Understanding Student Participation in Entrepreneurship Education Programs: A Critical Review*

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The rapid growth of entrepreneurship training in higher education warrants increased research on the impacts of entrepreneurship program participation. The purpose of this study is to develop a conceptual model of student participation in entrepreneurship education programs based on previously established models of student participation in learning activities and entrepreneurship education assessment theories. We systematically reviewed the literature using salsa methodology (search, appraisal, synthesis and analysis) to identify commonly used theories and variables in entrepreneurial assessment literature. Salsa method allows identification, evaluation, synthesis and analysis of most significant work in the field with respect to the area of interest. We found that these dominant theories only focused on individual factors and rarely highlighted external influences and barriers. This review led to development of an entrepreneurship-specific participation model. By merging multiple theories into one overarching model, we provide a foundational framework for systematic research examining student participation in undergraduate entrepreneurship programs. This overarching model identifies six variables that are especially important for entrepreneurship education program participation: entrepreneurial self-efficacy; desirability; entrepreneurial intent; life transitions; information and resources; and opportunities and barriers

Keywords: entrepreneurship education; theoretical frameworks; student participation; critical review; program development

1. Introduction

Fueled by the demand to develop future engineers prepared to succeed in a competitive, technology-driven global economy [1–4], entrepreneurship has gained significant attention in engineering education [5, 6]. Due to their technical expertise, engineers are well-positioned to initiate technology ventures and contribute to the growth of entrepreneurial activities [7]. However, to compete in a complex economic environment, in addition to technical skills, engineering students need to possess an entrepreneurial mindset [8] and abilities to understand market operations, identify opportunities, create value, and commercialize new products [9].

In response to the call for more innovative and entrepreneurial engineers, numerous universities and colleges have launched entrepreneurship programs (EPs) specific to engineering students. These emerging programs are unique in that they not only expose engineering students to traditional business skills, but also teach students how to embody entrepreneurial and innovative characteristics [10, 11]. In addition to positively impacting enrolled students' knowledge about starting new ventures, these programs also impact students' entrepreneurial self-efficacy [12–14]. While entrepreneurship is viewed as critical to developing the 21st century

engineer [15], it is not typically incorporated in the core engineering curriculum. In particular, the limited number of free electives available to students are a barrier to increasing enrollment in entrepreneurship courses [11]. As an alternative, several institutions address this challenge by developing entrepreneurial co-curricular activities rather than stand-alone courses. However, a recent analysis of student paths to entrepreneurship education indicates that women are 40% less likely to self-select into an entrepreneurial co-curricular activity than men [16].Thus, to broaden participation of diverse groups of students in EPs, it is critical that universities have an understanding of factors that influence students' decisions to engage or disengage in EPs. This understanding will help universities develop programs that encourage broad participation across student populations, contributing to the development of more entrepreneurially-minded and innovative graduates.

The purpose of this paper is to develop a conceptual framework for studying influencers on student participation in entrepreneurship education that is grounded in adult participation and entrepreneurship theory. This paper is a resource for administrators designing more effective EPs, and engineering faculty interested in studying entrepreneurship education, who often face the difficulty of

grounding their research in theory [17]. Theoretical work that can guide engineering education research is scarce [18] because studies often "reinvent the wheel rather than build on prior work in ways that advance our understanding" [19]. Although research examining different aspects of engineering entrepreneurship education is emerging, there is minimal work that has focused on developing a holistic understanding of student participation in EP, particularly in engineering education. By leveraging existing student participation and entrepreneurship theory, we present a model for examining participation in EPs and explicate relevant variables that may influence, encourage, and/or discourage participation.

2. Background

Research into participation in education programs indicates that a student's decision to participate in learning programs is a complex, individual process that is influenced by the individual's perceptions of self and social transitions [20]. In general, participation research can be categorized as either descriptive or explanatory [20]. Historically, descriptive research has dominated the field and commonly examines characteristics (e.g., socio-demographic information or motivational constructs and deterrents) of individuals who participate in, drop out of, or do not enroll in education programs. In contrast, to better understand the influence of student characteristics on participation in educational programs, research has become more explanatory, attempting to explain participation using theoretical underpinnings. One of the most commonly referenced explanatory models is the Chain-of-Response (COR) model for understanding participation in learning activities and programs (Cross, 1981). The COR model is widely noted as a foundational work in higher education research [21–25]. COR is a composite model of relevant motivational theories that can be used to explain student participation [26]. The COR model is an consolidation of three overlapping models: Congruence [27], Anticipated Benefits [28], and Paradigm of Recruitment [29] (Table 1). The Congruence model posits that the reasons for non-participation depend on both individual characteristics and a participant's perception

of his/her educational environments [29]. Similarly, the Anticipated Benefits model acknowledges the importance of environmental factors on student learning behavior while also emphasizing the individuals' perceptions of anticipated benefits from participation. Lastly, the Paradigm of Recruitment model argues that student motivation to participate in learning is dependent on their expectation of personal success and their perception that participation will be beneficial in achieving that success.

Grounded in these three intricately-related models, the COR model states that student participation is influenced by the individual's perceptions of his/her environmental conditions [26]. It argues that participation in learning programs results from interactions between six different variables, three internal (self-evaluation, attitudes about education, goals and expectations) and three external (life transitions, opportunities and barriers, information) variables.

Self-evaluation is defined as an individual's confidence in his/her abilities and is considered a fundamental variable influencing participation. Attitudes about education take into account the influence of social factors that shape an individual's perceptions of the learning activity or program. Goals and expectations capture one's motivation to engage in the learning program, emphasizing its basis in the individual's judgment that participation will contribute towards achieving future goals. Life transitions account for decisions individuals may need to take depending on their current phase in life. Opportunities and barriers capture special program features that hinder or enhance participation. Finally, information caters to the accessibility of resources (e.g., academic advising centers) that link students to appropriate learning opportunities. Thus, the COR model conceptualizes the decision to participate in an educational program as an interactive result of a spectrum of internal (self-evaluation, attitudes, goals and expectations) and external (life transitions, information, and opportunities and barriers) variables. These variables can be used to interpret what influences students when deciding to participate in a learning program, such as an EP. For example, an interpretation of what influences a female student's decision to participate in an EP is as follows: A woman's confidence in her

Table 1. Summary of underlying theories used in COR Model

Model/Paradigm	Main Argument
Congruence Model	Motivation for learning is a result of students' perceptions and interpretations of environmental factors.
Anticipated Benefits	Students' perceptions of anticipated rewards are a more important driver of motivation rather than environmental factors.
Paradigm of Recruitment	Motivation for learning is dependent on the expectation of personal success in the learning activity and the expectation that being successful in the activity will lead to positive results.

own ability to start a new venture (*self-evaluation*) might increase after interacting with other female entrepreneurs. This interaction may leave her with a positive attitude toward entrepreneurship (*attitude*) and she may consider starting her own venture or becoming self-employed (*goals and expectations*). To enhance her entrepreneurial skills, she may access information about EPs through her new connections with entrepreneurs (*information*). Conversely, her goals may be tempered by life events, such as maternity (*life transition*), yet reverted by the provision of an on-campus daycare program (*opportunities*).

This example illustrates the applicability of the COR model in understanding participation in entrepreneurship education programs and our rationale for using it to develop a framework for understanding student participation. However, the COR participation model is not specific to EP participation. To further refine this model in the context of entrepreneurship education programs specifically, we performed a critical review of entrepreneurship literature to identify key theories and variables that may impact students' participation in entrepreneurship education programs. The purposes of this review are to synthesize predominant theories used in entrepreneurship education research and merge them with COR to develop a model for understanding participation in entrepreneurship education programs. The research questions that guide this critical review were: (1) What are the dominant theories used in entrepreneurship education assessment research; and (2) How do these theories overlap with the COR model?

3. Methods

3.1 Critical review strategy

For this study, we performed a critical literature review of engineering entrepreneurship education assessment literature to identify key factors influencing participation in entrepreneurship education [30]. As described by Grant and Booth [30], a critical review evaluates existing literature by performing a conceptual synthesis and analysis to develop a model or a framework. While this literature review method has not been widely used in engineering education literature, it has been extensively used in the other disciplines [31–33]. It is particularly valuable in emergent areas of research in which there is a lack of conceptual and theoretical grounding. The nascent and emerging state of engineering entrepreneurship education warrants our choice of critical review over other literature review methodologies. In contrast with systematic [e.g., 34, 35] and narrative [e.g., 36, 37] reviews, a critical review of litera-

ture places additional emphasis on conceptual innovation and aims to synthesize literature to "manifest in a hypothesis or a model" [30]. This synthesis process of evaluating prior work and competing theories typically results in the conceptual development of a platform for future research in emerging areas of research.

The recommended Search, Appraisal, Synthesis and Analysis (SALSA) procedure guided our review methodology [30]. SALSA is a 4-step method that includes identifying the most significant work in the field (searching), evaluating the work for contribution in the area of interest (appraisal), performing a narrative or conceptual synthesis of relevant work (synthesis), and most importantly, developing a conceptual model or deriving a new theory (analysis).

3.2 Search, inclusion and exclusion criteria

The literature search used in this work was conducted for a larger systematic review of entrepreneurship education assessment [38]. For the larger review, three major research disciplines (science/engineering, education, and business) most relevant to entrepreneurship education were searched: Elsevier's Scopus (Science/Engineering), ProQuest's ERIC (Education), and ABI/INFORM (Business). The search terms: (*"entrepreneurship education" OR "entrepreneurial education"*) *AND* (*"measurement" OR "instrument" OR "assessment"*) were used for all fields. Only peer reviewed journal articles and conference proceedings published in English on or before September 3, 2015, were included. A total of 3,123 citations (Proquest's ERIC/ABI/INFORM = 1,780 and Scopus = 1,343) were found after the initial literature search. After extracting the duplicates, the final dataset consisted of 2,841 unique papers. Only empirical studies focusing on entrepreneurship education assessment in a higher education context were included, resulting in a total 359 articles.

Two researchers coded articles independently and the rubric was checked for inter-rater reliability (interclass correlation = 0.97). A liberal approach was taken for coding theories. If a theory or theoretical framework was discussed, prior to the methods section of the article, the theory was documented. This liberal approach was purposefully used to capture the many theories being used to inform entrepreneurship education assessment research. For this paper, the identified theories were evaluated for contribution in entrepreneurship education assessment based on how often they were cited or used in the list of 359 articles. We also performed a variable-level analysis between shortlisted theories to identify the key common theories and their constituting variables. Using our analysis

of the resultant theories coupled with the COR model, we developed a participation model specific to entrepreneurship education program participation.

4. Findings

4.1 Search

The analysis of 359 articles revealed that a limited number of authors explicitly utilized theories as the foundation for their research approaches. However, approximately 50% of authors cited a theory in the article before the methods section, suggesting that these theories may have driven at least in part their research development. In total, 153 distinct theories were referenced in the 359 articles. To include the most commonly used theories in entrepreneurship assessment, we focused on common theories found in our search irrespective of the disciplinary context they were used in. For our work, we included theories that were used in 10 or more articles.

4.2 Appraisal

In total, seven theories were used by 10 or more of the 359 considered studies (Table 2). Our review of these theories revealed that four theories were subordinate to three overarching theories: Theory of planned behavior [39], Social cognitive career theory [40] and Shapero's entrepreneurial event theory [41]. In the next sections, we describe and present a synthesis of the three overarching theories—Theory of planned behavior (TPB), Shapero's entrepreneurial event theory (SEE) and Social cognitive career theory (SCCT).

In our review, Theory of planned behavior (TPB) was the most cited theory and several articles also referenced Theory of reasoned action. TPB is an extension of Fishbein and Ajzen's theory of reasoned action. Specifically, while Theory of reasoned action [42] identifies one's attitude and social perceptions (subjective norm) toward performing a behavior as predictors of an individual's behaviors, Theory of planned behavior extends it by including perceived behavioral control or an individual's beliefs regarding the possession of required skills to perform a given behavior [39]. As such, Theory of reasoned action is incorporated into Theory of planned behavior.

Theories derived from Bandura's Social Learning theory [43] were the second most prominent theories cited, including Self-efficacy theory [44], social cognitive theory [45] and social cognitive career theory [40]. Social cognitive career theory (SCCT) is an evolution of Bandura's intricately connected prior work on social learning, social cognition, and self-efficacy. In social learning theory, Bandura described learning as a social process in which one's learning is influenced by one's own experiences and also by the observations he/she makes of other people's behaviors or actions. Social learning theory was later expanded and renamed as Social cognitive theory to account for the influence of social factors on individuals' thoughts and feelings and its resultant impact on action [46]. Social cognitive theory posits that personal, social and environmental factors have an influence on not just learning but also on individuals' motivation, affective and behavioral response. On the other hand, focusing on individual beliefs and motivation, in Self-efficacy theory, Bandura argues that one's perception of his/her ability to perform a specific task successfully or self-efficacy is significant determinant of how an individual approaches the task. Furthermore, based on the tenets of social learning theory, the author asserts that this self-efficacy is also mediated by personal and environmental factors.

Although social learning, social cognitive and Self-efficacy theories explicate the influence of individual and social factors on one's actions, they provide a general theoretical perceptive with minimal focus on students' career and academic behavior. In contrast, Social cognitive career theory (SCCT) presents a holistic framework for understanding career development. Based on Bandura's social learning, social cognitive, and Self-efficacy theory, SCCT posits that students' career interest and choices are an outcome of personal and social influencers, namely their perceptions of their ability to succeed in performing in given task and achieve desired outcomes and goals. Thus, three of the identified theories are encompassed by SCCT.

The third most commonly cited theory is Shapero's entrepreneurial event (SEE) theory. In contrast with other theories (Table 2), SEE is not a derivative of other prior theoretical work. Table 2 presents the list of commonly used theories in entrepreneurship assessment literature and key references. In the next sections, we describe and present a synthesis of the three overarching theories—Theory of planned behavior (TPB), Shapero's entrepreneurial event theory (SEE) and Social cognitive career theory (SCCT).

4.3 Synthesis

4.3.1 Theory of planned behavior

Azjen's (1988) Theory of planned behavior (TPB) is the most commonly used theory in framing business entrepreneurship education. TPB incorporates central concepts in social and behavioral sciences to predict and explain behaviors. According to TPB, intent is a fundamental cognitive determinant of

Table 2. List of commonly used theories in entrepreneurship assessment literature

Theory	Number of Studies	Key Reference
Theory of Planned Behavior	121	Ajzen [39]
Theory of Reasoned Action	10	Fishbein [42]
Social Cognitive Career Theory	14	Lent, Brown [40]
Social Cognitive Theory	23	Bandura [45]
Social Learning Theory	18	Bandura and Walters [43]
Self-Efficacy Theory	11	Bandura [44]
Shapero's Entrepreneurial Event Theory	25	Shapero and Sokol [41]

behavior; the stronger an individual's intent to engage in a specific behavior, the more likely s/he is to perform that behavior. There is significant empirical evidence of the predictive validity of TPB for several different behaviors, including lying, cheating, and playing video games [39].

TPB was first shown to be applicable for predicting entrepreneurial intent by Kolvereid [47], who validated TPB for predicting undergraduate self-employment career intention in undergraduate business students. Since that first study, TPB has been the most commonly used theory for studying entrepreneurial intent [48, 49], the intention to start a new business [50]. TPB posits that the likelihood that an individual will engage in entrepreneurial behavior is mediated by his intent to start a new business. This intent (and consequently behavior) is influenced by an individual's general attitudes and beliefs as well as external factors (Fig. 1a), including an individual's: (1) attitude towards entrepreneurial behavior; (2) perceived social pressure to pursue or not pursue entrepreneurship (subjective norm); and (3) and perception of ease or difficulty of pursuing entrepreneurship (perceived behavioral control).

4.3.2 Entrepreneurial event theory

Shapero and Sokol [41] Entrepreneurial Event Theory (SEE) captures entrepreneurial action taken by anyone, not just entrepreneurs. In SEE, an individual's pursuit of entrepreneurial behavior is a product of the individual's social and cultural environments. An individual's change in behavior is motivated by life transitions and decision-making is based on the best available options [51].The choice of the best available option is influenced by the individual's perceived feasibility and desire for that option. This desirability and perceptions of feasibility are mediated by various factors that are part of one's social and cultural environments such as financial and other support from family, peers, and mentors. Thus, the formation of an entrepreneurial event or the demonstration of entrepreneurial behavior is mediated by life transitions, the strength of desirability and the feasibility one holds towards the entrepreneurial behavior. Exter-

nal factors such as society and culture play a decisive role in determining how strongly one perceives the desirability and feasibility of an entrepreneurial behavior.

4.3.3 Social cognitive career theory

Social cognitive career theory (SCCT) provides a framework for understanding students' academic and career choices through a lens of motivational and cognitive processes. Specifically, three variables influence a student's career interest and choice: self-efficacy, outcome expectations, and goals. Self-efficacy is one's perception of his/her abilities to successfully perform a specific task. Self-efficacy is derived from past experiences and is also mediated by social and environmental influencers. Outcome expectations pertain to beliefs about the extent to which one's engagement in a behavior will lead to a desired outcome. Finally, goals are described as one' intentions to perform a specific behavior. An individual is more likely to engage in a specific behavior if the outcome is aligned with his/her goals. However, the theory also posits that individuals often set goals that are in line with their beliefs of their abilities (self-efficacy) and the results they expect to achieve from performing a behavior (outcome expectations).

4.3.4 Comparison of TPB, SEE and SCCT

TPB and SEE provide informative theoretical perspectives for understanding entrepreneurial behavior, while SCCT presents an examination of career development from a socio-cognitive perspective. Significant parallels exist between TPB, SEE and SCCT. First, the three theories identify an individual's confidence in his/her ability to perform the behavior or self-efficacy as a critical antecedent to entrepreneurial behavior and/or career choices. While the variable 'self-efficacy' is explicitly used in SCCT, it corresponds to perceived behavioral control in TPB and perceived feasibility in SEE. Second, both TPB and SEE include the influence of individual's attitudes towards a behavior and mediating impact of social factors on the attitudes in predicting that behavior. In TPB, attitude and
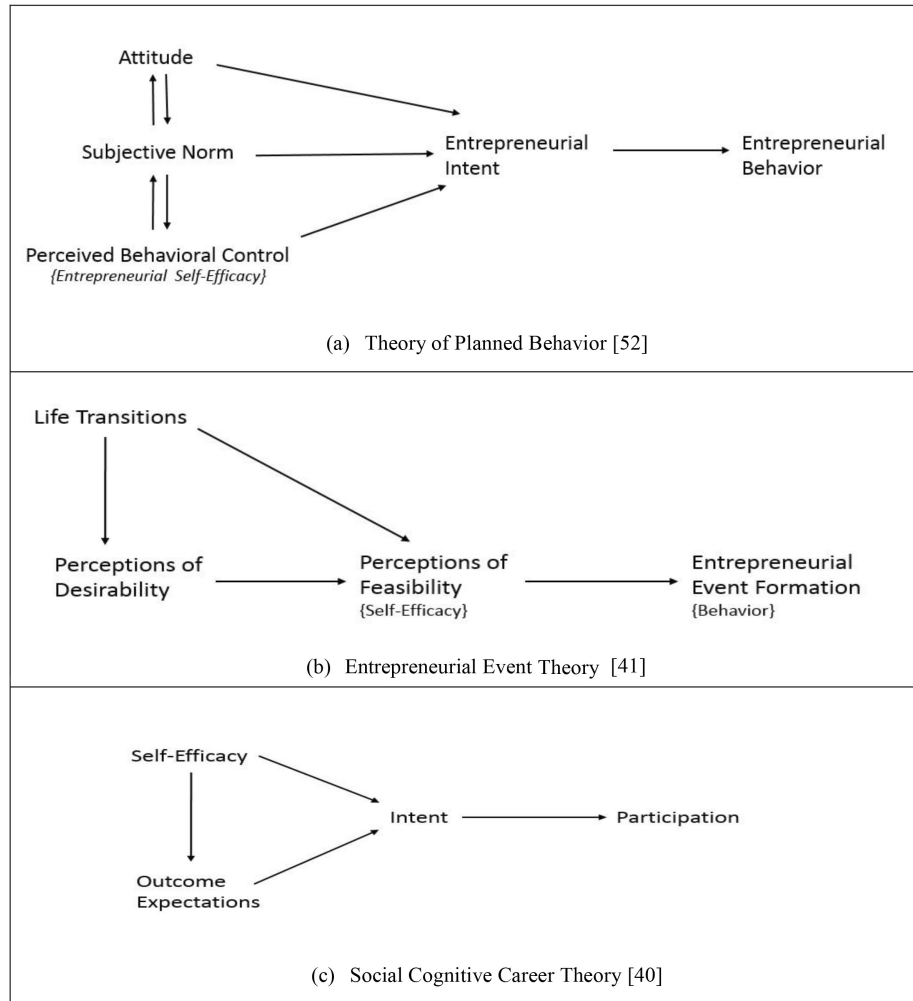
Fig. 1. Models of Entrepreneurship Assessment Theories.

subjective norms are presented as separate constructs. In SEE, the concept of perceived desirability includes both TPB's attitude and subjective norms.

In addition to these parallels, SCCT and SEE incorporate additional, unique constructs that are not presented in TPB. In contrast to TPB and SCCT, SEE introduces the construct of life transitions, which accounts for external life events that may impact one's decision to engage in a particular behavior. Similarly, SCCT introduces the importance of an individual's goals and expectations of participating in a particular behavior and the ability to meet his/her desired goals. Overall, with the only exception of life transitions in SEE, the three dominant theories used in entrepreneurship assessment literature are primarily inward facing, focusing on the individual as opposed to external influences and barriers. This implies that the majority of existing entrepreneurship education research has paid minimal attention to external factors. The models entrepreneurship theories are presented in Fig. 1.

4.3.5 Mapping to chain of response model

In contrast to the three theories (TPB, SCCT and SEE), the COR model offers a comprehensive approach to studying participation in education programs. It includes a wide spectrum of internal and external variables, taking into the account both the perspective of individual and outside influences. Our review of the COR model, TPB, and SEE, shows that the COR model shares several internal variables commonly studied in entrepreneurship education (Table 3). For example, 'self-evaluation' or one's confidence in his/her abilities constitutes the conceptions of perceived behavioral control (TPB), perceived feasibility (SEE) and self-efficacy (SCCT). In a similar manner, 'attitudes about education' encompasses attitude towards performing a behavior (TPB) and perceived desirability (SEE).

Table 3 illustrates that although the COR model accounts for both external and internal influencers of participation, it provides a generic conceptualization rather than a targeted model comprising of

Table 3. Comparison of Chain of Response, Theory of Planned Behavior and Shapero's Entrepreneurial Theory Variables *(Note: In instances where there was no correlate between theories, the box was shaded)*

	Chain of Response	Theory of Planned Behavior	Shapero's Entrepreneurial Theory	Social Cognitive Career Theory
Internal	Self-Evaluation	Perceived Behavioral Control	Perceived Feasibility	Self-Efficacy
	Attitudes about Education	Attitude	Perceived Desirability	
		Subjective Norm		
	Goals & Expectations			Outcome Expectations and Goals
External	Life Transition		Life Transition	
	Opportunities and Barriers			
	Information			

entrepreneurship-specific variables. To improve student participation in entrepreneurship education programs, it is important to develop a holistic understanding of all variables that may impact participation [53]. Minimal theoretical attention has been devoted to examining participation in engineering entrepreneurship programs. To contribute to the advancement of engineering education, it is important to develop theoretical foundations based on prior work to better inform practice and education research [19]. Using the COR model as our guiding framework and incorporating relevant entrepreneurship theories, in the analysis section, we present our Participation in Entrepreneurship Education Programs (PEEP) framework.

4.4 Analysis—Participation in Entrepreneurship Education Programs model

Building from the search, appraisal, and synthesis stages, we have developed a new model, the *Participation in Entrepreneurship Education Programs* (PEEP) model as a synthesis of student participation and entrepreneurship education theories. Guided by the COR participation model and incorporating entrepreneurship relevant theory (TPB, SCCT and SEE), the PEEP model captures the underlying assumption that participation in EP and the corresponding entrepreneurial behavior is not a result of a single act but is rather regulated by multiple variables (Fig. 2).

4.4.1 Participation in entrepreneurship education programs

In the PEEP model, the final outcome variable is student participation in entrepreneurship programs. It should be noted that participation is also considered a regulating variable that may predict continued participation in future programs or endeavors. The PEEP model includes six regulating variables for student entrepreneurial behavior: entrepreneurial self-efficacy, desirability, entrepreneurial intent, life transitions, opportunities and barriers, and information and resources. Three subordinate variables commonly used in entrepreneurship education research: attitude, subjective norm, and goals and expectations are conceptualized as influencing desirability.

4.4.2 Entrepreneurial self-efficacy

Entrepreneurial self-efficacy (ESE) is one of the most widely studied constructs in entrepreneurship education [54–57]. Originating from Bandura's concept of general self-efficacy [58], ESE is described as one's personal belief in his/her ability to be an entrepreneur. Self-efficacy impacts how individuals think and motivate themselves to demonstrate spe-
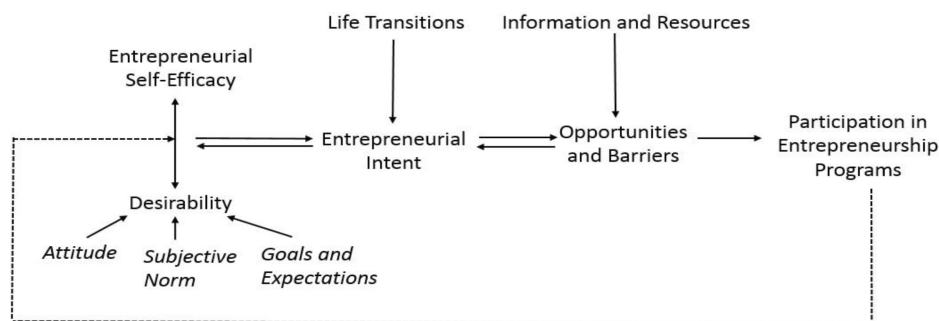

Fig. 2. Participation in Entrepreneurship Education Programs Model.

cific behaviors [44]. Individuals with a high sense of self-efficacy approach difficult tasks as challenges to overcome as opposed to threats to avoid, demonstrating an observable resilience [44]. In academic context, self-efficacy judgments influence students' interest [59], choice of activities and persistence in them [60].

The complexity of skills related to entrepreneurship has resulted in a broad interpretation of entrepreneurial self-efficacy (ESE) in the literature. Scholars differ in their interpretation of context, the specific factors to be delineated and how to interpret and report the results [54–57]. However, overall ESE is typically formulized as a measure of individuals' beliefs in their "ability to successfully launch an entrepreneurial venture" [56]. In spite of variations in defining ESE, there is undoubtedly a consensus on the importance of considering the impact of ESE for examining entrepreneurship education efforts. Thus, in the case of entrepreneurship education, entrepreneurial self-efficacy may impact students' interests and participation in EP.

4.4.3 Desirability

An individual's desirability of a particular outcome is dependent on the value he/she places on the targeted outcome. Leveraging the COR model, SEE and TPB, desirability is conceptualized as an outcome mediated by an individual's attitudes, goals and expectations, and social factors (subjective norm). One's *attitude* towards a specific behavior is described as the "degree to which a person has a favorable or unfavorable evaluation or appraisal of the behavior in question" [39]. Thus, a favorable attitude is developed by one's positive evaluation of an outcome or if one sees value in engaging in a behavior, leading to high desirability. Goals and expectations also influence desirability. If an individual can fulfill his/her goals and expectations by participating in a program, he/she will see the program as valuable and the program will be more desirable.

In addition, as argued in SEE and TPB, desirability is also influenced by social factors present in one's environment. For example, a social system that places high value on venture creation is more likely to create higher desirability for self-employment or venture creation than a system with contrasting values [41]. Termed as 'subjective norm' in TPB, these social factors account for "perceived social pressure to perform or not to perform the behavior" [39]. In other words, an individual will have more desirability to engage in a behavior if he/she places a higher value on a specific outcome, which will be governed by the attitude one has towards the outcome, the alignment of his/her goals and expectations with the outcome, and also

by the social approval of attitudes and goals that one holds towards a behavior. In the context of entrepreneurship education, the desirability to participate in EP will depend on one's attitudes towards such programs, their perceived judgment and subjective social approval in the ability of the program in meeting their goals and expectations.

4.4.4 Entrepreneurial intent

Entrepreneurial intent or the intention to start a new business is often used in entrepreneurship research as a predictor of entrepreneurial behavior [50, 61, 62]. For the purposes of PEEP, entrepreneurial intent is defined as an intention to initiate an entrepreneurial event as characterized by SEE. A student with higher entrepreneurial intent will be motivated to participate in an entrepreneurship program and view engagement as a conscious step in his/her future plans to initiate an entrepreneurial event. While intent is considered an essential driver for participation in entrepreneurial activities, existing research has suggested that entrepreneurial intent is often moderated and mediated by personal and environmental factors [63]. In the context of our proposed model, these mediatory relationships elucidate the interaction of the variables with each other as presented in the model. For example, individuals' self-confidence performing entrepreneurial tasks and succeeding in entrepreneurship (ESE) will impact the level of intent one has towards entrepreneurial careers [39], which will moderate their motivation to participation in EP. Similarly, environmental factors such as perceived social pressure to pursue or not pursue entrepreneurship due to their life circumstances will mediate the intensity of their intent [39].

4.4.5 Life transitions

While entrepreneurial self-efficacy and desirability are important factors shaping entrepreneurial intent, other external factors may also influence an individual's entrepreneurial intent. Shapero and Sokol [41] argued that the desirability to engage in entrepreneurship or entrepreneurial intent is significantly regulated by individuals' judgment of feasibility of the entrepreneurial activity. This judgment of feasibility is further influenced and constrained by external events or changes occurring in individuals' life path [41]. Individuals possessing entrepreneurial intent may "not ever actually set up a new business because myriad personal circumstances and environmental factors may militate against this" [63].

Recognizing the range of life transitions that can affect college students, the PEEP model extends the definitional coverage of life transitions to both personal and academic events that may hinder or

facilitate students' participation in EP. For example, while a life event such as divorce might hinder entrepreneurial engagement, a senior student's commitment to the completion of final-year projects and graduation might also diminish their intent to start a new business or participate in entrepreneurial activities. Thus, depending on individual circumstances, the level of entrepreneurial intent will vary between students, informing their participation and persistence in EP.

4.4.6 Opportunities and barriers

Programmatic opportunities and barriers hold an important position in informing engineering students' participation due to the nascent state of engineering entrepreneurship programs which often leverage content from different subject areas, instructors from different fields and numerous pedagogies that are used to foster student engagement both in and outside of the classroom [64–68]. The presence of a diverse array of programmatic opportunities available to students today influences student participation in entrepreneurship program, either encouraging or discouraging participation. For example, in the context of instruction, while the demonstrated willingness of entrepreneurship educators to use various engagement methods has the potential to broaden the reach of entrepreneurship education, some pedagogical approaches may not be appropriate for all students and situations as audience heterogeneity continues to broaden. This mismatch may discourage students to participate in entrepreneurship programs.

However, analogous to the original model [26], opportunities and barriers hold a bidirectional relationship with entrepreneurial intent in the PEEP model. High intent will motivate individuals to overcome barriers by seeking out different opportunities in EP. Conversely, the presence of barriers and lack of special opportunities will negatively impact students' intent. For example, a senior-year female student with high intent might participate in entrepreneurship seminar that will help resolve workload conflicts with her other academic responsibilities such as senior design project. However, underrepresentation of women among the seminar speakers might negatively impact her intent and confidence to pursue entrepreneurial career. Thus, it is important to consider different aspects of EP programs that may serve as opportunities or barriers for students interested in participating in EP. Researchers have highlighted the need to understand the different instructional needs and preferences of entrepreneurship education participants in reference with their academic and socio-demographic conditions [65].

4.4.7 Information and resources

The availability of accurate information about the existence and structure of educational programs is critical for the recruitment of intended participants [26]. Participation in EP is dependent on the accessibility of information that links interested students to entrepreneurship programs. How, what, and from whom individuals learn about opportunities and resources can impact the way in which they perceive entrepreneurship and identification of suitable entrepreneurial opportunities, which will cumulatively impact their participation in EP.

Students access information about educational programs through several methods of information transfer on college campuses such as student advising, canvasing, email and student networks [69]. In addition, in an effort to keep with the rise of social media strategies for student outreach, university units have started to leverage new social media platforms to disseminate information about new and current educational opportunities [70]. Successful student advising outside of the traditional degree path is reliant on the students' proactive behavior to seek out advising and the advisor's awareness of all university programs and opportunities outside of advising discipline.

While information and student advising centers are an obvious choice for gaining access to information about educational programs, an individual's social and professional networks play a crucial role in providing access to information and resources. Often referred as 'social capital', these connected groups of people provides for sharing of resources among group members [71]. The importance of social capital for entrepreneurship has been recognized within the business community [e.g., 72]. While all groups have resources or social capital, only some groups will provide the specific type of capital (information, resources, and opportunities) that will enhance participation in EP and future entrepreneurial pursuits. Thus, the groups to which an individual belongs can greatly enhance or inhibit their future participation in EP.

5. Discussion

Entrepreneurship education research occurs in many communities, from business to engineering. As a consequence, researchers adopt theories and methodologies that work most effectively within specific contexts. While this is useful for endeavors on a local, disciplinary scale, entrepreneurship education research as a field of study can only become truly effective when scholars find a common ground from which to build global-scale understanding that transcends disciplinary boundaries. Effective

research begins with a theoretical grounding. Thus, effective engineering entrepreneurship education research that draws from pre-existing research requires a coalescence of theoretical paradigms that has emerged from disparate fields. By merging multiple theories into one overarching model, we provide the foundation from which systematic research into entrepreneurial program participation can be constructed across various disciplines.

The direct applicability of the COR model in entrepreneurship education is limited because it provides a general framework for studying student participation without catering to variables that may influence students' decisions in entrepreneurship education programs. Our presented work identifies these entrepreneurship specific key influencers that are derived from the most commonly used theories in entrepreneurship education assessment literature. In addition to combining the work from two disparate fields (entrepreneurship assessment and student participation), the model is critical in addressing the limitations of past research conducted in the two areas. Our review of entrepreneurship assessment literature shows that in addition to the limited use of theoretical frameworks to guide existing research, the commonly-used theories are primarily inward facing and do not take into account external factors that may influence individual decisions. On the other hand, although the COR model is inclusive of internal and external factors, it is limited in providing a model that captures the specific variables that are deemed important in entrepreneurship education.

The value of the PEEP model lies in the fact that it identifies internal factors noted in existing entrepreneurship theories and maps them on to past student participation work (COR model). The PEEP model considers the nature of the individual and the environment in which the individual is immersed in and is specifically designed for entrepreneurship education. For example: A senior student belonging to an entrepreneurial family might have more inclination to start a new enterprise (*desirability*). Due to family support, he/she might also have higher confidence in his/her abilities to perform entrepreneurship-related tasks (*entrepreneurial self-efficacy*). Cumulatively, this high desirability and entrepreneurial self-efficacy will help in developing a stronger intent to pursue entrepreneurship in the student (*entrepreneurial intent*). However, for a student in a final college year (*life transitions*), fulfilling departmental credit requirements might impact his/her decision to prioritize core disciplinary courses over elective entrepreneurship (*opportunities and barriers*). To resolve this problem, the student might consult with an academic advisor (*information and resources*). The advisor might direct the student to consider the option of auditing the entrepreneurship course and use the course project to claim credit for an independent study under a department faculty (*opportunities and barriers*).

The above example illustrates that the PEEP model can be used to better understand students' attitudes and motivations towards participation in entrepreneurship programs, research impact of the entrepreneurship environment on student engagement, identify how specific features of entrepreneurship programs influence student involvement, or contextualize how different types of students choose to engage in entrepreneurship education. The model is important for engineering education particularly due to the increased attention that entrepreneurship has received in engineering over the past decade. Several higher education institutions have initiated entrepreneurship programs across the globe to expose undergraduate engineering students to support the development of entrepreneurial engineers. While we concur that these programs are important, we argue that the ongoing and future efforts in engineering entrepreneurship education should be examined and informed by empirical means. The presented model provides a framework that can be used to explore engineering entrepreneurship programs and how students choose to engage. Findings from such research can be used to inform the creation of more effective, inclusive engineering entrepreneurship programs and encouraging students of diverse backgrounds to engage in such programming.

Although engineering education researchers were the main target audience of this work, the framework presented here is not unique to engineering education and can be used in different disciplinary contexts. Researchers can use the model to examine the influence of the model's variables on each other and on students' decisions to engage in different informal and formal entrepreneurship programs. Researchers can also utilize the model to study differences in regard with student participation across student demographics such as gender and race. These studies can unpack the differences across student groups by examining the PEEP model variables and their interrelationships through different theoretical lenses (e.g., gender role theory and critical race theory). Results of such findings can be used to create entrepreneurship education programs that most effectively engage a broad and inclusive student population.

The model also holds applicability to instructors and program administrators. For instructors, the PEEP model provides a list of variables that may take into account when designing their courses. For example, the instructors may consider the link

between programmatic barriers such type of pedagogy and entrepreneurial intent to decide what instruction they should be using to help foster entrepreneurial intent in their students. Administrators can use the model to better design their entrepreneurship programs. The model provides variables that administrators may take into consideration when designing new programs and revise the existing ones to encourage participation from a diverse population of students.

6. Limitations

The systematic search methodology followed in our work strengthens the design of the framework and credibility that it is inclusive of the most common theories used in entrepreneurship assessment literature. Although published work serves as a resource to develop a framework, we recognize that it may not present the complete picture. In addition, we acknowledge the selection bias that our framework is derived from the most commonly cited theories in entrepreneurship assessment literature and is not all-inclusive. We also acknowledge that the presented work is entirely theoretical, lacking empirical validation. In our ongoing work, we are in the process of validating the framework through qualitative interviews and follow-up quantitative surveys conducted with engineering students and alumni. Our preliminary qualitative findings confirm the presence of variables discussed in the framework.

7. Conclusion

Prior work in entrepreneurship education has examined different variables in the context of commonly used theories such as theory of planned behavior. While we recognize the contribution of these studies, the majority of them have been conducted in isolation with minimal or no effort put towards constructing a holistic understanding of student participation in entrepreneurship programs. As a result, there is a lack of consistency in common language and theories that should be used to guide research in the rapidly growing area of engineering entrepreneurship. Our presented PEEP model was developed after systematically examining commonly used theories in entrepreneurship assessment literature. The PEEP model brings disparate approaches together into a single unified framework for studying student participation in entrepreneurship education programs. As cautioned by engineering education researchers, instead of reinventing the wheel, our work presents a framework conceptualizing student participation in entrepreneurship programs based on existing literature. This work is particularly useful for the advancement of engineering education considering the nascent state of engineering entrepreneurship.

Engineering entrepreneurship programs have emerged out of traditional business fields and evolved to be complex programs that aim in developing a wide range of attributes in engineers. Due to the lack of a foundational framework, these programs are different in structure and intended goals. As a result, there is an ongoing debate in the engineering education community on how these programs should be developed, what outcomes should be assessed and what the future of entrepreneurship education for engineers should look like? Administrators and practitioners often focus on course or program level outcomes for individual students and other influencers get less attention during program development and improvement.

In recognition of the need for engineering entrepreneurship education to cultivate future innovators, programs need to be particularly cognizant of how to increase broad student engagement. Our framework offers researchers, practitioners and administrators a means of examining how to develop more inclusive and diverse programing. The framework identifies critical influencers that can be measured to examine broad student engagement. For example, administrators can evaluate opportunities and barriers related to pedagogy and curriculum. They can assess which pedagogies are effective in achieving the desired outcomes and are in alignment with different student population preferences. This understanding can be used to attract a diverse student population to entrepreneurship programming and education. Also, curriculum can be examined to assess its value and relevance to students from different engineering disciplines such as mechanical and electrical engineering. Similarly, entrepreneurial self-efficacy of non-participating students can be studied to identify which student populations need more encouragement to engage in entrepreneurship programs and devise programmatic approaches accordingly. These examples reiterate that entrepreneurship education is complex and engineering students' participation in such programs is a result of multiple variables and their interactions. Administrators, practitioners and researchers should be wary of these mediating variables and perform more holistic yet targeted efforts to improve engineering entrepreneurship education and student engagement.

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