A Comparative Evaluation of MOOCs and Classroom Learning in Engineering and Science in India: A MOOC Policy Assessment

Anurag Mehra, Indian Institute of Technology Bombay, India
Pramath Kant, Indian Institute of Technology Bombay, India

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Abstract
In 2016, the Indian government introduced the SWAYAM regulation, allowing Indian MOOCs to be an alternative to regular classroom learning in higher education. The policy was designed to facilitate broader access to high-quality learning content and provisioning for credit transfer. However, after the introduction of the regulation, studies have yet to be conducted on the impact of MOOC policy in higher education. This study employs a policy evaluation framework to ascertain the effects of the SWAYAM MOOC policy on its key stakeholders, students, and faculty in higher education based on the data gathered from our survey. Drawing from more than five hundred survey data collected from multiple engineering and science colleges across India, we investigated the experiences of both faculty and students using quantitative and qualitative statistics. The analysis compared stakeholders' perspectives on MOOCs with traditional classroom learning. Our study revealed that the current version of MOOCs under the SWAYAM policy fails to provide avenues for face-to-face discussion, hands-on skill development or real-life learning experiences, which are crucial in engineering and science education. However, students and faculty agreed that MOOCs provide learning flexibility and enrich knowledge beyond the classroom curriculum. The faculty members also believe that MOOCs negatively impact the professional development of the students. We also found that students reaffirmed the importance of classroom learning and are convinced that MOOCs should not substitute classroom courses. The paper concludes by discussing the implications of the findings and highlighting feedback for policy stakeholders.

Keywords: Massive Open Online Content (MOOCs), Classroom Learning, India, NPTEL, SWAYAM, Policy Evaluation

Introduction

Massive Open Online Content (MOOC) has been envisioned to provide access to quality education and help reduce the cost of higher education. Supporters of MOOCs often highlight their benefits in terms of convenience, deep knowledge, qualified instructors and professional development. (Belanger & Thornton, 2013; Jacobs, 2013; Watted & Barak, 2018). Through these undercurrents of advantages, various governments have considered formalising MOOCs in higher education (White, 2014).

In India, MOOCs are influenced not only by individual motivations but also by government policies. The introduction of the AICTE Regulation Act 2016 was a policy intervention that allowed engineering and science colleges/institutes to run 20% of their courses using MOOCs (NPTEL) courses (AICTE (Credit Framework for Online Learning Course through SWAYAM) Regulations 2016, 2016). Although NPTEL/SWAYAM MOOCs primarily consist of recorded lectures, the faculty members and teaching assistants help the students clear their doubts in discussion forums. The students must complete weekly assignments and appear for in-person proctored end-semester examinations to receive a course completion certificate (Mehra & Kant, 1970; NPTEL, 2022). However, we need to assess the efficacy of this learning policy proposed as an alternative to classroom learning.

When policymakers address technology intervention in education, they must incorporate the views of primary stakeholders. Since faculty members and students are primary and internal stakeholders in higher education (Savga et al., 2018), their observations and experiences with teaching and learning are invaluable for policy assessment (Birkland, 2006). Our study attempts to understand the 'real' classroom and MOOC-based learning and elucidate the contrasts perceived by faculty members and students.

Literature Review

Arguments About MOOC-Based Learning

MOOCs have garnered both support and criticism over time. Supporters cite advantages like free accessibility, quality content from leading instructors, flexibility, and scalability, believing it will revolutionise higher education (Onah et al., 2014; Sharrock, 2015; Yuan & Powell, 2013). However, faculty opinions are mixed. Jaschik and Lederman, in their study, found differing views about online learning, with technology administrators being more optimistic about online course quality than college faculty. They also found bias among faculty towards online courses which they had taught online (Jaschik & Lederman, 2014).

Despite their advantages, some studies criticise MOOCs for lacking face-to-face and peer interactions (Evans & Myrick, 2015; Jacobs, 2013; Jaschik & Lederman, 2014). While MOOC platforms offer discussion forums, only some students utilise them; Breslow et al. found that only 3% of students are engaged in online forums (Breslow et al., 2013). The educators have emphasised the importance of student-to-student and student-instructor interactions for knowledge sharing and fostering critical discussions for effective learning (Dillenbourg, 1999; Kolowich, 2010).

The lack of interaction also affects student engagement, often examined through attrition rates (Onah et al., 2014). MOOCs face high attrition rates, with drop-off from online courses highlighted as a significant disadvantage.(Haber, 2013; Jordan, 2015; Koller et al., 2013).

Further, critics have raised concerns about students' evaluation in MOOC-based learning: plagiarism and the authenticity of learning (Hew & Cheung, 2014).

Most studies on MOOCs have focused on students' consumption patterns, motivations, and usage factors (Koller et al., 2013; Littlejohn et al., 2016; Watted & Barak, 2018). Studies have also dwelled on critical reasons for pursuing MOOCs which include acquiring new skills (Wang & Baker, 2015), enhancing employability (Dillahunt et al., 2016) and obtaining certificates (Shapiro et al., 2017). However, these studies fail to address student and faculty perspectives on MOOCs and their effectiveness in engineering and science disciplines. This study aims to bridge this gap.

NPTEL and SWAYAM Regulation

MOOCs in India have their roots in the National Program on Technology Enhanced Learning (NPTEL). The NPTEL programme ensued from a collaborated effort of the Indian Institute of Technology (IITs), Indian Institute of Management (IIMs) and Carnegie Mellon University (CMU) during the years 1999-2003 (Department of Secondary and Higher Education, 2007).

The 'broader' objective of the NPTEL project was to enhance the *'competitiveness of Indian industries* worldwide through high-quality engineering education. Thus, the key 'operational' objective was to increase access to high-quality educational content and material for engineering. The project identified students and faculty members as its essential target group (Department of Secondary and Higher Education, 2007).

The NPTEL has evolved in phases (Kant & Mehra, 1970). During NPTEL's Phase 2 review, the Project Implementation Committee (PIC) noted increasing enrollment and felt NPTEL could become a viable alternative to the 'in-class chalk and talk method ' (NPTEL PIC, 2014). The committee also felt that MOOC-based learning could solve the faculty shortage crisis (Sreevatsan & Venugopal, 2016). The proposal led to the creation of the NPTEL Online Certification (NOC) program in Phase 3, laying the groundwork for the SWAYAM program. The SWAYAM program's main objectives are:

- Develop the SWAYAM MOOC platform for hosting and running thousands of courses simultaneously.
- To conduct examinations and award certificates to learners after successfully passing the SWAYAM course.
- To provide guidelines and recommendations to Institutions on implementing Choice Based Credit System (CBCS) for SWAYAM MOOCs through the AICTE SWAYAM Regulation Act 2016. and UGC SWAYAM Regulation Act 2016 (Department of Higher Education, 2015).

The regulation allows engineering and science universities to use SWAYAM/NPTEL MOOCs for credit transfer in India. However, it limits SWAYAM credit transfer to 20% of total semester courses. Determining the weightage of credit transfer lies with the universities and colleges. It can use SWAYAM MOOCs when teachers of a subject are not available in their institute or for elective subjects (AICTE (Credit Framework for Online Learning Course through SWAYAM) Regulations 2016, 2016).

Government-funded MOOC platforms like NPTEL and SWAYAM lack significant policy scrutiny or feedback studies. There is no data on input or feedback from faculty, institutes, or students who are primary stakeholders of the policy. This study aims to assess the SWAYAM policy in engineering and science education and address the issue of stakeholders' feedback.

Policy Evaluation and Research Questions

There are different definitions of public policy. Guy Peters describes it as a "*set of activities that governments engage"* to change social and economic conditions (Peters, 2015). Thomas Dye views it as what the government "chooses to do or not do" (Dye, 2013), while James Anderson emphasises practical actions taken to address specific issues (Anderson, 2003).

The policymaking process involves six steps: identifying the problem, agenda setting, policy formulation with stakeholders, legitimisation through laws, implementation by state actors, and policy evaluation (Dye, 2013). Policy evaluation measures effectiveness against goals. It is an objective and evidence-based examination to assess the merit and value of government interventions (Nachmias, 1979; Vedung, 2013). Evaluation serves two primary purposes: learning and accountability (HM Treasury, 2020). It helps identify risks and challenges to ensure government actions maximise taxpayer benefits and improve governance.

In this study, we utilised the policy evaluation framework outlined in the Magenta Book from the United Kingdom. This framework encompasses three types of evaluation: process evaluation, impact evaluation, and value-for-money evaluation (cost-benefit analysis), explained below (HM Treasury, 2020):

Process evaluation primarily focuses on assessing the implementation of the policy interventions and delivery of the policy. It covers both subjective perceptions and objective issues of policy delivery based on operational data.

Impact evaluation assesses the impact of the policy interventions by scrutinising intended and unintended consequences and determining the extent of change due to policy interventions.

Value-for-money evaluation determines if the benefits of policy implementation outweigh its cost and whether policy intervention is using resources effectively.

This study aims to answer the following through the impact evaluation of SWAYAM policy using this framework:

1. What is the faculty's perception of MOOC-based learning compared to classroom learning?
    a. What is their belief in the SWAYAM policy implemented in Indian colleges and universities?
    b. What are the consequences of using MOOCs as the only source of learning?
2. What is the perception of students about MOOC-based learning as compared to classroom learning?

Methodology

We conducted surveys in-person and online across several colleges. It employed a Multi-Stage Systematic Random Sampling method to determine the number of colleges and institutes needed across various Indian states. This method identifies and selects clusters of the target population from the state, city, and, finally, neighbourhood (Bhandari, 2021; Penn

State Eberly College of Science, 2023). This approach allowed us to cover multiple states and representative engineering and science institutes and colleges (CSDS, 2019; Garg, 2019). The state and the cities for the survey were selected using the probability proportional to the sample size (PPS), a ratio of selected samples to the total population (CSDS, 2019; Penn State Eberly College of Science, 2023). After identifying the city, convenience sampling (Sedgwick, 2013) was used to select colleges, faculty members, and students. This method was necessary due to logistics and limited consent from institutions, instructors, and students. We conducted surveys only with those who agreed to participate.

Demography and Background of Faculty and Students

A total of 404 faculty members from private and public institutes/colleges participated in this survey. Approximately 57% were male, while the remaining 43% were female. The academic qualifications of faculty members are Ph.D. (42%) and Post-graduates (58%), which aligns with the minimum requirement to teach in engineering and science colleges in India.

Table 1 shows the demographic details of 515 students who participated in our survey. The Goodness of Fit test is significant for all demographic factors. We include the student's caste to address the representation of their social category. However, disclosing such personal details was purely discretionary and only valid responses to questions were considered for analysis.

Demographics of Students	**Sub-division**	**Distribution (%)**	χ^2	**df**	**p**
Type of Institute/College (N=515)	Public	40.20%	19.8	1	<.001
	Private	59.80%			
Gender (N =509)	Male	69.90%	84.2	1	<.001
	Female	30.10%			
Caste (N=505)	General	73.27%	382	2	<.001
	OBC	21.39%			
	SC/ST	5.35%			

Table 1: Demographic Data of the Students Participating in the Survey (N=515)

Methods for Analysis and Validation

Descriptive statistics: Responses to the questionnaire were measured on a 5-point Likert scale and analysed using descriptive statistics and non-parametric tests. Likert scale responses, treated as ordinal variables, were tested against independent nominal variables using Mann-Whitney tests (Laerd Statistics, 2018), and SPSS software was utilised for non-parametric testing. The statistical analysis used the Mann-Whitney test for two groups, while the Kruskal-Wallis test for three or more groups for nominal variables.

Thematic analysis has emerged as a critical tool for analysing qualitative data (Braun & Clarke, 2006; Walsh et al., 2019). It requires analysing and identifying the themes reflected in the open-ended question and categorising them (Braun & Clarke, 2006). We followed Braun and Clarke's recommendation to code and identify the major themes alongside close-ended questions to interpret data and reason their response.

Validation: To ensure credibility, we validated the survey using triangulation (Turner & Turner, 2017). The literature on triangulation describes several methods to triangulate the analysis (Guion, 2002). We have used data and methodological triangulation. Data triangulation involved two target populations – faculty members and students - to validate perceptions about MOOC versus classroom learning. Methodological triangulation used open-ended follow-up questions to Likert-scale questions to understand and validate the reasoning behind responses.

Findings and Analysis

This section assesses the data and expounds on faculty and students' perspectives of MOOCs and their comparison with classroom learning and its impact on faculty members and students. As a note, the MOOCs examined in the survey are primarily NPTEL/SWAYAM MOOCs of India.

Analysis of the Faculty Survey

Perception of MOOCs vs Classroom Learning: We asked the faculty members to express their opinion about Classroom and MOOCs-based learning on nine variables measured on a 5-point Likert scale (1= Strongly Disagree, 2= Disagree, 3=Neutral, 4= Agree, 5= Strongly Agree), and approximately four hundred of them responding. Tables 2 and 3 show the descriptive statistics of their responses for the two learning modes. The descriptive statistical analysis indicates four key attributes highlighting the difference between classroom learning and MOOCs: *Facilitates useful real-life interactions, Allows productive student engagement, Promotes peer-to-peer discussions and Easy to invigilate / proctor examinations*.

The attribute '*Facilitates useful real-life interactions'* has a high mean score and skewness in classroom learning compared to MOOC learning (from Tables 2 and 3). Approximately 93% believe that classroom learning facilitates better real-life interactions or experiments than MOOC-based learning (45%), including experiments, simulations, experience working in the laboratory, etc.

Attributes	**Mean**	**Median**	**Standardised mean score**	**Std. dev**	**Skewness**
Facilitates Useful Real-life Interactions	4.5	5.0	1.8	0.7	-2.12
Promotes Intense Peer to Peer Discussions	4.5	5.0	1.3	0.8	-1.50
Opportunity for Fair Objective Assessments	4.3	4.0	0.1	0.8	-1.22
Easy to Invigilate Proctor Examinations	4.2	4.0	-0.6	1.0	-1.15
Fosters Creative Teaching Lecturing	4.2	4.0	-0.4	0.8	-1.13
Allows Productive Student Engagement	4.3	4.0	0.1	0.9	-1.31
Easy to Conduct Planned Course in Time	4.0	4.0	-1.6	0.9	-1.15
Facilitates Knowledge Creation	4.2	4.0	-0.2	0.8	-0.88
Timely Feedback Given to Students	4.2	4.0	-0.3	0.8	-0.99

Table 2: Descriptive Statistics of Faculty Data on Classroom Learning

The faculty members also believe that the classroom learning environment facilitates *Better student engagement* and provides a more conducive milieu for *peer-to-peer interaction* than MOOC-based learning (from Tables 2 and 3). The data underscores the importance of interaction and student engagement in higher education, which the current MOOCs lack.

The data also highlights a substantial mean difference in the '*Easy to invigilate / proctor examinations*' attribute favouring classroom learning. The faculty members believe conducting and invigilating examinations in the classroom is better than MOOCs and more authentic. The analysis of the remaining five variables indicates that faculty believe that MOOC-based learning is on par with classroom learning.

We tested attribute responses to statistical tests for two independent variables: Gender and Type of College. The association test on classroom data indicated no significant difference in *Gender* or *Type of College* for all nine variables. However, the Mann-Whitney test on MOOC-based learning showed a statistically significant difference for two attributes: *gender* and *type of college*. The test showed that female faculty members agreed more about MOOCs facilitating real-life interactions than male faculty members (U = 3915, p = 0.047, r = -0.141).

Attributes	**Mean**	**Median**	**Standardised mean score**	**Std. dev.**	**Skewness**
Facilitates Useful Real-life Interactions	3.3	3	-0.4	1.1	-0.78
Promotes Intense Peer-to-Peer Discussions	3.0	3	-1.5	1.0	-0.12
Opportunity for Fair Objective Assessments	3.4	3	-0.2	1.1	-0.31
Easy to Invigilate Proctor Examinations	3.2	3	-0.7	1.2	-0.12
Fosters Creative Teaching Lecturing	3.6	4	0.4	0.9	-0.78
Allows Productive Student Engagement	3.2	3	-0.8	1.0	-0.23
Easy to Conduct Planned Course in Time	3.9	4	1.5	0.9	-0.79
Facilitates Knowledge Creation	3.8	4	1.1	0.8	-0.78
Timely Feedback Given to Students	3.7	4	0.7	1.0	-0.64

Table 3: Descriptive Statistics of Faculty Data on MOOC-Based Learning

The analysis between the two types of colleges showed that private institutes/college faculty members are more likely to believe that MOOCs will facilitate real-life user interaction and allow productive student engagement than public institute faculty. This perceptual difference is statistically significant [*Facilitate real-life interactions* (U = 4968, p = 0.014, r = 0.174) and *Allow productive student engagement* (U = 4688, p = 0.048, r = 0.142)]. It shows that public institute faculty have more confidence in classroom learning and are less inclined to use technology for teaching and learning.

Effects and Consequences of Teaching Exclusively Through MOOCs

We asked the faculty members to elucidate the consequences of using only MOOCs for teaching and learning in higher education (i.e., no classroom learning for the courses). Around 160 faculty responded to the question. The thematic analysis highlighted four salient themes: *Issues associated with teaching and learning*, *Impact on students' development*, *Impact on the faculty* and *Advantages of MOOCs*. Table 4 shows the themes and the codes to identify the themes from faculty responses.

Themes	**Sub-themes**
Issues Associated with Teaching and Learning	Lack of offline discussion with teacher / Lack of peer-to-peer discussion
	No or lack of doubt clearing
	Lack of conceptual understanding
	Lack of problem-solving
	Lack of real-world applications
Impact on Students' Development	Lack of personality development
	Lack of ability to work in a group
	Decrease in critical thinking.
	Decrease communication skill
	Decrease social engagement
Impact on Faculty	Unemployment of Teachers
	Student assessment is difficult
	Creativity decreases
	Teaching pedagogy Change
	Lack of knowledge creation
Advantages of MOOCs	Increases knowledge
	Accessibility of quality lectures/material
	Flexibility of self-learning at any time
	Better concept/ understanding
	Flexibility to select any course

Table 4: Thematic Analysis of the Faculty members' view on the Consequences of using MOOCs

Issues associated with teaching and learning: We coded the responses to open-ended questions during the thematic analysis and identified five critical sub-themes under this theme, as shown in Table 4. The faculty members have raised concerns regarding the lack of peer-to-peer or offline discussions. They also added that the lack of discussions would also impact the clearing of doubts among students. One of the faculty gave the following reasoning:

> *"Since there will be no one-on-one interaction, students might not be able to get their doubts cleared."*

The faculty members also highlighted the lack of real-world applications or hands-on experience necessary in science and engineering, highlighting the critical drawback of MOOC-based learning. Following are a few statements that faculty have highlighted:

"With just online mode, practical skills cannot be validated".

Impact on students' development: The faculty has asserted that exclusive MOOC-based learning will affect the students' development (refer to Table 4). They believe excessive usage of MOOCs will result in a lack of personality development, decreased communication skills and reduced critical thinking. Table 5 (number of samples around 200) shows that most faculty believe that using MOOCs will foster critical thinking (as evidenced by high negative skewness) among students and positively impact the student's personality development. However, it will decrease the social engagement of students and is likely to affect communication skills.

Student development attributes	**Decrease/ Negative**	**No effect**	**Positive /Increase**	**Mean**	**Standardised mean score**	**Skewness**
Critical thinking	14%	21%	66%	2.52	0.6	-1.16
Personality development	17%	42%	41%	2.25	-0.2	-0.413
Engagement in social life	35%	39%	26%	1.91	-1.2	0.166
Ability to interact and communicate professionally	26%	32%	42%	2.17	-0.5	-0.312
Knowledge creation	2%	16%	82%	2.79	1.4	-2.16

Table 5: Descriptive Statistics of the Faculty Data on the Impact of MOOCs on Students' Development

A few faculty also noted the absence of collaboration or teamwork in MOOCs, which is usually encouraged in project or laboratory experiments. One such faculty stated the following answer:

"Students might not learn the ability to work in the group and solve the problem."

Impact on faculty: Some faculty members believe that MOOC-based teaching will negatively impact faculty. They believe that only using MOOCs for learning will result in job loss. The following quote from a faculty member vividly reflects this sentiment:

"Excessive use of the online courses make teacher feel unsafe thinking these courses will replace classroom teaching."

The second concern relates to student assessment. The faculty will face challenges evaluating the students' learning if the courses are solely run on MOOCs. They underline the need for authentic learning and not plagiarised learning. Third, the faculty members feel that online learning does not provide the opportunity to adapt teaching methods based on students' understanding levels. Following is a quote expressing the concern:

"A teacher who teaches physically in front of students can change their way of delivering according to students' requirements, which is not possible in online courses."

Advantages of MOOCs: While many faculty members have stated the negative impact of MOOCs, some have also advocated its benefits (refer to Table 4). The first advantage identified is the increase in knowledge, with many faculty members believing that MOOCs enhance students' understanding of subjects. The second advantage is the accessibility of quality materials and lectures, as MOOCs from premier Indian institutes (NPTEL/SWAYAM) provide resources that would otherwise be unavailable to most students. Faculty also noted that MOOCs offer flexibility, allowing students to learn at their convenience, irrespective of time and place.

Analysis of the Student Survey

Student's Perception of MOOC-Based Learning vs. Classroom Learning: This section explores the students' beliefs about MOOC courses and how they differ from the classroom courses they pursue in their respective institutes/colleges. We measured the data on a 5-point Likert scale (1= Strongly Disagree, 2= Disagree, 3=Neutral, 4= Agree, 5= Strongly Agree) for both learning modes. Four hundred ninety students responded to the questions, but were filtered based on valid responses.

Attributes	**Mean**	**Median**	**Mode**	**Standardised mean score**	**Skewness**
Allows sufficient live demonstrations, simulations and examples	3.7	4	4	0.8	-0.4
Assignments cover almost all the topics in the course	3.6	4	4	0.5	-0.4
Ease of availability of course resources	3.5	4	4	0.4	-0.5
Feedback on the assignments/homework is given frequently	3.5	4	4	0.4	-0.4
Find it hard to apply concepts to real-life problems	3.2	3	3	-0.4	0.0
Flexibility of learning (anytime and anywhere)	2.8	3	2	-1.4	0.2
Flexibility to choose the instructor of liking	2.9	3	2	-1.2	0.1
I am easily distracted	3.0	3	3	-0.9	0.0
I can fit learning into my life more easily	3.4	3	3	0.0	-0.2
Learning is self-paced	3.1	3	3	-0.6	-0.1
Learning is stressful	3.1	3	3	-0.7	-0.1
Opportunity for face-to-face discussion with teacher	4.2	4	5	2.2	-1.3
Promotes healthy peer discussions/ reviews	3.8	4	4	1.2	-0.6
Use of various multimedia tools enhances learning experience	3.3	3	4	-0.2	-0.3

Table 6: Descriptive Statistics of Students' Data on Classroom Learning

Tables 6 and 7 show the descriptive statistics of the responses for Classrooms and MOOCs, respectively. The students firmly believe that MOOCs are convenient for learning. The convenience parameters *such as flexibility to learn, selecting instructors,* and *self-paced learning* have a high agreement among students. Various MOOC platforms provide many learning resources that students can choose depending on their needs and help build skills they can apply in real life and make learning less stressful.

Apart from benefits, students have also acknowledged concerns about MOOCs. Similar to faculty sentiment, students feel MOOCs do not provide interaction with faculty or review with peers as classroom learning. They also accept that MOOCs are a greater source of distraction than classrooms. However, there is no significant difference between MOOCs and Classroom for '*live demonstrations', 'assignments, or feedback on the assignment*' *attributes.*

Attributes	**Mean**	**Median**	**Mode**	**Standardised mean score**	**Skewness**
Allows sufficient live demonstrations, simulations and examples	3.7	4	4	0.6	-0.5
Assignments cover almost all the topics in the course	3.8	4	4	0.6	-0.5
Ease of availability of course resources	4.1	4	4	0.4	-0.7
Feedback on the assignments/homework is given frequently	3.5	4	4	-0.5	-0.3
Find it hard to apply concepts to real-life problems	3.0	3	3	0.4	0.0
Flexibility of learning (anytime and anywhere)	4.5	5	5	1.3	-1.3
Flexibility to choose the instructor of liking	3.9	4	4	0.0	-0.8
I am easily distracted	3.3	3	4	0.6	-0.2
I can fit learning into my life more easily	4.0	4	4	-0.1	-0.8
Learning is self-paced	4.3	4	4	1.3	-0.8
Learning is stressful	2.7	3	2	-2.6	0.4
Opportunity for face-to-face discussion with teacher	2.7	3	2	-0.7	0.3
Promotes healthy peer discussions/ reviews	3.5	4	4	-0.7	-0.4
Use of various multimedia tools enhances learning experience	4.1	4	4	-0.5	-0.9

Table 7: Descriptive Statistics of Students' Data on MOOC-based learning

Attending a Classroom Course for the Same Course Pursued via MOOC

The survey asked students about their attitudes towards attending classroom courses for a course they had taken or completed through a MOOC, using a Likert scale: '*If I am enrolled in an online course, I am less likely to attend the same course in the classroom?'*. There is no clear statistically significant difference between the percentages of students who would attend a classroom course they took online and those who would not (Figure 1).

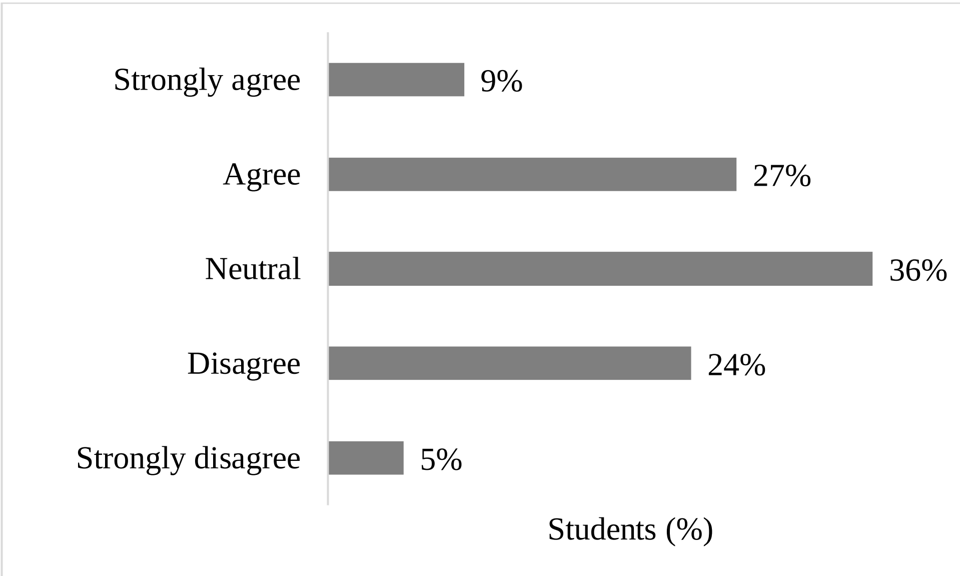

Figure 1: Students' Opinions on Attending Classroom for the Course Pursued on MOOCs

However, the Mann-Whitney U test showed a statistically significant effect on the responses based on the student's college type, i.e., public/private (U=26302, p=.011, Z=-2.59, r= -.115). We can infer that private college students are more likely not to attend classroom courses if they have pursued the same course in MOOCs. The thematic analysis of the reasons revealed two distinct opinions: those who disagreed and those who agreed.

Thematic analysis (Strongly disagree / Disagree): The two themes were identified among the students who disagreed with the lower likelihood of attending classes: learning benefits and classroom benefits (refer to Table 8). As identified in the analysis, the learning benefits bolster the argument of learning inadequacies of MOOC-based learning. The students who are likely to attend the classroom reiterate the importance of the brick-and-mortar environment that the classroom provides. Following is a quote from a student:

> *"The material taught in such courses is usually focused on a practical point of view, whereas the classroom is mostly theory-oriented, discussing the logic and reasoning behind it. Thus, both are required for the best possible outcome."*

The revision of learning is an essential ritual for the students, and a combination of MOOC and classroom learning provides the best learning method. To quote a student:

> *"Different teachers have different styles of teaching. It provides a revision."*

The second theme highlights classroom benefits like diverse learning perspectives, face-to-face interaction, and an engaging learning environment (Table 8). Students believe that classroom learning fosters interaction among peers and faculty, enhancing their understanding of diverse perspectives and providing practical learning experiences. The following quote from a student illustrates this:

> *"Classrooms have the benefit of understanding something from classmates' doubt and perspective of someone else. Also, it is interactive in real-time, which has a different effect than MOOCs."*

<table>
<tr><th>Students' Perception</th><th>Themes</th><th>Sub-themes</th></tr>
<tr><td rowspan="9">Strongly Disagree or Disagree.</td><td rowspan="4">Learning Benefits</td><td>Better understanding/knowledge</td></tr>
<tr><td>Discussion of doubts in class</td></tr>
<tr><td>Revision</td></tr>
<tr><td>Practical learning</td></tr>
<tr><td rowspan="5">Classroom Benefits</td><td>Different perspective</td></tr>
<tr><td>Face-to-face interaction</td></tr>
<tr><td>Learning is efficient</td></tr>
<tr><td>Better environment for learning</td></tr>
<tr><td>Interactive classroom</td></tr>
<tr><td rowspan="10">Strongly Agree or Agree.</td><td rowspan="5">Convenient and Efficient</td><td>Ease of access</td></tr>
<tr><td>Less wastage of time</td></tr>
<tr><td>Flexibility to learn</td></tr>
<tr><td>Comfortable learning</td></tr>
<tr><td>Revisit online content</td></tr>
<tr><td rowspan="3">Online Learning Benefits</td><td>Better content and source of learning</td></tr>
<tr><td>Resolve doubts</td></tr>
<tr><td>More knowledge</td></tr>
<tr><td rowspan="2">Concerns</td><td>Issues of classroom</td></tr>
<tr><td>Unwanted repetitive learning</td></tr>
</table>

Table 8: Thematic Analysis of the Reasons

Thematic analysis (Strongly agree / Agree): Most students (more than one-third) also answered that they would not attend the classroom if they had learned the same course on MOOCs/Online. We identified three central themes from open-ended responses: convenience and efficiency, benefits and concerns (refer to Table 8).

Students appreciate MOOCs' ease of access, time efficiency, flexibility, and comfort in revisiting online content. Many students consider attending the same course in a classroom a waste of time, as MOOCs offer the flexibility and comfort that traditional classrooms lack.

Second, students identified that the benefits of online learning outweigh those of classroom learning, citing better content, resources, and opportunities for resolving doubts. Third, they expressed concerns about offline learning, including unnecessary repetition and classroom issues. Many students felt that learning the same material twice was redundant, and negative classroom learning experiences influenced their preference for MOOCs over traditional classes. Below is a quote expressing the sentiment:

> *"I agree because if I get sufficient knowledge on a particular topic, then there is no need to go through the classroom for the same courses."*

Can MOOCs Replace Classroom Learning?

We also asked students if they believe MOOCs can replace classroom learning. There is no statistical difference between the responses. One-third think MOOCs can serve as substitutes, while two-thirds either disagree or lack any opinion. A chi-square test showed a significant association between responses and college type ($\chi^2 = 6.27$, df = 2, p = .044; Cramér's V = .11), indicating private college students are likely to believe that MOOCs will replace classroom learning more than public college students (from Table 9).

Type of Institution/College		**No**	**Yes**	**Can't Say**	**Total**
Public	Observed (Expected)_	81 (68.3)	57 (65.9)	69 (72.8)	207
	% within row	39.10%	27.5 %	33.3 %	100.0 %
Private	Observed (Expected)	89 (101.7)	107 (98.1)	112 (108.2)	308
	% within row	28.9 %	34.7 %	36.4 %	100.0 %
Total	Observed	170	164	181	515

Table 9: Goodness of Association between Institute Type and the Response to MOOCs as a Substitute for Classrooms

Discussion

This study's motivation was to compare classroom and MOOC-based learning as perceived by faculty and engineering and science students as part of the SWAYAM policy evaluation. The analysis focused on ascertaining and quantifying the perceived beliefs for better understanding and decision-making of the policy stakeholders. This section discusses the findings and answers the research questions of this study.

Faculty Insights: Assessing the Benefits and Limitations of MOOCs vs. Classroom

From the analysis, the faculty experience of classroom and MOOC-based learning identified the following themes: advantages and issues with MOOCs.

India has millions of students pursuing science and engineering; not everyone can access quality content/material. Our analysis of the faculty survey provides evidence supporting the advantages of MOOC-based learning. According to them, MOOCs offer quality content, flexibility, and convenience, easing learning pressure. According to them, quality MOOC courses enhance critical thinking and knowledge creation and deepen students' understanding by covering content beyond the syllabus. Thus, making MOOCs useful supplementary material.

Even though MOOCs have advantages, faculty members have raised issues about it. They argue that the lack of student-instructor or peer-to-peer interactions hinders explanations, discussions, and knowledge elicitation (Dillenbourg, 1999; Jacobs, 2013). The faculty members echoed similar issues about MOOCs lacking peer-to-peer or student-faculty interactions in our survey. They reiterated the value of student engagement for clearing doubts and enhancing conceptual understanding of the subject matter.

Besides theoretical lessons, engineering and science include real-life experiments and hands-on experience, which MOOC-based learning lacks (Belanger & Thornton, 2013). The faculty members raised similar concerns about MOOCs in the survey. In its present form, MOOC-based learning is insufficient for practical skill development.

Consequences of Using MOOC-Based Learning

The faculty members are increasingly concerned that overuse of MOOCs may stymie students' personality development, social skills, and professional communication. They believe that interactions in traditional settings foster knowledge and enhance students' ability to articulate their understanding effectively. The faculty insists that students must be able to communicate their knowledge of their subject effectively.

MOOCs face severe criticism regarding students' assessment mechanisms and learning authenticity. Snyder and Young have highlighted the concerns about cheating and plagiarism in online education (Snyder, 2012; Young, 2012). Even though the MOOC platform asks students to uphold and abide by the honour code (Coursera, 2021; edX, 2019), assessment mechanisms have raised doubts about the integrity of student learning (Hew & Cheung, 2014; Young, 2012). align with these concerns, as many faculty members questioned the fairness of online proctoring and assessment. Some suggested in-person proctored exams at designated test centres for MOOC learners (Hew & Cheung, 2014), a method already implemented by NPTEL/SWAYAM for course-end exams (NPTEL, 2022). However, the assessment of weekly assignments on NPTEL remains questionable, as it still relies on students' honour codes.

Lastly, the faculty members are increasingly concerned about the MOOC policy and its over-reliance on MOOCs. Anxiety about potential job losses is growing. Teachers in both public and private colleges fear that offering courses through MOOCs will result in faculty job losses as technology replaces human roles. Although the policy does not explicitly recognise this consequence, faculty members believe that job loss will be an unintended outcome of the MOOC initiative.

Students' Perception of MOOCs vs. Classroom

Our students' survey data analysis revealed three themes when comparing MOOC-based learning to classroom learning. They are convenience, pedagogical benefits, and drawbacks.

The supporters of MOOCs have often proclaimed convenience as an advantage for pursuing MOOC courses (Cole & Timmerman, 2015; Jacobs, 2013). Our analysis revealed that convenience is a significant advantage of MOOCs for students as they provide flexibility, self-paced learning, reduced stress, and easily accessible resources. They valued the option to revisit lectures, which is impossible in a classroom setting, allowing MOOC-based learning to transcend time and space.

Students acknowledge that MOOCs provide better learning resources and material than regular classroom courses and content. They believe MOOC content and knowledgeable MOOC instructors provide better learning resources, which helps to build a comprehensive understanding of the subjects. In addition, the students learn from instructors of different quality who offer similar courses.

While students in our survey embraced MOOCs for their benefits, they also recognised several drawbacks. They echoed faculty concerns about the lack of discussions and interactions with teachers and peers, leaving them with unresolved doubts due to the absence of immediate faculty support in classrooms. Many students preferred a physical classroom environment for better learning and felt that online learning often leads to distractions. Based on survey data, student opinions on whether MOOCs can replace traditional classrooms are divided and unconvincing.

Conclusion and Recommendations

Although faculty and students recognise the benefits of MOOCs, our study suggests that considering them as an alternative to classroom learning is overly optimistic. They have highlighted several shortcomings with current MOOC platforms: lack of peer interaction, discussion, and hands-on learning opportunities critical for engineering and science disciplines. Our analysis reaffirms the confidence in traditional education, casting doubt on the viability of MOOCs. Policymakers, therefore, must consider stakeholders' feedback, as evident from this study, when formulating MOOC policies. Based on our analysis, we recommend the following measures for using MOOC-based learning in engineering and science education:

- Introduce weightage for experiments or laboratory assessments before awarding credit for MOOC-based courses.
- Change the use of SWAYAM MOOC from semester course weightage to percentage of total credit.
- Empower college faculty members to use MOOCs based on their pedagogy preference.
- Promote new pedagogical methods (e.g., Blended learning: 30%-50% MOOCs with the rest as classroom learning) tailored to course requirements.
- Allow college instructors to assess students who complete NPTEL/SWAYAM MOOCs. The total grade should include NPTEL/SWAYAM MOOC completion grades, practical assessments, and the institute instructor's evaluation.

Though this study provides insights into stakeholders' perceptions and recommendations, it has limitations. This study applies to engineering and science disciplines and does not generalise to humanities or non-technical disciplines. Second, the study is based on India's education system and laws. Third, the rise of generative AI is changing the learning paradigm; hence, further research is needed. Nonetheless, our analysis can be a reference for future research and help educational institutions and governments make policy decisions for MOOC-based learning.

References

Agarwal, A. (2014). *Why massive open online courses (still) matter*. Ted. https://ted2srt.org/talks/anant_agarwal_why_massive_open_online_courses_still_matter

AICTE (Credit Framework for online learning course through SWAYAM) Regulations 2016, Pub. L. No. 171415 (2016). https://egazette.nic.in/WriteReadData/2016/171415.pdf

Anderson, J. E. (2003). *Public Policymaking* (Fifth). Houghton Mifflin Company.

Belanger, Y., & Thornton, J. (2013). *Bioelectricity: A quantitative approach Duke University's first MOOC*. 1–528. http://dukespace.lib.duke.edu/dspace/bitstream/handle/10161/6216/Duke_Bioelectricity_MOOC_Fall2012.pdf

Bhandari, P. (2021). *Multistage Sampling*. Scribbr. Retrieved on March 15, 2023 https://www.scribbr.com/methodology/multistage-sampling/

Birkland, T. A. (2006). Agenda Setting in Public Policy. In F. Fischer, G. J. Miller, & M. S. Sidney (Eds.), *Handbook of Public Policy Theory, Politics, and Methods* (pp. 63–78). CRC Press.

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, *3* (2), 77–101. https://doi.org/10.1191/1478088706qp063oa

Breslow, L., Pritchard, D. E., DeBoer, J., Stump, G. S., Ho, A. D., & Seaton, D. T. (2013). Studying Learning in the Worldwide Classroom Research into edX's First MOOC. *Research & Practice in Assessment*, *8*(Summer), 13–26. http://eds.b.ebscohost.com.library.esc.edu/eds/pdfviewer/pdfviewer?vid=1&sid=2c170537-bede-422a-b10f-3df29e48915e%40sessionmgr198&hid=112%5Cnhttp://www.rpajournal.com/dev/wp-content/uploads/2013/05/SF2.pdf

Chen, Y. H., & Chen, P. J. (2015). MOOC study group: Facilitation strategies, influential factors, and student perceived gains. *Computers and Education*, *86*, 55–70. https://doi.org/10.1016/j.compedu.2015.03.008

Cole, A. W., & Timmerman, C. E. (2015). What Do Current College Students Think about MOOCs ? *Journal of Online Learning and Teaching*, *11*(2), 188–202.

Coursera. (2021). *Coursera Honor Code*. https://learner.coursera.help/hc/en-us/articles/209818863-Coursera-Honor-Code

CSDS. (2019). *Social media and political behaviour*. Retrieved on March 18, 2023 from www.csds.in%7Cwww.lokniti.org

Department of Higher Education. (2015). MOOCs Massive Open Online Courses: An initiative under National Mission on Education through Information Communication Technology (NME-ICT) Programme. In *Ministry of Human Resources Development Department of Higher Education*.

Department of Secondary and Higher Education. (2007). *National Programme on Technology Enhanced Learning (NPTEL)* (Issue July 2003). https://archive.nptel.ac.in/resources.html

Dillahunt, T. R., Ng, S., Fiesta, M., & Wang, Z. (2016). Do Massive Open Online Course Platforms Support Employability ? *CSCW'16*, 233–244. https://doi.org/http://dx.doi.org/10.1145/2818048.2819924

Dillenbourg, P. (1999). *What do you mean by collaborative learning? Collaborative-Learning: Cognitive approaches*. *1*(January 1999).

Dye, R. T. (2013). *Understanding Public Policy* (Fourteenth). Pearson Education, Inc.edX. (2019). *edX Terms of Service*. EdX. https://www.edx.org/edx-terms-service

Evans, S., & Myrick, J. G. (2015). How MOOC instructors view the pedagogy and purposes of massive open online courses. *Distance Education*, *36*(3), 295–311. https://doi.org/10.1080/01587919.2015.1081736

Garg, V. K. (2019). Analysis of Cluster and Multistage Sampling : A Survey on Higher Education Discontinuity in Rural Areas using Cluster Sampling. *Think India Journal*, *22*(12), 67–79.

Guion, L. A. (2002). *Triangulation: Establishing the Validity of Qualitative Studies. Institute of Food and Agricultural Sciences: University of Florida*. 1–3.

Haber, J. (2013). *MOOC attrition rates running the numbers*. HuffingtonPost. http://www.huffingtonpost.com/jonathan-haber/mooc-attrition-rates-runn_b_4325299.html?

Hew, K. F., & Cheung, W. S. (2014). Students' and instructors' use of massive open online courses (MOOCs): Motivations and challenges. *Educational Research Review*, *12*, 45–58. https://doi.org/10.1016/j.edurev.2014.05.001

HM Treasury. (2020). *Magenta book. Central Government guidance on evaluation* (Issue March). https://www.gov.uk/government/publications/the-magenta-book

Jacobs, A. J. (2013, April 20). Two Cheers for Web U! *The New York Times*, 6.

Jaschik, S., & Lederman, D. (2014). Faculty Attitudes on Technology. *Inside Higher Ed*, 1–44.

Jordan, K. (2015). Massive Open Online Course Completion Rates Revisited: Assessment, Length and Attrition. *International Review of Research in Open and Distributed Learning*, *16*(3). https://doi.org/https://doi.org/10.19173/irrodl.v16i3.2112

Kant P., & Mehra A. (1970). A Critical Evaluation of the National Programme on Technology Enhanced Learning (NPTEL): The Flagship Indian Massive Open Online Courses (MOOCs) Programme ISSN: 2188-1162 *The European Conference on Education 2022: Official Conference Proceedings (pp. 529-547*) https://doi.org/10.22492/issn.2188-1162.2022.43

Koller, D., Ng, A., & Chen, Z. (2013). *Retention and Intention in Massive Open Online Courses: In Depth*. EDUCAUSE Review. https://er.educause.edu/articles/2013/6/retention-and-intention-in-massive-open-online-courses-in-depth

Kolowich, S. (2010). *The Human Element*. Inside Higher Ed. https://www.insidehighered.com/news/2010/03/29/human-element

Laerd Statistics. (2018). *Mann-Whitney U Test using SPSS Statistics*. Lund Research Ltd. https://statistics.laerd.com/spss-tutorials/mann-whitney-u-test-using-spss-statistics.php

Littlejohn, A., Hood, N., Milligan, C., & Mustain, P. (2016). Learning in MOOCs: Motivations and self-regulated learning in MOOCs. *Internet and Higher Education*, *29*, 40–48. https://doi.org/http://dx.doi.org/10.1016/j.iheduc.2015.12.003

Nachmias, D. (1979). *Public Policy Evaluation: Approaches and Methods*. St. Martin's Press, New York.

NPTEL. (2022). *About NPTEL*. NPTEL Website. https://archive.nptel.ac.in/about_nptel.html

NPTEL PIC. (2014). Minutes of the NPTEL PIC Meeting On 23 November 2014-At Senate Room Building, IIT Delhi. In *NPTEL Website*. Retrieved on September 30, 2022 from https://archive.nptel.ac.in/resources.html

Onah, D. F. O., Sinclair, J., & Russell, B. (2014). Dropout rates of massive open online courses: Behavioural patterns. *6th International Conference on Education and New Learning Technologies*, 5825–5834.

Penn State Eberly College of Science. (2023). *Multi-Stage Sampling: Two Stages with S.R.S at Each Stage*. Pennsylvania State University. Retrieved on March 12, 2023 from https://online.stat.psu.edu/stat506/lesson/9/9.1

Peters, B. G. (2015). *Advanced Introduction to Public Policy*. Edward Elgar Publisher.

Savga, L., Krykliy, O., & Kyrychenko, K. (2018). The Role of Internal and External Stakeholders in Higher Education System in Ukraine. *Business Ethics and Leadership*, *2*(1), 32–43. https://doi.org/10.21272/bel.2(1).32-43.2018

Shapiro, H. B., Lee, C. H., Wyman Roth, N. E., Li, K., Çetinkaya-Rundel, M., & Canelas, D. A. (2017). Understanding the massive open online course (MOOC) student experience: An examination of attitudes, motivations, and barriers. *Computers and Education*, *110*, 35–50. https://doi.org/10.1016/j.compedu.2017.03.003

Sharrock, G. (2015). Making sense of the MOOCs debate. *Journal of Higher Education Policy and Management*, *37*(5), 597–609. https://doi.org/10.1080/1360080X.2015.1079399

Snyder, M. D. (2012). State of the profession: Much Ado about MOOCs. *Academe*, *98*(6), 19–21.

Sreevatsan, A., & Venugopal, V. (2016, January). Online learning set for big leap. *The Hindu*. Retrieved on October 10, 2022 from https://www.thehindu.com/features/education/issues/online-learning-set-for-bigleap/article2844705.ece

Turner, P., & Turner, S. (2017). Triangulation In Practice 2 . Triangulation in Presence Research. *Triangulation In Practice*, 1–13.

Vedung, E. (2013). Six Models of Evaluation. In E. A. Jr., S. Fritzen, M. Howlett, M. Ramesh, & X. Wu (Eds.), *Routledge Handbook of Public Policy* (pp. 387–400). Routledge.

Walsh, R. S., McClean, B., Doyle, N., Ryan, S., Scarborough-Lang, S. J., Rishton, A., & Dagnall, N. (2019). A thematic analysis investigating the impact of positive behavioral support training on the lives of service providers: "it makes you think differently." *Frontiers in Psychology*, *10*(OCT). https://doi.org/10.3389/fpsyg.2019.02408

Wang, Y., & Baker, R. (2015). Content or platform: Why do students complete MOOCs? *Journal of Online Learning and Teaching*, *11*(1), 17.

Watkins, M. W. (2018). Exploratory Factor Analysis: A Guide to Best Practice. *Journal of Black Psychology*, *44*(3), 219–246. https://doi.org/10.1177/0095798418771807

Watted, A., & Barak, M. (2018). Motivating factors of MOOC completers: Comparing between university-affiliated students and general participation. *Internet and Higher Education*, *37*, 11–20. https://doi.org/https://doi.org/10.1016/j.iheduc.2017.12.001

White, E. M. (2014). MOOC as Threat and Promise. In S. Krause & C. Lowe (Eds.), *Invasion of the MOOCs- The Promise and Perils of Massive Open Online Courses* (pp. 150–155). Parlor Press, Anderson, South Carolina.

Young, J. R. (2012, September 8). Coursera Announces Big Expansions, Adding 17 universities. *The Chronicle of Higher Education*. https://www.chronicle.com/blogs/wiredcampus/coursera-announces-expansion-adding-16-universities

Yuan, L., & Powell, S. (2013). *MOOCs and Open Education : Implications for Higher Education A white paper*.

Contact email: pramathkant.iitb@gmail.com