A Critical Evaluation of the National Programme on Technology Enhanced Learning (NPTEL): The Flagship Indian Massive Open Online Courses (MOOCs) Programme

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Abstract
NPTEL is a prominent Indian example of an online learning system backed by the Indian State. Driven by the government regulatory policy and learners' needs, NPTEL has become popular with students enrolled in the Indian higher education sector, especially in engineering and science disciplines. This paper critically evaluates NPTEL among Indian learners using NPTEL and field survey data. The data analysis for various engineering and science MOOCs is based on parameters such as registration rate, completion rate, type of users, and the reasons for using NPTEL. Firstly, the study shows a high completion rate for Computer Science and Engineering (CSE) and Professional Communication courses, but low completion rate for Physics and Electrical and Electronics Engineering courses. Secondly, most students have pursued programming courses of CSE in NPTEL. The field survey revealed positive student feedback on their institute's effort and help to pursue and complete NPTEL courses. However, it also highlights the disparity between students of public and private colleges in receiving monetary aid for pursuing NPTEL courses. Finally, the last section discusses the implications and observations of NPTEL based on our findings and the future scope of work on MOOCs policy.

Keywords: MOOCs, India, NPTEL, Policy, Engineering and Science

1. Introduction

MOOCs emerged in 2008 when George Siemens and Stephen Downes launched an online course on 'Connectivism and Connective Knowledge'. Stephen Downes referred to it as 'cMOOCs' or 'connectivist MOOCs' (Downes, 2012). The focus was on creating and sharing knowledge among learners. Later in 2011, two professors, Sebastian Thrun and Peter Norvig, from the Computer Science Department of Stanford University, launched an online course titled 'The Introduction to AI (Artificial Intelligence)'. Downes termed this kind of MOOC xMOOC (Downes, 2012). The following year, 2012, saw the launch of two private MOOC platforms, which led to the year being called the 'Year of MOOCs' (Pappano, 2012).

The Indian government, too, got influenced by the idea of MOOCs (Pandey, 2014). The National Programme on Technology Enhanced Learning (NPTEL), started by the Government of India, is an Indian xMOOC platform that has become synonymous with online learning in India, along with Coursera, edX and Udemy (Sharangpani, 2017). The platform got a boost when the Government of India introduced the SWAYAM Regulation Act 2016, allowing the use of NPTEL courses for credit transfer (AICTE (Credit Framework for Online Learning Course through SWAYAM) Regulations 2016, 2016).

All the hype around NPTEL has revolved around the rhetoric of high enrolments for NPTEL MOOCs (Choudhury, 2019; Nanda, 2019). However, like other MOOC platforms, it is also plagued with high dropout rates. There is a substantial gap between the enrolments and completion numbers that vary with disciplines and their courses. As of December 2020, NPTEL enrolments stood at 12.4 million, while only approximately 0.64 million (~5%) users completed the courses (NPTEL, 2021). The overall data does not present the break-up of the disciplines/subjects contributing to high enrolment numbers or varying completion numbers. This study focuses on analysing NPTEL MOOCs by addressing the following questions:

- What are the disciplines and courses of NPTEL for which students enrol and register?
- Who are the dominant users of NPTEL MOOCs in various disciplines?
- Which disciplines/courses are suitable for the MOOCs mode in engineering and sciences?
- How is NPTEL (SWAYAM) policy being implemented in universities in India?

2. Literature Review

2.1 Issues associated with MOOCs completion

The emergence of MOOCs created enthusiasm among learners, which was reflected in the large enrolment numbers in different MOOCs (Pappano, 2012). However, despite the rise in their popularity, it has not been a smooth ride for MOOCs (Ahmad, 2018). One of the main criticisms of MOOCs has been the low completion rates (or high dropout rates) in contrast to the high enrolment numbers (Koller et al., 2013; Liyanagunawardena et al., 2014). Clow termed this phenomenon a 'funnel of participation' and argued that MOOC users have little commitment during the MOOCs' initial period.' Therefore, the filtering of learners happens at later stages of MOOCs (Clow, 2013).

Most MOOCs have completion rates of 6-10% (Franceschin, 2016; Jordan, 2014; Murray, 2019). There are several reasons which can lead to high dropout rates, such as lack of time, course difficulty, lack of digital skills, differing expectations, bad peer reviews (Onah et al.,

2014), learner's attitude toward learning: motivation, goal-setting, self-regulation, self-satisfaction (Littlejohn et al., 2016). Watted and Barak have argued that career and educational benefits affect the completion of MOOCs (Watted & Barak, 2018). However, Watted and Barak's analysis is based on the MOOC course 'Nanotechnology and Nanosensors'. Our study examines the hypothesis across several engineering and science courses of NPTEL.

Some argue the completion rate (conversely, the dropout rate) also depends on the duration of a given MOOC course. Jordan (2015) observed that the shorter the MOOC period, the higher the completion rate. The duration of MOOCs can vary from weeks to months. NPTEL courses have fixed durations: four weeks, eight weeks, or twelve weeks (NPTEL, 2019a).

2.2 The Evolution of NPTEL

The NPTEL program was envisaged in the year 1999 with the collaboration between seven IITs (Indian Institute of Technology) and IISc (Indian Institute of Science) Bangalore, and funded by the Ministry of Human Resource Development (India, 2007).

Phase 1: The first phase of NPTEL was from 2003 to 2007. According to the official NPTEL document (India, 2007), the aim was to develop high-quality learning material and make it accessible to engineering students and teachers across the country. The focus was on creating e-learning content on videos and web content for various engineering disciplines. The learning materials were also available on CDs and DVDs (NPTEL, 2020b).

Phase 2 and 3**:** Phase 2 (2009-2014) and Phase 3 (2015 onwards) introduced more online content besides Phase 1 courses (NPTEL, 2020a). In Phase 3, NPTEL also opened its online courses for certification. The NPTEL Online Certificate (NOC) program was started to enhance the reach of NPTEL content by making it more attractive to potential students. The inception of NOC proved to be a significant step toward laying the foundation for the SWAYAM Regulation Act 2016. After the enactment of the Act, SWAYAM then subsumed NOC under its regulation. After successfully completing a course under SWAYAM, the certificate earned is eligible for credit transfer in any college/institute (State or Private) in India (AICTE (Credit Framework for Online Learning Course through SWAYAM) Regulations 2016, 2016).

2.3 What makes NPTEL Online Certificate (NOC) Program Different from Other MOOC providers?

There are significant differences between NPTEL and other MOOC providers, such as Coursera, edX, Udemy, etc. NPTEL is a public MOOC platform, while these popular MOOC platforms are more or less private.

NPTEL has set a standard criterion for assessing NOC courses: weekly assignment submissions and a final examination. The assignment submission carried a 25% weightage, while the end-of-course examination had a 75% weightage. However, from July 2019, the new criterion requires learners to have an average assignment score > = 40 and a final exam score >= 40 (NPTEL, 2020a).

The NOC learners must complete the in-person proctored, online end-of-course examination to get the course certificate. The examinations are held in over 130 cities across India. The

learner's ID (any government-issued or student ID), submitted during the enrolment of the course, is cross-verified at the examination centre to avoid the use of fraudulent means (NPTEL, 2020a). In contrast, other MOOC providers do not have any common assessment criteria. They are just content/course aggregators which run on different monetary business models for sustenance (Pani, 2019).

The certification exam fee is around INR 1100 (approximately $15), which is nominal (NPTEL, 2020a). The certificate cost of other MOOC providers, such as Coursera, edX, etc., is high compared to NPTEL certification. Coursera charges $39-$79 based on subscription or individual pricing models (Shah & Pickard, 2021), while edX prices its certification between $50-$300 (edX, 2019).

3. Method

The data source used for our study is available on the official NPTEL Online Certification (NOC) web portal (NPTEL, 2020c). The portal contains data for various engineering, science and humanities discipline MOOCs. However, we restricted this study's scope to engineering and science disciplines.

3.1 NPTEL MOOCs Research Data Set and Caveats

The enrolment number in NPTEL MOOC courses varies across disciplines and within disciplines. We have considered courses with at least a thousand enrolments for this study. The courses having 5% lesser enrolments of a thousand, i.e., courses with enrolment numbers above 950, have also been considered. We examined the data published by NPTEL for four semesters (Jul-Dec 2017, Jan-June 2018, Jul-Dec 2018, Jan-June 2019 and July-Dec 2019) though the data is available till the 2020-21 semester. However, the NPTEL data for 2020 is still getting updated. We have classified the courses into five different groups of disciplines for this study:

- Computer Sciences and Engineering (CSE),
- Electrical and Electronics Engineering (EEE),
- (Core) Engineering disciplines (Mechanical Engineering, Civil Engineering, Chemical Engineering),
- Professional Communication, and
- Sciences (Mathematics, Physics and Chemistry/Biochemistry).

CSE and EEE courses are further divided into sub-disciplines based on specialised subjects. The reason for separating CSE and EEE courses from Core Engineering courses is the magnitude of enrolments and the distinct patterns observed in the CSE and EEE. It also prevents Simpson's paradox (Agresti, 2007) which is observed if the sub-disciplines are combined with (Core) Engineering for the analysis. Simpson's paradox occurs when the trend is observed when data is grouped but reverses or vanishes when data is combined (Agresti, 2007).

3.2 Survey Data Set

Based on SWAYAM(NPTEL) regulation on the use of NPTEL in higher education, we conducted an in-person survey with the students of engineering and science colleges. We selected state and city of colleges based on the number of colleges located in the region using

stratified random sampling. We surveyed the following Indian states: Uttar Pradesh, West Bengal and Maharashtra.

We requested students to participate and fill in the NPTEL survey questionnaire. The questions focused on eliciting students' perceptions about the support provided by their college to implement the NPTEL policies. The response to the questions was measured using a 5-point Likert scale. The responses were also subjected to a statistical test using Kendall Tau-B ordinal (we considered the Likert response as an ordinal variable). Kendall Tau-b is a non-parametric test to measure the goodness of association between variables when one variable is ordinal (SPSS,2022).

3.3 Terminology

Before analysing the NPTEL MOOCs, it is important to define enrolment, registration and completion rates for NPTEL data (NPTEL, 2020d). Enrolment is the number of users interested in pursuing a particular NPTEL course by enrolling before it begins.

Registration is the number of enrolled learners who have registered for certification in a course. Registration rate is the percentage of enrolled learners registered for the certification. Completion rate is the percentage of the registered number of learners who have completed the course by appearing for the final course examination. It includes people who have completed the course 'successfully' and those who did not pass the course (which NPTEL refers to as 'participation'). The completion (retention) rate, therefore, is:

$$Completion\ Rate\ (Retention) = \frac{No.of\ Users\ taking\ the\ course\ end\ exam}{Registered\ Users} * 100 \qquad (1)$$

4. Findings and Analysis

4.1 Enrolment and Registration

The data, shown in Figure 1, indicates that Computer Science and Engineering (CSE) courses capture the bulk of enrolment numbers among all subjects. Chemical Engineering and Chemistry have the lowest enrolment numbers among all the disciplines. However, the registration numbers of all disciplines are meagre compared to their enrolment numbers (From Figure 1). CSE courses have the bulk of registration numbers though the registration rate is lesser than the rate of Professional Communication courses.

Computer Science and Engineering (CSE): Table 1 shows that a substantial portion of CSE enrolments are from Programming courses (Python, C and C++). The other popular courses with higher registration rates are Database Management Systems (DBMS) and the Internet of Things (IoT). It is also interesting to note that Artificial Intelligence, which has high enrolment, has an abysmal registration rate. The data also shows that traditional programming courses overwhelmingly attract more students than contemporary CSE courses. This includes the newer specialisations like Artificial Intelligence and Human-Computer Interface. It is also important to note that the data on *Blockchain* is an outlier as it makes up only one course conducted in July-Dec 2019, unlike other CSE courses conducted multiple times on NPTEL.

Electrical and Electronics Engineering(EEE): In EEE, we found Electronics Engineering and Electrical Engineering courses have higher enrolment numbers than other EEE sub-

disciplines. However, Miscellaneous (EEE) and Signal Processing courses have the highest registration rates at 11.5% and 10.4%, respectively.

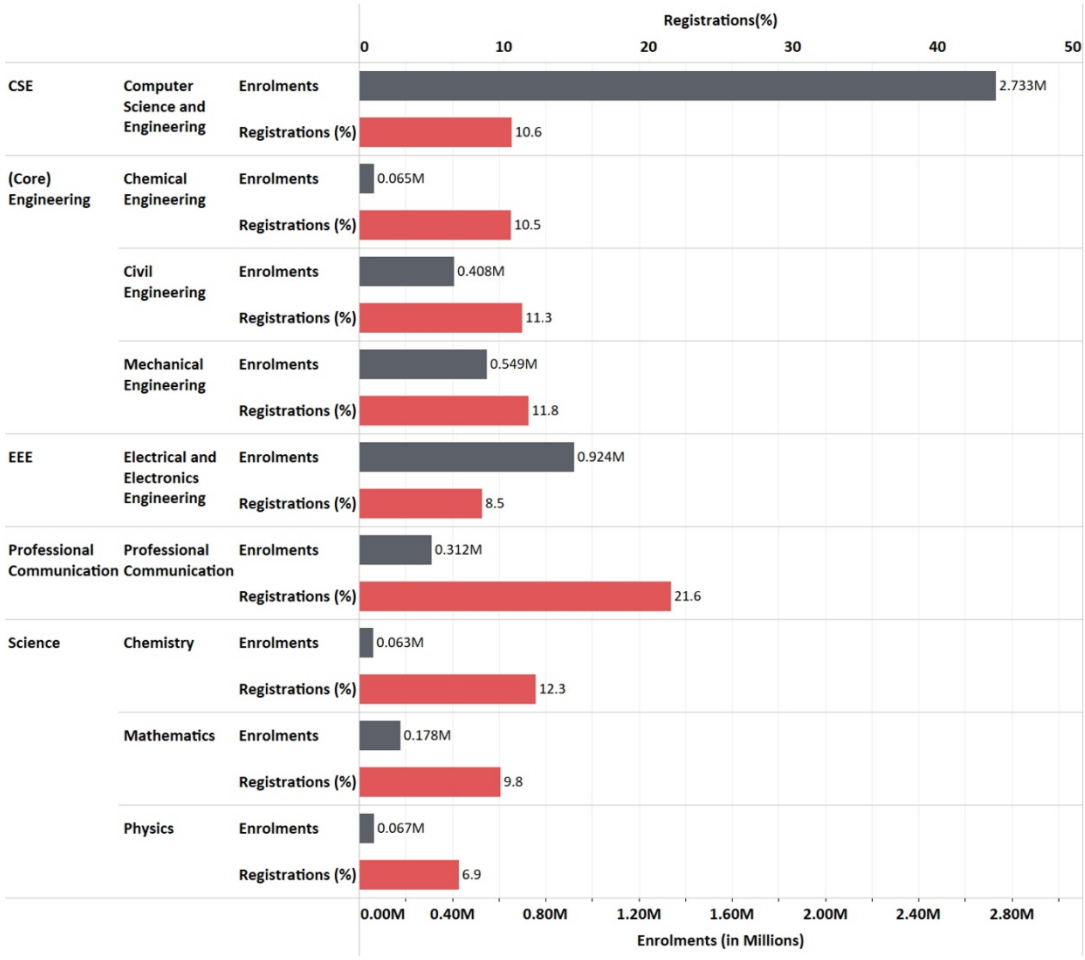

Figure 1: Enrolment and Registration (%) for the disciplines.

The analysis showed specific courses with high registration rates compared to other courses within (Core) Engineering disciplines of NPTEL. Re-run of the Mechanical Engineering course, 'Laws of Thermodynamics' in 2018, saw a mammoth 65% registration. The same course in 2017 had only a 13.6% registration rate. The course 'Integrated Waste Management For A Smart City' in Civil Engineering courses had a 29% registration rate. The course 'Electronic Waste Management-Issues and Challenges' had a 30% registration rate in 2019, while the same course in 2018 had a 13% registration rate. In Chemical Engineering, 'Technologies For Clean And Renewable Energy Production' and 'Chemical Process Safety' had a 24% and 21% registration rate, respectively.

Examining courses in Professional Communication revealed that the 'Enhancing Soft Skills and Personality' course had the maximum enrolment numbers, while 'Soft Skills' had the highest registration rate.

Stream	Subject/Sub-Disciplines	Enrolments	Registration Rates(%)
Computer Science and Engineering	Algorithm	1,43,371	7.2
	Artificial Intelligence	3,23,862	6.8
	Blockchain	1,801	90.9
	Cloud Computing	1,68,104	7.7
	Computation	1,05,000	8.1
	Computer Architecture	50,041	7.5
	Computer Design	42,563	10.4
	Computer Security	59,900	8.1
	Data Science	1,16,081	9.7
	Database Management System (DBMS)	1,62,498	12.9
	Embedded	20,927	9.0
	Human-Computer Interface (HCI)	12,623	5.3
	Inter-disciplinary	1,204	5.6
	Internet of Things (IoT)	1,66,564	16.0
	Networks	1,03,676	10.0
	Operating System (OS)	41,558	9.0
	Programming	11,74,367	12.0
	Software Development	38,736	10.1
Electrical and Electronics Engineering	Communication Engineering	1,65,615	6.6
	Control Engineering	72,285	9.2
	Electrical Engineering	2,56,264	8.2
	Electronics Engineering	2,90,051	8.9
	Miscellaneous	52,740	11.5
	Signal Processing	87,065	9.4
Professional Communication	Better Spoken English	32936	9.7
	Business English Communication	12135	11.5
	Developing Soft Skills and Personality	67879	29.9
	Development Research Methods	1621	10.4
	Employment Communication (A Lab based course)	4682	15.2
	English Language for Competitive Exams	25874	9.8
	Enhancing Soft Skills and Personality	55084	25.7
	Intellectual Property	2167	17.3
	Interpersonal Skills	6567	23.7
	Soft Skills	39767	30.9
	Speaking Effectively	25350	12.6
	Technical English for Engineers	37656	19.6

Table 1: Enrolment and Registration Rate (%) of Sub-Discipline and Courses of CSE, EEE, and Professional Communication

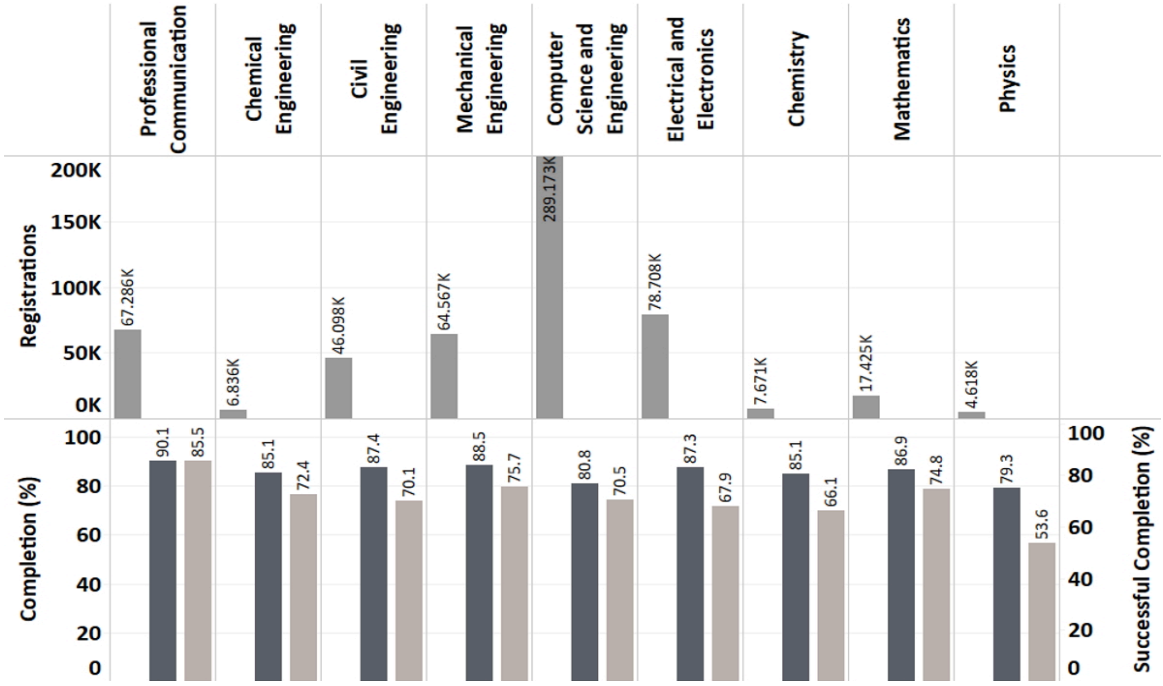

Figure 2: Registration, Completion rate, and Successful Completion Rate of the disciplines

4.2 Completion Rate

Figure 2 shows the registration numbers and corresponding completion rates for various disciplines. The figure shows that major 'funneling' (Clow, 2013) of learners' participation occurs between the time of enrolment and registration of the course. Evidently, all disciplines except Physics have similar completion rates post NPTEL registration.

However, a different picture emerges if we examine the fraction of learners among the registered users who completed the course and did so successfully. Figure 2 shows that Professional Communication courses have the highest successful completion rates among all the disciplines. On the other hand, Physics, Chemistry and EEE courses have the lowest successful completion rate.

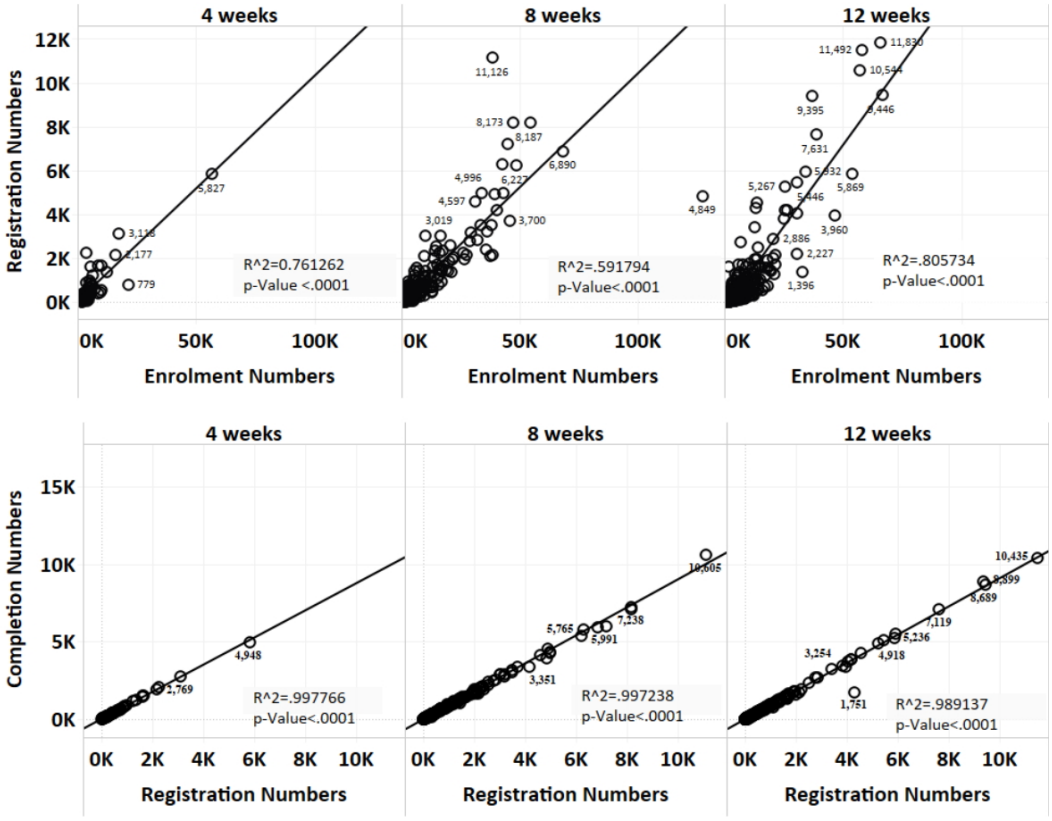

Figure 3: Relation Between Enrolment and Registration (top) and Registration and Users who Completed MOOCs (bottom), for the Three Durations.

4.3 Impact of Course duration on Registration and Completion Numbers

Figure 3 shows the correlation between enrolment numbers and registration numbers (top) and the correlation between registration numbers and completion numbers course (bottom) for the three different durations. The correlation between enrolment numbers and registration numbers is strongest and positive for 12-weeks, and moderately strong and positive for 8-weeks and 4-weeks NPTEL courses. The correlation between registration numbers and completion numbers is also strong and positive for all three durations. Therefore, the analysis shows that registration rates and users completing the NPTEL MOOCs are not inversely related to it
s duration. This finding is contrary to Jordan's observation (Jordan, 2015).

4.4 Types of Users

The NPTEL categorises its registered users into 'Students', 'Faculty', and 'Others'. The cumulative user data indicates that most users are students, though it cannot be generalised for all the courses. Some courses have higher faculty participation than students.

4.4.1 Faculty as Users

Figure 4 exhibits student and faculty users as a percentage of each discipline. Science courses have more faculty as users, followed by EEE courses, while Professional Communication and CSE courses have higher student participation.

The high faculty participation motivated us to examine the number of courses in each discipline contributing to this high level of participation. Figure 5 shows the faculty users fragmented into three percentage distribution bands based on the number of courses in each discipline: *'>40%*' of courses, '*>20% and <=40%*' of courses and '*< =20%*' courses. Most of the Chemistry and Mathematics courses have almost 50% of faculty users than student users of NPTEL. For example, Mathematics courses such as 'Integral Equations, Calculus of Variations and its Applications', ' Ordinary and Partial Differential Equations and Applications ' had over 60% of the faculty. 'Semi-conductors Optoelectronics,' 'Fibre Optics,' and 'Solid State Physics' of Physics had over 50% of faculty users.

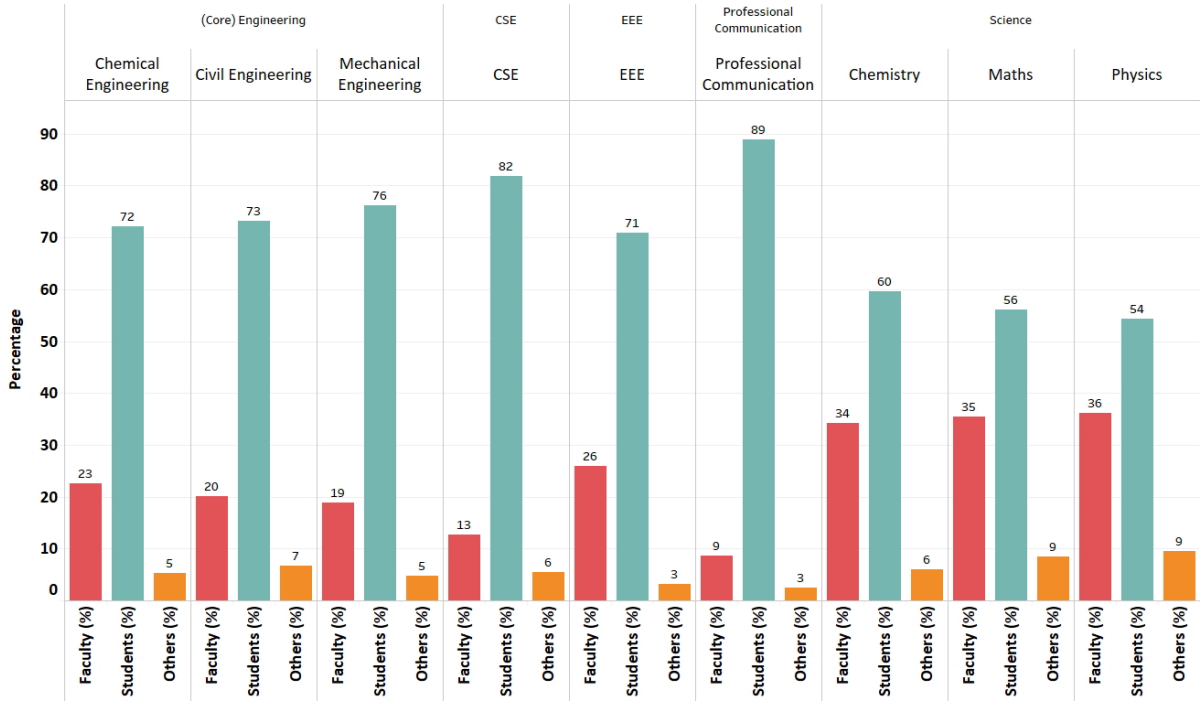

Figure 4: User Distribution, Category-wise, as Percentage, for Various Disciplines

In EEE, Communication Engineering and Electrical Engineering (from Figure 5) contribute or have higher faculty participation (From Figure 4). Though faculty participation is considerably lesser than in Science, it is still higher than CSE and Professional Communication courses. Albeit the percentage of faculty users in (Core) Engineering is lower than that of Sciences and EEE, a few courses had high faculty participation, such as, 'Geosynthetics Testing Laboratory' (68%) from Civil Engineering and 'Heat Exchangers: Fundamentals and Design Analysis' (43%) from Mechanical Engineering had a significant percentage of faculty users.

4.4.2 Students as Users

Students make up a high percentage of users of CSE courses, as depicted in Figure 4. The Programming courses have 90.3% of students, followed by Database Management Systems (DBMS) and Operating System courses, respectively, at 87.2% and 83%. Courses on Human-Computer Interface (HCI), Computer Design and Data Science have a lower percentage of student users than other CSE courses. The conventional CSE courses (such as Programming and DBMS) have a higher registration rate than the newer CSE courses (such as Artificial Intelligence and Data Science). This may be because of the lack of quality faculty for

conventional CSE courses in engineering, IT companies seeking more programmers for jobs, lack of sufficient learning among students, or the students of other disciplines are also pursuing these courses to make themselves employable.

Professional Communication courses have the highest student participation among all disciplines, as shown in Figure 4. Courses such as 'Soft Skills', 'English Language for Competitive Exams' and 'Speaking Effectively' have over 90% of students, which points to the possibility of colleges running these courses as compulsory courses in their curriculum as a reflection of embracing SWAYAM policy.

In EEE, almost all the courses of its sub-disciplines have a similar percentage of student users. The percentage of students in the sub-discipline of EEE lies between 68% -74%, showing that over two-thirds of the users are students. It possibly shows that students are facing difficulty in classroom learning. Or, faculty is unavailable in the institutes for EEE subjects; therefore, courses are being offered via NPTEL with credit transfer provisions.

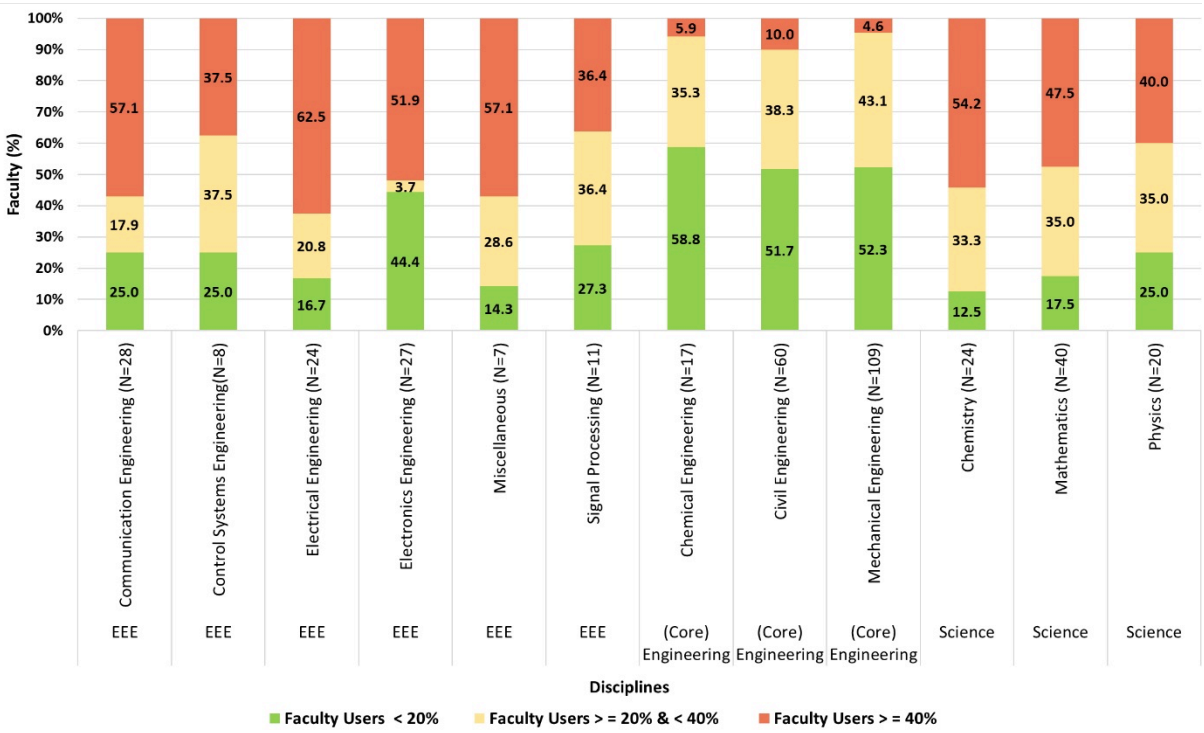

Figure 5: Distribution of Faculty Users for EEE, (Core) Engineering and Science Disciplines (N=No. of Courses)

4.5 Reasons for using NPTEL MOOCs

As SWAYAM/NPTEL platform is a large-scale MOOCs-based learning platform with a valid certification process, used pan India, several factors influence its use among learners. NPTEL data captures the reason users pursued an NPTEL course. The data on the 'Reasons for using NPTEL' is exclusive, i.e., the user was allowed to select only one reason from the given set of reasons. However, this is not always the case, as users may have more than one reason for using NPTEL or any other MOOCs. Figure 6 depicts users' reasons as a percentage distribution for various disciplines. The two frequently cited reasons for pursuing MOOCs

across all disciplines are [to] 'Explore New Domains' and 'Your College or Instructor encouraged'. As a result, no contrast or meaningful pattern could be discerned for comparative analysis. Therefore, these two reasons have not been considered for the study.

The analysis found that Database Management Systems (DBMS) courses and Programming courses (which include Python, C and C++) have a higher percentage of users who selected '*Campus Recruitment* '. The students are pursuing NPTEL to learn the technical skills required for jobs. Which, apparently, their college is failing to provide.

Professional Communication courses have a higher percentage of choosing *'Mandated by College'* and *'Credit Transfer via College*' for all disciplines of the study. The analysis also indicates a significant increase, from 6% in 2018 to 18% in 2019, for credit transfer. This increase indicates that colleges are gradually increasing the use of NPTEL courses as substitutes for classroom courses.

Among (Core) Engineering and EEE disciplines, '*GATE Preparation*' (an all-India postgraduate entrance exam) is one of the primary reasons students pursue NPTEL. This suggests inadequate learning in colleges, thus forcing students to rely on NPTEL.

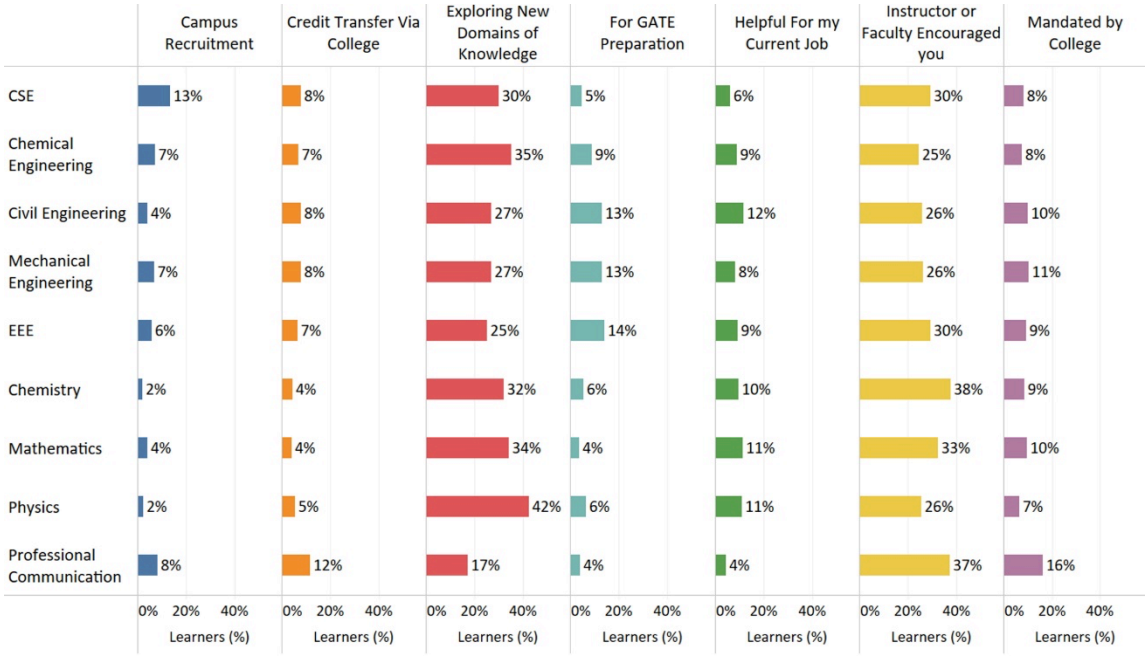

Figure 6: Reasons for using NPTEL as selected by the Users

4.6 NPTEL/SWAYAM Policy in Colleges and Universities

Several universities and colleges have embraced the SWAYAM policy in their technical education program. For example, Dr. A.P.J. Abdul Kalam Technical University of Uttar Pradesh and the Maulana Abul Kalam Azad University of Technology of West Bengal are offering students an incentive of an Honours degree in Bachelor of Technology if they complete additional 20 credits from NPTEL. They have also mandated first-year students to complete Professional communication courses from NPTEL (AKTU, 2018; MAKAUT, 2018). Jawaharlal Nehru Technological University Hyderabad of Telangana and the Sri

Venkateswara University of Tirupati are running elective courses via NPTEL (JNTU, 2018; SVUCE, 2020).

We conducted surveys with students to ascertain the extent of NPTEL policy acceptance and policy support offered by the colleges. Of over 500 students who responded to the survey, 365 (~70%) responded positively to the assistance provided by their institute to pursue NPTEL. Figure 7 shows the students' responses to five survey questions measured on the Likert Scale. The data highlights that most colleges and universities share information and motivate their students to register for NPTEL courses. The responses also show that faculty are helping students with their online assignments and clearing doubts. Universities and colleges also ensure that students are getting access to computer labs to pursue NPTEL courses. However, one in four students also raised the concern of no such support from their department or college.

All responses to the five questions were subjected to the Kendall Tau-b statistical test for the ordinal variable against a nominal variable: the type of college (public and private). The test showed a statistically significant result for responses to one question: providing financial assistance towards registration (Kendall's Tau-b= -0.107, p= 0.027). It shows that public colleges are more likely to provide financial aid to students than private colleges for NPTEL courses. Thus, questions the policy of using MOOCs as a solution to overcome the problem of equitable access to education.

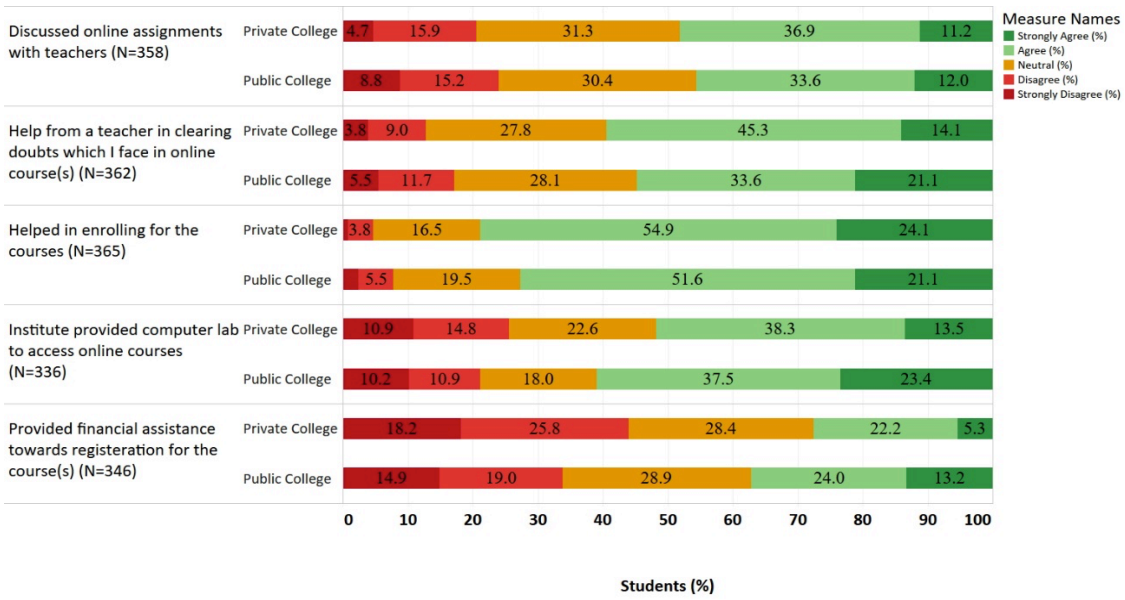

Figure 7: Response of Students of two type of colleges to NPTEL Policy support in their college

5. Discussion

The following sections will attempt to synthesise our analysis with observations on the use of MOOCs in engineering and sciences viz-a-viz policy on MOOCs.

5.1 Registration, Completion Rate and Impact of Duration

The analysis of NPTEL data reveals varying enrolment numbers across various disciplines. This observation motivated us to examine why CSE and Professional Communication courses have higher enrolment numbers than other engineering and science disciplines. The enormous number of learners enrolling in CSE courses indicates numerous students are pursuing these courses irrespective of their discipline. They are pursuing these courses to acquire skills for employability. Which is because of the increasing number of jobs available in digital technology (Nasscom, 2020).

The analysis highlights the difference between enrolment and registration numbers, akin to attrition rates, as observed in the various studies of MOOC providers (Franceschin, 2016; Jordan, 2014; Murray, 2019). We observed that Professional Communication courses have the highest registration rates among all disciplines. This is likely because several state technical universities have mandated Professional Communication courses from NPTEL/SWAYAM (AKTU, 2018; MAKAUT, 2018) in their curriculum. Ergo is reflected in the NPTEL data.

For NPTEL MOOCs, contrary to Jordan's finding (Jordan, 2015), the course duration does not play any role in the dropout rate. The drive to complete the course can be attributed to self-motivation, the desire to earn a certificate and the incentive of credit transfer on successful completion through the SWAYAM policy.

5.2 Users and their reason for pursuing NPTEL MOOCs

The NPTEL data showed that faculty and students are major users of NPTEL MOOCs. However, the percentage of faculty and students using NPTEL varies across various disciplines. Disciplines such as CSE and (Core) Engineering have a high percentage of student users, while Sciences and EEE have a higher percentage of faculty users. This raises the question of why Sciences and EEE have higher faculty users than CSE or Professional Communication courses.

Several reasons explain the higher percentage of faculty users in the Sciences, EEE and specific (Core) Engineering Courses. The first reason can be understood by examining the faculty's learning attitude towards their journey to becoming teachers. The teachers might not have acquired the competency required to teach the fundamental subjects of their respective disciplines. Therefore, course certification might be a recourse to attain the desired confidence level to teach the students and acquire professional competence (Hew & Cheung, 2014; Dillahunt et al., 2016; Watted & Barak, 2018).

The second reason for high faculty users pertains to their job requirements (Hood et al., 2015). The faculty may be using MOOCs to keep themselves abreast of the latest curriculum in their respective fields. This is reflected in specific contemporary CSE courses which have higher faculty participation (e.g., Data Science and Human-Computer Interface (HCI)).

The analysis of student data raises questions about the state of the higher education system. Students highlighting reasons such as, '*Your college or faculty encouraged you to enrol*' and '*Mandated by Colleg*e,' indicate the problem of quality faculty in the institutes. The syllabus documents of various institutes show that they mandate students to complete the courses

online and fulfil the degree requirements. There is also a possibility that colleges are offloading teaching responsibility by using NPTEL in regular curricula.

The reasons such as `*Campus Placement*' (for CSE) and *'Gate Preparation*' (for EEE and other Engineering disciplines) raise concerns about the standard of the colleges and the quality of the faculty teaching in such colleges. It also indicates the inability of the institutes to make students employable. Hence, students find NPTEL MOOCs an apt alternative to classroom teaching, making them employable.

5.3 Suitability of MOOCs to Engineering and Science courses

The low registration and completion rates also question the adoption of specific disciplines in the MOOCs format. The analysis shows that learners find MOOCs courses of Sciences, especially Physics and Chemistry, challenging to pursue and complete in the online format. This is reflected in the low successful completion rate of Physics, EEE and Chemistry NPTEL courses.

There can be several reasons which explain the difficulty in completing MOOCs. The MOOCs might have pedagogical monotony, unfulfilled learning expectations from MOOCs, and low or no skill value compared to other courses (such as CSE). Therefore, educational institutions that see MOOCs as a technology to teach engineering and science courses must consider the suitability of courses and the socio-culture of the students (Bayne, 2015).

5.4 SWAYAM Policy in Colleges and Universities

The SWAYAM regulation act empowers universities and colleges to substitute classroom courses with NPTEL/SWAYAM courses. However, the curriculum documents of several state technical universities and colleges reflect a more cautious approach. Such universities are running professional communication courses or elective courses in technical education via NPTEL (AKTU, 2018; JNTU, 2018; MAKAUT, 2018; SVUCE, 2020).

Our analysis mainly reflected positive feedback in assessing the enforcement of the SWAYAM policy from the student's perspective. The data from the survey indicates colleges are leaving no stones unturned to help students register for NPTEL courses. The students are getting support from institute faculty in clearing their doubts and assignments. Institutes are also providing students with computer labs to access NPTEL. This is especially beneficial to the students who do not have access to any digital infrastructure.

However, the SWAYAM policy is also facing a hurdle. The results showed that more public colleges provide financial aid to students to register for the NPTEL course than private colleges. This, inadvertently, is creating inequality in accessing NPTEL courses. Thus, depriving students of NPTEL policy benefits of certification and transfer of credits.

6. Conclusion and Future Scope

NPTEL/SWAYAM platform is a government-funded MOOC platform. It is perhaps the most extensive scale attempted by any public/national system in the world to enable the use of these courses in the regular curricula. In this context, our study will be helpful to those interested in designing and deploying massive digital education systems, especially state and public agencies.

Our study showed that the registration and completion rates are high for CSE and Professional Communication courses but not for Electrical and Electronics Engineering and Science courses. Thus, MOOC-based learning may not be effective in all disciplines of Science and Engineering. NPTEL allows users to select only one 'reason' while sharing their reason for pursuing NPTEL. However, in our opinion, multiple reasons affect the use of NPTEL, which the current NPTEL data does not reflect. The existing NPTEL data also does not consider students' learning environment conditions, such as classroom learning, institute infrastructure, etc. or external factors which may compel or motivate students to pursue MOOCs.

Even though our study is based on NPTEL MOOCs, there are other MOOCs platforms which Indian learners also use (Coursers, edX, Udemy, etc.). Therefore, further investigation is required to understand and gain insights into the MOOC ecosystem operating in India.

Our findings also suggest that further research is needed along two strands: (a) to ascertain how well the substitution of a MOOC for a classroom course work in science and engineering disciplines, and what kind of scope exists for the redesign of these MOOCs to make them more suitable for STEM subjects; (b) to evaluate MOOCs as a tool of policy intervention by the government in higher education - whether allowing MOOCs for credits actually works or not and are there are shortfalls in learning outcomes. Answers to these questions will suggest whether to curtail the 'for credit' idea or to make it even more pervasive.

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Resources

Link for NPTEL data: https://archive.nptel.ac.in/noc/noc_course.html

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