Mass-scale Online Synchronous Entrepreneurship Education for Engineers

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Abstract

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For decades the business of ideas and creating startups was relegated to the business schools with engineers coming in to just complete the creative part of the business or to create the Minimum Viable Product or MVP. But for the last decade or so, we have seen a proliferation of engineering schools offer entrepreneurship education. In the United States, many faculty and engineering students act as the entrepreneurial lead and participate in the Innovation Corps programs offered by NSF [1]. This has been successful in promoting start-ups originating from universities and led by students, faculty and post-doctoral fellows, who are trained using the Lean Launchpad method. [2] In order to replicate this model in India, we embarked on a mass online education specifically for students and faculty from Tier 2 and Tier 3 colleges. MOOCs (Massive Open Online Course) are online courses which enable large numbers to participate via the web or other technologies. MOOCs have a long history and have primarily been asynchronous so that international students can also avail of this. In this article, we delineate how we modified that approach by piloting this synchronously. The Covid19 situation was an added incentive to offer this course to students who could not meet in person due to restrictions for in-person classes. Over 350 students from 20 different engineering colleges from India were recruited for a pilot program along with the faculty from their schools. Each college recruited approximately 20 students and 1 faculty member for the course. The course was being offered using the "Lean Launchpad" methodology, teaching one class per two weeks. The expectation was that the faculty participating in the course would be able to use this course as the foundation for offering entrepreneurship courses for credit as required by the All-India Council for Technical Education (AICTE). The teaching team consisted of business and engineering faculty from different parts of the US, while the students were from different parts of India. Various platforms such as Zoom, GoToMeeting or MS Teams were used for teaching the class, while Canvas was used to post the lecture slides, videos and homework assignments. The students were also required to conduct customer discovery using social distancing and other platforms. More than 50% of the students completed the program. The paper explains the process of creating such Synchronous MOOCs specifically for Entrepreneurship education and the lessons learnt.

Introduction

The National Science Foundation initiated the Innovation Corps program for promoting entrepreneurship among STEM-based faculty and students using the Steve Blank "Lean Launchpad" method [1-2]. The Mass Scale Online Synchronous Education course described in this paper was an attempt on the part of the Indo-Universal Collaboration for Engineering Education or IUCEE, a group of Indian origin faculty and industry mentors world-wide to provide entrepreneurship education and training to Indian students and faculty using the Lean Launchpad method. IUCEE's vision is to improve the quality and global relevance of engineering education in India and their mission is to build an ecosystem for transforming engineering education in India with the assistance of engineering education experts and industry from around the world. IUCEE attempts to do this by targeting several engineering colleges and universities, their students and faculty across India and providing them an opportunity to receive guidance and mentoring from

industry and academia [3]. More specifically, IUCEE's mission is also to assist the colleges and universities to meet the National Education Policy 2020 mission, which are [3]:

To prepare engineering graduates:

- Who are thoughtful, well-rounded, multidisciplinary, holistic and creative with ethical values, intellectual curiosity and scientific temper,
- With developed cognitive, collaborative and professional skills,
- To participate in knowledge creation, innovation and entrepreneurship, thereby contributing to a growing national economy, and,
- To find and implement robust solutions to problems of society

Since teaching entrepreneurship is a key part of the National Education Policy, IUCEE faculty initiated a Mass online class to train faculty and students at the same time. The expectation was that students could benefit but at the same time, faculty would be motivated to initiate courses for entrepreneurship education that could be tailored to the needs of the students of their colleges.

Entrepreneurs come in many shapes, sizes, educational background age and gender. We have seen millions of entrepreneurs from necessity entrepreneurs to high tech entrepreneurs create businesses every day [4]. But the issue is, does education help? In addition, entrepreneurship is seen as a business domain and every entrepreneur needs to understand basics of business such as financing, marketing etc. So, do engineers make better entrepreneurs or does the area of study not matter?

Covid-19 has affected education in more ways than one and digital online tools have been used to educate at all levels of education. MOOC's have been around for decades and its growth rate was not very high till now. How do we take the idea of entrepreneurship education which is actively experiential to a digital world and still be effective? MOOC's traditionally have been asynchronous and seen very low completion rates, between 3% to 15% [5-6]. Does having synchronous MOOCs increase completion rate is an area of research and no definitive answers have been forthcoming from available research. The paper presents literature review of Entrepreneurship education and specifically for engineering students. It then follows with MOOC's and country specific information and details how the course was created, marketed and executed and it concludes with lessons learnt and limitations.

Entrepreneurship education

Does entrepreneurship education add value, or should we let people just start businesses? Several researchers have tackled this question and the result is a resounding yes. In an empirical study done by a researcher in Malaysia, they found positive results on the impact of education on entrepreneurship Inclination [7]. Other researchers also found that exposure to entrepreneurship education fosters the development of entrepreneurship [8]. These researchers found a positive role played by the university in enhancing entrepreneurship [9,10].

In order to check for entrepreneurship skills and improve the venture's effectiveness, research done by Elmuti, found among 170 working entrepreneurs a "causal linkages between entrepreneurial education (managerial skills), social competence (interpersonal skills), and to a greater degree, basic entrepreneurial training skills and ventures' effectiveness," [11]. They concluded that

education creates confidence, trust and openness and we should marry it with innovation and reflection.

Other researchers also found a positive impact on education on entrepreneurship [8,12]. Edwards and Muir in 2005 found that lectures played a role in influencing Entrepreneurial inclination [13].

In addition, several studies have checked other variables such as family background or income as confounds and even controlling for those, a positive result for entrepreneurship education was found. Some of the characteristics are listed below [14-39].

- Gender
- Ethnicity
- Religion
- Age
- Birth order
- Places of origin
- Programs of study
- Working experience
- Business Background of parents

Engineers as entrepreneurs

Having noted that educating entrepreneurs does impact their effectiveness, we now focus on engineering students being exposed to entrepreneurial education. A study found that students from a business background tend to have better entrepreneurial intention than engineering students [40]. In addition, within engineering students, male students tended to show a higher propensity for entrepreneurship than females.

Other researchers concur that EE (Entrepreneurship Education) does impact Entrepreneurial Intention but wanted to check if context mattered [41]. In their study they found that EE impacts both Business and engineering students positively, but subjective norms negatively impact engineering students, i.e., that the community of engineers do not "approve" of engineers doing entrepreneurship. Another study examined the attitudes of EE in engineers in 500 students at 3 institutions with entrepreneurship programs [42]. Over two thirds felt that EE could help them, but less than a third felt it was being addressed by their faculty. They even found that certain engineering disciplines such as mechanical and electrical had higher rates of participation in EE.

A controlled study of engineering students found that students who had taken at least one EE was a strong predictor of business ownership [43]. Their results showed that "Significantly more of the EEs group had started businesses (48% had owned a business at some time since graduation) than those in the comparison group (26% had owned a business at some time since graduation)," [43].

Distance learning (MOOCs)- Massive Open Online courses

The idea of distance learning has been around for decades through open universities, mail order learning etc. But technology has changed Distance education significantly. The idea was first coined [44] by Downes and Siemens in 2008:" 'connectivist' distributed peer learning model." [ ]

MIT's OCW and Stanford's released recordings of their classes and in 2011 this field exploded [45].

MOOCs implies open access and global. Some are free and normally , there is a video component to instruction through online platforms and is aimed at allowing thousands to be educated.

Looking at google trends we find that only in 2014 did this phenomenon start picking up as seen from the Figure 1 below. This graph below from google trends shows us the interest in MOOCs (search word). As can be seen it had increased in the last 6 years or so and Covid caused the numbers to explode.
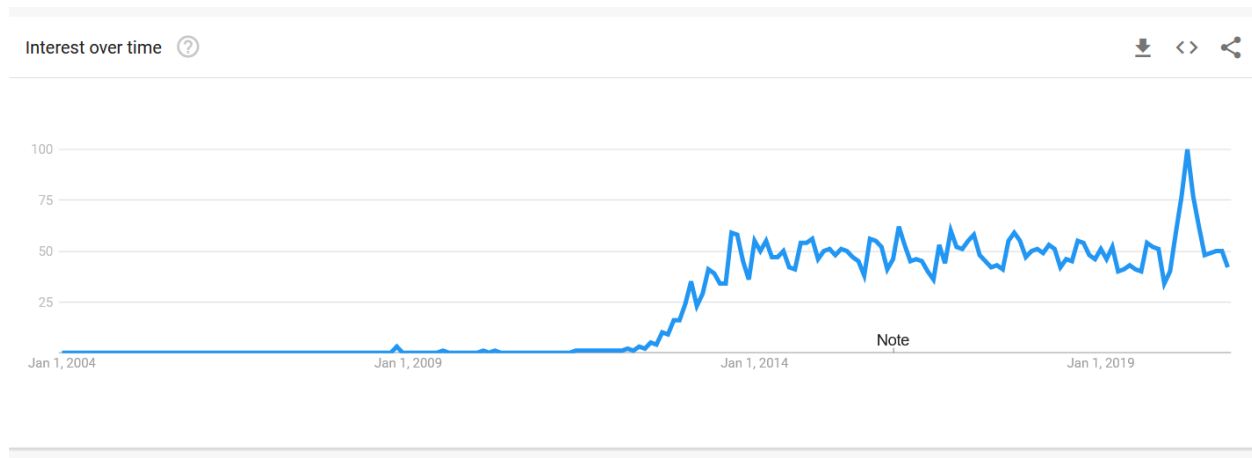

Figure 1: MOOCs across time (search words on google) Source: Google trends

MOOC's were seen as democratizing education and giving access to millions. Anecdotes of students from tiny villages in Asia making it to MIT were cited as success metrics. An entire industry emerged with Coursera, Udacity, udemy, EdX all joining the bandwagon with mixed results. Udacity claims that 92% of their learners get a job after they finish a program. Rates of completing a course is much lower than in a college setting with 3 to 15% completion rates [5].

Another characteristic was synchronous vs asynchronous. Asynchronous was touted as a great benefit as people in different time zones could access the rich content at their pace and time. In a recent 2020 study done by Serdyukov in the book by Beckwith state [46] that it "may deprive students of the two critical benefits of education, personal and social development, and cause deterioration of the learning outcomes." In 2008, a study found that students did suffer from asynchronous learning in checking the effectiveness of the teaching method due to the lack of interaction [47].

The issue then was how does one combine the benefits of MOOC's and synchronous learning and thus we created and piloted a course combining these two aspects.

Course structure

Over 350 students from 20 different engineering colleges from India were recruited for a pilot program along with the faculty from their schools. No pre-assessment was done for entrepreneurial mindset. The students did not get any school credit but received a certificate for completion. Each

college recruited approximately 20 students and 1 faculty for the course. The course was offered using the "Lean Launchpad" methodology, teaching one class per two weeks. Table 1 shows the list of classes taught. The expectation was that the faculty participating in the course would be able to use this course as the foundation for offering entrepreneurship courses for credit as required by the All-India Council for Technical Education (AICTE). The teaching team consisted of business and engineering faculty from different parts of the US, while the students were from different parts of India. The faculty from the individual colleges in India were responsible for grading the homework submissions of their students.

Synchronous Sessions

We created 8 sessions of synchronous material. Some examples include pitching. Now In a classroom one would have had students pitch by standing in front of the class. This was not feasible, so we had them write out their ideas using the "wow how now 30 second pitch idea". Additionally, a homework was set up to create a 30 second video of the pitch.

Other activities which were done synchronously consisted of asking them to answer various polls or questions that we posed. To teach the concept of pivot, we had all students stand up and then rotate themselves 180 degrees and list what they saw. For design thinking, we had them draw and had each of them draw prototypes in real time while we gave prompts.

Every session had an interactive component. We attempted not to lecture for too long. For the negotiation session, we had them in groups of 2 and they had to negotiate as per the case.

Table 1. Topics covered in the MOOC course

Week	Course description
1	Entrepreneurial Mindset
2	Pitch an idea – Identify the problem to be solved
3	Circular Design thinking
4	Understanding how to get effective customer feedback (using Lean Launchpad method)
5	Iterate using lean startup
6	Create the minimum value product (MVP) and prototype
7	Create the Business Model Canvas
8	Start selling the idea and negotiation exercises

Cultural aspects (India)

In India we see an increased interest in MOOCs and the top 4 locations with the highest interest were in South India, as shown in Figure 2.
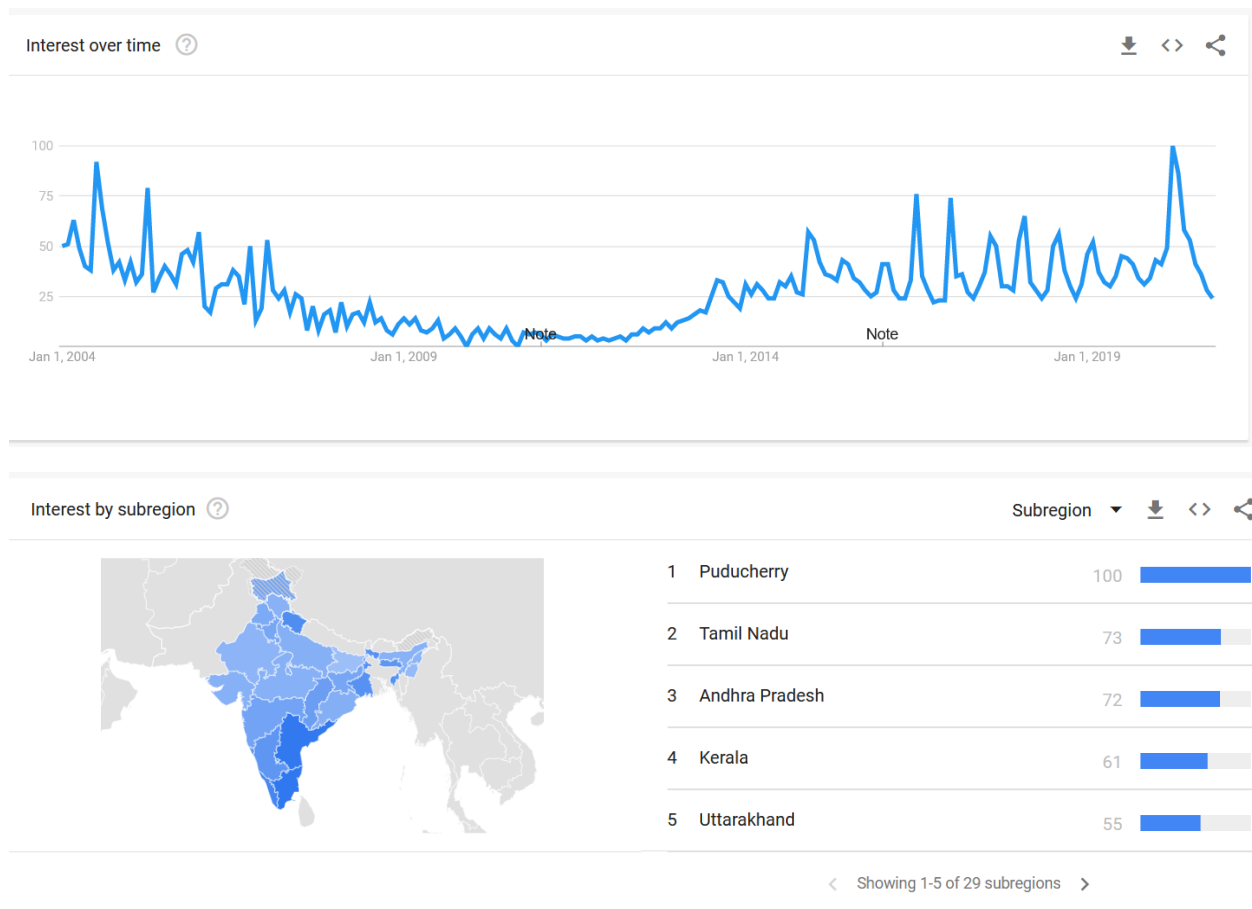
Figure 2. Level of interest in MOOC's in India

Source : Google trends

It should be pointed out that India does not have an NSF I-Corp program, and if available, such a course could be used to evaluate the interest in an entrepreneurship type of course or program for students from countries such as India.

The course was offered to engineering students who were primarily in the southern part of the country, specifically the states of Andhra Pradesh, Telengana, Maharashtraa, Karnataka, Tamil Nadu and Kerala. There were also students from one state in the northern part of the country. Given the fact that both the professors leading this were of Indian origin and had done a major part of their education through college in India (albeit a few decades earlier), we were clued into the cultural aspects. Additionally, we have been visiting India almost annually to keep abreast of the changes there. The other interesting aspect of this course was that this was primarily offered to students who were not part of the educated elite attending the Indian Institutes of Technologies (IIT's), or the National Institutes of Technology (NIT's), where the students are admitted after passing a grueling entrance exam. This suggested that MOOC's courses such as these would help to democratize educational and entrepreneurial opportunities for many students who may not be able to afford to attend the expensive educational programs at IIT's and NIT's.

As far as the course was concerned, most of the activities were universal. We did make some tweaks such as examples related to the local parts of the country, such as social media examples or websites or even the distribution chain.

Impact measurement

The idea here was that students get hands-on experience in creating an MVP for an idea. In order to measure impact, we used a couple of metrics. One was the number of teams formed and continued till the end of the 15 weeks. Another was a post survey after the class to see if students found it useful.

Going forward, we are monitoring to check if any faculty started a class on their campus and that will be collected for the next 12 to 18 months. In addition, we are also monitoring the progress of the student teams to see if they continue with their project. Staarting January 2021, another faculty will lead a class with the same faculty to reiterate and help them sort out issues in development of the course. There is also interest on the part of the colleges to continue the class for a second set of students and faculty to take advantage of the interest that has been generated. Anecdotally, the feedback from several students, especially those who received a score of 75% or better grade in the class have decided to take their idea forward to form their own companies. This suggested that those students who did well in the course also gained the knowledge to become entrepreneurs. The other interesting phenomenon that we observed was that their performance in the course was shared widely on Facebook and LinkedIn, with several students remarking that the success of their peers was an inspiration to them and could motivate them to enroll in the course the next time it was to be offered.

A total of 119 students completed the course, with 45 students earning a grade of 75% or better, which is a completion rate of better than 50% of the students who started. A few conversations about the ones who could not complete tended to be around, lack of wifi as well as health reasons. This wasn't a comprehensive study reaching all who hadn't completed. This was encouraging to the teaching team, in spite of not being able to meet the students face to face during the course. Table 2 shows the list of colleges and the number of students who successfully completed the course and earned a distinction or 75% or better grade in the class.

Informally we collected feedback at every meeting via chat and messages. For most of them we had innumerable positive reviews.

Table 2. List of colleges and their locations who completed the MOOC's course

Institution	Grade
AISSMS College of Engineering, Maharashtra	2 Distinction, 9 Completed
BHG College of Engineering and Technology, Gujarat	4 Distinction, 4 Completed
BMS College of Engineering, Karnataka	6 Distinction, 6 Completed
BVRIT Hyderabad for Women, Telengana	9 Distinction, 9 Completed

Kalasalingam Academy of Research and Education, Tamil Nadu	6 Distinction, 6 Completed
KJ Somaiya College of Engineering, Maharashtra	3 Completed
KK Wagh Institute for Engineering Education and Research, Maharashtra	1 Completed
KL University, Andhra Pradesh	1 Completed
Marwadi University, Gujarat	6 Completed
NITTTR Chennai, Tamil Nadu	3 Distinction, 3 Completed
PSG Institute of Technology, Tamil Nadu	1 Completed
Rajarambapu Institute of Technology, Maharashtra	1 Distinction, 6 Completed
Ramco Institute of Technology, Tamil Nadu	2 Distinction, 3 Completed
Saintgits College of Engineering, Kerala	2 Distinction, 6 Completed
St. Joseph Engineering College, Karnataka	3 Distinction, 7 Completed
Thiagarajar College of Engineering, Tamil Nadu	6 Distinction, 10 Completed
Vardhaman College of Engineering, Telengana	1 Completed
Vidya Jyoti Institute of Technology, Telengana	2 Completed
VNR VJ Insitute of Engineering and Technology, Telengana	2 Completed
Vishwakarma University, Maharashtra	1 Completed
Vidyavardhaka College of Engineering, Karnataka	1 Distinction

Feedback on the class

A post course survey was conducted, and the results are shown below:

There were 21 respondents. The first question was "did you learn anything?" and as can be seen the majority said that they learnt many tools. Over 90% agreed to continue to work on their idea going forward, which is heartening to know. 96% felt that this online MOOC kind of session worked well. The results are given in Figure 3. Figure 4 shows the results of the survey about whether the on-line administration of the course worked or not.

 The comments on future improvements centered on "getting to meet a successful entrepreneur" and "investors" also meeting some engineering entrepreneurs. Additionally, we are now aiding engineering colleges to create entrepreneurship courses, after the students and faculty successfully attended this course.

Rate the Entrepreneurship course
21 responses

- 1: 0 (0%)
- 2: 0 (0%)
- 3: 0 (0%)
- 4: 7 (33.3%)
- 5: 14 (66.7%)
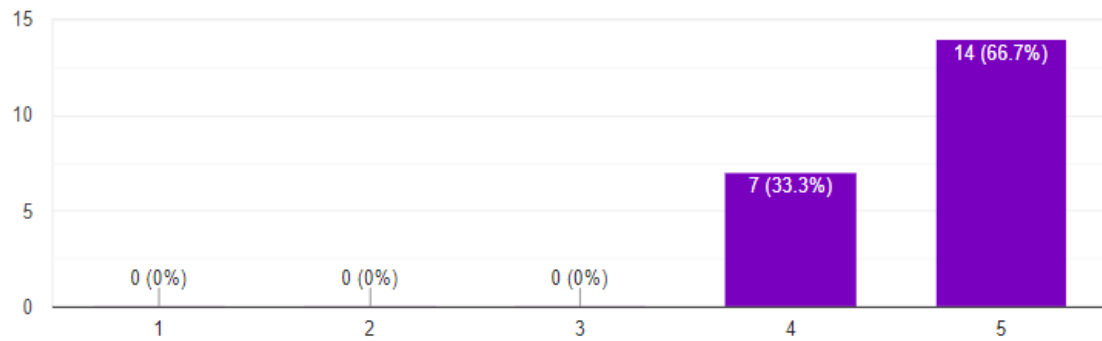
Will you continue to work on your idea?
21 responses

- 1: 0 (0%)
- 2: 0 (0%)
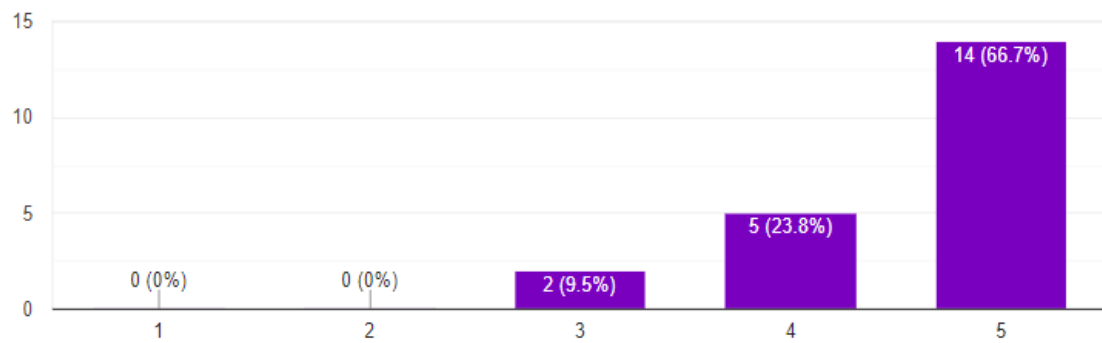- 3: 2 (9.5%)
- 4: 5 (23.8%)
- 5: 14 (66.7%)

Figure 3. Ratings collected after the course administration

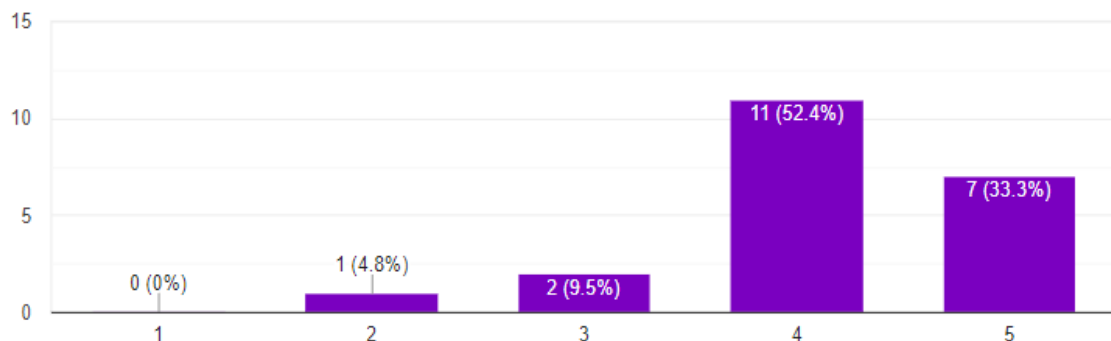Did you think this online method worked?

21 responses

Figure 4. Survey results about the on-line administration method

Lessons learned

Steps to creating a class.

The most important facet is finding students in any education setting along with teachers with a strong interest in setting up future courses with an entrepreneurship focus. This was done under the aegis of the Indo-Universal Collaboration for Engineering Education (IUCEE), an umbrella organization that collaborates with engineering and entrepreneurial faculty from across the world which marketed the course and got over 200+ students and 20+ faculty to attend.

Once the flyer was sent it took a few weeks to get them on board. We then created a syllabus and decided to have 8 sessions over a 4-month period. We met every 2 weeks via webex /zoom .

Initially in month 1, we convened a session where all the participants were invited to get familiar with the tools such as Canvas and webex. In this session, we gave an overview of the next 16 weeks and explained the purpose and methodology of the class.

Each class was an hour long and was led by one of 2 faculty members. The focus was to keep it interactive. The way we did this was through polls and questions. There was very little verbal connect by the students. For example, we asked the students to pitch an idea and they would write it in the chat box. One of the professors would read them out. Every session was highly interactive.

Every week homework was assigned such as film your pitch, filling up the BMC or Business Model Canvas, and even creating a website for their company. Students were very adept at picking up the tools without much effort. Tools such as google sheets and others were used to form teams and work together.

Percentage of homework completion declined over the 16 weeks, as is normal in a regular class too. The students who finished all the homework assignments were awarded certificates for this course.

To continue the interaction with the faculty, an entrepreneurship cluster has been formed, with a monthly interactive meeting. The cluster currently has over 80 members. To make it easier for faculty and mentors from India to participate, the meeting has been set up at a time and day that is convenient for participants from India. Volunteers are invited every month to present a 10-minute overview of their success and issues, with other participants offering suggestions to overcome potential issues and to collaborate in the future. The entrepreneurship cluster is perhaps one of the best results of the MOOC's course.

Discussion

Several scholars have proved conclusively that entrepreneurship is a vehicle of wealth creation and also jobs. Additionally, it aids regions to become more competitive, and have social and economic benefits. In a 2017 study, researchers found that entrepreneurship education, aids the development of "abilities, skills, attitudes and knowledge that are very meaningful attributes for engaging in entrepreneurial activities," [48].

The idea of MOOCs is over a decade old and synchronous MOOCS are the rarity rather than the norm. The decision to do so was to engage students more and given an interactive entrepreneurship education, which turned out to be a decision helpful to motivate students and faculty.

We learnt from this pilot that planning and preparing for the classes to ensure a high degree of interactivity was critical.

Our experiences in running this course also suggested that we should continue our interaction and engagement with the students, faculty and the college leadership about how to continue assisting the colleges and students. One of the teaching faculty has started an entrepreneurship cluster and will be continuing a monthly one hour zoom meeting to assist the faculty at the colleges to initiate entrepreneurship courses so that the colleges could meet the new AICTE requirements to teach entrepreneurship as part of the engineering curriculum to all engineering students.

Conclusions

The main conclusion of this pilot was that conducting MOOCs synchronously was totally feasible and the outcomes were positive . This is a way forward to reach masses in disparate locations and time zones while keeping them engaged. Teaching is a two-way process, and the interaction did enable students to stay involved and engaged. The number of students who remain engaged and completed the course was almost double the rate of earlier MOOCs [5].

This suggests that we can use this platform to engage more students and have them avail of education by meeting them at a time and place where it is convenient for them. Additionally, encouraging such sessions could improve the engagement and retention of students .

Limitations

Webex was a limitation, as we could not see the faces of the students. We did do one zoom class while teaching sales and negotiation. Fall off as per most MOOCs' the percentage starting and ended was only 30%. Feedback on this fall-off in the interaction levels was not available as the group was inaccessible. However, we believe that as an initial effort, this was a successful as 50%

of the students continued the interactive sessions through the 16 weeks of the program. We believe that more interactive sessions might be needed in order to keep the interest high among the students.

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