Elements of Entrepreneurially Minded Learning: KEEN White Paper

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Abstract: Entrepreneurially Minded Learning (EML) is receiving attention within the KEEN community as it refers to a pedagogical approach emphasizing discovery, opportunity identification, and value creation, while building on other active pedagogies such as problem-based learning. The goal of EML is to go beyond delivering entrepreneurship knowledge and skills to students by providing them with opportunities to approach engineering problems and challenges in a more entrepreneurial way.

Among educators, faculty, administrators, and researchers involved with KEEN, there are questions related to the meaning of EML. These revolve around its definition, boundaries, and best practices for promoting it in engineering programs and classrooms. Some are uncertain about what is included in EML and the specific outcomes expected of programs designed to develop entrepreneurially minded engineering students. Others wonder how to assess the performance of EML initiatives, which are perceived as having goals and definitions that are much less concrete than those found in typical engineering curricula.

The purpose of this white paper is to summarize definitions and research on EML in a form that is accessible and practical for KEEN educators. It is not intended to be a comprehensive review of all academic literature related to entrepreneurship education. Instead, it is a targeted presentation of scholarship that frames the elements of EML. The summary provides a foundation upon which educators can build a rationale for EML-related pedagogical approaches and classroom practices that will change the minds (and lives) of the students they teach.

1. EML in Context

For many years, there has been debate in the field of entrepreneurship education about the degree to which entrepreneurs are “born” or “made” (Henry, Hill, & Leitch, 2005), and uncertainty around the extent to which entrepreneurship is a set of principles, terms, competencies, and skills that can be learned versus a set of attributes that make one opportunistic, competitive, proactive, risk tolerant, autonomous, and innovative (Caird, 1992; Kirby, 2004). Entrepreneurship education, which was traditionally housed in business schools, focused primarily on skills and knowledge relevant to new venture creation, thereby differentiating it from general management education, which emphasized preparation for employment in larger, more established organizations.

More recently, increasing attention is being given to the development of what is termed “entrepreneurial mindset,” which broadens the definition of entrepreneurship education beyond solely teaching students to form ventures (Lackeus, 2015). An entrepreneurial mindset has been defined as the way entrepreneurs think differently about given tasks (Haynie, Shepherd, Mosakowski, & Earley, 2010), and the cognitive strategies which provide them with the ability to rapidly sense, act, and mobilize, even under uncertain conditions (Ireland, Hitt, & Sirmon, 2003). It is believed that

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entrepreneurial cognition can be developed through education (Hisrich, Langan-Fox, & Grant, 2007). This has resonated with the engineering education community where: 1) there is a recognition that entrepreneurship education can provide an efficient context for teaching students how to generate economic and/or social value from their engineering knowledge; 2) companies of all sizes are seeking graduates with the mindset and intrapreneurial skills necessary to participate in firm renewal and revitalization (Antoncic & Hisrich, 2001); and 3) the reality is that many engineering graduates will continue to pursue employment in established organizations.

2. Where Does EML Fit?

Entrepreneurship education is a rapidly growing field with varied, and, at times conflicting, definitions and goals (Gorman, Hanlon, & King, 1997; Morris, Kuratko, & Cornwall, 2013). In order to describe what EML is, it may be helpful to describe what it isn’t. Due to the broadening definition of entrepreneurship education, it is important to situate EML among the various types of educational offerings that are available to students.

EML is not

- Focus solely on venture creation
- A repackaged business minor for engineering students
- Measured by how many startups are created by students

EML is

- Focused on developing mindsets and skills in students
- Preparing students to identify problems and solve them in innovative ways
- Measured by how students’ knowledge, thinking patterns, skills, and attitudes are changed

Given its expansion across academic disciplines and student populations, entrepreneurship education encompasses a wide range of curricular offerings and desired outcomes. One strategy for categorizing entrepreneurship education offerings is to use a matrix with two dimensions: 1) current intention to start a new venture, and 2) the level of uncertainty associated with the value proposition of a particular venture or value generating activity (Wheadon & Duval-Couetil, 2015). These were chosen because they represent learning outcomes associated with the goals/interests of differing student populations, and specific aspects of entrepreneurship education on which educators should focus depending on the quadrant in which they teach. Table 1 shows a matrix with four categories of entrepreneurship education offerings.

Table 1. Categorized emphases in entrepreneurship education offerings and outcomes

<table>
<thead>
<tr>
<th>Uncertainty/novelty of value proposition of a particular activity</th>
<th>Current intention to start new ventures</th>
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<tbody>
<tr>
<td>Low</td>
<td>Low Traditional business skills</td>
</tr>
<tr>
<td>High</td>
<td>High Small business creation</td>
</tr>
<tr>
<td>Intrapreneurship/Corporate entrepreneurship</td>
<td>Tech startup</td>
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Given that the purpose of KEEN’s EML initiative is to equip engineering students with the mindset they need to succeed in today’s economy and create value in society, it is not focused solely on outcomes such as small business creation or new tech startups. Instead, skills and knowledge associated with all of these activities are included in what students learn, but the focus is on
developing entrepreneurially minded engineers, whether or not they actually go on to create startups. Although there is a great deal of common content across the four quadrants, some elements of entrepreneurship education are emphasized differently, depending on the desired outcome and offering. For this reason, it is important to understand where EML fits within the broader entrepreneurship education landscape.

3. What Is Included in EML?

The benefits and intended outcomes of entrepreneurship education are broad, and researchers are only beginning to describe the many benefits that students derive from participation. This makes it difficult to create a definitive list of skills, traits, knowledge, and behaviors that students should exhibit. However, by leveraging educational research, this paper provides a foundational framework in which future work can identify, categorize, and integrate the desired outcomes of EML, and find the best practices for helping students to reach them.

Educational assessment literature identifies the outcomes of specific courses or programs by dividing measurable characteristics into three categories (Anderson & Bourke, 2010). The first category, cognitive characteristics, is concerned with different types of knowledge and one’s ability to recall, apply, or evaluate knowledge. The second is psychomotor characteristics, which includes one’s ability to act, move, and perform physical tasks. The third category is affective factors. These are associated with ways of feeling including interest, attitudes, values, self-esteem, or locus of control.

By adapting this framework slightly for specific use in entrepreneurship education, researchers have identified similar domains that can facilitate understanding of the elements of EML (Wheadon & Duval-Couetil, 2015). These adapted domains cover the three learning domains most relevant for EML and are shown in Figure 1.

![Figure 1. Entrepreneurial Learning Domains](image)

The adapted learning domains for EML are the affective domain, the thinking pattern domain, and the content knowledge/skills domain. These three domains describe the main elements of EML. In order to adopt an entrepreneurial mindset, a student must develop affective factors, such as interest, confidence, curiosity, and motivation. They also need to learn to think the way entrepreneurs think, and to look at problems with the same frameworks and approaches that entrepreneurs do. In addition, there are concepts and skills that students need to learn to be entrepreneurially minded. These include understanding how to identify and evaluate opportunities, analyze market data, and develop business models.
3.1. Affective Factors

In the context of Entrepreneurially Minded Learning, affective factors describe what students feel with regard to entrepreneurship education and careers. Much of the existing research in the field of entrepreneurship education concerns students’ entrepreneurial intentions. Studies show that the intention to become an entrepreneur is greatly shaped by students’ affective traits, such as self-confidence, self-efficacy, values, motivations, and interests (Rae & Carswell, 2001). A number of studies have shown the impact that entrepreneurial education has on these traits in university students in general (Rae & Woodier-Harris, 2013; Rideout & Gray, 2013), and on engineering students in particular (Duval-Couetil, Reed-Rhoads, & Haghighi, 2012).

In order to become more entrepreneurially minded, students will need to develop affective factors in addition to gaining the skills, knowledge, and thinking patterns of successful entrepreneurs. This paper will not (and cannot) exhaustively list the affective factors that students need to develop, but will illustrate with a few examples:

- Entrepreneurial self-efficacy—a belief that they can succeed in value-creating activity
- Orientation toward value creation—a desire to participate in creating new value
- Habitual curiosity—a drive to understand how things work, and how to make them work better

It is not important that educators understand and rigidly define every affective factor that students must develop. Instead, they should focus on the feelings, beliefs, and motivations of their students and seek to understand how different learning experiences contribute to the development of an entrepreneurial mindset.

3.2. Thinking Patterns

In recent years, there have been a number of exciting developments in the field of entrepreneurial cognition. Entrepreneurial cognition is concerned with how entrepreneurs think, especially how they think differently from non-entrepreneurs (Mitchell et al., 2007). Considering the situated, metacognitive nature of entrepreneurial mindset (Haynie et al., 2010), educators can, and should, help students to understand and develop thinking patterns that are utilized by successful entrepreneurs. Providing students with these thinking patterns will help them to create new value in whatever work they pursue.

The Theory of Effectuation (Sarasvathy, 2008) has gained particular attention and impacted entrepreneurship curricula in leading entrepreneurship programs in the United States and Europe. This theory posits that entrepreneurs rely more heavily on effectual logic, as opposed to the predictive logic typically employed by engineers. Effectual logic can be an important part of the thinking patterns domain of EML. It will help students to know how to start with the means they have at hand, move forward in uncertain situations, partner with other stakeholders, and dynamically respond to contingencies that inevitably arise when creating novel value (Read, Sarasvathy, Dew, Wiltbank, & Ohlsson, 2011). Although future research will likely uncover additional ways in which entrepreneurs think differently from others, these principles may serve as a foundation for educators’ attempts to help students think more entrepreneurially.

These thought patterns also provide support for KEEN’s stated emphasis on the 3 Cs: curiosity, connections, and creating value. Curiosity is manifested in the effectual thinker’s focus on learning and discovery over execution. Rather than creating a plan and avoiding unknowns, the effectual thinker’s curiosity pushes him or her to embrace the unknown and learn from new information. Connections are the basic tools of effectual thinking. Focusing on the means-at-hand forces a student
to make connections between their current knowledge, skills, and resources and the problems they face. Then, with an orientation toward adaptive partnership, the effectual thinker connects with others to find new ways to create value.

The Theory of Effectuation is not the final word on EML, but is a useful way of understanding the thinking patterns that underlie entrepreneurial action. By understanding and applying current research in entrepreneurial cognition, educators can provide students with educational experiences that will help them learn to create new value in highly uncertain situations.

3.3. Content Knowledge/Skills

Emphasis on developing an entrepreneurial mindset does not diminish the importance of content knowledge that students need. In order to think entrepreneurially, students need to be fluent in entrepreneurial language and understand concepts and processes associated with venture creation. Being comfortable with these nuts and bolts can have a positive impact on affective characteristics like self-efficacy, interest, and motivation.

Numerous studies have attempted to detail the entrepreneurial knowledge and skills that are relevant to modern engineering students (Besterfield-Sacre et al., 2013; Duval-Couetil, Kisenwether, Tranquilo, & Wheadon, 2013; Ferguson, Cawthorne, Ahn, & Ohland, 2013; Kleine & Yoder, 2011; Kriewall & Mekemson, 2010; Wheadon & Duval-Couetil, 2014). All of these efforts have contributed to better understanding of entrepreneurial learning pertinent to engineering students, but no single study has definitively catalogued all of the expected learning outcomes of entrepreneurship courses and programs. Although they do not perfectly agree, these studies share common elements that lay the foundation for further work in identifying the particular outcomes of entrepreneurship education:

- Opportunity recognition
- Design iteration and prototyping
- Market research and analysis
- Business models and processes
- Business structures and functions
- Intellectual property
- Project management
- Sales and marketing
- Strategic and financial planning
- Communication and presentation
- Leadership and ethics

Again, this list is not intended to be exhaustive, but is illustrative of the content knowledge and skills domain of entrepreneurial learning. Continued research should be conducted to integrate existing research and refine the identified outcomes of EML.

4. Pedagogical and Curricular Implications

Understanding the different entrepreneurial learning domains, gives educators a better framework for identifying the elements of entrepreneurship education and where EML fits within it. These frameworks serve as a guide for deciding what experiences to offer and what students should gain as a result of their learning. Although there is still not a concrete list of every affective characteristic, thinking pattern, and skill that students should acquire through entrepreneurship education, these frameworks provide some boundaries and give greater definition to EML and its activities. While there remains much opportunity to better understand pedagogical approaches and outcomes pertinent to engineering students, there are some elements of EML that we can be confident in:
In order to better create value in society, students need to learn how to discover, identify, and dig deeper into real problems rather than just solve given problems.

Learning how to think like an entrepreneur is at least as important as understanding entrepreneurship concepts.

Learning through experience and reflection is critical to entrepreneurship education due to the situated nature of entrepreneurial thought and action.

EML is student-centered and focused on developing a combination of affective factors, thinking patterns, knowledge, and skills.

It involves creating learning experiences through which students develop self-efficacy, value-orientation, interest, and curiosity.

It involves pedagogical approaches such as problem-based learning, active learning, and others (Hung, Jonassen, & Liu, 2008).

Curricula should focus on activities that help students develop skills and knowledge that will benefit them whether or not they create a new venture.

5. EML in the Classroom

Entrepreneurially minded learning is concerned with helping engineering students to think, act, and feel like entrepreneurs. This means that in the EML-focused classroom, educators will be concerned with developing students’ thinking patterns, skills, and affective traits.

Because entrepreneurial thought and action is situated in various contexts, it is not possible (or desirable) to create a checklist of exactly what must happen in the classroom. Instead, Table 2 provides a list of important elements identified by a working group convened by KEEN. Included with each element are specific classroom applications and “reflection questions.” Reflection questions are intended to prompt educators to consider how a new approach in their classroom can help students develop as entrepreneurs.

6. The Future of EML

The purpose of this document is to lay a foundation for future work in EML, not be the final word on the definition of EML or the perfect plan for implementing it in engineering courses and programs. Based on this foundation, there are a number of areas where future development and research are needed.

- Definition of the specific outcomes in the three learning domains (affective, thinking patterns, knowledge skills) pertinent to engineers: Considering EML’s focus, are there content areas in traditional entrepreneurship education that are more relevant (or less relevant) to engineering students? What affective traits are most valuable for entrepreneurs?

- Development of methods and course content that focus on what is currently known about entrepreneurial thinking (including the Theory of Effectuation): Should methods differ based on the course in which EML is integrated (e.g. a first-year statics course vs. a third-year thermodynamics course)? Does EML require dedicated entrepreneurship fundamentals or entrepreneurial thinking courses that are outside of the typical engineering curriculum?

- Resources for developing entrepreneurial affective factors in engineering students: Are there specific activities that are proven to help engineering students to feel more confidence or interest in entrepreneurial activity?

- Assessment strategies for characteristics in each domain: What methods can be used to effectively measure thinking patterns? What instruments currently exist to measure affective characteristics in entrepreneurship students? How effective are current instruments?
### Table 2. Key elements of entrepreneurial thought and action in the classroom

<table>
<thead>
<tr>
<th>Elements of EML</th>
<th>Classroom Applications</th>
<th>Reflection questions</th>
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<tbody>
<tr>
<td>EML is student-centered. Its whole purpose is to develop entrepreneurial traits in students. Learning should not be focused on content-coverage or venture creation. Those elements may be present, but are means to an end.</td>
<td>Student-centered pedagogies include active, collaborative, and problem-based learning, among others. Instructors should focus on what helps each student to develop in the three learning domains. Formative assessments, realistic problems, experiential learning, and reflective practice take precedence over students passively learning through lectures, readings, and tests.</td>
<td>How do educators let students take center stage in learning (especially when students are accustomed to being passive learners)? What would classes look like if students’ individual passions, interests, or future aspirations impacted the content and activities in an engineering course?</td>
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<tr>
<td>Learning how to identify and evaluate problems is as important as learning to solve them. Students need more practice finding and framing problems, rather than solving problems that are handed to them.</td>
<td>Instructors should find ways to allow students to find new problems to solve. Problem-focused brainstorming, anthropological observations, and root-cause analysis are a few ways that students can learn to think more about the problem before jumping to a solution.</td>
<td>What if, instead of giving students problems that require engineering content knowledge gained in a course, students were challenged to find problems that could be solved using what they had learned?</td>
</tr>
<tr>
<td>Metacognition is important to an entrepreneurial mindset. Students should learn to employ the same types of logic and thinking patterns that entrepreneurs use.</td>
<td>Instructors should understand and explicitly teach entrepreneurial thinking patterns. Students should learn to use thinking patterns or heuristics that are most effective given their situations.</td>
<td>What if students were graded on how they thought, rather than the content of their answers? How would that change the way they approach problems? How would it change the way educators assess learning?</td>
</tr>
<tr>
<td>EML emphasizes action. Most engineering coursework is learning how to plan projects and predict how they will work. EML pushes students to move forward in uncertainty, and improve as they learn.</td>
<td>Instructors can help students identify the means they have at hand and guide them to create value for others using their particular talents, desires, knowledge, and social connections. Instructors can encourage students to bring in outside perspectives, materials, and knowledge to apply to their projects.</td>
<td>What if final design projects were due the first week of class, and then were improved throughout the semester based on what students learned? How would that affect their ability to move forward in uncertainty?</td>
</tr>
<tr>
<td>Reflection is one of the most important factors in learning both entrepreneurship and design.</td>
<td>Instructors must give students opportunities to reflect on their experiences. These can be debriefs on projects, formative assessments, written reflections, or group/class discussions. If students are unaccustomed to reflection, it is helpful for instructors to provide suggested questions or format.</td>
<td>What if design projects were graded on how much they changed as a result of reflection and feedback (rather than meeting specific criteria)?</td>
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References


