Using the Design Thinking Approach to Develop an Entrepreneurial Development Center

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Applying the design thinking approach for establishing an Entrepreneurial Development Center

Introduction

Demographic dividend of a country implies a better share of the working-age population of the total population and augurs well for healthy growth of the country's economy [1]. India has a huge demographic dividend with 320 million students that include 26 million college students. They will soon be in the job market and if they don't find meaningful jobs, the demographic dividend will turn into a demographic curse, which could be too difficult to handle [2]. One way to avoid the dividend turning into a curse is, to nurture innovative entrepreneurs. There is sufficient evidence that even poor, illiterate, disadvantaged, and other non-business communities can become innovative entrepreneurs[3] [4]. Colleges need to identify and nurture all potential innovative entrepreneurs among their students and beyond. Entrepreneurs can come from any educational discipline, but engineering appears to be the most fertile discipline, especially for innovative entrepreneurs. Towards that, various engineering colleges have been establishing Entrepreneurial Development Centers (EDC). The centers (also referred to as entrepreneurial education training programs) focus on developing entrepreneurial capabilities and mindset (associated socio-emotional skills and entrepreneurship awareness) and raising successful enterprises[5]. We decided to use the design thinking approach, which is elaborated by Buchanan[6] as addressing intractable human concerns through design, and started by understanding requirements of prospective student entrepreneurs to establish a more useful EDC. The paper explains the approach that consisted of learning from people, finding patterns, and arriving at design principles for design of the proposed EDC, and concluding remarks.

Method

The design thinking process entails the following five steps – learn from people, find patterns, arrive at design principles, make tangibles, and iterate relentlessly [7]. This paper covers the first three steps to arrive at design principles for establishing the EDC at our college.

Learn from people

We conducted half-day sessions for 206 sophomore and junior students to explain the critical need of entrepreneurship, potential entrepreneurial areas, and why and how they can become campus CEOs i.e. start their enterprises during their college days [8]. We illustrate the broad structure of the session in Figure 1, which is derived from the framework proposed by Waychal [9].

The objective of the 3-hour session was to highlight the need for innovative entrepreneurship, to help choose appropriate challenge areas for starting enterprises, to understand possible levers and hurdles in their entrepreneurial journeys, and to understand the areas in which they would require support in becoming successful entrepreneurs.

| Introduction – Expectations, Commitments, Learning pyramid |

| Innovative entrepreneurship – Basics, Importance, Global and national level challenges |

| Examples of patent-worthy projects by sophomore college students |

| Choosing challenge domains |

| Principles for developing competencies – can learn, diversity is key, start with challenges, RBIS catalyze |

| Benefits of innovative entrepreneurship - Drives economy, Solves problems, Satisfies personally |

| Why and how to become Campus CEO? |

| Closure |

Figure 1: A broad structure of the session

At the outset, we checked expectations of participants from the workshop. If the expectations were in line with the workshop objectives, we told them that the expectations will be fulfilled, else we explained the reasons for not fulfilling those expectations. We explained the reasons of using active-learning pedagogy and informed that the pedagogy requires full participation from them to reap maximum benefits from the workshop.

We defined innovation as fresh thinking that delivers value to stakeholders [10] and dwelt on the tremendous progress that humanity has made, especially over the last century in the areas of longevity, energy, transportation, telecommunication, and information. That was followed by deliberations on various global challenges, which perhaps have arisen due to the progress made. We discussed challenges such as distressed economies, the fast depletion of quality resources such as water, air, and food, the fast-rising population, overloaded urban infrastructure, and severe imbalances in ecology. We portrayed the national (Indian) situation on the challenges landscape indicating that India has 2.4% land, 4% water and 1% forest that is harboring 16% of global population, and the only solution is that the 16% population thinks innovatively and brings in sustainable improvements in life and living standards. We also presented the fourteen grand challenges [11] and the initiatives of the Indian National Academy of Engineering (INAE) [12] to tackle the Indian challenges.

We presented a few patent-worthy projects executed by sophomore students in another college in the same region. The examples included a multilingual mobile-based social media application for farmers, automatic detection of potholes on roads and informing their locations and

sizes to municipal authorities, automatic detection of traffic violations, and a platform for learning mathematics and English on the cost effective 25 USD 'Akash' tablets.

We explained the following four principles of developing innovative entrepreneurial competencies [13]; (a) The competencies can be developed, b) Diversity is the key, c) Start by choosing a challenge, d) RBIS (Research-Based Instructional Strategies) catalyze development of the competencies.

In the rest of the document, entrepreneurship would mean innovative entrepreneurship, wherein one solves problem(s) in an innovative way and makes cost-effective and ethical solutions available to people who are facing the problem(s).

We then identified broad challenge areas such as education, health, energy, security, efficient enterprises, urban infrastructure, environment, and poverty; and appealed to the students to choose one area that was closest to their hearts. This was followed by detailing out the challenges into sub challenges as given in Table 1.

Table 1: Challenges and sub-challenges

Challenge	Sub-challenges
Education	Personalized education and virtual reality
Health	Health informatics and engineering of medicines
Energy	Economical solar energy and other sources of energy
Enterprises	Productivity, quality, and turnaround time in enterprises
Poverty	Village economy and precision farming
Environment	Urban infrastructure and access to clean water

We did highlight that these were examples of challenges and sub-challenges, and that they were free to think of different ones. We also provided them with resources such as a list of problems that the government of India has published for seeking innovative solutions (https://innovate.mygov.in), to help them explore different areas.

We then discussed the benefits of entrepreneurship as 'driving economies', 'solving problems innovatively', and 'providing personal satisfaction'.

Following that, we suggested the participants to initiate their enterprises during their college days and become campus CEOs as there is lesser risk and easy access to resources[8]. We screened and discussed an audio-visual clip of Pinkett in this context (https://www.youtube.com/watch?v=ucMytOOVelY).

We then closed the session by seeking feedback based on Reichheld's net promoter score concept [14]. The average for the two sessions turned out to be 4.40/5; 4 was 'recommendation' and 5 was 'proactive recommendation' to other colleagues. The major likes were knowledge of

entrepreneurship, teaching methods that were interactive, innovative, positive, refreshing, brought clarity, and managed time well. (Figure 2).
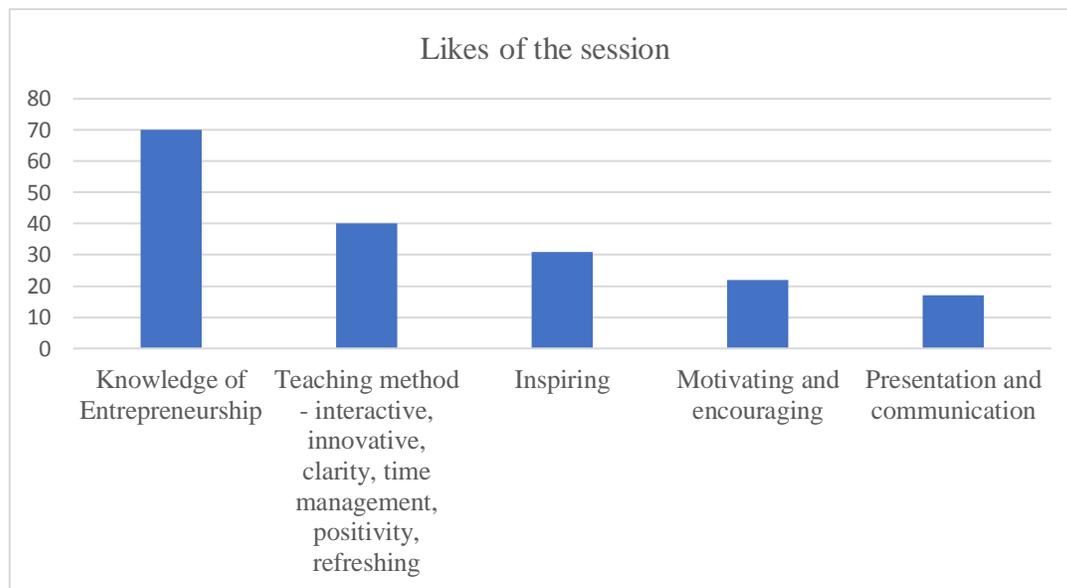

Figure 2 – Major likes of the session (206 students were asked to provide one thing that they liked about the session. The X axis has features that students liked and the Y axis has numbers of students, who liked the feature).

Most of the students (174) did not list any dislikes. Those who listed included the session was not interactive (9 students), was short (7 students), and boring (2 students). One each listed the lack of clarity, lengthy, had less examples, was slow, had poor sound quality, the facilitator was strict, and the session was fast.

Find patterns

Throughout the session, we sought inputs, as per the form given in Appendix A, from the participants. At the start of the session, we asked how many of them would like to become entrepreneurs and many participants (184 out of 206 i.e. 89%) responded in an affirmative way. There was almost no gender-based difference (90% males and 88% females) on their desires to become an entrepreneur. Towards the end of the session, we repeated the question and saw the net increase of 2 affirmations (4 changed from 'yes' to 'no' and 6 changed from 'no' to 'yes') taking the total number to students, who were keen to become entrepreneurs to 186 (90%).

When we analyzed the above data by departments, we found that everybody from information technology, civil engineering, and electronics wanted to become an entrepreneur. Nine computer engineering, six electrical engineering, and seven mechanical students were not keen to become entrepreneurs – interestingly in case of computer engineering, 7 out of 9 were females and in case of electrical engineering, 3 out of 6 were females. From other departments, all females were keen to become entrepreneurs (Table 2).

Table 2 – Department and gender-wise willingness of students to become entrepreneurs

Department	Students wanting to become an entrepreneur	Students NOT wanting to become an entrepreneur	Female students wanting to become an entrepreneur	Female students NOT wanting to become an entrepreneur
Computer	63	9	30	7
Information technology	13	0	7	0
Civil	24	0	11	0
Electrical	30	6	10	3
Electronics	17	0	9	0
Mechanical	37	7	8	0
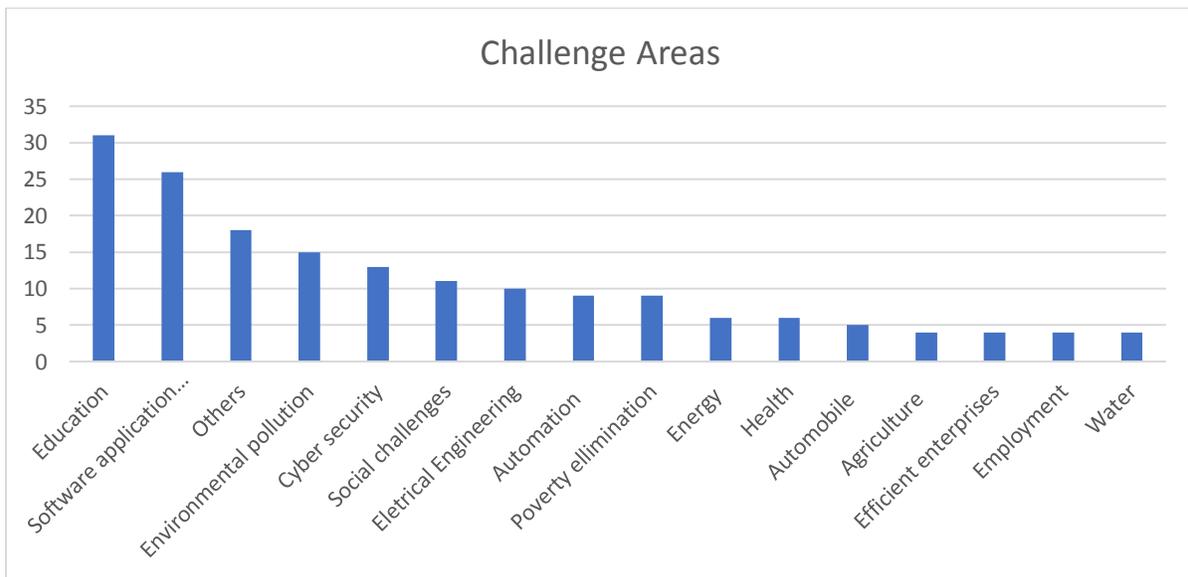
Figure 3 – Challenge areas chosen by students (206 students were asked to provide a domain - challenge area in which they would like to work. The X axis has challenge areas that students wanted to work on and the Y axis has numbers of students who liked to work in those areas)

Since many students were first-generation students, education topped the list of the challenge areas. We require to appraise students that developing software, or civil, or electrical engineering are not challenge areas and they should identify domain areas. It will be interesting to see areas that those students choose. Environmental pollution, cyber security, social challenges, automation, poverty elimination, energy, health, automobile, agriculture, water were

notable areas. We also had 'Others' that included remote communication, transportation, financial, unemployment, and urban infrastructure (Figure 3). As many as 33 students did not indicate any area.

It was also heartening to note that the most common reason for becoming an entrepreneur was to solve pressing problems of humanity in an innovative way (Figure 4). Many students seemed to be impressed by the hype of entrepreneurship and want to become one for no specific reasons. Freedom, earning money, helping society and nation, owning and leading a company, earning respect and power, and creating job opportunities were other reasons given by students.
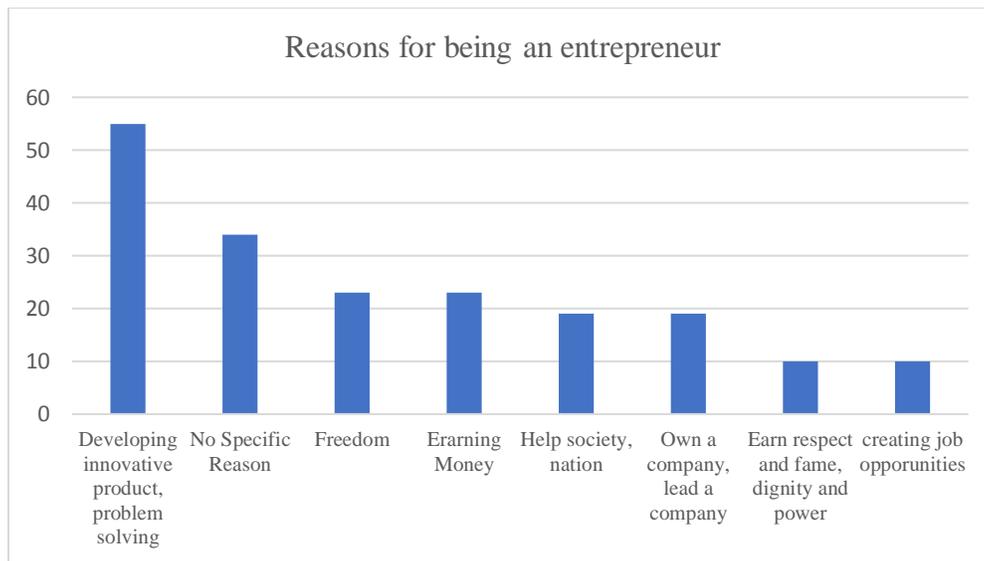
Figure 4 – Students' reasons for being an entrepreneur (206 students were asked one reason for becoming an entrepreneur. The X axis has reasons for being an entrepreneur and the Y axis has numbers of students, who have given those reasons for being an entrepreneur)
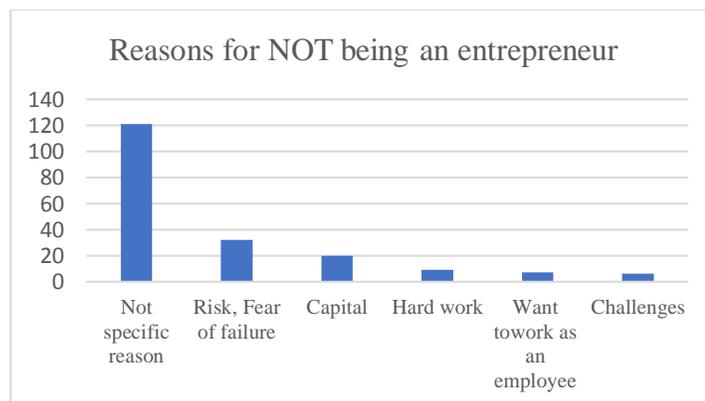

Figure 5 – Students' reasons for NOT being an entrepreneur (206 students were asked one reason for NOT becoming an entrepreneur. The X axis provides reasons for NOT being an entrepreneur and the Y axis has numbers of students who have given those reasons for NOT being an entrepreneur)

Many students (120) did not present any reason for not wanting to be an entrepreneur, perhaps, because they wanted to become entrepreneurs (Figure 5). Only 2 of the 22, who did not have entrepreneurship on their mind, did not quote any reason for not becoming an entrepreneur. The most important reasons mentioned were risk and fear of failure, followed by the lack of capital, hard work required on the entrepreneurial path, and challenges (difficulties) involved. A few had made up their minds to become employees. It seemed that some students wanted to become entrepreneurs, but were not equipped. They sought support for motivation and idea selection. Guidance, mentoring, academic, lab facility, and parental support were reasonable requests.
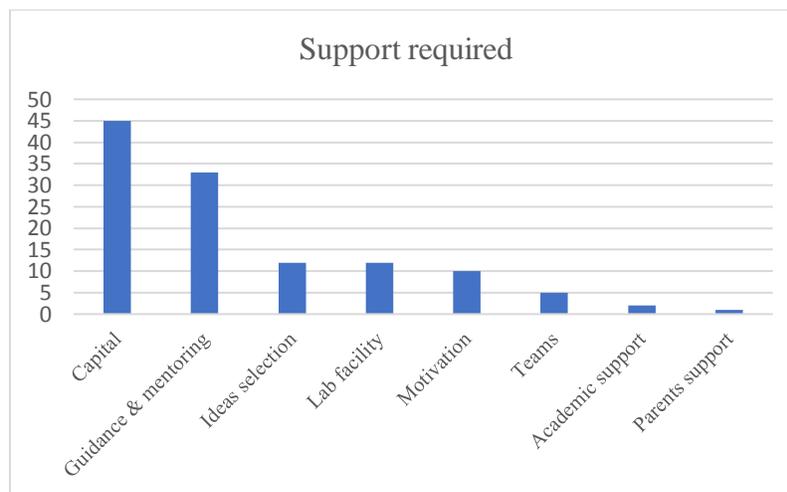

Figure 6 – Support required for becoming an entrepreneur (206 students were asked an area in which they would require support to be an entrepreneur. The X axis provides area in which students require support for being an entrepreneur and the Y axis has numbers of students who require support in those areas).

A few weeks after the session, we administered GET2 test (General measure of Enterprising Tendency test) [15] to a set of sophomore and junior students. The test was developed in 1988 for college students by Caird and Johnson, who believed that entrepreneurial characteristics can be measured and developed. They introduced five key entrepreneurial characteristics, i.e., need for achievement, need for autonomy, creative tendency, calculated risk-taking, and internal locus of control. The test has 54 items. The need for achievement, locus of control, creative tendency, and calculated risk taking are measured by 12 items each, and the need for autonomy is measured by 6 items. The items are mixed i.e. they have positive and negative entrepreneurial statements. The participants choose between "agree" and "disagree" and receive a score between 0 and 100 for each characteristic. Caird [16] has described the five characteristics in detail.

The test was used by Ishiguro to assess entrepreneurial capabilities of students [17] as well as by Cromie and Callaghan [18] to compare the characteristics of entrepreneurs with MBA students, and of public sector employees with private sector employees in the UK.

We assessed 144 (114 male and 30 female) students. This set had some students, who attended the session and some who did not. Out of those 144 students, 140 (111 male and 29 female) want to become entrepreneurs (as expressed before taking up the assessment). Figure 7 presents their five characteristics in box plots, and figure 8 and figure 9 present box plots for prospective male and female entrepreneurs. Table 3 compares characteristics of prospective male and female entrepreneurs. The need for autonomy is the lowest of all the characteristics; with prospective female entrepreneurs scoring statistically significantly lower than their male counterparts (p value 0.016). The prospective female entrepreneurs are better on the need for achievement and creative tendencies but the differences are not statistically significant. The males are better on risk taking, the difference is not significant, though.
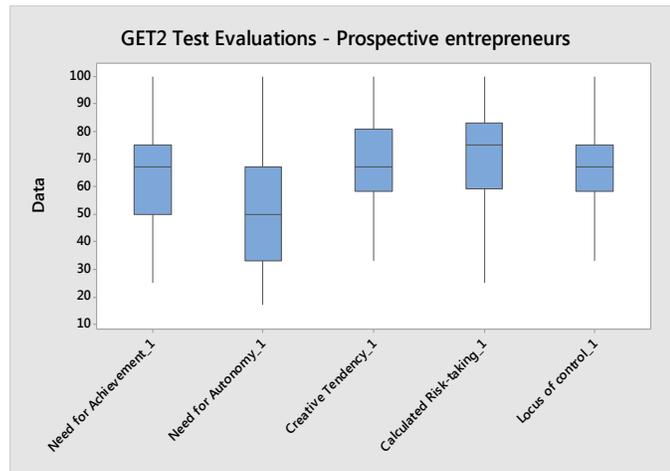

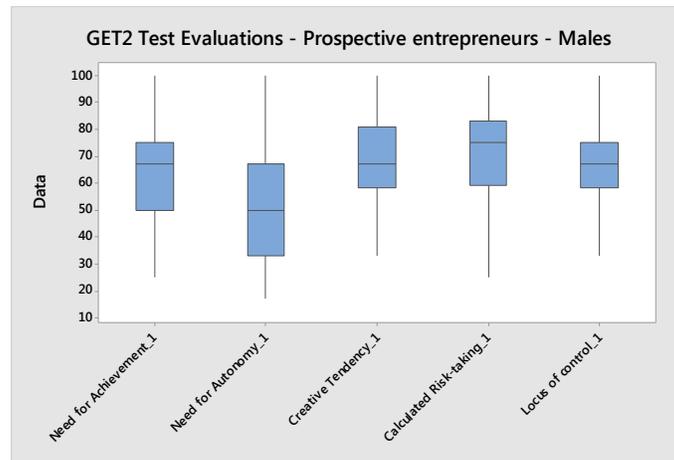Figure 7 - Characteristics of prospective entrepreneurs (N=140)

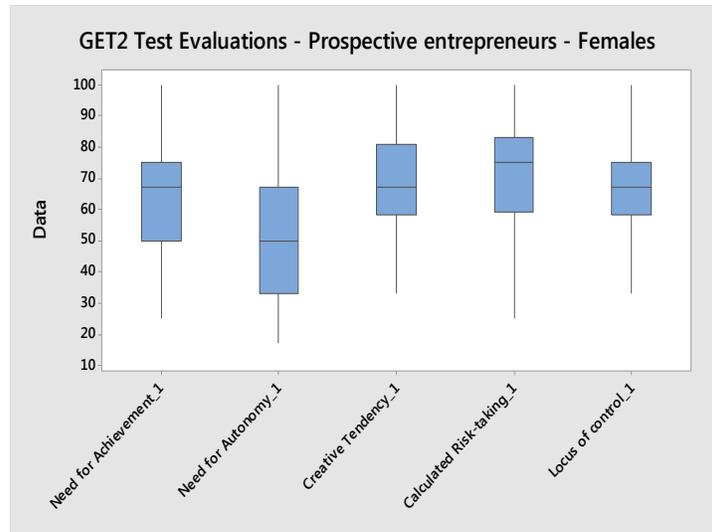Figure 8 - Characteristics of prospective male entrepreneurs (N=111)

Figure 9 - Characteristics of prospective female entrepreneur (N=29)

Table 3 – Comparing characteristics of prospective male and female entrepreneurs

Characteristics	Mean for Males	Mean for Females	P-value
Need for Achievement	63.3	66	0.359
Need for Autonomy	**57.6**	**48.4**	**0.016**
Creative Tendency	68.4	70.0	0.582
Calculated Risk-taking	72.7	67.6	0.140
Locus of control	67.5	66.9	0.804

Design principles

We have arrived at the following principles based on the patterns that we discovered after analyzing inputs from students, the main stakeholders of the proposed Entrepreneurship Development Center (EDC).

Reality check

It seems that entrepreneurship has become so much glamorized that almost everyone wants to become an entrepreneur. While we will be happy to have so many prospective entrepreneurs, we would like all of them to possess proper understanding of the requirements, challenges, and hard work involved in becoming an entrepreneur.

We need prospective student entrepreneurs having a reality check in terms of what is required to be an entrepreneur, and what are their strengths and weaknesses. The GET2 assessment can also be used for the purpose. We plan organizing narration of life stories of

successful and not successful entrepreneurs, which could be through in-person interactions, over video calls, or through audio visual recordings. This could also take care of the motivation of prospective student entrepreneurs.

Facilitating idea selection

Once students develop proper understanding of entrepreneurship and commit to follow that path, we need to help them select proper ideas. We need to make them aware of the necessity of first choosing a challenge domain and then developing a technological solution for a problem in that domain, and not the other way around. Towards that, we need to organize brainstorming sessions on challenges in different domains to generate ideas and facilitate selection of appropriate ideas. Since we know the domains that the prospective entrepreneurs are interested in, we will be able to bring in experts from the corresponding domains to facilitate the brainstorming sessions.

Organizing business plan competition and hackathon

After committed prospective entrepreneurs have possible ideas, we need to organize a business plan competition and hackathon. Prior to that, we will have to conduct a training session on making business plans and hackathons. The competitions will help us choose the best prospective entrepreneurs. The college can decide the number of student entrepreneurs it can support based on available resources and infrastructure.

Creating pool of experts / mentors

The competition will allow us to interact with external experts and help create a pool of mentors**.** Besides that, we need to network with experts in different domains to create a pool of mentors. We need mentors to refine the entrepreneurial mindset and associated socio-emotional skills.

Developing faculty mentors

The college cannot rely too much on external experts and should have some of its faculty mentor prospective entrepreneurs. In the beginning, they can be co-mentors along with external mentors and slowly take up full mentorship. This will also help many prospective entrepreneurs, who are interested in the education domain.

Developing a library of resources

All prospective entrepreneurs will have to develop knowledge in many areas such as finance, human resources, and marketing, as well as keep themselves abreast of domain and technology developments in relevant areas. They will also have to develop soft skills such as decision-making, negotiation, and conflict management. Many students have rightly identified developing knowledge as one of the support areas. Since the Internet is flooded with knowledge resources, we need to select effective resources that can add value to our prospective

entrepreneurs. We will also have to develop resources to meet specific requirements such as water management in that locality.

Play down the need of capital

Many prospective entrepreneurs have sought support for capital. We must make them aware that once they have a worthwhile business proposal, they will not have problems in finding investors. We can organize sessions with some investors so that prospective entrepreneurs can be assured of financial support for deserving business plans.

Laboratory and EDC facilities

One of the benefits of students starting ventures during college is easy and free access to laboratories. The college can develop proper policies and procedures to make the facilities available. Besides, the college can build appropriately furnished and equipped development center.

Conclusion

There cannot be any argument about nurturing entrepreneurship in engineering colleges but there can be different views on how it can be done to increase its chances of success. Many colleges, all over the world, are establishing entrepreneurship development centers and having mixed successes. We, therefore, decided to adopt a design thinking approach to establish such a center at a rural engineering college in India to increase its chances of success. We conducted a session for 206 students to explain the importance of entrepreneurship, especially in the Indian context, discussed various challenge domains, made students aware of the benefits of becoming entrepreneurs, and emphasized that the required entrepreneurial competencies can be developed. We also carried out assessment of entrepreneurial characteristics using the GET2 instrument for 144 students to help prospective entrepreneurs understand their strengths and weaknesses, and help the EDC authorities understand collective strengths and weaknesses of their prospective entrepreneurs.

We found that most of the students are attracted to the entrepreneurial pathway, largely driven by the lure of the pathway's glamour. Many prospective entrepreneurs seem to be interested in education (31 students). Some students seem to be focusing on technological solutions without even deciding the problem domain, which needs to be corrected. Thirty-three students had not indicated any area. The students also believe that they would require support in organizing capital (45 students) and mentoring in their entrepreneurial journeys (32 students). Their most common reason for becoming an entrepreneur is to develop innovative products to solve real-life problems (55 students), which is heartening. In terms of the entrepreneurial characteristics, the cohort was found to be weaker on autonomy; the prospective women entrepreneurs were significantly weaker (48.4 average) on this count than their male counterparts (57.6 average). Our design principles cover helping students having reality check on their fitness to take up the entrepreneurial pathway, organizing business plan competition and hackathon,

making mentors - external as well as faculty - available, and making resources, such as college laboratories and appropriately furnished development centers available to prospective entrepreneurs.

The study has helped in garnering design principles for EDC. The real success of the study is in the realization of a successful center with many commercially viable enterprises. That will, of course, depend on many factors including the right translation of the principles in design and meticulous operationalization of the center. The study has discovered huge, perhaps misguided, enthusiasm for entrepreneurship and we may have to iterate the exercises of understanding students' requirements and characteristics as they progress on the entrepreneurial path. Nevertheless, the study provides useful ideas for educators, who want to develop such Innovative Entrepreneurial Development Centers in their institutes.

Acknowledgements

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Appendix A: Participant Information Collection Form

1. Would you like to be an entrepreneur? Yes / No

2. One reason you would like to be an entrepreneur

3. One reason you would not like to be an entrepreneur

4. Choose challenge areas about which you feel passionate and come up with as many challenges as possible.

5. Would you like consider to be an entrepreneur? Yes / No

6. One thing you liked about the session

7. One thing you did not like about the session

8. Name and Contact Details

9. Department

10. Support you may require to be an entrepreneur