From Entrepreneur to Designer: The Transferable Design Principles of the Entrepreneur

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Abstract

The competencies and outcomes of entrepreneurial activities spark the interest of many stakeholders across innovation ecosystems – governments, companies, entrepreneurs, and educational institutions alike. Typically, those of an entrepreneurial bent are sought after for their ability to create new ventures and deliver multiple forms of societal value, such as creating jobs, bolstering the economy, and translating technology into real world applications. Yet, beyond these outcomes, at the core of entrepreneurial activities is a qualitatively distinct design approach; and thus an entrepreneurial mindset has the potential to be a powerful philosophy to scaffold thinking and solve problems in any domain. However, very little has been explicitly written about how this mindset and problem-solving philosophy could map to domains in which new ventures are not a desired outcome.

This paper focuses on synthesizing and distilling the design and problem-solving strategies of the entrepreneur to make them broadly applicable beyond business centric contexts. The paper reviews multiple literature streams in entrepreneurship, entrepreneurial expertise, effectuation, entrepreneurial firm design, and entrepreneurial opportunity recognition, problem-solving and decision-making using Boyer’s scholarship of integration lens as a guiding approach. This approach places value on integrating insights into new language that unifies concepts often dispersed across domains. Emphasis is placed on the design (problem solving) principles of entrepreneurs and their applicability across contexts, synthesizing such principles in a proposed framework of entrepreneurship as a problem-solving philosophy. Overall, the paper complements current research streams in entrepreneurship by helping further characterize the entrepreneurial method, while simultaneously opening new research and teaching directions, thus enriching the engineering education space and related fields.

Introduction

From the work of Cantillon [1], Knight [2], and Schumpeter [3], to more recent efforts by Casson [4], Gartner [5], Shane [6] and Sarasvathy [7], entrepreneurship is a field with a rich historical tradition. This field examines the mechanisms by which opportunities to create value are discovered, evaluated and exploited (e.g., how, by whom, and what results of them), and thus involves the nexus of an opportunity and enterprising individuals [6, 8, 9]. There are many different ways by which entrepreneurs can be characterized: by their function (e.g., innovate, take or avoid risk, create organizations), role (e.g., firm founder, intrapreneurial owner-manager), personality (imaginative, self-confident, pragmatic), competence/skills (good judgment, big picture thinking), behaviors (e.g., making timely decisions, building consensus), and performance (e.g., number of ventures created, accumulation of wealth and reputation,
successes/failures) [10]. Entrepreneurship is therefore not a static concept, and multiple perspectives exist to characterize what makes entrepreneurs entrepreneurial – which could go well beyond traditionally assumed business centric contexts and venture creation roles.

The term entrepreneurship, however, is often associated with business building [6] whether in new venture or intrapreneurial contexts, even though some of the most salient characteristics in central theories of entrepreneurship potentially transcend this singular purpose [11]. Some of these characteristics, for example, include: risk taker and insurer [1], manager of risk and uncertainty [2], decision maker in novel situations [3], decision maker with imperfect information [4], opportunity recognizer [9], and builder of new goals and means given an initial set of means, knowledge, and relationships [7]. Casson [4], for example, argues that “the title of entrepreneur should, however, be confined to an owner or manager who exhibits the key trait of entrepreneurship: judgment in decision making. Judgment is a capacity for making a successful decision when no obviously correct model or decision rule is available or when relevant data is unreliable or incomplete.” Similarly, Sarasvathy [12] suggests that “entrepreneurs are entrepreneurial, as differentiated from managerial and strategic, because they think effectually: they believe in a yet to be made future that can substantially be shaped by human action; and they realize that to the extent that this human action can control the future, they need not expend energies trying to predict it” and that entrepreneurial reasoning demands “imagination, spontaneity, [calculated] risk-taking, and salesmanship.” Sarasvathy and Venkatamaran [11] even suggest that entrepreneurship, though at an early stage, has potential to become as significant as the scientific method over time.

Implicit across these perspectives is the notion that entrepreneurship has potential to play a much broader role throughout society – beyond creating new ventures, bringing new solutions to market, or creating new markets. Yet in multiple fields, such as engineering education, there is a tendency to view entrepreneurship as business building [13], even though some entrepreneurship scholars (e.g.,[6, 11]) find this worldview problematic. Although there is recognition that the benefits of entrepreneurship education may transcend business-related competencies and, for instance, link to multiple ABET criteria [14], discussions of entrepreneurship education tend to focus on business-centric offerings and outcomes (e.g., business skills, small business creation, intrapreneurship, tech startups) [13, 15, 16]. Although valuable and important for economics and business-related aspects of entrepreneurship, this venture-creation perspective could limit the application of entrepreneurial principles in new contexts where they could be useful; for example, academic engineering research or engineering design.

There thus seems to be potential in extending notions of entrepreneurship, by framing it as a qualitatively different type of design and problems-solving activity. What if, for example, one wanted to frame and make decisions for non-business related tasks/activities with an entrepreneurial lens? One could imagine, for instance, entrepreneurial approaches to graduate engineering research, undergraduate engineering design, or, beyond engineering, a social or scientific movement. In social contexts, consider the microfinance movement, which did not begin with the intention of addressing financial issues for the poor, but as an effort to understand and reduce famine in Bangladesh [17]. This movement could be considered “entrepreneurial” in a broader sense because a distinct set of related issues seem to have been at its core: deviations in goals (e.g., reducing famine, improving irrigation, addressing farming ecosystem challenges,
helping the poorest segment of the population), changes in context (e.g., agricultural techniques, irrigation, farming ecosystems, value chains), different end users (e.g., farmers, landowners, marginalized workers) and operating model pivots (e.g., university action research project, farming cooperative, informal bank for the poor, institutionalized bank for the poor).

In engineering, examination of case studies could shed light on what it means to be entrepreneurial in purely technical and conceptual contexts. Such an examination calls for translational activities that help unearth the mechanisms that embody the entrepreneurial method. These translational activities should synthesize and integrate entrepreneurship concepts into larger frameworks, and illustrate how entrepreneurial principles apply across contexts.

In this light, this paper provides a framework of entrepreneurship as a design philosophy, shown in Figure 1. Such a perspective describes entrepreneurship as a set of principles that are applicable to multiple fields and problem spaces. This perspective is developed through a scholarship of integration (SOI), an emerging use-inspired approach grounded on the report *Scholarship Reconsidered* [18], which consists of placing one’s research and the research of others into larger frameworks that can generate re-interpretation of knowledge, while simultaneously opening up new research and practice directions [19]. Here, we propose that a perspective of entrepreneurship as a design philosophy helps align and translate many entrepreneurship concepts and bodies of related literature for a broad array of fields, and in particular for the engineering education space. In this paper, design is defined as a “goal-directed problem-solving activity [20] that initiates change in human made things [21], and involves optimizing parameters [22] and balancing tradeoffs to meet targeted user needs [23]” [24] (p. 739). The framework, however, is not claimed to be normative; it only provides a starting point that aims to stimulate discussion in the entrepreneurship and engineering education communities regarding the broader applicability of the entrepreneurial method.

The paper unpacks this framework of entrepreneurship as a design philosophy as follows. The paper first describes the SOI approach employed to develop the framework. Each component of the framework is then presented, making visible the links to the isolated research and practice insights that informed it and their connections within the framework. The paper then concludes with a discussion of implications for the fields of engineering education, and entrepreneurship education, including an invitation to the community to build on the framework described herein.
Figure 1. A framework of entrepreneurial design and problem solving
A Scholarship of Integration Approach to Building Frameworks

An approach that is useful in the development of use-inspired frameworks is the scholarship of integration (SOI) [19]. This approach, based on one of Boyer’s four forms of scholarship (discovery, application, integration, teaching) [18], focuses on connecting isolated knowledge within and across perspectives and disciplines, which leads to new insights and language, places specialized knowledge in a broader context, and reveals patterns that are useful to researchers and practitioners. Although it has been slower to gain acceptance as a scholarly activity relative to other forms of scholarship, SOI efforts are becoming more central to research, because they emphasize interdisciplinary endeavors, and help create unifying frameworks that transcend historically or culturally imposed worldviews, boundaries, and research directions [25].

Scholarship of integration studies tend to use approaches categorically related to literature reviews (e.g., meta-analysis, systematic literature reviews), potentially mixed with other approaches (e.g., case studies, surveys, verbal protocols) in highly iterative cycles that generate frameworks as byproducts, among other types of outcomes [19, 24]. These use-inspired frameworks can help support evidence-based decision making, address practice-related issues of high concern, stimulate reflective practice, enhance teaching [26] as well as create new directions in research and practice [19]. It is “serious, disciplined work that seeks to interpret, draw together, and bring insight to bear on original research” and aims to fit one’s own research and the research of others into larger patterns [18] (p. 19).

In this study, the scholarship of integration aims to create a framework that illustrates the mindset, processes, and behaviors of the entrepreneur for uses beyond business-centric contexts, and in particular for design and problem-solving purposes. These dimensions of focus are inspired by work in the field of education, which focuses on the possible variations in thinking, acting, and being that illustrate multiple trajectories for becoming a “professional” [27], which in the design space has been used to open up conversations of what it means to be a design professional [28]. Herein, mindset refers to the attitudinal traits that are often associated with entrepreneurs. Processes describe the methods and activities used by entrepreneurs to transform inputs into outputs. Finally, behaviors codify the patterns of thought and action that are used to carry out the multiple activities involved in entrepreneurial processes. As a clarifying note, a behaviorist perspective of the term “behavior” is not advocated, as it is considered that thought and action should not be separated in these patterns [29].

The framework aims to help define what it means to be entrepreneurial in contexts such as engineering, where multiple applications of the entrepreneurial mindset, processes, and behaviors likely exist. Mapping existing entrepreneurship research in a framework that integrates the mindset, processes, and behaviors can potentially illustrate multiple trajectories for entrepreneurialism that go beyond culturally imposed contexts, and that highlight entrepreneurship as a broader method.

To achieve this, we review research related to entrepreneurship across contexts: management, strategy, economics, entrepreneurship, entrepreneurial cognition, entrepreneurship education, and engineering education, as well as practitioner frameworks of entrepreneurship. Rather than attempting to create a survey of the literature, the emphasis of this scholarship of integration
effort is on re-interpreting and translating entrepreneurship research into a framework that is not bounded by business-centric phenomena and concepts. As such, the work described herein emphasizes language creation beyond synthesis. These integration and language creation activities were aligned with a set of dimensions that guide and create boundaries for the framework. Dimensions considered herein include: 1) emphasis on capturing elements of entrepreneurial mindset, processes, and behaviors in an attempt to create a holistic framework, 2) links to design and problem solving while simultaneously retaining the essence of entrepreneurial activities, 3) explicit links to established entrepreneurship research and/or practice literature, and 4) detachment from business-centric contexts.

This SOI activity is highly iterative and focuses on distilling the essence of the entrepreneurial mindset, behaviors, and processes, placing such de-contextualized insights into an organized framework that the authors believe can help facilitate their use across contexts. Iterations of the framework were pursued with an end-user in mind, here stakeholders (e.g., faculty, graduate students) interested in broadening their design and problem-solving skills in engineering and engineering education contexts, as well as those interested in research on engineering entrepreneurship education. The end product is an expansive and broadly applicable framework that provides insight into entrepreneurial characteristics that may have transferability into other problem solving domains.

**Entrepreneurship as a Generic Design and Problem Solving Philosophy**

The following sections unpack each of the elements of the framework of entrepreneurship as a design and problem-solving philosophy, shown in Figure 1. Each element of the framework is presented, making visible its links to entrepreneurship research or practice and then translated into a “first principles” (i.e., generalizable) construct that is more broadly applicable. As a reminder, the framework presented herein and its elements only provide a generative/starting point for future efforts on characterizing entrepreneurship as a qualitatively different way of addressing design challenges.

**Mindset**

Research has shown that the way you view yourself, i.e., your mindset, affects various aspects of one’s life [30, 31], likely including our ability to frame problems and design solutions to address challenges. Although each individual entrepreneur is unique, research has suggested that their collection of worldviews and attitudes, i.e., the entrepreneurial mindset [32], has a unique set of features that influences our ability to frame and solve problems in pursuit of desired outcomes.

For example, the concept of opportunity is central to the field of entrepreneurship [8, 33, 34], and this concept seems to play a key role in the entrepreneurial mindset. Entrepreneurs are often said to have a distinct alertness to opportunities, which often stems from being keenly aware of their worldview (e.g., industries, markets, technology landscape, society), which helps them detect weak and strong changes to it [35]. In broader design contexts, this likely implies the need to develop a sensitivity to changes in our working worldviews (e.g., technology trends in an engineering research field, or shifts in funding models for research programs) to be able to detect
changes that alert one of possible opportunities. Also related to the recognition of opportunities is the entrepreneur’s curiosity for the counterfactual [36, 37]. Effectively, entrepreneurs display a tendency to respond to stimuli that is perceived as unexpected [36]. While in business-centric contexts this disposition may lead to new venture opportunity identification, in broader contexts, this attitude can influence one’s ability to spot opportunities for new goals or means in domains such as engineering research or engineering design.

Other entrepreneurial mindset components suggested in extent research include a sense of a controllable future [38], comfort with ambiguity [39], and a willingness to learn and adapt [40-42]. These features likely stem from the separation of quantifiable risk and unmeasurable uncertainty described by Frank Knight [2], as entrepreneurs tend to have comfort with control, adaptation, and ambiguity, but tend to have risk preferences that span the risk-seeking—risk-averse spectrum [43, 44]. What this could mean for a generic entrepreneurial mindset is that while risk attitudes will have variance across problem solvers, mindset components that should likely be recognized (and fostered) as entrepreneurial should emphasize control over prediction, acceptance of the natural uncertainty that accompanies entrepreneurial efforts, and a disposition toward learning and change.

Still, other entrepreneurial attitudes are anchored on the entrepreneur’s action-orientation and grit, and include a bias toward action [45, 46], a strong sense of ownership [47], and commitment toward a vision [48]. Sometimes, entrepreneurs tend to have prior knowledge, experiences and/or perceive stimuli in their environment that confirm beliefs that starting a new venture is desirable and feasible [49], effectively displaying a bias toward action and commitment to their vision. Other times, the action-orientation and grit stem from the desire to be perceived as the inventor, founder, or developer of an idea [48], which reflects a deep interest in such an idea and desire to have a sense of ownership. These entrepreneurial attitudes are likely equally important in non business-centric contexts such as engineering design or scientific research, where a strong sense of ownership is developed as more efforts are invested in a research idea, and where individuals can likely be motivated by having “ownership” roles (i.e., inventor, founder, designer, developer). Effectively, while some people naturally display these traits, others can develop them through an interest in being identified as an inventor, founder, designer, or developer of a new idea.

Finally, entrepreneurship, like other forms of design, is an inherently social process since founders are typically joined by team members along a path to scale, and help make critical decisions for the directions of a new venture [50]. Similarly, an entrepreneurial approach to design likely requires a positive team attitude, and more research is required to understand mindset components of entrepreneurial design as a social activity, similar to efforts focused on understanding design as a social process (e.g., [51]).

Processes

Beyond mindset attributes, the second element of the framework focuses on processes (see Figure 1). Process theories are typically concerned with the transformation of inputs to outputs, and in entrepreneurial contexts they include the activities associated with perceiving opportunities and creating organizations or artifacts to pursue them [52]. A broad array of
entrepreneurship process models exist, both in research and practice, yet some commonalities exist across them [52].

Herein, features of three models are integrated: the “four steps to epiphany” [53] the “guide to growth” [54] and “effectuation” [7, 12, 55], shown in Figure 1. These models were selected because of their diversity, as they are representative of different entrepreneurial contexts – new venture development, intrapreneurship, and generic entrepreneurship, respectively – and are not meant to represent an exhaustive analysis of entrepreneurship process models. Our interest is instead in translating select aspects of these models for non-business centric contexts, and illustrating a gamut of strategies that are used in new venture, intrapreneurial, and effectual pursuits. Readers interested in a review of entrepreneurship process models are referred to Moroz and Hindle [52].

Analysis of these process models reveals an underlying structure that is synthesized into three stages: 1) a stage in which entrepreneurs recognize opportunities to pursue, 2) a stage in which they shape solutions iteratively and in action, and 3) a stage in which they progressively scale solutions. The following paragraphs unpack some common variations across the models, with the intent of showing the array of activities that can be employed in each of the aforementioned underlying stages.

With regard to recognizing opportunities, the aforementioned process models illustrate an array of activities that can be used to discover opportunities across contexts, or create opportunities given existing means. In the four steps to epiphany model [53], for instance, product hypotheses are developed by founding teams as product development is considered a separate activity from customer development. In generic design, this would be analogous to a team generating hypotheses for a solution to a challenge (in any given form), stating: what the solution/artifact consists of; who is the end user(s); what problem is solved for them; how will a solution be delivered; what other competing solutions exist for a given problem; how will end users learn (and why they will want a solution); and, for a solution that is part of an existing category, if it modifies such a category, or if it creates a new category. In contrast, the guide to growth approach [54] suggests that opportunities should come from pattern recognition activities, as well as awareness of the characteristics of a desired end goal. Emphasis is placed on problems that potential end-users cannot adequately solve – i.e., their “jobs to done” [56] – and devising means to address such problems; or on starting with an idea for a solution and thinking about who would “hire” that solution to solve a given problem. In a more generic opportunity recognition activity, the effectual model begins with an inventory of available means – knowing who you are, what you know (and likely what you don’t know), who you know, and what you can do. These in turn determine possibilities for what one can do in terms of interacting with people, identifying new means to pursue, or goals that can be addressed with existing means. As such, multiple process-based activities can be employed to recognize opportunities in entrepreneurial ways. In engineering, for instance, one might hypothesize, recognize patterns, or effectually identify end user problems that one could address by developing a technical or conceptual solution, or start from a solution and look for problems it could solve.

With regard to shaping solutions iteratively and in action, again these models offer a gamut of activities. Common across these processes are activities for shaping ideas, through highly
iterative cycles, and with a bias toward learning in action (i.e., learning from small experiments or actual implementation of solutions that generate insights for solution shaping purposes). Some of these activities include discovering end-users (i.e., engaging in a significant number of proactive interactions with potential end users), validating end-users (i.e., attempting to get end users to engage in early adoption or small trial), or creating end users (i.e., efforts to grow adoption after a set of small trials) [53]. Effectively, these activities focus on interactions with people and on building partnerships (e.g., through small trial) in an effort to co-shape solutions. Other activities in this stage can include actions to systematically document ideas (e.g., through preparation of idea resumes), assess solution performance, and evaluate the alignment of a solution with broader goals from a portfolio perspective [54].

With regard to progressively scaling solutions, the models offer an array of activities to consider. Many of these activities focus on discovering the path to success, rather than on predicting how to succeed. In addition, they emphasize departure from pre-established goals or means [55], effectively embracing what in the management sciences is termed an emergent strategy [42], as critical information is gathered through experiments or trials. Rather than implementing solutions at full scale, these entrepreneurial approaches emphasize a stepwise scaling of solutions to learn what will and will not work, by planning to learn [54] and proactively pursuing “smart” failure [57, 58]. Similar approaches could be useful in engineering and engineering education research and practice, where often times plans from deviate from originally envisioned paths.

**Behaviors**

Another component of the framework described herein, consists of behaviors, i.e., the patterns of thought and action that help implement the aforementioned process activities, synthesized in Table 1. This component of the framework is important, because some entrepreneurship scholars argue that “research on the entrepreneur should focus on what the entrepreneur does, not who the entrepreneur is” [5] (pg. 57). These behaviors constitute discrete patterns of thought and action that can be used at various stages of entrepreneurial problem-solving processes. They can be used as sequences of thought and action employed in reflective practice [59], teaching and learning goals [24], heuristics or strategies [60] that are specific to entrepreneurial design and applicable across contexts. As suggested in other design studies (e.g., [61, 62]), these behaviors could be used in parallel or sequential combinations and could likely change over the course of design instance, process stage, or project. Such behaviors were identified in the literature that focuses on the mechanisms by which entrepreneurs search for opportunities, and find and exploit them.
### Table 1. Synthesis of entrepreneurial behaviors

<table>
<thead>
<tr>
<th>Behavior</th>
<th>Illustrative References</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Study end users and empathize</td>
<td>[53, 54, 63]</td>
<td>Focusing on end users and their needs or problems as sources of opportunity, and iterative learning</td>
</tr>
<tr>
<td>Satisfice instead of optimize</td>
<td>[64-66]</td>
<td>Setting solution performance to “satisfactory/good enough” for faster benefits and learning, rather than seeking to completely optimize solutions</td>
</tr>
<tr>
<td>Employ heuristics and frameworks</td>
<td>[67]</td>
<td>Using patterns/frameworks to make rapid decisions, especially in high-velocity environments</td>
</tr>
<tr>
<td>Emphasize delivery mechanisms</td>
<td>[68, 69]</td>
<td>Thinking beyond a solution to consider how it will be delivered and operated, including business/operating models</td>
</tr>
<tr>
<td>Explore the counterintuitive</td>
<td>[36, 37, 54]</td>
<td>Thinking about alternatives even if they may counter conventional logic</td>
</tr>
<tr>
<td>Act on qualitative information</td>
<td>[54, 70, 71]</td>
<td>Using qualitative information when quantitative information is not available, impossible to obtain, or likely to be wrong</td>
</tr>
<tr>
<td>Play with combinations</td>
<td>[54, 68, 72-75]</td>
<td>Arranging and re-arranging solution components (e.g., performance, information, delivery model elements, resources, assets, relationships)</td>
</tr>
<tr>
<td>Imagine ends for existing means</td>
<td>[7, 12, 55, 76]</td>
<td>Imagining possible goals or new means to pursue (i.e., ends) based on a current inventory of existing means</td>
</tr>
<tr>
<td>Pivot from means contexts and goals</td>
<td>[12, 53, 77, 78]</td>
<td>Proactively deviating from existing means, contexts, goals, operating/business models as a result of learning, and adaptation activities</td>
</tr>
<tr>
<td>Re-shape external forces</td>
<td>[33, 55, 63]</td>
<td>Proactively addressing external forces (e.g., systems, macro economics, societal, cultural) affecting an entrepreneurial endeavor</td>
</tr>
<tr>
<td>Design and build organizations</td>
<td>[6, 54, 79, 80]</td>
<td>Creating and organizing teams and capabilities for entrepreneurial pursuits</td>
</tr>
<tr>
<td>Plan to learn and iterate</td>
<td>[41, 42, 54, 58, 78]</td>
<td>Pursuing highly iterative cycles of rapid experimentation for learning and adaptation purposes, considering affordable losses along the way</td>
</tr>
<tr>
<td>Leverage the unexpected</td>
<td>[7, 11, 12, 38, 55, 81]</td>
<td>Viewing unexpected outcomes as opportunities</td>
</tr>
<tr>
<td>Communicate via metaphors</td>
<td>[82]</td>
<td>Communicating the unusual in usual ways</td>
</tr>
</tbody>
</table>

### Outcomes

The final component of the framework consists of the outcomes of entrepreneurial design. Herein, we classify entrepreneurial outcomes by their links to the aforementioned process stages (although we recognize that some of these outcomes are likely relevant in other process stages as well, because design activities, by their very nature, are highly non-linear and iterative).

For example, entrepreneurial design can lead to outcomes related to **recognizing opportunities** that are likely valuable across an array of engineering and engineering education settings, such as:

- New view of opportunities
- New benefits
- New/different solutions
- New answers

Other outcomes of entrepreneurial design are likely related to **shaping solutions iteratively and in action** for any type of design activity, for instance:
• Counterintuitive paths
• Broader idea sets
• Speedy decisions

Still others can be linked to progressively scaling solutions. Such outcomes encompass typical entrepreneurship outcomes, such as venture creation, intrapreneurial pursuits, and social ventures, but also go beyond these outcomes to encompass:
• Startups
• Intrapreneurial ventures
• Social ventures
• Additional resources
• Stakeholder support
• Program/project scale

As such, the mindset, process, and behaviors of entrepreneurs are broadly applicable and could bring a number of benefits to the pursuit of new ventures, projects, solution development efforts, scientific discovery efforts, social movements and beyond. In the case of future engineers, a number of avenues likely exist to foster this mindset, process and related behaviors in students. The following section discusses possible ways to embed such mindset process and behaviors in students, researchers and practitioners, particularly in the context of engineering education.

Discussion

The varying mindset, process, and behaviors outlined in Figure 1 can be embedded across a space of entrepreneurial education offerings, as shown in Figure 2. This figure plots the nature of mindset-instilling experiences relative to the curricular-context in which they are conveyed, and highlights broad categories of pedagogical treatment – not exhaustive – that can be employed.

![Figure 2. Spectrum of Entrepreneurship Education Activities (Illustrative/Not-exhaustive)](image-url)
Though the mapping of the pedagogical approaches to entrepreneurship education is not definitive, Figure 2 highlights examples of activities that are likely needed to instill entrepreneurship as a generic design and problem-solving philosophy in students: from tailored courses in entrepreneurial problem-solving, to advisor-student workshops, multidisciplinary experiential learning courses, and collaborations with practice and industry. These activities are suggested as complementary to traditional entrepreneurship education offerings such as business plan competitions and entry-level entrepreneurship coursework.

The link between the framework in Figure 1 and the pedagogical approaches in Figure 2 is that the entrepreneurial mindset, processes, and behaviors in the framework represent learning goals that could be achieved through an array of pedagogical approaches. In what could be considered a “backward design” approach [83] to aligning curriculum, assessment, and pedagogy [84], the mindset, process, and behaviors could represent what we want students to know, what we want them to be able to do, and who we would like them to be. From this starting point, one can select assessment mechanisms and plan instruction activities accordingly. This backward design process should be aligned with the overall program curriculum to ensure that as many aspects of the entrepreneurial mindset, process, and behaviors as possible are instilled – based on the context, interests, and intent of a particular educational program. For example, in contexts where graduate level engineering research is a critical part of university-based activities, advisor-student workshops could be created to help instill behaviors such as exploring the counterintuitive, studying end users and empathizing, and pivoting from means, goals, and contexts with the goal of using such competencies (and having a shared vocabulary) in research activities. Similarly, one could create real-world, experiential collaborations with practitioners and industry that let undergraduate students develop other select entrepreneurial mindset, process and behavior components.

However, much is yet to be known about how the entrepreneurial mindset, processes, and behaviors are fostered across pedagogical activities. With this in mind, important questions to consider in the development of the entrepreneurial mindset, the adoption of entrepreneurial processes, and the cultivation of entrepreneurial behaviors include:

- What are the links between select elements of the framework in Figure 1, and the pedagogical activities in Figure 2?
- Which activities in Figure 2 are more suited to instill the entrepreneurial mindset, processes, and behaviors?
- What new types of experiences beyond those in Figure 2 could be developed to instill the mindset, processes, and behaviors in students?
- What content, assessment, and pedagogical approaches are appropriate for each element of the framework?
- How do holistic/phenomenographic views of entrepreneurship change as we attempt to instill entrepreneurship as a type of problem-solving competency?
Conclusions

In this paper, we created a framework of entrepreneurship as a design and problem-solving philosophy using Boyer’s scholarship of integration approach. Such a framework – consisting of mindset attributes, processes/activities, and behaviors of entrepreneurs – aims to position entrepreneurship as a broadly applicable form of design. Its aim is to provide a new perspective on the meaning of “being entrepreneurial” for the field of engineering education – one that goes far beyond the current venture creation emphasis, and that can be applied in broader engineering practice. Yet, efforts to position entrepreneurialism as a “method” are still in early stages, and more revisions on frameworks like the one created herein are needed. Thus we would like to invite the community to add elements to our framework or to include elements from this one to their own. One important point of consideration for future work in this regard, is to ensure that this type of framework truly captures aspects of entrepreneurship, distilling them from other related schools of thought, such as design and innovation (and acknowledge areas of overlap). Thus it is likely important to also study what is not entrepreneurship. Another important avenue for future work is related to the development of cases that document and exemplify the implementation of the framework in the classroom, in research, and in practice. Through these efforts, our ultimate goal is to democratize entrepreneurship, i.e., for it to move beyond technology commercialization and economic development, and become recognized as a qualitatively different form of design.

References


