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Towards a Sustainable Engineering Entrepreneurship Education

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Abstract

Efforts are ongoing to actively engage private and public educational administrators, community leaders, non-government agencies, state and local government leaders, and other entrepreneurial ecosystems to embrace entrepreneurship. These ecosystems are expected to provide the platform where students can develop ideas that will shape and transform their future. The goal will be to create outstanding opportunities for sustainable growth. For example, the current higher education pedagogy will require taking a closer look at the unique assets of colleges and universities in order to align curricula and institutional programs with industry needs. Engineering entrepreneurship education should focus on teaching young adults, at earlier ages, about innovation and the associated challenges. Some of these challenges include sustainability, access, safety, and lack of awareness. The paper will discuss the challenges, ideas, long-term approaches as well as general insights on how institutions can integrate core entrepreneurship values into the academic curriculum.

Introduction

The core foundation of any nation rests squarely on the strength, creativity, and innovativeness of its young adult population. This has led to deliberate and concerted efforts from local, state, and national governments, as well as industry to stimulate immediate and future economic emancipation, prosperity, security, and safety of the youth. For example, a great and strategic push in the Commonwealth of Virginia (COV) to invest in young people received a big boost when the government deliberately signed on to strengthen the creativity and innovation infrastructure for young people through the instrumentality of *Executive Order Number 47* (McAuliffe, 2015). The government sought to accomplish these objectives by actively engaging private and public sector leaders, educators, and other entrepreneurial ecosystems. Therefore, the need to identify various avenues to reach out to these young population becomes imperative. Colleges, universities, and high schools have become veritable avenues for reaching out to young adults whose principal goal of acquiring education and securing gainful employment is to send out as many job applications and *resumes* as possible. With very limited opportunities, hopes have been dashed and dreams broken. Consequently, these young adults are consigned to their fate and bleak future.

The notion that classrooms and businesses provide the platform where students can develop ideas that will transform their future and create outstanding opportunity for sustainable growth remains true. In particular, a look at the current higher education orientation reveals that unique assets of colleges' and universities' curricular and institutional programs are closely aligned with the needs of the organized private sector and other industry stakeholders. The authors argue that the principal aim of entrepreneurship education should be related to personal development of the young adults through the creation of avenues where they are aware of their own unique abilities for the purpose of enhancing their entrepreneurial mindset. The essence of this entrepreneurial mindset is to direct the young adult's mindset and orientation toward entrepreneurial activities,

learning to deal with uncertainty and change, and pursuing innovation (Fayolle & Gailly, 2008). Entrepreneurial learning is described as recognizing and creating opportunities, acting on those opportunities in innovative and even opportunistic ways, moving between ideas and activities, interacting socially, using imaginative technologies to create multiple forms of value, and managing organizations (Rae, 2003). The authors add that entrepreneurial learning is transformative, social, imaginal, emotional, and experiential that applies in diverse circumstances.

The entrepreneurial learning espoused in this paper is geared towards encouraging young adults and students to become actual entrepreneurs. It is not enough to develop only entrepreneurial mindset which can be likened to a *bridge to no-where*. This paper is at variance with the work of Taks et al. (2014), which was geared toward encouraging individuals' internal development of an entrepreneurial mindset. Since entrepreneurial studies may encourage willing students to pursue careers as future entrepreneurs, what can stop a young adult student entrepreneur from designing curriculum tailored to his or her own need and get academic credit for it? Cumbersome roadblocks often found between getting a sound education and pursuing an entrepreneurial venture can be removed. Therefore, engineering entrepreneurship education should focus on teaching young adults, at earlier ages, about innovation and the associated challenges. Some of these challenges include sustainability, access, safety, and lack of awareness. Innovative ways to award academic credits to students and young people who start businesses or engage in any innovative activity will create flexibility in curriculum related activities. The paper will focus on the motivation, our paper's relationship to other papers, our methodology and our interim assessment regarding the sustainability of entrepreneurship education. We will discuss the challenges, ideas, long-term approaches as well as insights on how institutions can integrate core entrepreneurship values into the academic curriculum.

A daunting challenge facing the entire educational system lies in preparing young adult students for jobs that do not currently exist. Specifically, the educational system continues to grapple with how to identify and educate current entrepreneur-minded students and those who will be future entrepreneurs. As a result, entrepreneurial education has a crucial role to play in identifying and nurturing these potential change agents in our life time and beyond. However, substantial issues exist that can prove to be a cog in the wheel of progress. Part of the challenge stems from calls for a complete rethink of existing approaches towards ensuring a sustainable entrepreneurship education. Since there are no clear ways for universities and colleges of knowing exactly what the future job market will look like, it is apparent, and widely believed, around the world that entrepreneurship will jump-start the drive for the creation of many of these new jobs. Also, it is an uphill task developing and nurturing the entrepreneurial skills in the classroom that students will need to do the jobs of tomorrow, either for themselves or for someone else. The task becomes daunting going by the various ways entrepreneurship has been described. According to Kent (1990), many of these definitions overlap and contradict each other. For example, entrepreneurs have been seen as risk takers under conditions of uncertainty. Other definitions view entrepreneurs as innovators. When entrepreneurship is viewed from a dynamic rather than a static process perspective, it then means that entrepreneurs deal with a lot of uncertainty by innovating in very competitive environments with minimal and less than perfect information.

The task of identifying young adults who possess entrepreneurial potential will require a broader expansion of the current educational curriculum. This will impact the effectiveness of the entire entrepreneurship education program. To be sustainable, entrepreneurship education will need to focus on developing innovation, the taking of risk, mindset of making things, problem solving, and engagement in disruptive skills which will afford students total freedom, if they

choose not to conform to the status quo. Kuratko (2016) appropriately viewed innovation as the creative pursuit of ideas. The creative pursuit of new and enduring ideas is central to the domain of entrepreneurship and innovation.

It has become imperative for educational institutions to facilitate entrepreneurship and innovation by creating a significant economic impact on campus and its surrounding communities. The use of existing infrastructure of higher education institutions can relegate departments to operating in silos, which makes it more difficult for administrators and faculty members to understand whether there are other departments that are doing similar activities around problem solving, design, and engineering. There should be a push to take an inventory of what the different academic departments are already doing and what technologies and equipment are already available, but are perhaps less visible or accessible to students in different fields. Collaborating with other higher education institutions or other local organizations or industry is one way to fully leverage existing resources and address resource limitations. The involvement of faculty members from the social science and education research can enhance the understanding of a student's entrepreneurial mindset. At the heart of entrepreneurship and innovation is problem solving and the creation of physical spaces where students can tackle pertinent problems together. This is very crucial in sustaining entrepreneurial education.

Overview of the Concept of "Sustainability" versus "Sustainable"

For the purpose of this paper, it is necessary to make an attempt at distinguishing between the concepts of "sustainability" and "sustainable". The reason is that *sustainability* and *sustainable* have been used inter-changeably by authors, researchers, and practitioners in like manner. Typically, the two concepts are intertwined in their meaning, usage, and context in explaining sustainable engineering entrepreneurship education. Sustainability primarily relates to the interrelationships of human objects and their environment. On the other hand, sustainable may refer to all necessary actions required to keep existing entrepreneurship curriculum or program or system to be continuously operational in order to successfully meet set objective. In this case, the mission-readiness objective of the curriculum or program is the focal point. Hence, sustainable entrepreneurship education, in the context of this paper, can be described as those actions designed to meet the operational and performance readiness requirements of academic programs or curriculum in an effective and efficient manner. In this context, sustainability lays emphasis on the entrepreneurial mindset, thinking, behavior, spirit, entrepreneurial potential, environmental opportunities, and increase in entrepreneurial talent.

In essence, sustainability is bio-centric in nature. As a result, it recognizes the interplay of various socio-economic and ecological systems on a short rather than on a long term basis. Cutcher-Gershenfeld et al. (2004) defined sustainability with respect to trade-offs among economic development, social and environmental goals. It is generally a broad concept. The authors advocate that systems must be sustainable on environmental, economic, developmental, social and political dimensions. Therefore, sustainability robustly relates to the capability to replenish or retain major characteristics, resources, and inputs over a period of time. As more educational institutions commit to sustainable engineering entrepreneurship education, the urgent need to devise long term strategies as against short term, quick fix or stop gap strategies offered

by current practices becomes imperative. This will require the incorporation of lessons learned in the early emergence of entrepreneurship and utilize them in shaping future entrepreneurship framework. This proactive strategy can substantially boost long term sustainability through reduction in lifecycle information access and operational efficiency and effectiveness.

According to Mckeown (2002), the Brundtland Committee in 1987 described the concept of sustainable development as what satisfies current people's needs without endangering future generations' ability for satisfying their own needs. In their description, the three components involved are: environment, society, and economics. Therefore, integrating the concept of sustainability and entrepreneurship through education is crucial for encouraging the birth of new sustainable businesses in the future (Cohen and Winn, 2007)

Review of Previous Work

Parra (2013) stated that the primary goal of the "United Nations Decade of Education and Sustainable Development" covering 2005 to 2014 is geared towards integrating the principles, values, and practices of sustainability in all aspects of education. This calls for behavior changes that will engender economic, social as well environmentally sustainable future. The author attempts to promote a sustainable entrepreneurial vision through the incorporation of new values for teaching and learning of potential entrepreneurs right from the moment an idea is conceived for the purpose of creating a for-profit, non-profit or hybrid endeavor. Hartsell (2006) stated that values are dynamic and listed several motivational factors that can change them over time. Some of society's components responsible for the process of proliferating an individual's value system include parents and home environment, teachers and other school staff, peers, religious personalities, government, media, as well as the work environment. Silcock and Duncan (2001)

argue that teaching values is crucial to education; it should become a consciously internalized guide for behavior. This growth process, according to Lantieri and Nambiar (2004), is a continuous differentiation and integration that separate concepts and feelings and order them as a whole. According to the authors, this process is time-consuming, troubled, and laborious.

In his work, Genderson (1990) identified three approaches or models to explaining entrepreneurship. These approaches include certain personal traits, events studies, and the venture school. The first approach refers to personal traits that produce success while the second approach focuses on environmental forces that cause entrepreneurship to come about. The third approach recognizes that entrepreneurial efforts are part of an ongoing process and are not isolated or viewed as random events. The author disagrees with views expressed by a well know Austrian Economist, Joseph Schumpeter, who equates entrepreneurship with innovation (Kent, 1990). Gunderson is of the opinion that entrepreneurship is a process of small incremental innovation as opposed to making a giant leap forward and sees an entrepreneur as being very focused, seeing what others have overlooked. The author further argues that most of the widely available resources relating to entrepreneurship curricular are very narrow in their focus and are mainly geared toward teaching students survival skills.

Rabbior (1990) offered a blueprint for successful entrepreneurship education programs. He contends that entrepreneurship should be defined in its broadest possible context, as a process of creative change and concludes that entrepreneurial activity should not be a compulsory outcome of an entrepreneurship education program. Basic socioeconomic forces will expand the scope of entrepreneurial education because of changes routed in the belief that owning your own business represents one of the few major pathways available to the lower economic class to build wealth as opposed for working for someone else. Today, the computer revolution is also presenting limitless

opportunities for new ventures that have near-zero entry costs and other unavoidable start-up barriers prevalent in many businesses.

Education and entrepreneurship are the main enabling conditions for future change. As a result, institutions of higher education should function as role-models of sustainability (Coman, 2008). According to the author, many currently taught courses in "entrepreneurship" emphasize starting a small business; instead, they should emphasize transformational entrepreneurship (the type that changes the values and behavior of stakeholders and citizens). The entrepreneur of the immediate future will be most likely a graduate of a higher educational institution who has the essential skills to start a new business. The new graduate entrepreneur will be endowed with creativity, has penchant and capacity for problem solving, and is extremely talented in personal relations. The would-be entrepreneur is expected to be the bearer of a new characterization of talent for doing business in a global environment. Perhaps, rightly so, the would-be entrepreneur is highly connected as well as collaborates with the environment while committing to sustainability. In essence, the concept of entrepreneurial university or college may be seen as a direct response to a fast changing business environment where graduates are more prepared and capable of solving more and more complex problems that confront business as a result of globalization.

Robinson (2014) discussed the complex nature of entrepreneurship as well as the wide range of knowledge, behaviors, and motivations involved in the entrepreneurial process. The author's work was illustrated through in-class entrepreneurship simulation. The complexity involved in entrepreneurial activities in academic setting requires an equally complex set of activities to facilitate the acquisition and understanding of the requisite entrepreneurial abilities (Robinson and Malach, 2004). In his work, Drummond (2012), linked team-based learning and

critical thinking skills to effective entrepreneurship education while Gibbs (2002) categorized various forms of experiential education as case analysis and writing in-class and out of class exercises and simulation, projects, interviews, business plan writing, consulting, among others.

Methodology

This is a review paper that examines the various challenges, approaches, ideas, and insights that can enhance entrepreneurial education as shown in Figure 1. What constitutes an entrepreneurship program in terms of content and teaching approach continues to be a subject matter for discussion (Garner, 1990). The reason for this is because of the tendency for various countries and their educational institutions to design entrepreneurship education typically in line with their peculiar needs instead of copying what has been implemented and tested in another place.

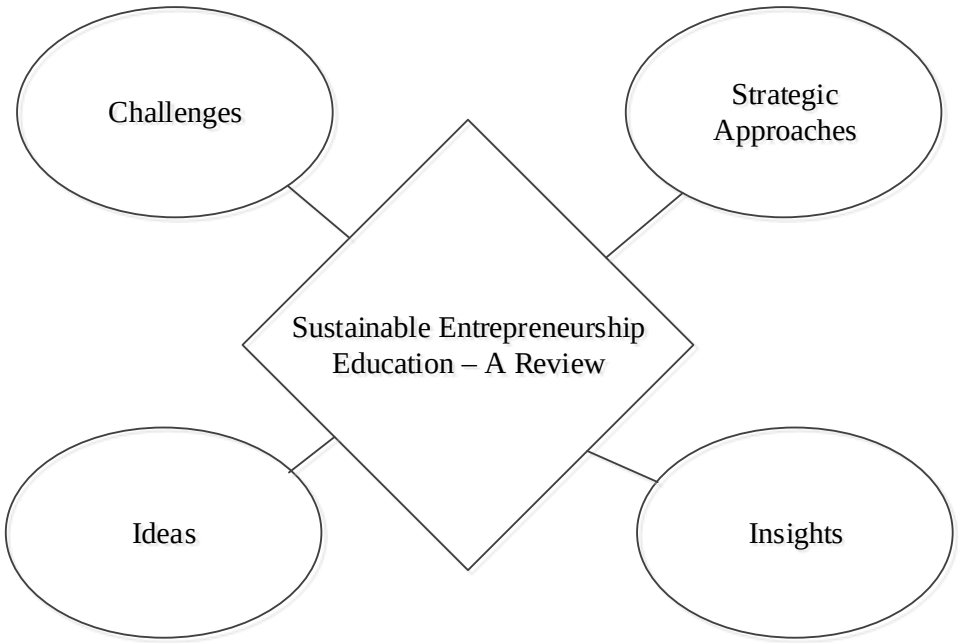

Figure 1: Catalysts of Sustainable Entrepreneurship Education

According to Murray and White (1986), entrepreneurship education attained global acclaim in 1998 when the UNESCO World Conference recognized its value and advocated for its incorporation in higher education. Following this trend, China began a huge push for entrepreneurship education mainly through entrepreneurship competitions of college students in university campuses in the late 1990s. Since 2002, the Chinese government has taken a leading role in promoting entrepreneurship education. This development has been largely driven by the government's desire to address the structural unemployment of university graduates, a problem which has arisen from mass higher education (Zhou and Xu, 2012)

One of the noticeable trends in universities and colleges is the growth of entrepreneurship education programs. A big challenge is how to sustain these initiatives. For example, entrepreneurship programs in the engineering schools and colleges may be constrained by physical space to design and build project prototypes. Assuming the spaces are available, the need to free up existing tools and technologies in ways that students can use them more flexibly on campus will promote entrepreneurship education. This will engender capacity building of spaces and working platforms. Likewise, another big challenge to sustainable entrepreneurship education is how to involve the broader community. There is need to develop a two-way pipeline for collaborative activities on one hand and bridge commercialization gap between ideas, projects, and product prototypes and market on the other hand. Sustainable policies like total student empowerment is lacking. For example, students may be limited with what projects they may be allowed to engage in or work on because of their country of origin or nationality. The implication is that bright students do not get a shot at creativity and development. Likewise, student intellectual property issues for student work are not clearly understood and therefore lead to lack of standardization. Awareness and support clearly pose huge challenges because mindsets on the

part of government agencies and institutions to offer financial support to entrepreneurial centers is not forthcoming. There may be serious misconception about what entrepreneurship means altogether.

Konda et al (2015) discussed the phenomenon of social entrepreneurship which challenges their assumptions about human behavior, economic action, and their beliefs about the role of entrepreneurship in society. The authors argue that social innovations are central in addressing social, environmental, and economic problems, because they greatly shape sustainable development. Senge et al. (2008) recognized what they described as the grand challenges currently faced by the global community that range from climate change to ageing societies, financialization, poverty, social exclusion, migration, and social conflicts. These challenges manifest themselves on a global scale or on a smaller scale within local communities. The authors established that these challenges are interconnected and represent the symptom of a larger unbalanced global system, including institutions of higher learning and the entire educational system. Entrepreneurship and innovations are thus coming into the forefront of social development plans, which will be based largely on the principles of "sustainability principles".

The Commonwealth of Virginia is home to some of the best universities, and colleges in the world. A solid and deliberate entrepreneurial framework can provide young graduates and continuing students the tools that are needed to thrive in the 21st century workforce. It also ensures that these adult men and women will have the strong foundation to become creative and innovative leaders of the new Virginia, the United States, and world economy. In classrooms and businesses across the Commonwealth, these budding young entrepreneurs will have the opportunity to develop the ideas that will transform our future. Past efforts have achieved great success in supporting young entrepreneurs, but this strategic initiative provides an outstanding opportunity

for improvement and growth. The universities and colleges, through this initiative, should work to strengthen the innovation infrastructure for young people by engaging with leaders in the public and private sectors, the education and business communities, and entrepreneurship ecosystems.

In 2015, a strategic push was made by Governor Terry McAuliffe of the Commonwealth of Virginia, when he instituted a 24-memeber Youth Entrepreneurship Council that includes student innovators, entrepreneurs, business leaders, and educators from every region in the Commonwealth. The goal is to work with higher education and other public and private sector resources. The Council is also charged with conducting a comprehensive assessment of current local, state, and federal programs and services available to young entrepreneurs. The Council will work closely with institutions of higher education and other state agencies to grow vibrant regional ecosystems across Virginia, while supporting opportunities to advance research, innovation, and commercialization at Virginia's colleges and universities. The group is charged with addressing five significant priorities related to youth entrepreneurial ecosystem. These key priority areas are:

- Expand students' intellectual property (IP) rights
- Promote the formation of collaborative spaces for entrepreneurs and students to meet
- Encourage schools to offer courses in entrepreneurship that are easily accessible to all students and to integrate innovation into the curriculum
- Identify ways for colleges and universities to award academic credits to students for starting a business
- Remove unnecessary costs for students starting a businesses in Virginia

Wright and Katz (2016) reflected on the article written by Katz, Harshman, and Lund Dean (2000) where the authors advocated for establishing classroom norms for promoting and protecting student intellectual property. Why is this important? Universities and other educational institutions

of higher learning are very protective of revenue streams related to intellectual property interests for the institutions and professors, while largely ignoring or overlooking the financial and legal interests of students in the entrepreneurial process. This seeming lack of attention, both in universities and in the literature, is fascinating, given the new push and impetus recorded and evidenced in the growth in entrepreneurial education courses in many academic institutions around the world, especially in the United States.

The establishment of *makerspace* collaborative platforms in universities and institutions of higher learning can inspire students to own their learning and, in the process, deepen their thinking by exploring the world with all the resources at their disposal. Makerspace platforms can provide the students the opportunity to tinker and iterate their way through projects inspired by the space. As a result, such makerspace platforms can generate more questions than answers because asking the right questions can lead to deeper understanding. According to Kurti et al. (2014), these kinds of lessons cannot be learned in a vacuum, and when independent exploration is the goal, the design of the space and the choice of the tools become mission critical. The culture of student ownership as opposed to the presence of high technological tools is a panacea for innovation and creativity.

If the push is to encourage schools to offer courses in entrepreneurship that are easily accessible to all students and to integrate innovation into the curriculum, it may be shocking to know that many engineering schools still do not have a single course in entrepreneurship. Drucker (1985) recognized a long time ago that entrepreneurship is a process that can be learned and hence is teachable. Furthermore, identifying ways for universities and other higher institutions of learning to award academic credit to students for starting a business can enhance sustainable entrepreneurship education. On the national front, there has been a rapidly expanding interest in dual enrollment courses and award of academic credits for students who start their own businesses.

Nationally, Marken et al. (2013) noted that there has been a rapidly expanding interest in dual enrollment courses and experiences among high school students. According to the authors, the range of dual enrollment opportunities has broadened to comprise college courses for students seeking to enter the workplace or proceed to postsecondary technical education programs. Wang et al. (2015) in their work, attempted to fill this gap by delving into the process of how dual enrollment is related to academic success among students attending two-year technical colleges. The authors examined academic momentum as a potential mediator of the relationship between dual enrollment and educational outcomes.

Removing unnecessary barrier to students planning to be entrepreneurs will enhance sustainable entrepreneurship education. Chen et al. (2014) used the theory of planned behavior to hypothesize how economic poverty and perceived poverty can predict college students' intention to start businesses**.** The authors tested whether or not people experiencing different types of poverty (the poor, the unsatisfied, and the complacent) have a different degree of likelihood of starting a new business. They found that the poor were the most likely to start a business after graduation, followed by the unsatisfied; the complacent had the lowest score for probability of starting a business after graduation.

Insights and Conclusions

As universities and colleges embrace entrepreneurial education, sustaining the concept is a huge challenge. A hard look must be taken at the unique assets of universities and colleges with a view to aligning curricular and programs with the needs of the industry partners. How far these goals are being met remain to be seen. Partnership with local governmental and non-governmental

organizations such as the Chamber of Commerce or Faith-based public schools could be a game-changer towards a sustainable entrepreneurship education.

Other veritable insights could stem from encouraging school and community collaboration in ways that allow each an opportunity to leverage their strengths while making concerted efforts to engage the leadership of higher educational institutions about the importance of sustainable entrepreneurship education. Since entrepreneurial education is blossoming in this 21st Century education system, top-down leadership approach is a panacea for sustainable entrepreneurial performance. Entrepreneurial education requires the development of sustained rigor in its entire pedagogical educational attainment as a principal determinant of entrepreneurial success. We have reviewed the entrepreneurship education, sustainability concepts, challenges, ideas, approaches and insights about diverse subjects related to entrepreneurship education. This review permits a conclusion with some reflections that are expected to lead to a better way for achieving a sustainable entrepreneurial education. Our purpose is to promote the development of this new kind of entrepreneurial mindset within the purview of sustainability. This new concept of sustainable entrepreneurship education embraces total activities, constructs, and programs that can be an engine for economic and social development.

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