Research Article

How have the SWAYAM MOOCs impacted Indian higher education? An inquiry through data mining approach

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Abstract

Examining the phenomenon "How have the SWAYAM MOOCs impacted Indian Higher Education (HE)?" is the study's goal. The Study Web of Active Learning for Young Aspiring Minds (SWAYAM), a local MOOC platform that houses all Indian MOOCs, is where the data is gathered. The results of the study shed light on a variety of aspects of SWAYAM MOOCs and their worth to the Indian HE. First, there is a noticeable heterodoxy in the nine national coordinators' contributions to the growth of MOOCs. The National Program on Technology Enhanced Learning and Consortium for Educational Communication are determined to cover about 74 per cent of SWAYAM courses. Second, the length of the courses suggests that students can pick any size of course that is suitable for their academic growth. Thirdly, most courses can be transferred for credit, per academic evaluation. Fourth, HE courses are more likely to be offered (95 per cent) than school education (SE) courses (5 per cent). Fifth, according to the syllabi-formation principle, all of the courses in SE are advanced, but only 13 per cent and 81 per cent of the courses in HE, respectively, are introductory and advanced. Sixth, SWAYAM MOOCs largely meet the demands of students studying science, technology, engineering, and mathematics (STEM).

Keywords: MOOC, Technology-enhanced Learning, Data Mining, Higher Education, STEM, Educational Policy Research

Introduction

The way educational transactions are carried out has drastically changed in the twenty-first century. It is thought that the subjects of education and educational technology have seen a rebirth in the age of the digital revolution. Everyone needs to get used to using information and communication technology (ICT) in everyday activities including educational components because of the recent COVID-19 pandemic. Given the ICT industry's explosive growth, the Government of India (GoI) seeks to radically transform the way education is now delivered. India has one of the biggest educational systems in the world. Due to its vastness and demographic variety, the nation's educational transactional procedures occasionally run into problems. Massive open online courses (MOOCs) are being proposed as a potential remedy to these constraints. All the Indian MOOCs are being transacted through the sole national online platform Study Web of Active Learning for Young and Aspiring Minds (SWAYAM). SWAYAM is dedicated to meeting students' educational needs from secondary education (SE) to higher education (HE) through technology advancement. The most recent National Education Policy, 2020 (NEP 2020), calls for significant modifications to the current structure of HE to bring about

an educational revolution. The reforms cover a wide range of topics, such as the establishment of the academic bank of credit (ABC) framework, globalisation and privatisation of HE, providing students with numerous entry and exit points for their course structures, etc. (Ministry of Human Resource Development, 2020).

It has been seen recently that educational technology (EdTech) businesses are working hard to gain or enhance their share of educational practices. EdTech giants are working nonstop to gather, edit, and share a big data bank with the global educational stakeholders to succeed in their endeavours. As a result, technical terms like '*data mining*' *and 'big data analytics' come into the context. "Data mining is defined as a process used to extract usable data from a larger set of raw data. It implies analyzing data patterns in large batches of data using one or more software. Data mining has applications in multiple fields, like science and research. As an application of data mining, businesses can learn more about their customers and develop more effective strategies related to various business functions and in turn leverage resources more optimally and insightfully. This helps businesses be closer to their objective and make better decisions. Data mining involves effective data collection and warehousing as well as computer processing. For segmenting the data and evaluating the probability of future events, data mining uses sophisticated mathematical algorithms. Data mining is also known as knowledge discovery in data (KDD)"* (The Economic Times, 2022). The key here is to consider how, despite these technical restrictions, the same concept of data mining may be applied to the context of education using the eyes of an educational researcher. What kinds of conclusions does the exercise lead to if it is continued? The backdrop of the current study is provided to answer these questions.

The introduction explores the intersection of technology and education. With MOOCs at its centre, the technology acceptance model (TAM) seems to be a key concept in associated activities and education research.

Abdulaal (2021) studies the landscape of Egyptian universities. Perceived utility, accessibility, and exogenous variables are the aspects that impact user reactions to MOOC activities. Adomaviciuti et al. (2023) examine the e-learners' behavioural features. By repeating their research on 44 distinct nations, they capture the impact of a greater contextual precipice. The results show that TAM only accounts for the MOOC participants' intention to continue. The ability of the model to forecast the two other e-learning behaviours, the desire to finish and the intention to cancel MOOCs, is limited.

It is clear from MOOCs and TAM that the study topic and its setting have output viability. What does the existing body of literature suggest in this regard?

Method

A review of the literature on the use of MOOCs in HE and its various facets

Descriptive research explains the existence of several MOOC types in the literature (Suresh and Srinivasan, 2020). Out of the variety of MOOCs available, the MOOCs is seen as a model for social inclusion in education (Marta-Lazo et al., 2019). The structural and operational components of MOOC are examined. The development of multilingual material, the availability of credit transfer, the right design, quality, and delivery of course continue to be important research concerns (Trehan et al., 2017). A group of scholars proposes flexible learning paths in HE using the accessibility of MOOCs in support of achieving

sustainable development goals (SDG4) in education (Martin and Godonoga, 2020). The contribution of support units' entrepreneurial endeavours to the digital transformation of Norwegian HE is examined by Langseth et al. (2023). It is praised that MOOC study findings can be used to virtually complete laboratory tasks in regards to augmented reality (Makransky et al., 2019). According to the perspectives of MOOC participants, some academics have expressed doubt about the notion of success and dropout requirements (Henderikx et al., 2017). Suggestions for minimising such a crisis include automatic urgency detection in discussion forums (Alrajhi et al., 2024), self-regulated learning (Onah et al., 2024), and proper course design (Nujid and Tholibon, 2024). MOOCs are often criticised for their assessment and instructional practices. Solutions include learner-centric assessment (Blum-Smith et al., 2021; Shah et al., 2023), mixed evaluation techniques (Meinert et al., 2018), appropriate use of instructional design (Ntourmas et al., 2022), pedagogy in language MOOCs (Wong, 2021), etc. Gu (2024) investigates how incorporating reinforcement learning enhances the general pleasure, engagement, and performance of students. The sustainability of MOOC platforms in India is contingent upon several elements, including content, pedagogy, and usability (Garg et al., 2023).

A review of the literature on MOOC research in the context of the Indian education system (IES)

The NEP 2020 anticipates that MOOCs will significantly influence the growth of institutions that are future-ready (Mittal, 2020). Malik and Hooda (2023) advocate for the effective integration of technology and pedagogy to improve access, equity, and quality in HE in India. A vision framework (Jain et al., 2014) shows how the use of MOOCs is expected to alter India's educational system. In addition to using more conventional teaching techniques, staff and students from ten state-run universities in India found that taking MOOCs aided them in meeting their learning goals (Kundu and Bej, 2020). According to a comparison study of Indian consumers of two different MOOC platforms, each group has varied learning requirements (Sanzgiri, 2020). Indian HE stakeholders' perspectives on government e-learning initiatives are shown through a case study (Singh et al., 2021). The intention of educators (Virani et al., 2023) and students (Singh, 2022) to use MOOCs is explored when using TAM in Indian contexts. Positioning their research in the Indian HE context a group of academics is found to be advocating for better education in India, despite the majority of studies supporting the applicability of MOOC for quality HE (Nemer and O'Neill, 2019). According to Pramanik (2018), SWAYAM MOOCs are still allegedly in the testing stage. The Ministry of Education (MoE, formerly MHRD), GoI, periodically releases announcements to assist the development of MOOCs in India (University Grants Commission, 2016a). The circulations help the researcher to look into the development and application of MOOCs in India. MoE published a notice describing the credit system for online learning courses through SWAYAM in the Gazette of India to increase awareness of MOOCs among the teaching-learning community in India (University Grants Commission, 2016b).

Rationale of the Study

Studies are being done on a range of aspects of MOOCs and how they relate to HE (vide Section 2.1). Numerous studies have examined MOOCs, the Indian educational context, and SWAYAM separately. These studies have described academic (e.g., Singh et al.,

2021; Viriani et al., 2023), administrative (e.g., Jain et al., 2014; Malik and Hooda, 2023), and technical aspects of MOOC design (University Grants Commission, 2016a,b). However, very little study is observed by the researcher evaluating SWAYAM MOOCs' impact on the IES. To the best of our knowledge, this is the first effort of its sort to investigate the native MOOC platform's (SWAYAM) academic contribution across the country.

Meanwhile, SWAYAM has been conducting MOOC transactions since 2017 (Banchariya, 2019). It is anticipated that SWAYAM has gathered a sizable amount of data on numerous MOOC related topics after years of operation. The available literature shows a knowledge gap that might be filled by highlighting the contributions of SWAYAM MOOCs to Indian HE.

Research Question (RQ)

The sole RQ acts as the cornerstone for constructing the research objective.

RQ: How have the SWAYAM MOOCs impacted the Indian HE?

Methodology

The background for the inquiry is the IES (like Singh, 2022) in general and Indian HE in particular, following Malik and Hooda, (2023) for instance. This phenomenological investigation is based on the TAM theoretical underpinnings (e.g., Abdulaal, 2021; Viriani et al., 2023). The website of the relevant official body (i.e., SWAYAM) is www.swayam.gov.in which provided the data for this case study (Banchariya, 2019; Sanzgiri, 2020). When accessing the website, users can examine two different sorts of courses: those that are in progress (i.e., for the current semester) and those that are upcoming (i.e., for the following semester). The researcher decided to inquire about the ongoing (enrolment closed) category of 1170 courses because of the erratic nature of the database for future courses (referring to the following semester). Data was gathered between September 10 and September 30, 2022.

The purpose of the study's inquiry is established through the use of descriptive data analysis (Kundu and Bej, 2020). Because they are always to some extent blended into other types of traditional course categories, the calculations in this study do not take into account any special National Program on Technology Enhanced Learning (NPTEL) or Annual Refresher Program in Teaching (ARPIT) courses.

Yang et al. (2024) screen learners' emotional input on several course aspects while reporting on MOOC course development strategies. To present the results of their research, they make use of text mining, deep learning, and the multi-attribute decision-making method. In an independent study, Mendoza et al. (2024) chose to use the process mining approach to analyse the language MOOC participants' procrastination patterns.

The current investigation's goal has nothing to do with creating a MOOC or learning about the MOOC process. According to The Economic Times (2022), the problem's nature makes it inappropriate to use text mining (Yang et al., 2024) or process mining (Mendoza et al., 2024). Instead, it lends itself more to a data mining strategy. Henceforth, the subsequent steps of analysis (i.e., data screening and data analysis) use data mining methodology to produce a meaningful interpretation (i.e., data synthesis) out of this large amount of raw data. Several criteria are used to analyse data, and these are covered in detail in the section that follows. Figure 1 represents the conceptual framework of the research.

Figure-1: Conceptual framework of the research

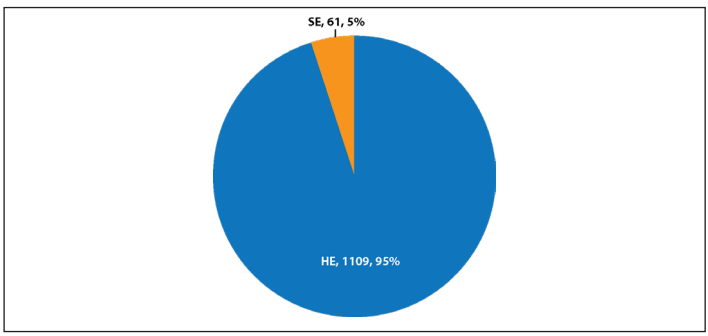
Data Collection	Data Screening	Data Analysis	Data Synthesis
Database searched: www.syayam.gov.in	Screening criterias: Different categorical variables as included in the main tex	Database searched: www.syayam.gov.in	Done on the basis of descriptive analysis
Duration of data collection: 10-30th September, 2022	Screening technique: 1. Manual 2. Non consideration of courses which are being run on repeat 3. Non consideration of NPTEL/ARPIT course	Analysis technique: Descriptive statistics	
Database of 1170 courses			

Results

RQ: How have the SWAYAM MOOCs impacted the Indian HE?

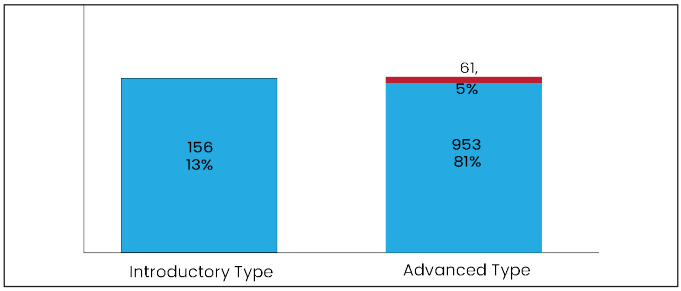
The majority of the IES is comprised of SE and HE. Advancing to HE necessitates having a solid foundation in SE. SWAYAM MOOC availability is now lensed in compliance with SE/HE. MOOCs only partially (5 per cent) met the needs of SE, with 95 per cent of the courses addressing HE. The relevant results are shown in Figure 2.

Figure-2: Accessibility of SWAYAM MOOCs in terms of SE/HE



During the analysis, the researcher carefully considers the titles of the courses. Some of the courses are obvious candidates for the foundational, introductory, or fundamental course categories. These courses are grouped as introductory types in this study to provide uniformity. The remaining courses are under the advanced category. The analysis overview is shown in Figure 3.

Figure-3: The classification of all SWAYAM MOOCs



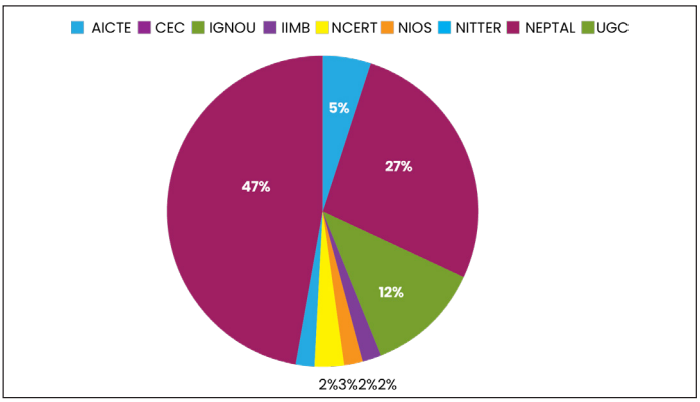
The researcher was unable to find any introductory-style curriculum for SE students, even though the education community views these pupils as novices. The result suggests that the creation and delivery of SWAYAM courses should place a larger emphasis on the level(s) of content difficulty.

SWAYAM filters

MOOC coordinators

SWAYAM is supported by nine national coordinators, including the University Grants Commission (UGC), NPTEL, National Institute of Technical Teachers Training and Research (NITTTR), National Institute of Open Schooling (NIOS), National Council of Educational Research and Training (NCERT), Indian Institute of Management Bangalore (IIMB), Indira Gandhi National Open University (IGNOU), Consortium for Educational Communication (CEC), and All India Council for Technical Education (AICTE). Figure 4 displays a list of the contributions made to the MOOC by the SWAYAM coordinators.

Figure-4: Contributions from SWAYAM coordinators

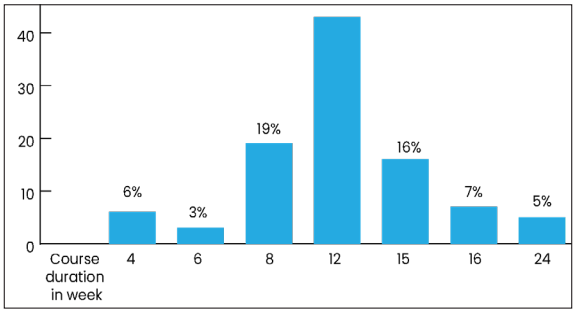


The MOOC coordinators' distinctive contributions reveal a striking heterodoxy. Nearly half (47 per cent) of the current MOOCs are created by NPTEL. CEC covers 27 per cent of the remaining MOOC corpus. Therefore, it is unlikely that NPTEL and CEC will complement 74 per cent of the SWAYAM courses.

Course duration

The MOOCs are reported to run anything from 4 to 24 weeks when the course length is taken into account. The majority of courses endure 12 weeks, but other courses with the highest enrolment often last 8 to 15 weeks. In terms of course duration, the running course spectrum exhibits a somewhat typical frequency distribution (Figure 5).

Figure-5: Runtime for MOOCs

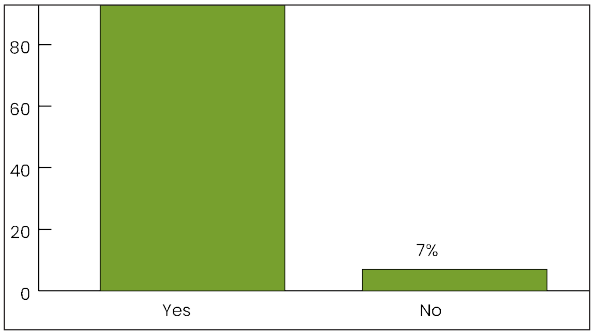


It demonstrates that students have a wide range of course length options to further their academic and professional endeavours. Scalability of the course duration is thought to provide MOOC participants greater freedom in their learning and goal-setting, both short and long term.

Course credit

Academic evaluation of courses completed through the SWAYAM platform is assessed following the GoI advocacy for the introduction of the credit transfer option (UGC, 2022). The researcher portrayed how effectively the current MOOCs offered a credit transfer option in light of SWAYAM learning (Figure 6).

Figure-6: Credit transfers possibility

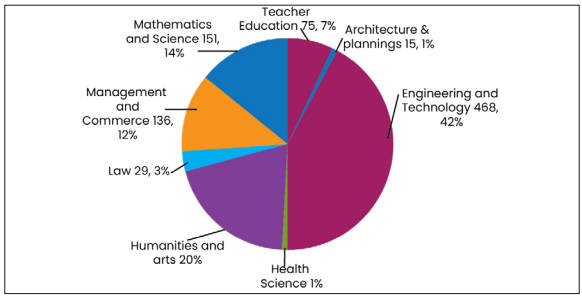


The outcome shows that almost every course is transferable for credit toward an academic assessment. This viability offers the chance to take into account SWAYAM MOOCs for native learners' academic pursuits.

Course category

The goal of the current study is to evaluate SWAYAM MOOCs' impact on the Indian HE. The corpus of MOOCs is microscopically analysed across several areas to respond to this RQ (Figure 7).

Figure-7: Discipline-specific SWAYAM MOOCs



Similar to Figure 4, Figure 7 shows how the SWAYAM platform's course categories are disproportionally distributed. It's clear that the platform essentially meets the demand for science, technology, engineering, and mathematics (STEM) education. Conversely, most students don't pursue fields like health science, law, architecture and planning, or even teacher education. The activities of national coordinators are evaluated for each course discipline. Figures 8-16 displays the microanalysis.

Figure-8: Contributions to architecture and planning

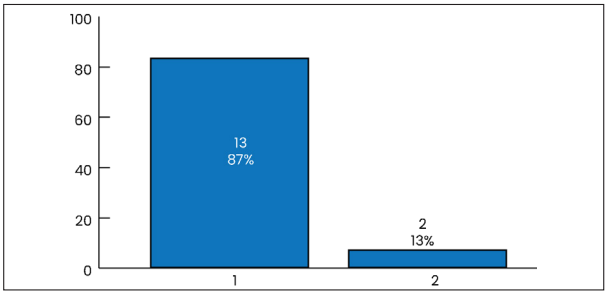


Figure-9: Contributions to the engineering and technology

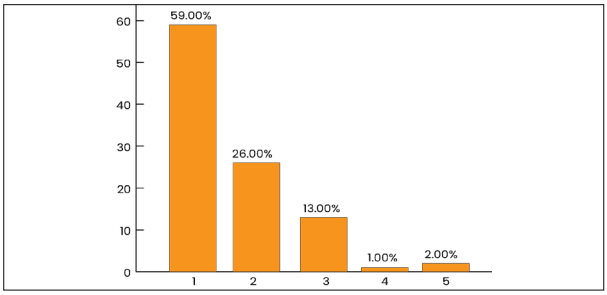


Figure-10: Contributions to health sciences

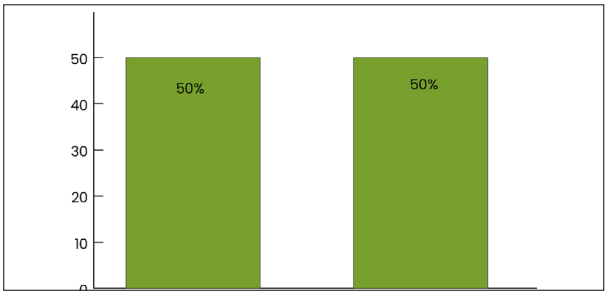


Figure-11: Contributions to humanities and arts

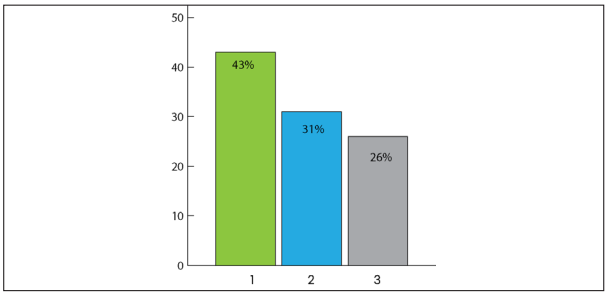


Figure-12: Contributions to the legal profession

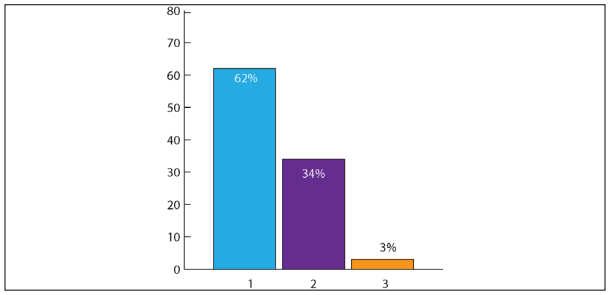


Figure-13: Contributions to the management and commerce sector

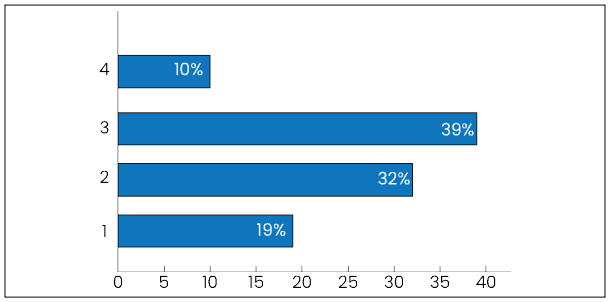


Figure-14: Contributions to mathematics and science

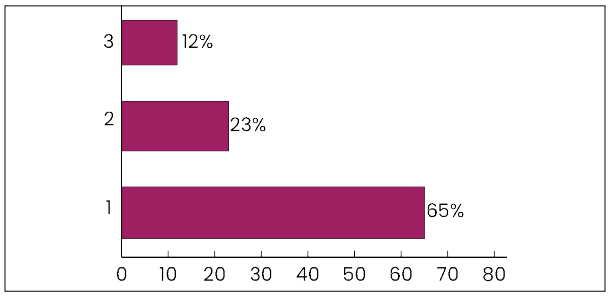
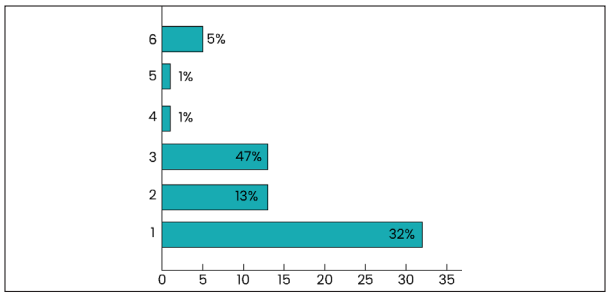


Figure-15: Contributions to teacher education



Figures 8–15 supplement Figure 4's report on the discipline-specific analysis, which also aids in identifying the primary contributor for each discipline. Learners may use this filtering strategy to choose the right MOOC for their future enrolment by taking into account their favourite discipline and keeping the main contributor in mind.

The contribution of SWAYAM MOOCs on the IES (SE/HE) is summarised in Figure 16.

Figure-16: Contribution of SWAYAM MOOCs to the IES

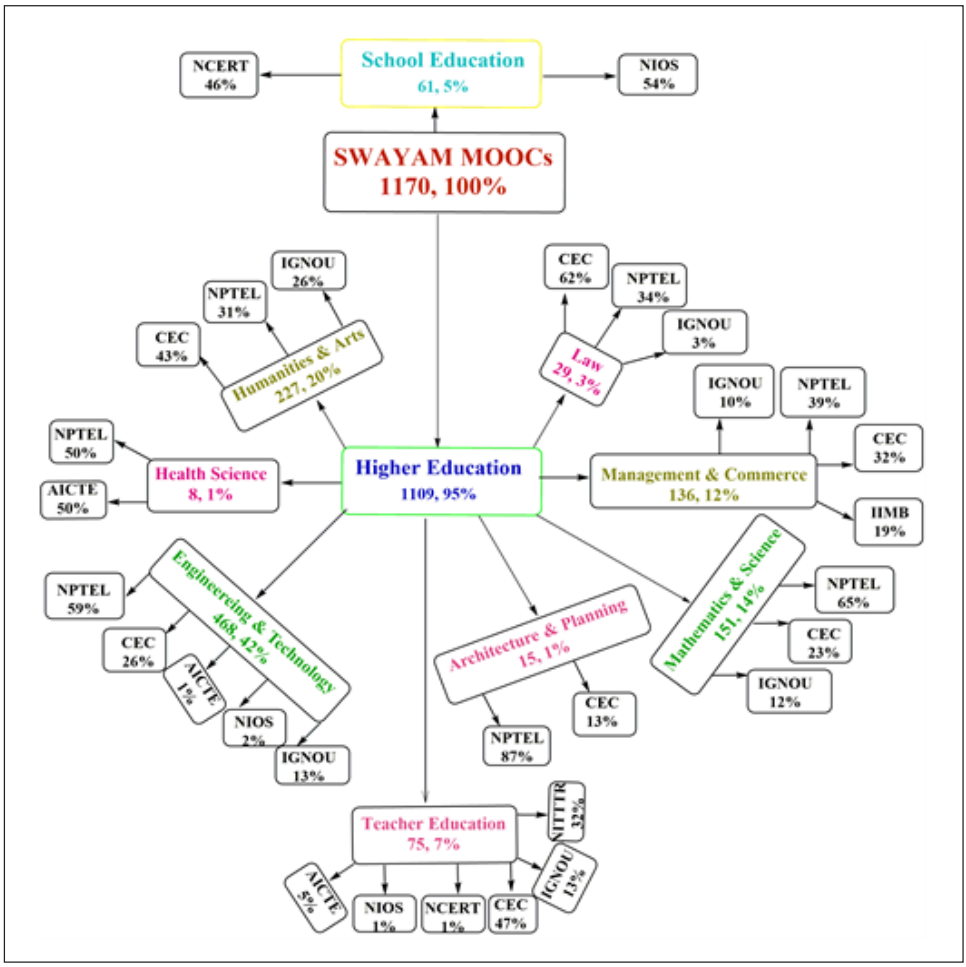


Figure 16 helps us visualise the Gestalt view and provides a concise answer to the RQ based on our disjointed studies from Figures 2–15. The Gestalt view (Figure 16) is important as it depicts the research problem's macro analysis (at the IES level), whereas Figures 2–15 show meso (at the SE/HE level) or micro (at certain disciplines) representations of the same.

Discussion

On results of the RQ

The knowledge offered by each of the categorical elements used to generate the RQ can be very useful to the education community. Only 5 per cent of SWAYAM MOOCs are specifically designed to meet the demands of SE; the other 95 per cent of courses are focused on HE (Figure 2). Another interpretation of these theoretical data suggests that whereas beneficiaries of MOOCs for SE show a stronger reliance on the traditional educational system, beneficiaries of MOOCs for HE show a greater interest in the online learning environment. Given that SE places a stronger focus on institutional processes, such a result raises the question of how students will be able to seamlessly transition to an online learning environment for HE. Bates's (2019) assessment and the present appraisal of MOOCs' suitability for HE are equivalent.

The course corpus contains only advanced SE issues; no basic courses are present (Figure 3). To create MOOCs for SE, more thought should be given to the sort of course or level (introductory/advanced). Thus, a balanced instructional design of course content or pedagogy is sought (Garg et al., 2023; Ntourmas et al., 2022).

Of the nine national MOOC coordinators, NPTEL seems to be the most active in terms of its contribution (Figure 4). The current observation is supported by earlier observations (Chauhan and Goel, 2017). Because the courses may be accessed from a mobile device, the overhaul efficacy (of NPTEL) can be explained (Gulati, 2008). It might be claimed that accessibility and technology have been major factors in this, supporting Malik and Hooda's advocacy (2023). However, the researcher believes that since the SWAYAM app is already available on the Google Play store, factors other than the standard or accessibility of the courses are greatly influencing this situation. The well-known reputation of the IITs, which has substantially increased the attraction of NPTEL courses over those provided by other national coordinators, maybe another factor. The issue of academic elitism or the branding of HE in various MOOC learning contexts is becoming relevant (Naidu, 2020; Rambe and Moeti, 2017). The responsibility for providing engineering courses via SWAYAM falls on NPTEL. The researcher wonders why other coordinators haven't been able to create MOOCs of the same scale given the expertise of NPTEL coordinating institutes. An inquiry of this nature prompts an investigation of the other SWAYAM coordinators regarding their infrastructure, workforce planning, workforce expatriation, financial budget, etc. From now on, the concept of MOOCs' scalability in various educational contexts is becoming more prevalent here (Gu, 2024; Rodes et al., 2021).

Students can enrol in courses that last 4 to 24 weeks (Figure 5). However, it seems that 12-week courses are the most popular. These results sharply contrast with those of Wong (2021), who found that most language MOOCs are completed in no more than six hours. In their research, Onah et al. (2024) critique the rigidity of MOOCs. It is emphasised that the current data indicate a flexible e-learning environment through SWAYAM, which contradicts their observations. In keeping with the same idea, students may easily define short and long term learning goals and manage their time.

Figure 6 from this study on the efficacy of SWAYAM courses shows that 93 per cent of MOOCs are acceptable for credit transfer. This result is by the recent GoI guideline (UGC, 2016b).

STEM related topics are covered in 56 per cent of the courses, as shown in Figure 7. It implies that SWAYAM courses often accommodate STEM students' needs. The new research is consistent with prior studies (Iacono and Vercelli, 2023; Majid et al., 2020).

Business and commerce (12 per cent) and humanities and arts (20 per cent) disciplines both have fewer MOOCs available (Figure 7). The usage of MOOCs in critical professions including law, health, planning, architecture, and teacher education, however, is extremely limited. The numerous and subjective disciplines of HE are underserved by SWAYAM MOOCs, allowing many other fields to suffer from a lack of access to top-notch content. Thus, SWAYAM appears to expand limited learner choice and learning routes on the listed fields, in contrast to the novel MOOC platform (Onah et al., 2024).

Limitations and practical implications

Limitations/future direction of research

The study is exclusive to SWAYAM, a native MOOC platform. Therefore, the study's conclusions cannot be completely valid from a worldwide standpoint. Future research can be conducted by using an international MOOC platform to gauge its impact globally.

In the current study, the researcher tries to determine how Indian MOOCs have impacted its HE. A cross-national study on two or more international MOOC platforms (e.g., Sanzgiri, 2020), in the researcher's opinion, would offer a clearer picture of this area in different contexts.

Practical implications

The discussion section of the study touches on several areas of education, including SE, HE, and the usage of MOOCs on the SWAYAM platform. Out of the analyses, the researcher believes that the study findings may have some practical implications.

Practical implications for policy-makers in India

The researcher notices a large disparity in the number of MOOCs available that are pertinent to SE/HE (Figure 2). Educational policymakers and MOOC creators (Blackmon, 2018) have the chance to work together and improve performance in this field.

Why did NPTEL continue to produce the most MOOCs in comparison to the other coordinators, maintaining its position as having the highest productivity? The results of the analysis need to be confirmed, and it is anticipated that other coordinators too will be able to apply them (Figure 4).

SWAYAM continues to be highly effective in fulfilling the criteria of STEM courses in the case of HE, while other professions like teacher education, law, health science, architecture, and planning, etc., continue to be undervalued. The policymaking authority is anticipated to step in and defuse the situation (Figure 7).

Practical implications for educators in India

Only 5 per cent of MOOCs relevant to the Indian SE are now available (Figure 2). The results strongly imply that there are more MOOCs required for school pupils. Teachers connected to SE may step up to help ease the situation.

Figure 3 shows that no introductory MOOCs for SE are found; instead, all are of the advanced variety. Therefore, a strict pedagogical perspective is required from school educators, in this direction.

Figure 2 demonstrates that 95 per cent of SWAYAM MOOCs are connected to HE. The growing accessibility of MOOCs can help students succeed in their HE and careers. Faculties in HE may advise their students to increase MOOC participation and spread SWAYAM awareness.

The variety of MOOCs that are offered is seen in Figure 5. Students now have the choice to enrol in any short or long term course that best meets their needs. Instructors can serve as mentors by offering their advice to students to help them choose the right course(s).

In 93 per cent of instances, SWAYAM MOOCs can be transferred for credit during academic assessment (Figure 6). Students can gain from the flexibility of e-learning in addition to their regular education and academic performance. Educators might use this chance to organise their curricula in a way that keeps MOOC learning as a viable option for students in addition to institutional

learning (Kursun, 2016; University Grants Commission, 2021).

Conclusions

The study's findings include several significant insights about SWAYAM MOOCs and their impact on Indian higher education. First of all, in terms of accessibility, HE courses are more likely to be offered than SE courses (95 per cent vs. 5 per cent, as shown in Figure 2). Secondly, for SE and HE, the distribution of introductory and advanced courses is not done with pedagogy in mind (Figure 3). Thirdly, there is a clear heterodoxy in the contributions made to the expansion of MOOCs by the nine national coordinators. The NPTEL and CEC's total coverage of the SWAYAM courses is found to be roughly 74 per cent. NPTEL emerges as the platform that is most actively involved in the creation of e-content when the diverse contributions of various MOOC coordinators are taken into consideration. There are no records of courses that UGC has developed (Figure 4). Fourth, there is a variety of course lengths available, ranging from 4 to 24 weeks, providing more flexibility to e-learners in managing time and setting their learning goals accordingly (Figure 5). Fifth, the majority of courses are recognised under GoI guidelines as transferable for credit (Figure 6). Finally, SWAYAM MOOCs substantially satisfy the needs of STEM students, according to 56 per cent of study respondents. The least well-fed industries tend to be those in teacher education, law, health science, architecture and planning (Figure 16). The results of the study show some practical repercussions for the Indian education community. A few of the study's conclusions are applicable universally. Realising equity throughout SE/HE and among many student groups from various subjective HE domains would undoubtedly be a difficult issue for MOOC creators, educational policymakers, and administrators. The limitations of this study point toward potential areas of future research. The conclusions of this contextual study are thought to have some general applicability to the field of education in terms of MOOC learning, HE, and STEM.

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