

Massive Open Online Courses (MOOCs): A Perspective from the Engineering Education

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Abstract—The COVID Pandemic was a big hit not only for the education sector but also finance sector, industrial sector etc. Due to this adverse situation the physical classes were abruptly stopped and there was a chaos. During this arduous situation universities switched to E-learning. Students started taking MOOC courses. Massive Open Online Courses (MOOC) are online courses offered by diverse educators with the goal of enabling everyone to access content at reasonable prices from any location. This paper presents how Universities can influence students to enroll in courses. For this study purpose students at a University in Pune provided the data in the form of Feedback and Suggestions. Students can enroll in a Course for one of two reasons: to learn new things and develop their abilities, or to gain University Credits. The results showed that many students were completing MOOC courses for credit than for personal growth, a strong correlation between enrolling in a MOOC course for university credit and successful completion is observed. A strong need for University teachers to offer their expertise on these platforms to ensure global knowledge sharing was also observed.

Keywords— MOOC; Self Learning; MOOC Platforms; Performance.

JEET Category— Practice

I. INTRODUCTION

MOOC that is Massive Open Online Courses are distance learning programs which are designed for students who are geographically dispersed. Although these courses don't always offer credits, majority of them may offer certifications and help them enhance employment opportunities or further studies. The main purpose for selecting these courses is to get extra knowledge apart from what is taught in colleges/universities. Due to the COVID-19 pandemic educational institutions were forced to shift their teaching to online mode these MOOC courses are in limelight.

The term MOOC is derived as – Massive, because enrollments are unlimited and can run into hundreds of thousands. Open, because anyone can enroll - that is, there is no admission process. Online, because they are delivered via the Internet. Course, because their goal is to teach a specific

subject. Most of the MOOCs are made by Universities. Some of the first universities to make them are Stanford, MIT and Harvard. MOOCs are particularly beneficial for students of developing countries for whom the travelling cost and physical tuition fees would be prohibitive. [4] Indicated that the participation of students from the Developing countries of Asia and Africa is relatively low with the majority being from North America or Europe. Now many universities are offering free credits for these MOOC courses to motivate students to enhance their skillsets.

This paper first discuss summary on available literature in section II, followed by the methodology for implementing MOOC at the University level in section III. The challenges and advantages of MOOC are highlighted in section IV. The results are discussed in section V

II. BACKGROUND WORK

MOOCs combine developments in online and distant learning from a number of pedagogical and technological fields, such as Web-enhanced learning, connectivism; Learning Management Systems (LMS), e-learning, Computer-Supported Collaborative Learning (CSCL), Open and Distance Learning, and Computer-Based Education and Training (CBT). These advancements have motivated us to study different aspects of E-learning through MOOCs.

Four key questions given below were examined and studied in order to better understand the need to reach and assist a large number of student learners, which sparked additional creativity.

1) How MOOC is beneficial for student's E-learning?

To adapt to a vast, dynamic, and always changing world, engineering is quickly modernizing and evolving. Every engineer should therefore make an effort to go beyond what has already been thought of and verified. MOOC is a solution to stay up with quickly developing technologies, and learn beyond the prescribed course and a limited number of texts.

MOOC implemented at university level helps the students to pursue the curricular elements in addition to the mandated curriculum, which requires them to push the limits of their knowledge and practice self-learning.

Author A. Y. Lozovoy (2019) analyzed the advantages and disadvantage of online education from the viewpoints of both, the online course participant, and the online education provider, such as a college or university. Online education has several advantages for the students such as they can enroll for the courses from different geographical places and can obtain the knowledge base by registering the online courses of different categories, disciplines.

This also gives them flexibility in their schedule, performing multiple activities, and improved access to quality education and choice.

Through these courses students learn from a diversity of mentors and teachers in many professions, which broadens the perspective and skills.

2) *Real Need of MOOC in pandemic situation?*

The pandemic has caused detrimental effects causing schools in 186 different nations to close. This has affected more than 1.2 billion students. This has created a state of confusion and ruckus making many wonder if e-learning would carry on after the pandemic and what will be the effects of all this in the global education sector.

This led to an increase in the demand of Online Platforms substantially and considering this as an opportunity many online platforms started providing free access to their services to entice students to complete their courses.

Amit S, Karim R, Kafy AA (2022) assessed MOOC market trend in Covid pandemic for Indian and Bangladesh on various factors like, education market background, government policies etc. According to this research article Amit S, Karim R, Kafy AA (2022) India's Coursera user base is growing at a rate of 505% every year, it is safe to claim that India has a good chance of growing its MOOC market. As a result, MOOCs could offer a less expensive answer for the students from rural areas to enroll in higher education

3) *Post pandemic scenario of MOOC?*

Students learned throughout the pandemic that online learning can be used to expand knowledge and facilitate improved time management. Even after the epidemic, an increase in the number of participants enrolling in MOOC courses is noticed, since they play a vital role in gaining engineering expertise. After taking physical classes, participants these days consider traditional offline study and complement it with online learning as they can coexist and provide a better environment for e-learning.

4) *How MOOC designers attract students by providing different offers?*

Higher education institutes that provide online learning alternatives should anticipate attracting students from all walks of life as online courses gain popularity and acceptance as a mode of education that produces the same classroom outcomes.

This makes the potential audience for these courses essentially limitless, especially when combined with the global availability of independent online courses that provide accessibility for everyone.

There can be multiple ways in which an online course designer can allure students.

1. **Communicating in multiple platforms:** There are many ways for instructors to communicate with individuals in an e-learning environment. Students frequently respond well to explanation screencast films, which are getting easier and less expensive to produce.
2. **Promote Online Classes using paid social media ads:** It is preferred to use Facebook ads to draw students to the online courses. Especially now that the majority of students only have access to online courses. The advertisements have the power to draw in prospective students and earn their trust.
3. **Provide Useful course material:** Designing the course material on the basis of student's requirement is the most important and effective way to allure students. Understanding the needs of the students and designing the course accordingly is of great importance. If the course is designed as per the modern need of students then more and more students will join that course.
4. **Offer Certificates or Course Completion:** Students adore receiving praise and acknowledgment for the effort they put into a course. This acknowledgement may come in the form of the instructor's praise or a certificate that documents their accomplishment. Also, many times these certifications can help them improve their resume and also help them in Universities
5. **Share Customer Testimonials:** Any business needs to establish credibility and trust, but marketing online courses require it much more. People won't believe how good the course is until they read the experience of people who have already completed that course. Reading positive comments and reviews from past students always give people that confidence and credibility about that course.

Some existing research papers were reviewed to better understand the MOOC structure.

Hone, K., & El Said, G. (2016) proposed the factors affecting the retention of MOOC courses. According to the survey in this paper a model is explained for 79% variance of MOOC course retentions. Some decisive factors were- interaction with the instructor and course content. The authors report that students who passed the mid-point of a course are generally more likely to complete the whole course.

Christensen, G., Steinmetz, A., Alcorn, B., Bennett, A., Woods, D., & Emanuel, E. (2013) discussed the crowd who choose to pursue MOOC courses and the reason behind it. From the study in this paper, it was seen that majority of the participants in the course were young, well-educated and majority of them from developed countries. Also, there were a significant number of males as compared to females especially in BRIC and other developing countries

Ebben, M., & Murphy, J. (2014) research article covered the early years of MOOC scholarship (2009–2013) and provides an analysis of these empirical studies that conceptualizes key themes and places them in a historical context. There are two

major MOOC-related scholarly periods that have been identified, each with related study issues and imperatives. Effects of video production on students' engagement have been proposed in Guo, P., Kim, J., & Rubin, R. (2014). Some of the key findings are, shorter videos, informal talking-head videos are more engaging. A set of recommendations are provided in this study to MOOC platforms.

A comparative study had been presented in Watted, A., & Barak, M. (2018) which lists the motivating factors between University affiliated students and general participants. Participants in MOOCs are driven by general interest, growth, and enrichment and are focused on the advantages for their careers. The goal of university-affiliated MOOC participants is to advance knowledge.

Howarth, J., D'Alessandro, S., Johnson, L., & White, L. (2016) discussed about what drives students through a MOOC and what conditions might result in later enrolling in a university. The paper contends that the majority of students are persuaded to enroll in MOOCs by how closely the course topic and subject matter connect with their own goals and by the creation of an alluring value proposition.

Reich, J., & Ruipérez Valiente, J. (2019) focused a change from the field uniting around a newer, more established business model while still pledging to reorganize higher education. Three patterns that are emerging are highlighted to help understand the causes of this change: The majority of MOOC students drop out after their first year, participation in MOOCs has increased mostly in the wealthiest nations in the globe, and the low completion rates that have plagued MOOCs for the past few years have not improved.

Yousef, A. M., Chatti, M. A., Schroeder, U., & Wosnitza, M. (2014) discovered and evaluated around 74 indicators and divided into two primary categories of Educational and Technological criteria. The categories of Learning Analytics and assessment were considered to be the most important components of successful MOOCs.

The main claim made in Ross, J, Sinclair, C, Knox, J, Bayne, S, Macleod, H (2014) is that paying attention to the complexity of the MOOC teacher's identity and experience will ultimately support fruitful discussion concerning retention, access, and the purpose and meaning of the MOOC. At the moment, this discussion is typically focused on the student or the technology, leaving out the teacher entirely.

The work in this paper examines about MOOCs that were published between 2011 and 2022 in an effort to better understand MOOCs. From these academic works, research trends are identified.

1) Timing trends

The Fig.1 Represents the number of articles published between 2011 and 2022 spanning a period of twelve years. Between 2012 and 2015, there was an increase in the number of research published, which peaked in 2016, although the data were deemed insufficient to identify a definite trend. While there were some swings, a trend toward rising publication numbers was nonetheless evident. There has

been limited research undertaken in the field of engineering education despite the growing number of MOOC-related studies.

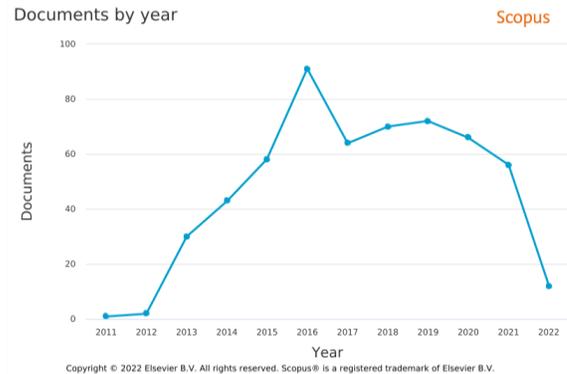


Fig.1 Year wise research documents published on MOOC in Engineering Education

2) Country wise research trend

The major influencers in the field of "MOOCs in engineering research" are compiled in Fig. 2. As can be observed, United States (n = 100) as the country with the most studies published on MOOCs in engineering education followed by China (n = 100) and Spain (n = 75).

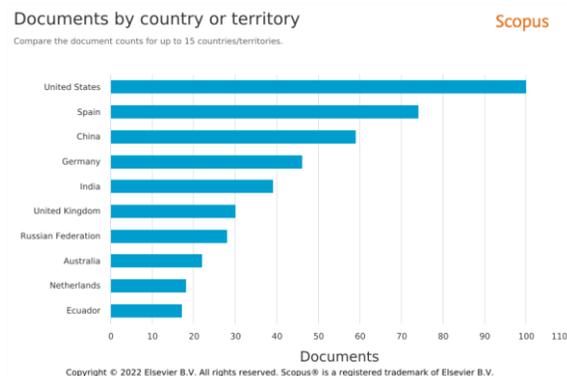


Fig.2 Year wise research document published on MOOC in Engineering Education

3) Subject-area wise research trends

The subject-areas were examined used for MOOC research in order to assist students in becoming Lifelong Learners. Fig. 3 shows the research trends in MOOC engineering education by subject area. The most studied subject, according to the analysis, is Computer Science (30.4%), which is followed by Social Studies (24.7%) and Engineering (21.9%).

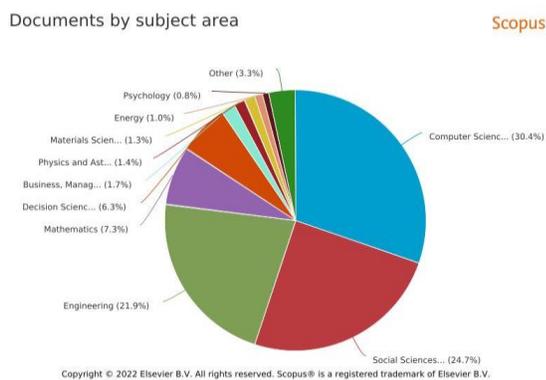


Fig.3 Subject-area wise research document published on MOOC in Engineering Education

III. METHODOLOGY

This section discusses the process of MOOC implementation carried out at the University. This study was performed on 491 students and it was ensured that all the students are completing the courses before they graduate from the university. Around seventeen steps are involved in this experiment starting for MOOC selection criteria to transferring the credits on their final mark sheet.

A. Method

The process of MOOC implementation at the University has the following steps explained in Fig.4.

1) Form a MOOC committee and prepare MOOC policy

To manage the entire MOOC process, a committee must be formed. The committee is responsible for formulating and devising a thorough MOOC policy to provide consistency, accountability, efficiency. The rules made by the committee should provide some clarity on how the Program should operate.

2) Approval from Higher Authorities

A higher authority's approval of certain policies is required once the policies have been drafted. The policy must be checked to make sure everything is correct, legal, and upholds all applicable university codes of conduct. For instance, before the Committee can incorporate something in their regulations, the higher authorities must agree that students would receive credits depending on the MOOCs they have finished.

3) Courses, Platform, Credits, Roles and Responsibilities of Stakeholders

There are many different platforms that offer courses that cover a wide range of talents, including technical skills, project management skills, artistic skills, etc. These courses are available on a number of sites, including Udemy, Coursera, NPTEL, and others. These courses may be offered for free, on a subscription basis, or for a fee. Additionally, prices may change depending on the course. The University will provide credits ranging from 0 to 6 after these courses are finished, with each course worth 2 credits. There will only be 3 courses that receive credit, however students are encouraged to take additional courses for their own advantage. In order for a course to qualify for the 2 credits, it must be longer than 8 weeks or 30 hours.

4) University Support

University may also be very important in this process. Universities and platforms might collaborate to offer the courses at a discount or even for free. Based on how well students perform in these courses, they may also award scholarships to those students. Universities can encourage students by demonstrating their appreciation for them, such as by giving awards or applauding those who perform well on social media sites like LinkedIn, among other things

5) Orientation MOOC

The policy must be explained to the students in a MOOC in order for them to comprehend it. The students can learn all the information pertaining to the policy during this orientation. Additionally, this introduction can serve as a platform for encouraging students to enroll in these MOOCs and emphasizing their benefits.

6) Awareness/Briefing about the Policies, Doubt Solving

If Students have any doubts then they can be cleared then and there. Subsequently if they have any doubts later on the MOOC committee can help them with those.

7) Identification of Mentors/Facilitators

Every course has a key skill that students can gain. But students are in their learning phase and right guidance to them while learning is necessary. If an expert in that particular skill which the student is trying to acquire can help the students better understand the concept. The right advice from the mentors can give the students the right path of gaining the knowledge.

8) Mentors one to one encouragements as per their expertise

A disadvantage of online course is the lack of interaction between the instructor and the students. Having being able to converse with the mentor can be supplementary to the lack of conversation between the students and the instructor. Here the role of the mentor is to give the full insights of the course. How students should access this course to learn the skill to their fullest. They should chalk down all the aspects of the course according to their level of difficulty, say simple, medium and hard. This will help the student to channel their focus according to the level of difficulty. The mentors can also help them in building their confidence by motivating them through the process. The mentors can also share the future opportunities of that skill and course and how beneficial that course will be for the student.

9) Continuous interaction with the student (discussion, facilitation)

It is possible that after some time students might lose interest in doing a particular course. It is also possible that a student is getting many doubts continuously. Discussion with facilitator and group of students having similar domains also helps student to solve assignments and do some mini projects so they get a practical knowledge of it to really understand and learn those concepts. That is why it is very important to have regular interactions with students.

10) Keep track of virtual and physical assessment

The courses should have evaluations after a certain time so that the students can review how well they have understood the subject and these evaluations can also act as a quick revision for

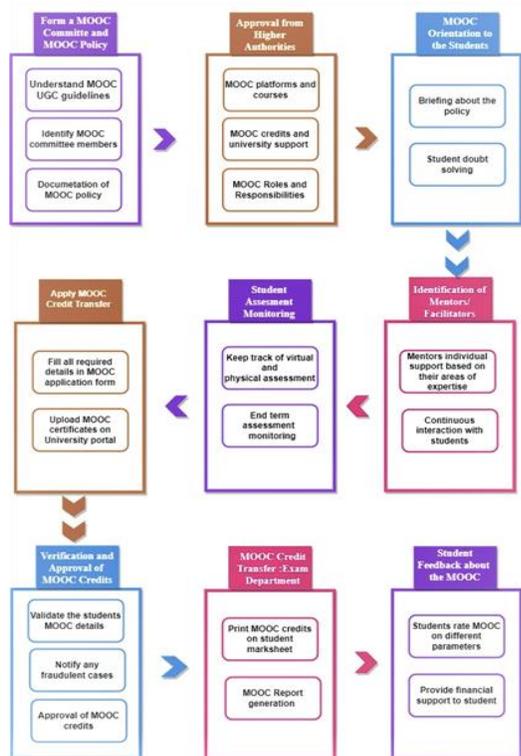


Fig.4 Phases of Research Process

these students. Many a times students might just complete the courses for the sake of getting the credits and certificates. But with fair evaluations students can really.

11) End term assessment monitoring

These courses must have a final assessment test to make sure that the student has really understood the topic or not. There should be cutoff passing marks. If the student scores below that score, then the student won't get the certificate and credit. This ensures that the student has properly done the course and not just for the sake of getting the credits.

12) Submission of certificate to university online portal

After completing the certificate, the students will receive a certificate of completion. Students must upload this certificate on the college portal to get the credits. This will help the university keep a track of the student's progress and the university can process the student to provide the credits.

13) Validation of certificates

The College / University must ensure that the certificates are authentic and the courses follow all the guidelines that the university has placed. Many times fake certificates are created, so checking the authenticity of the certificate is vital. And also, the committee members should check if the course satisfies the criterion for getting credits. For example, if the course's duration is of 8 weeks or above

14) Report generation

This crucial stage in the MOOC implementation process allows for a better understanding of the various approaches'

students have taken to finishing the course. This will produce documents at the university level that contain all kinds of information on MOOCs. The report is an important document which can provide key insights like the liking of the student, how the student is performing in evaluations, his understanding of the concept, etc. These studies are also utilized to enhance MOOC procedures at the university level.

15) MOOC credit transfer to exam section

Every course completion means a student has earned certain credits. These credits can be updated by the student section. So after all the verification process the credits can be transferred to the exam section.

16) Student feedback

Student's feedback can be quite informative. The suggestions can improve the process. MOOCs are for the benefit to the student and understand how they feel about the whole process can help the committee to bring some key changes for the benefit of students and also the University.

17) University financial support

The University can refund certain amount or the whole of the money to the students for completing this course. They can also do this based on the merit system. Students who are performing exceedingly well in their courses will get this refund. This will motivate students to complete more and more courses.

After the MOOC process was implemented, the observations of students are indicted in the subsections ahead.

B. For Self-Improvement and learning

College curriculums are restricted to guidelines and many times are insufficient for students to learn and hone their skills. With the wide range of courses available literally on most of the important topics, to broaden their skill-set or explore new areas and domains they pick up these courses apart from their college courses for enhancing their skills or experimenting in different domains or other numerous reasons with the availability of the seemingly infinite courses available online it is easier for them achieve this.

Further, students who might not otherwise have access to knowledge and those who cannot pay the costs of higher education may benefit from MOOCs.

An effective method of online learning, non-traditional education delivered through MOOCs can supplement traditional university education.

These MOOC courses can have numerous benefits like introducing the student to a diverse group of professionals and students. Introduction to such kinds of online communities can help students interact with other peers and also create contacts in the industry.

C. To get the credits offered by universities

It was observed from the dataset collected in this paper that many students were taking and completing MOOC courses to get the credits offered by their university. Universities can play a major role in influencing students to pursue MOOC courses. By providing these incentives in the form of credits, students try to complete these courses which otherwise they wouldn't have.

IV. CHALLENGES OF MOOC COURSES IN ONLINE LEARNING

MOOC courses are a blessing to this tech savvy world. But there are some challenges that exist in these courses. The assessment is solved in an unsupervised condition. With the vast available resources online, it is completely possible that a student might cheat to get the answers. This might hamper the authenticity of the certificate. The students might lose their confidence if they aren't able to solve these assignments.

These MOOC courses are prerecorded lectures, some students do not get the opportunity to solve their doubts and interact with their professors. This is a major challenge of MOOC because this interaction with the instructors can be of vital importance. Furthermore, a student is learning in an individual environment. Therefore, there isn't any competition involved in the process. In schools students can compete with each other's to improve their grades. But in MOOC courses there is hardly any visible competition.

V. RESULTS AND DISCUSSION

The Fig.5 depicts the students' chosen courses by track. The course that the majority of students choose in the graph is Software Design. While 480 students chose Data Science, 491 students chose Software Design. 33 people chose Cyber Security as their course, and 111 people chose High Performance Computing (HPC). 154 students took courses in areas other than the titles listed above.

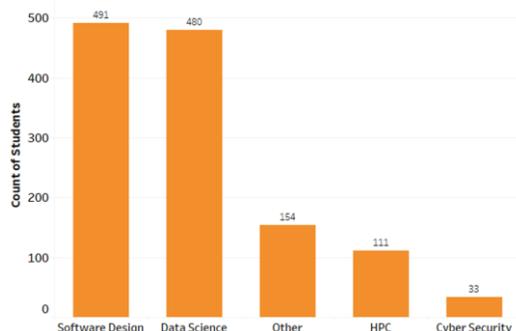


Fig.5 Track wise courses opted by Computer Engineering students

The platforms used by students to accomplish these projects are shown in the Fig. 6. Sizable number of students went with Coursera however 374 students chose Udemy as their platform of choice.

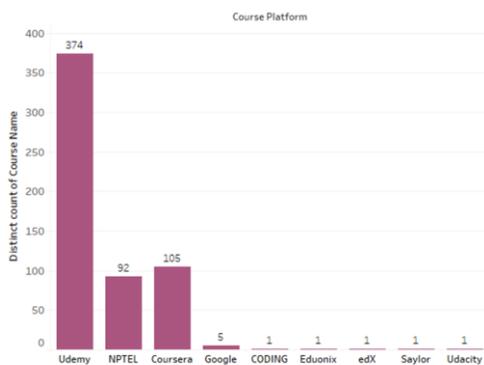


Fig.6 Number of courses opted MOOC platforms

The split of the platforms which students chose to complete a particular course in a particular domain is depicted in Fig.7.

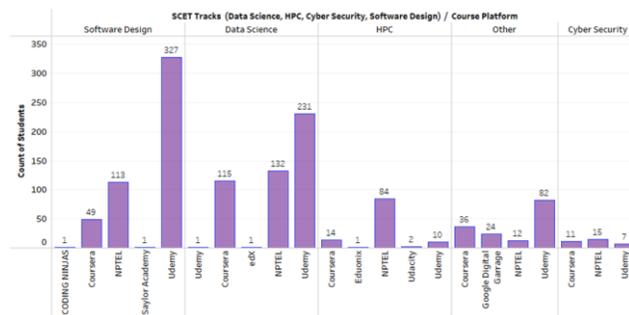


Fig.7 Trackwise and Platformwise courses opted by Computer Engineering students

Some names of the Top courses are listed in the Fig. 8. Some of the most completed courses are Programming in JAVA, The Joy of Computing Using Python, Machine Learning & Deep Learning in Python and R etc.

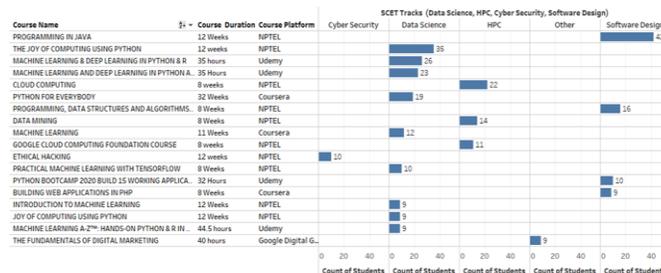


Fig.8 Topmost Courses opted by the Computer Engineering students

MOOCS as a mode of learning also assists learners (Engineering students) in lifelong learning which is listed as one of the Graduate Attribute by the National Board Of Accreditation in India, under the Outcome Based Education (OBE) which has been widely adopted and implemented particularly by the Faculty of Engineering.

It precisely fits the statement on the Program Objectives (PO) in verbose manner too. "Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change".

Fig.9 –to– 12 depicts the student's responses to the survey questionnaire and the impact of MOOCS on their future career inclinations. Some students did more than one courses based on their interests, which was quite encouraging to note.

While thinking about further Studies, Do you think MOOC Courses helped you to gain more insight into the Domain Knowledge

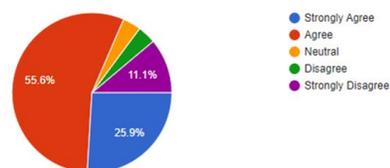


Fig.9 Feedback regarding courses to gain insights in domain knowledge

MOOC courses helped bridge the academic gap. To what extent you agree above statement.

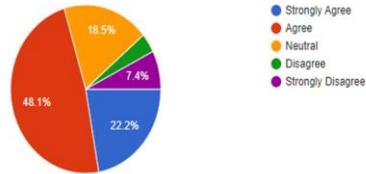


Fig.10 Feedback regarding choice of courses to bridge the academic gap

While thinking about further Studies, Do you think MOOC Courses helped you to gain more insight into the Domain Knowledge

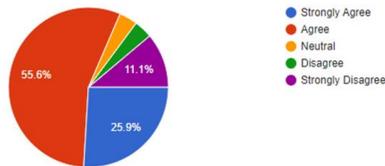


Fig.11 Choice of Courses to focus on Higher Studies

To what extent do you agree that, MOOC courses helped to enhance your skillset w.r.t. internship/capstone projects/ placement

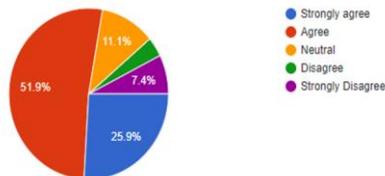


Fig.12 Choice of Courses to enhance the skillset

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