type were our main variables of inquiry, 'gender' were also included as a control variable in the correlation analysis. The purpose was to account for differences in mean scores that may occur due to the gender differences in our studied sample. Lastly, in the third step, the significant correlations identified in the previous step were further examined using hierarchical multiple regression analysis. Hierarchical multiple regression allows examination of the influence of multiple independent variables in explaining the variance in the dependent variable. The process involves entering the independent variables in steps into the regression model and examining the amount of variance explained by the model after each addition.

Table 1. Institution Entrepreneurial Ecosystems

Entrepreneurial Ecosystem Type		**"Developer"**	**"Hub"**
	Entrepreneurial Program Component	**Institution A**	**Institution B**
Domain	Curricular Activities	Degree programs: • Entrepreneurship Major • Engineering Entrepreneurship Major • Entrepreneurship Minor Courses (examples): • Entrepreneurship and Innovation • New Venture Development • Financing and Legal Aspects of Entrepreneurship	Degree programs: • Entrepreneurship Major • Entrepreneurship Minor Graduate certificate Study Abroad Experience Courses (examples): • Diversity, Equity, and Inclusion in Entrepreneurship • Digital Product Design • Creativity & Design • Innovation Business Models • Entrepreneurship Marketing, etc.
	Co-Curricular Activities	Pitch competitions (idea and business model) Entrepreneurship student organizations Coffee with an entrepreneur (started in past academic year) Meetings with entrepreneurship faculty (started in past academic year)	Pitch competitions Clean energy venture challenge Startup Career Fair Provost Jump Start Grants Innovation Corps program Trips to startups and entrepreneurial hubs across the U.S. Entrepreneurial student incubators Hacker competition Entrepreneurial mentoring
	Entrepreneurship Research	Very limited entrepreneurship research although focus is starting to shift	Active entrepreneurship research program
Dimensions	Stakeholders	5 Faculty Members Associated with Center for Innovation and Entrepreneurship Support from Deans in College of Business, Engineering, and Science and Mathematics	30 Faculty Members Associated with Center for Entrepreneurship Dedicated staff for Center for Entrepreneurship focused on Leadership, Education, Fellowships, Tech Acceleration, and Operations Entrepreneurial Mentors Alumni (1,500 engaged)
	Resources	Center for Innovation and Entrepreneurship (re-initiated within past 2 academic years at time of publication) Innovation Venture Fund	Center for Entrepreneurship (in existence for 10 years at time of publication) Entrepreneurial incubators Fellowships for students seeking to continue their ventures Access to entrepreneurial mentors
	Infrastructure	Center for Innovation and Entrepreneurship located in College of Business but not tied specifically to this College with office, collaboration, and teaching space	Center for Entrepreneurship (in existence for 10 years at time of publication) housed outside of any specific school at the University
	Culture	Strong support for the development of innovation and entrepreneurship tools New Executive Director for Center for Innovation and Entrepreneurship was hired two years ago at time of publication Plans for creating a broader entrepreneurial ecosystem through Entrepreneurship Advisory Committee and development of new partnerships	Affiliated with a broad entrepreneurial ecosystem in the local area and beyond Partners with different schools across the university Provides immersive curricular and co-curricular experiences for students who feel they are ready to be challenged Provides advising to students who are seeking one-on-one mentorship

Table 2. Instrument Reliability

Construct	Cronbach Alpha	Factor Loadings	Items
Searching	0.81	0.83	Come up with a new idea for a product or service
		0.84	Identify the need for a new product or service
		0.64	Design a product or service that will satisfy customer needs and wants
Planning	0.77	0.74	Estimate customer demand for a new product or service
		0.83	Determine a competitive price for a new product or service
		0.59	Estimate the amount of start-up funds and working capital necessary to launch a new product or service
		0.59	Design an effective marketing/advertising campaign for a new product or service
Marshalling	0.76	0.75	Get others to identify with and believe in my vision and plans for a new product or service
		0.75	Network in order to make contact with and exchange information with others
		0.66	Clearly and concisely explain my new product or service in everyday terms
Implementing People	0.89	0.80	Supervise team members
		0.79	Recruit and hire team members
		0.78	Delegate tasks and responsibilities to team members
		0.82	Deal effectively with day-to-day problems and crises
		0.71	Inspire, encourage, and motivate my team members
		0.66	Train team members
Implementing Finance	0.92	0.76	Organize and maintain the financial records
		0.92	Manage the financial assets
		0.71	Read and interpret financial statements

4. Results

4.1 Descriptive Statistics

Our descriptive statistics results showed that students in institution B had higher mean scores for all five ESE constructs when compared to institution A (Table 3). The difference was highest in case of planning and marshalling scores with mean score at institution B being 0.53 and 0.68 more than institution A respectively. The lowest difference in scores were noted for searching and implementing people. The students' reported mean searching score at institution B was 3.63 in comparison to 3.33 in institution A (mean difference = 0.30). Similarly, students' implementing people mean score was 3.37 and 3.77 at institution A and institution B respectively (mean difference = 0.40). Lastly. in case of implementing finance, mean score was 0.32 higher in institution B (mean score = 3.19) than institution A (mean score = 2.87).

In addition, no predominant patterns in the mean scores for the five ESE constructs were noted across the four years (Table 4). This shows that students ESE did not always increase or decrease based on students' academic standing. For example, in case of institution A, while the mean searching scores

Table 3. Mean Scores by Institution

Constructs	Institution A			Institution B			Mean Difference
	N	Mean	Std Dev	N	Mean	Std Dev	
Searching	63	3.33	0.93	55	3.63	0.73	0.30
Planning	63	2.54	0.76	55	3.07	0.73	0.53
Marshaling	63	3.09	0.87	55	3.77	0.73	0.68
Implementing People	63	3.37	0.88	55	3.77	0.70	0.40
Implementing Finance	63	2.87	1.19	55	3.19	1.07	0.32

were highest for second year students followed by first, fourth and third year; the mean planning scores were highest for first year students followed by fourth, second, and third year. Similarly, in case of institution B, while high searching scores were noted highest for second year students followed by third and fourth year; the planning scores were highest for third year students followed by second and fourth year students. However, examination of student scores within the year and across the two institutions showed that second, third, and fourth year students at institution B reported higher scores than students at institution A for all ESE constructs with the only exception of implementing finance for fourth year students. For instance, for second year students, mean scores at institution B were 3.88, 3.08, 4.11, 3.78 and 3.77 in contrast to 3.58, 2.47, 2.83, 3.44 and 3.30 at institution A for searching, planning, marshalling, implementing people, and implementing finance respectively. Similar patterns were noted for third year students with students at institution B reporting higher scores for all the five ESE constructs when compared to third year students at institution A. In contrast, for fourth year students, while scores for searching, planning, marshalling, and implementing people were higher for institution B students; implementing finance scores were higher in case of institution A.

Overall, these descriptive results point out that students at institution B reported higher ESE than students at institution A. Furthermore, apart from minor exceptions and absence of first year students at institution B in our sample, mean scores were again higher for institution B in case of all ESE constructs when examined for the three academic years present in our sample. In other words, the type of institution and academic year interacted differently with students' reported scores for the five ESE constructs. These interactions were further examined using bivariate correlation analysis to identify significant correlations between the independent variables and our dependent variables (ESE mean scores).

4.2 Bivariate Pearson Correlation Analysis

To identify statistically significant correlations between the five ESE constructs and our independent variables (institution, academic status, and gender), a bivariate Pearson correlation analysis was performed (Table 5). In our analysis, gender was not found to be significantly correlated with any of the five ESE constructs. However, the five ESE constructs differed in their correlations with institution and academic status. Particularly, while searching and implementing finance did not significantly correlate with institution and academic status, significant correlations were noted for planning, marshalling and implementing people constructs. In the case of planning, significant correlations were noted with institution ($p < 0.01$) and not with students' academic year. For the marshaling construct, both academic year and institution were found to be

Table 4. Mean Scores by Institution and Academic Year

Constructs	Institution	1st Year	2nd Year	3rd Year	4th Year
Searching	*A*	3.43 (0.89)	3.58 (0.94)	3.17 (1.03)	3.30 (0.91)
	B		3.88 (0.19)	3.80 (0.71)	3.56 (0.75)
Planning	*A*	2.72 (0.93)	2.47 (0.57)	2.42 (0.85)	2.57 (0.72)
	B		3.08 (0.14)	3.25(0.65)	3.02 (0.79)
Marshalling	*A*	3.13 (0.89)	2.83 (0.80)	3.00 (0.85)	3.29 (0.95)
	B		4.11 (0.51)	3.84 (0.73)	3.78 (0.75)
Implementing People	*A*	3.10 (1.03)	3.44 (0.74)	3.10 (0.91)	3.69 (0.81)
	B		3.78 (0.69)	3.95 (0.66)	3.71 (0.61)
Implementing Finance	*A*	2.13 (1.32)	3.30 (1.06)	2.76 (1.19)	3.06 (1.13)
	B		3.77 (0.69)	3.66 (0.82)	2.92 (1.13)

Table 5. Pearson correlation coefficients

	Searching	Planning	Marshalling	Implementing People	Implementing Finance
Academic Year	–0.027	0.084	0.206*	0.204*	0.076
Institution	0.174	0.339**	0.403**	0.243**	0.138
Gender	–0.041	–0.050	0.019	0.012	–0.151

* $p < 0.05$, ** $p < 0.01$.

significantly correlated with p-values less than .05 and .01 respectively. Similarly, both academic year and institution significantly correlated with implementing people with p-values less than .05 and .01 respectively. To summarize, although gender was not found to be significantly correlated with any of the five ESE constructs, significant correlations were found between institution and academic year and three ESE constructs (planning, marshaling, and implementing people). These findings highlighted that institutional contexts played a stronger influencing role in mediating students ESE than gender. These correlations were examined in the hierarchical multiple regression analysis.

4.3 Regression Analysis

In the regression analysis, independent variable academic year was entered followed by institution for the three constructs shortlisted in the correlation analysis. Table 6 presents a summary of the regression analysis. It reports variance accounted for at the first and second step of regression analysis (R^2), changes in variance accounted for after institution was added to the model (ΔR^2), beta estimates (B), standard error of beta estimates (S.E. B), and standardized beta estimates (β). The results show that only institution and not academic year had a significant impact on accounting for variance in ESE scores pertaining to planning and marshaling constructs. For planning, the R^2 values or the variance account for increased from 0.007 to 0.118 when institution was added to the analysis. In simpler words, while academic year accounted for 0.7% of variance in planning scores, the model accounted for 11.8% of the variance when institution was added to the analysis. Similarly, for marshaling, the variance accounted for increased from 4.2% (only academic year) to 16.5% when institution was added to the regression analysis. Thus, in both cases, statistical significance was found after institution was added in the second step of the regression analysis with $p < 0.05$. For implementing people, academic year accounted for 4.1% of the variance. Addition of institution lead to an increase in variance accounted for 7.3%. Although statistical significance was not found, p-value for model after addition of institution was 0.05.

In other words, these results demonstrate that students' institution significantly accounted for the variance in students' mean scores for several ESE constructs, with no significance noted for students' academic year and no correlation with gender. The reported mean scores for the ESE constructs were higher for students in institution B when compared to institution A. No significant variances in students' searching and implementing finance scores were found due to differences in institution. On the other hand, for planning, marshalling and implementing people, variances in scores were accounted due to difference in students' institution.

5. Discussion

The results of our study demonstrate that there exist differences in students' entrepreneurial self-efficacy across different entrepreneurial ecosystems housed at two institutions. In our study, institution B represents a large Midwestern research intensive university that has a strong history of innovation and entrepreneurship. It has a well-established center for entrepreneurship that offers coursework, accelerators, innovation programs, and entrepreneurship experiences to students on its campus. In other words, according to the work done by Brush [44], this institution would be considered to be a 'hub'. In comparison, institution A is a mid-size north Atlantic research university that has recently started growing its entrepreneurship programs. Although institution A now offers many of the same opportunities that institution B offers to its students, these programs have only been available for the past few years. In alignment with Brush's [44] entrepreneurship education ecosystem model, institution A would be a 'developer' where it has the necessary support, resources, and commitment towards entrepreneurship but the programming offerings are still growing and developing. The results demonstrated that undergraduates at insti-

Table 6. Hierarchical multiple regression

	Independent Variable	**R^2**	**ΔR^2**	**B**	**S.E. B**	β
Planning	*Academic Year*	0.007		–0.048	0.078	–0.059
	Institution	0.118	0.111	0.570	0.152	0.362*
Marshalling	*Academic Year*	0.042		0.051	0.085	0.056
	Institution	0.165	0.123	0.671	0.165	0.381*
Implementing People	*Academic Year*	0.041		0.108	0.084	0.127
	Institution	0.073	0.032	0.317	0.162	0.193^

* $p < 0.05$; ^$p = 0.05$.

tution B had higher mean scores for all of the entrepreneurial self-efficacy measures and statistically significant higher mean scores for three of the five entrepreneurial self-efficacy measures (planning, marshalling, and implementing people). Further it was found that there was a significant correlation between these measures of entrepreneurial self-efficacy and institution type.

This observed difference could be as a result of the resources available through the 'hub' ecosystem at institution B in comparison to the 'developer' ecosystem at institution A. For example, in comparison with institution A, institution B constituted a strong network of alumni and entrepreneurs which engaged with students through the curricular and co-curricular programs. At the time of this publication writing, institution A was just starting to build out its entrepreneurial network with the launch of new activities including coffee with an entrepreneur. This difference in the availability of role models at these two institutions may have led to the observed differences in entrepreneurial self-efficacy with institution B having higher levels due to the ease of access with these mentors and role models. Several researchers have noted positive impact of role models on entrepreneurial self-efficacy. For example, BarNir, Watson, & Hutchins [47] found that there was a positive correlation between entrepreneurial self-efficacy and exposure to role models. This result was also supported in the work by St-Jean, Radu-Lefebvre, & Mathieu [48] on mentorship of novice entrepreneurs by entrepreneurial role models. The desire to learn about entrepreneurship from entrepreneurs was also found in the study by Pittaway, Gazzard, Shore, & Williamson [49] where they observed that students elect to participate in extracurricular experiences to gain practical learning experiences and the opportunity to learn from entrepreneurs themselves.

Furthermore, the differences in entrepreneurial self-efficacy between institutions may have also occurred due to the differences in curricular and extra-curricular opportunities that are available to the students at the two different institutions. As noted in Table 1, institution B has a diverse set of offerings available to their students ranging from on campus pitch competitions and career fairs to off-campus experiences such as the trips to start-ups and entrepreneurial hubs across the U.S. In contrast, institution A has been growing its list of offerings but currently is mainly still focused on events offered through the student entrepreneurship programs and its pitch competitions. Shinnar, Hsu, & Powell [50] voiced how there is a strong theoretical argument for a positive role of entrepreneurship curriculum on entrepreneurial self-efficacy. Claudia [51] demonstrated that extra-curricular activities were important and provided a needed chance for students to learn about entrepreneurship by doing. Also, work by Arranz, Ubierna, Arroyabe, Perez, & Fdez. de Arroyabe [52] showed that the impact of curricular and extracurricular activities could be unequal across university students. In addition, researchers have found that curricular and co-curricular programs may lead to different effects on students' entrepreneurial self-efficacy [53]. These results all support that the additional learning opportunities provided through co-curricular experiences may be a key difference between the observed differences in entrepreneurial self-efficacy at these two institutions. In the context of our findings, the differences in the type of curricular and co-curricular programming at institution A (developer ecosystem) and institution B (hub ecosystem) provides an explanation to higher self-efficacy in planning, marshalling, and implementing people aspects of entrepreneurship among institution B students in contrast with institution A. Particularly, the availability of programs such as trips to startups to meet practicing entrepreneurs and venture capitalists, incubators providing resources for projects, and funding through university grants would have allowed students with better learning opportunities to engage in developing a business plan for identified opportunities (planning); gathering and organizing resources for their entrepreneurial projects (marshalling); and working with other students and stakeholders (implementing people).

Our study didn't reveal any notable differences in entrepreneurial self-efficacy between students in different years of their degree program. This may be due to the low numbers of students that were sampled at each stage of their degree program or the types of degree programs in which the students were enrolled. For instance, many of the students that were included as part of this study were not studying entrepreneurship. As such, it wouldn't be expected for these students to obtain progressive exposure to elements associated with entrepreneurial self-efficacy unless the students specifically sought out these experiences through selected coursework and extracurricular experiences. Interestingly, our results didn't indicate a correlation between entrepreneurial self-efficacy and gender. This is in contrast to several studies that have demonstrated that there are differences in entrepreneurial self-efficacy between male and female students with female students typically demonstrating lower levels of entrepreneurial self-efficacy [16, 50, 54]. This result is definitely worth further investigation to determine what aspects of the specific institutional environments that were present at these institutions may

have led to this effect and how it could be modeled at other institutions.

6. Implications

Entrepreneurship education in engineering continues to grow with institutions offering nuanced if not entirely different curricular and co-curricular entrepreneurship programs based on their intended goals and availability of resources. While these different educational models explore different curricular and pedagogical approaches for developing entrepreneurial skills in engineers, they also create entrepreneurial ecosystems in which students interact. Our exploratory study begins to unpack how differences in entrepreneurial ecosystems may inform student attributes, entrepreneurial self-efficacy in our case. These attributes will not only impact their success in the courses and entrepreneurial pursuits but will also have ramifications on engineering students' decision to participate or not participate in entrepreneurship education programs [55].

This study has two main implications for entrepreneurship education practice. First, institutional environment and more broadly the entrepreneurial ecosystem at an institution is very important in mediating the entrepreneurial self-efficacy of students. For this reason, it could be useful for institutions to assess what type of entrepreneurship education ecosystem they have in place and then determine the steps necessary to modify their ecosystem to where they would like to be [44]. Chen and colleagues [37] were one of the first to mention that there could be a mediating effect of environment on entrepreneurial self-efficacy when they found that supportive environments that had resources and opportunities available could lead to improvements in entrepreneurial self-efficacy. Despite this observation, there have been very few studies which have taken the time to investigate this occurrence. The study by Wennberg et al. [56] on the impacts of culture on entrepreneurial self-efficacy is one of the few to look into the mediating effect of environment in more detail. Further, Schmutzler, Andonova, and Diaz-Serrano [57] observed that individuals with low entrepreneurial self-efficacy may rely more on cues provided by their social context to learn about entrepreneurial behavior. This demonstrates just how important the entrepreneurial ecosystem within an institution is to developing entrepreneurial self-efficacy among its student population. Although the results of this study offer support for the impact of entrepreneurial ecosystem at an institution on entrepreneurial self-efficacy, there is still a lot more work that needs to be done in order to strengthen and support these claims. The second implication is that gender may not always be a moderating factor on entrepreneurial self-efficacy. Based on the work in this study, gender wasn't found to have a correlation in the entrepreneurial self-efficacy of students at either institution. More work needs to be done to further understand what elements of these particular institutional contexts may have led to this observation and whether it occurs at other institutions with similar entrepreneurial ecosystems.

7. Limitations and Future Research Lines

This study has a few limitations that impact its generalizability. For instance, the sample sizes are relatively small (<65 students at each campus). The data was also collected from just two exemplar institutions with different institutional contexts and as such the results may not be the same if a comparison were to be performed with multiple institutions representative of each type of institutional context and entrepreneurial ecosystem. The other limitation associated with this study is the source for the sample. At one of the institutions, the sample was obtained from an e-mail recruitment sent out to all business and engineering undergraduate students. Students from this institution hence self-selected to participate which may have resulted in mean scores that are not representative of the entire business and engineering undergraduate population at this institution as a whole. Similarly, students from the second institution completed the survey as part of their participation within an entrepreneurship class, this may have influenced the results that were obtained and also not be an accurate representation of the entire business and engineering undergraduate population.

Despite these limitations, the results illustrate that entrepreneurial self-efficacy can be affected by the entrepreneurial ecosystem at an institution. These limitations could be addressed in the future by attempting to have a broader sampling of the business and engineering undergraduate populations at both institutions. They could also be remedied by conducting the study with additional institutions that have similar entrepreneurial ecosystems and institutional contexts. New research in this area would help address our understanding of the role of institutional entrepreneurial ecosystem on the development of entrepreneurial self-efficacy amongst undergraduate engineering student populations. Lastly, from a translation of research to practice perspective, our results point out that different institutional ecosystems may differ in the type and breadth of entrepreneurship programming and consequently will have an impact of students' learning and affective responses towards entrepre-

neurship and innovation. Thus, the research community may focus on examining how large entrepreneurship education programs (hubs) can be brought to scale, particularly at resource-limited institutions. Researchers may begin with identifying the key aspects of content, assessment, and pedagogy for effective entrepreneurship education; and use the findings to inform development of entrepreneurship education programs at 'developer' institutions by creating partnerships with 'hub' institutions. This will allow the benefits of entrepreneurship education to be reaped by a broad engineering student population and shift entrepreneurship education from being a privilege for students at select institutions to an educational experience for all engineering students irrespective of their institutional type.

8. Conclusion

In this article we have demonstrated that the entrepreneurial ecosystem of a higher education institution can have a significant correlation on the entrepreneurial self-efficacy demonstrated by its engineering and business students. The effect of environment on entrepreneurial self-efficacy has been mentioned as a potential influencer for a number of years but very limited research has been conducted on this effect. Our current study presents preliminary results that students at an institution with a more established and broader base of entrepreneurial programs (curricular and extracurricular) will result in students with higher levels of entrepreneurial self-efficacy particularly in the constructs of planning, marshaling, and implementing people. Further research needs to be performed to include a larger sample set of institutions with similar entrepreneurial ecosystems to verify the initial claims shown in this study.

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