Empowering Faculty Members through Mooc in Techno-Pedagogical Content

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EMPOWERING FACULTY MEMBERS IN TECHNO-PEDAGOGY USING MOOCs

Abstract:
In the era of globalization driven by sustainability, technical teachers face a significant challenge in developing graduates who meet the intended learning outcomes in accordance with attributes listed in the Washington Accord. The current generation of students poses a significant challenge to the faculty members due to various factors, hence there is an urgent need to redefine the learning space that suits the current student generation. The graduating students are not meeting the requirements of the industries and employability means major issue in technical education. The statistics show that only 39% of diploma graduates and 43% of undergraduates are getting placed after graduation (AICTE 2022). One of the main reasons for unemployment and underemployment is the gap in the teaching-learning process. The faculty members needed to connect the content to the context, by adopting active teaching-learning strategies. There are more than 32713 faculty members at diploma-level technical institutions and 409412 faculty members at undergraduate technical institutions (AICTE 2021). Out of which, around 20000 faculty members are getting trained in content and pedagogical training through various training programmes offered at the government training institutions. Only 20% of the faculty members are only trained; however, the remaining need to be empowered periodically through various training modes. The need to increase the training programme is difficult due to the three main reasons:

(a) Institutions are not willing to spare faculty members due to shortage.
(b) The Importance of techno-pedagogical training and its implementation is difficult.
(c) The Limited number of trained professionals.

Providing training to such a massive number is a mammoth task, it is possible only if the technology is coupled to the training process. To encash the advantages of MOOCs, it is wise to provide training through scientifically designed MOOCs delivered by expert members with case studies. It gives an excellent chance for the faculty members to enrich their knowledge in the four major clusters (a) content knowledge; (b) pedagogical knowledge; (c) pedagogical cum technical content knowledge; and (d) technology cum pedagogical knowledge. The "TEAM – **T**echnology enabled **E**nvironment, **A**ssessment and **M**aterial" framework is designed for effective implementation to upskill the faculty members. The programme's efficacy is assessed based on the feedback of around 58102 participants. The training focused on the course titled "Technology enabled learning, lifelong self-learning".
However, just online MOOC alone will not provide the envisaged results; it needs to have a blended approach in getting connected with the faculty members in a phased manner with real-time change projects. The blended approach will facilitate evaluating the faculty members and the training programme's efficacy, and the individual portfolio will validate the project's success. However, the great challenge is the implementation and evaluation phase of the programme. The framework is proposed for effective implementation and measuring key performance indicators during the mentoring phase. The paper outlines the framework, content and rubrics adopted for the evaluation of the effectiveness of MOOC-based training through mentoring activity.

Introduction:

In the era of digitalization and globalization, training faculty members in the latest techno-pedagogical skill set is required to design instruction efficiently, deliver the course content effectively, and deploy appropriate modes of student assessment. The professional development programme, also known as the faculty development programme, is crucial for faculty members in higher education as it helps them to be updated with the latest educational

practices and techniques, which will facilitate them to be more effective in handling their teaching and learning environments [Ernst, E. W, 1995; Brawner et.al. 2002; Noel N Schulz and Kirk H Schulz, 2004; Hew et al. 2020; Kaili et. al., 2021; Lina et.al., 2022]. At present, faculty members focus on teaching techniques with modern gadgets; however, in the rapidly changing education landscape, it is realized that more than techniques, it is essential to understand the underlying principles and philosophy of deploying tools for effective teaching [Kaili et.al., 2021; Sprenger and Schwaninger, 2021; Xieling et.al., 2021]. This knowledge helps them be more effective in their teaching and learning environments and to provide students with a high-quality education relevant to their needs and interests. Pedagogical training also allows faculty members to be more innovative and creative in their teaching practices, making their lessons more engaging and effective for students [Prince 2004; Janardhanan and Panda. 2019].

After the pandemic, the adoption of technological/digital tools has been maximized; there has been a growing emphasis on integrating technological tools into the classroom [Shivangi 2020; Khe et.al., 2020; Sprenger and Schwaninger, 2021]. The students adapted to technology, and there is a paradigm shift in classroom instruction with technology to make teaching and learning more engaging, efficient, and effective. However, to harness the potential of technology-enabled learning, it is essential to upskill teachers in techno-pedagogical skills [Lina et.al., 2020]. Empowering teachers with technological tools for teaching involves providing them with the training, support, and resources they need to incorporate technology effectively into their lesson plans. One key benefit of empowering teachers with technological tools is that it can help level the playing field regarding educational access.

Technology can provide new opportunities for students who may need access to specific resources or information. It facilitates students to attend online lectures/webinars and other learning resources from any experts (national/international), thus providing learning beyond boundaries. Another benefit is that technology can make learning more engaging and interactive for students since they are digital natives [Otto and Strimel, 2022]. The effective use of technological tools helps them to stay focused and motivated and ultimately improve in attaining the intended learning outcome. However, it is essential to note that more than simply using technological tools, the faculty members must integrate technology into their lesson plans and instruction. This involves training on how to use specific software and tools and guidance on how to use technology to achieve specific learning objectives is need of the hour.

This paper focuses on the implementation of the framework to upskill faculty members in the area of techno-pedagogical skills. The paper also outlines how individual faculty members could respond and how institutions could support their effort with the implemented scheme as a case study. In the last, it is concluded with the lesson learnt and directions ahead in the professional development programme.

Challenges in faculty upskilling:

Upskilling faculty members in pedagogy and technology tools could be complex and challenging. Techno-pedagogical training provides faculty members with the skills required to design and deliver effective instructional materials and activities with the means adopted by the students. At present, the focus of upskilling is in four major clusters (a) content knowledge; (b) pedagogical knowledge; (c) pedagogical cum technical content knowledge; and (d) technology cum pedagogical knowledge, as shown in figure 1.

Figure 1: Faculty upskilling clusters

The training programme is grouped into four major clusters that focus on developing the skill set of the faculty members.

(a) Content knowledge: The programme focuses on the latest thrust area and continuous content updating. It is structured based on the development in the field of engineering.
(b) Pedagogical knowledge: The programme focuses on the pedagogical area viz., teaching-learning principles, classroom management, student assessment, student motivation and adolescent characteristics.
(c) Pedagogical cum technical content knowledge: The programme focuses on how to teach particular technical content to learners. It provides models and demonstration videos to be adopted in classroom instruction to enhance the students understanding. For example, ASCE EXCEED, NITTTRC – EXCITE Programmes.
(d) Technology cum pedagogical knowledge (Techno-pedagogical): The programme focuses on how to deploy technological tools in classroom instruction. It also includes courses in media and information literacy for the faculty members to empower into digitally literate.

Some of the main challenges that institutions face in upskilling faculty members are:

1. Resistance to change: One of the biggest challenges in upskilling faculty in pedagogy and technology tools is resistance to change. Senior faculty members may be hesitant to adopt new teaching methods and technology since they are comfortable with traditional teaching methods. The senior faculty members and middle-level faculty members only expressed their discomfort with the training when compared to young faculty members [Paskins and Fink 2015].
2. Lack of resources: Another challenge is the lack of resources to support faculty in upskilling. This includes funding for training and professional development, access to technology and software, and technical support. The institutional support and infrastructure for the implementation play an important role in technological adoption [Pradeep and Om 2018].
3. Time constraints: Faculty members often have busy schedules and limited time to learn new skills and technologies. This can make it difficult for them to engage in training and professional development programs.
4. Varying levels of tech proficiency: Faculty members have varying levels of proficiency with technology, which can make it challenging to design training programs that meet the needs of all faculty members. It can be difficult to strike a balance between providing

basic training for those who are new to technology and advanced training for those who are already proficient.
5. Sustainability: Maintaining a culture of continuous learning and upskilling can be a challenge in the long run. Institutions need to create a sustainable system of professional development and support that encourages faculty to continue to improve their skills and stay up to date with the latest pedagogical and technological advances.

Institutions can address these challenges by providing adequate resources, incentivizing faculty to engage in professional development and upskilling, creating a culture of continuous learning, and tailoring training programs to meet the needs of individual faculty members. It is important to recognize that upskilling faculty is an ongoing process that requires continuous investment and effort. By prioritizing faculty development, institutions can create a more dynamic and effective learning environment that benefits students and faculty alike [Pajares 1992; Jeff et.al, 2005; Palmira et.al., 2022].

Training through Massive Open Online Courses (MOOC):

After the Covid 19 pandemic, faculty members are accustomed to the online training programme and providing training in contact mode to many faculty members on the effective use of technological tools is quite cumbersome. Synchronous and asynchronous training programme plays a vital role in the upskilling of faculty members [Hew, K.F., Cheung, W.S 2014; Ahmed A. Al-Imarah and Robin Shields, 2019; Amado, C 2022; Yıldırım, B 2022]. In the online mode of training, there are several benefits as well as challenges. The benefits of the training are listed below:

1. Flexibility: MOOCs are designed to be flexible, allowing faculty members to learn at their own pace and during the schedule offering. This can be particularly beneficial for faculty members who have busy schedules or who are unable to attend traditional in-person training programmes. The training calendar lists the start date of the training programme and also the date of the live session. It facilitates clarifying their doubts and handholding them during the training session.
2. Access to high-quality content: MOOCs are often developed by leading experts in the field, providing access to high-quality content and resources that may not be available through traditional training programmes. The content is vetted by a subject expert and also a video expert for the quality of editing.
3. Cost-effective: MOOCs are often free or low-cost, making them a cost-effective alternative to traditional training programs that may require travel and other expenses.
4. Networking opportunities: MOOCs often provide opportunities for participants to network and collaborate with other faculty members from around the country and world. This can be a valuable opportunity for faculty members to share ideas and best practices.

However, there are also some challenges in using MOOCs for faculty training:

1. Lack of interaction: MOOCs are often self-paced and asynchronous, which means that there may be limited opportunities for immediate interaction and the learners need to wait for the live session.
2. Limited customization: MOOCs are designed to be scalable and may not be tailored to the specific needs of individual faculty members or institutions. Individual difference is not acknowledged, and everyone needs to complete all the sections of the course.
3. Technology issues: MOOCs require reliable internet access and technology skills, which can be a challenge for faculty members who may not be comfortable with technology.
4. Credentialing issues: MOOCs may not always provide formal recognition or credentials that are recognized by institutions or accrediting bodies. However, the regulatory

authority issued a circular to the learners for the equivalence in the national-level MOOCs viz., SWAYAM, ARPIT etc.,

Despite these challenges, MOOCs can be an effective tool for faculty training and upskilling, particularly when used in combination with other training methods such as in-person workshops and coaching. Institutions can also address some of the challenges of MOOCs by providing additional support and resources to faculty members, such as online forums and virtual office hours with instructors.

Framework for Training:

The adoption of MOOC could be used for all four programme clusters, as mentioned above. The paper outlines the framework adopted for training more than 58102 learners in techno-pedagogy content and empowering them with media and information literacy. The techno-pedagogical training content focus on three significant aspects; (a) the learning environment; (b) the learning materials; and (c) the assessment of learning. It helps faculty members understand how to adopt technological tools in the classroom and their underlying principles for effective implementation. The training is provided with the "TEAM – **T**echnology enabled **E**nvironment, **A**ssessment and **M**aterial" framework. The performance of TEAM requires components as follows: (a) Infrastructure; (b) Infostructure; and (c) Info culture, as shown in figure 2.

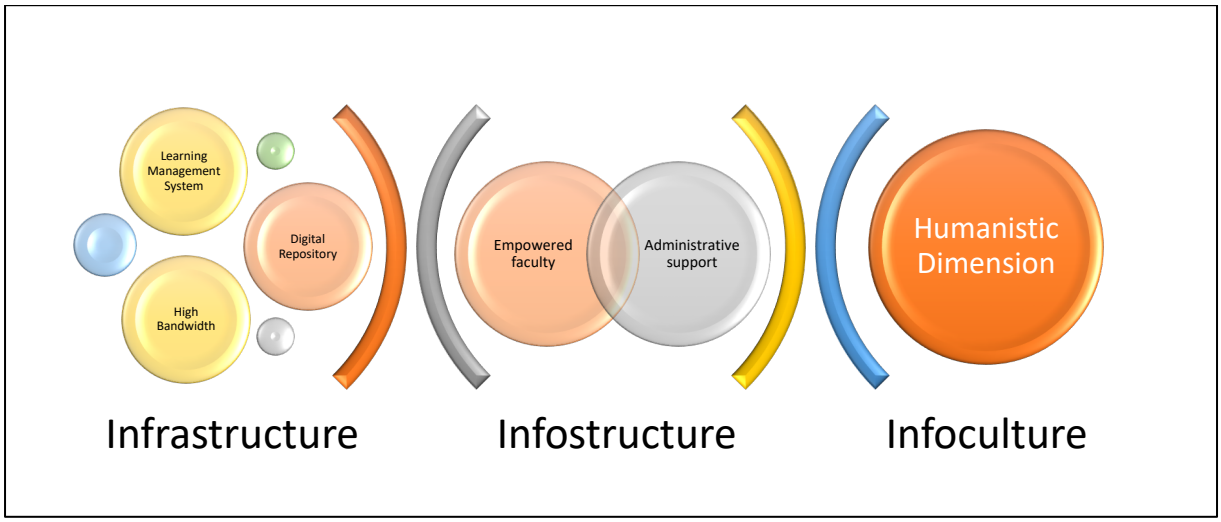

Figure 2: Components of Technology enabled Environment, Assessment, and Material

One of the underlying aims of teaching and learning is to enhance the livelihood of the learners through employability after graduation. If we look into statistics of student pass-out and job placement [AICTE, 2022], it is alarming and disturbing due to its less percentage of students getting jobs after their graduation. The statistics show that only 39% of diploma graduates and 43% of undergraduates are getting placed after graduation with all disciplines, as stated in the AICTE statistics. To improve the student graduation rate and increase their placement opportunity, it is important to focus on the faculty training and aligning their instructions to meet the intended learning outcomes. The upskilling programme needs to focus on effectively and efficiently engaging the classroom. After the pandemic, the faculty encounter the following issues in the class:

1. Students are not attending class on time.
2. Students need to complete the assignments.
3. Students feel shy to ask questions and shed away from clarifying their doubts.
4. Students are not watching/reading the take-home assignments.

5. Students are not performing well in the assessments etc.

There is a gap exists between faculty expectations and student performance. The upskilling should focus on these gaps and address effective teaching coupled with technology to address a few of the issues the faculty members encounter in their profession. Learning about technology-infused instruction techniques facilitates faculty members to deploy active instructional strategies to the students.

To create a pool of empowered faculty members, the training course was offered through MOOC. The authors developed the MOOC titled "Technology enabled learning, lifelong self-learning" offered as scheduled course for the duration of eight weeks, and it was a mandatory course to be completed by young faculty members (Batch – A) and the mid-level and senior faculty members (Batch – B); it was optional. The young faculty members have less than five years of teaching experience, and 11586 faculty members registered for this course. In batch B, we had total registration of 46516 faculty members. To maximize enrolment and completion rates, the regulatory authority All India Council for Technical Education (AICTE) made it compulsory for young faculty members. The course registration scheme is outlined in figure 3.

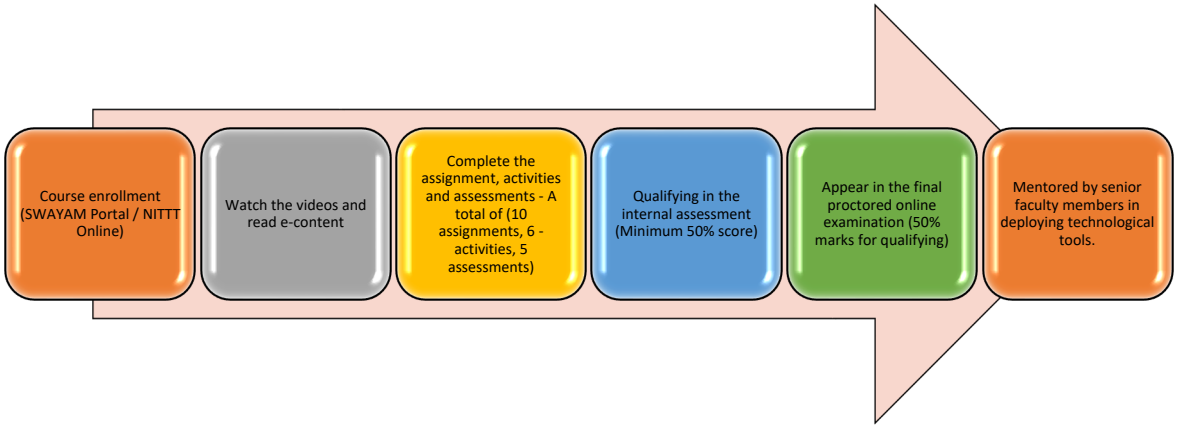

Figure 3: MOOC registration to certification scheme

For learners, learning through MOOCs provided several advantages due to the flexibility of learning at their own pace during the scheduled course. It costs lower to the government due to the reduction in the food, accommodation and travelling charges. Therefore, MOOCs can offer many benefits to learners for free, ostensibly much more effectively than established models of higher education [Perna et al., 2014]. The enrolment vs certification varied in both batches, although the course is free. The percentage of learners who appeared for the examination varied in both batches, a total of 94% appeared for the examination in batch A, and only 4% appeared in batch B. In batch B, the mid-level and senior faculty members attended the course actively; however, for certification bleak response due to the minimum amount charged for the examination. The upskilling programme also needs institutional and administrative support to implement successfully. In the figure 4, the registration and certification for both the batches is shown.

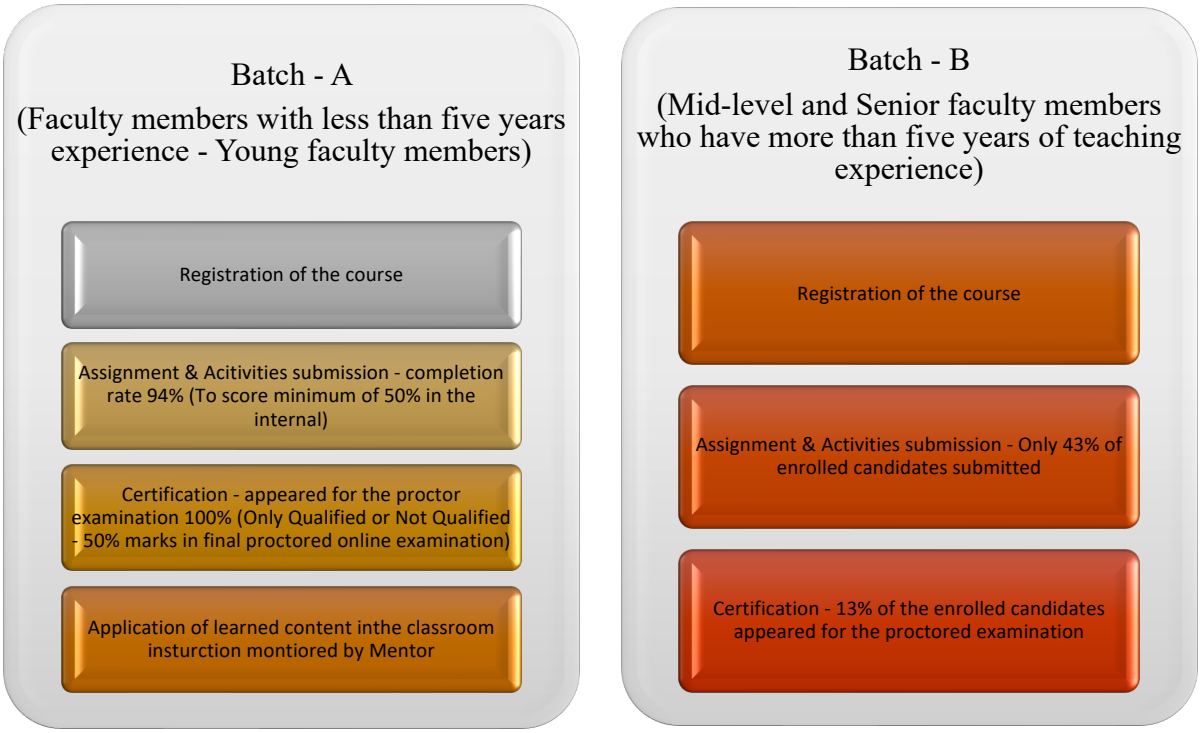

Figure 4: MOOC-based training scheme.

Techno-Pedagogy training content:
The content of the training programme is clustered into five sections as shown in figure 5. The course taught only free and open-source software's which facilitated the faculty members to learn, adopt and implement the same without any further financial burden during and after the course.

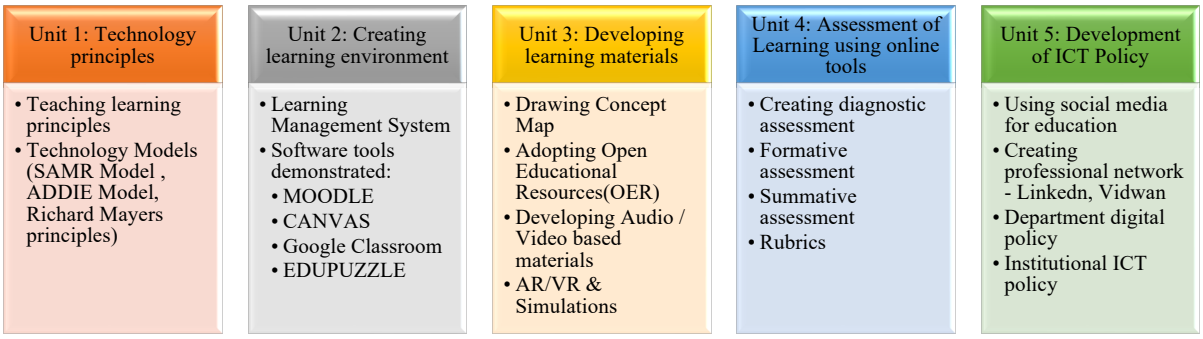

Figure 5: Content of the Techno-Pedagogical Training Programme

The framework for the training programme is given in figure 6, where ten assignments, six activities and five assessments are given with measurable outcomes. In this framework, faculty members access a MOOC platform (SWAYAM) that provides them with access to a specific MOOC "Technology Enabled Learning and Lifelong Learning" course. The MOOC contains course content, interactive features, and assessment and certification tools that allow faculty members to learn at their own pace and track their progress. After completing the online course, the faculty members shall appear for the online examination for certification. Once faculty members have completed the MOOC, they develop a plan that outlines how they will implement the new knowledge and skills they have acquired in their teaching,

research, and service roles. The plan may also include opportunities for continuous improvements, such as attending follow-up workshops or participating in peer review and mentoring activities. The mentor needs to certify the same after one semester about the utilization of the learned content. Overall, the MOOC framework provides faculty members with an accessible, flexible, and scalable way to enhance their professional development and contribute to the mission of the institution. The rubrics for mentor assessment are provided in Table 1, and evidence to be maintained by MOOC – Technology-enabled learning participants is provided in Table 2.

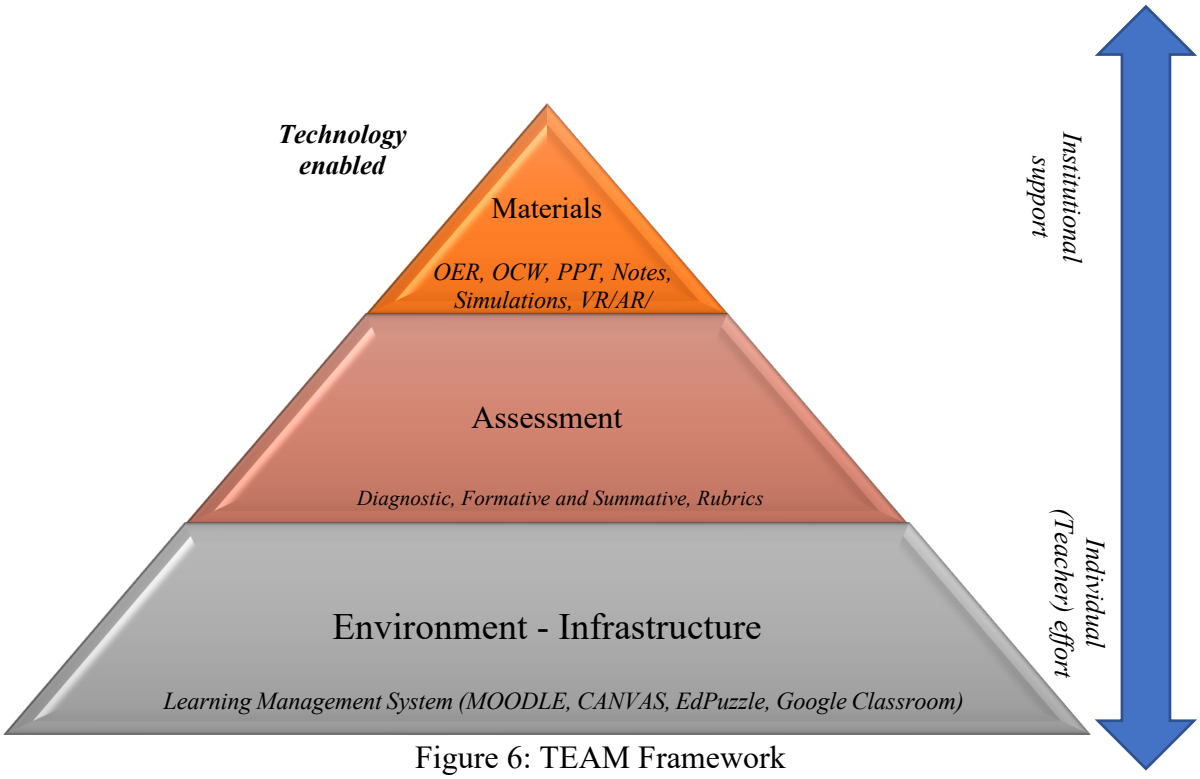

Figure 6: TEAM Framework

Table 1: Rubric for evaluation competency by Mentor

Sl.No.	Key Performance Criteria (KPC)	Very Good(4)	Good(3)	Fair(2)	Need to Improve (1)
1	Utilized ICT tools for Teaching	Adapted, prepared and implemented ***four*** Online course learning environment, course materials including assessing the skills using ICT Tools	Adapted, prepared and implemented three online course learning environment, course materials including assessing the skills using ICT Tools.	Adapted, prepared and implemented two online course learning environment, course materials including assessing the skills using ICT Tools.	Adapted, prepared and implemented ***one*** online course learning environment, course materials including assessing the skills using ICT Tools.
2	Interpreted the course curriculumand implemented virtual laboratoryfor laboratory teaching.	Implemented the virtual laboratory for *all* the listed practical's of a course and assessed the development of the *practical cognitive and*	Implementedthe virtual laboratory for *50%* the listed practical's of a course and assessed the developmentof the *practical cognitive and social skills*	Implementedthe virtual laboratory for *25%* the listed practical's of a course and assessed the development of the *practical cognitive and social skills*	Implemented the virtual laboratory for *10%* thelisted practical's ofa course and assessed the development of the *practical cognitive and*

Sl.No.	Key Performance Criteria (KPC)	Very Good(4)	Good(3)	Fair(2)	Need to Improve (1)
		social skills			*social skills*
3	Adopted Blended and Flipped Classroom	Developed lesson plans, implement d blended and flipped approach for *40% of the lessons* according to the developed *course plan*of the semester indicating the learningoutcomes and relevant teaching methods and media	Developed lesson plans implemented blended and flipped approach for *30% of the lessons* according to the developed*course plan* of the semester indicating the learning outcomes andrelevant teaching methods and media	Developed lesson plans implemented blended and flipped approach for *20% of the lessons* according to the developed *course plan* of the semester indicating the learning outcomes andrelevant teaching methods and media	Developed lesson plans implemente d blended and flipped approach for *10% of the lessons* according to the developed *course plan*of the semester indicating the learningoutcomes and relevant teaching methods and media
4	Digital Literacy – Possess ORCID,SCOPUS ID, GOOGLE SCHOLAR, RESEARCH GATE	Created the researcher ID in any *four* portals	Created the researcher IDin any *three* portals	Created the research IDin *two* portals	Created theresearch IDin *one* portal
5	Completed one MOOC related to International and also SWAYAM a ARPIT course	Enrolled MOOC in on *International* and *National* Platform and completed MOOC with commendable certificate.	Enrolled MOOC from National Platform and completed MOOC with commendable certificate.	Enrolled and completed any one MOOC	Enrolled but not completed any MOOC
6	Used WEBINAR to teach students	Developed own Webinar to teach students	Used available webinar material to teach students	Enrolled for webinar and attended the webinar.	Enrolled but not attended webinar
7	Used Social Media account for Teaching-Learning (T-L) situations	*Used three Social Media Account (Google meet, YouTube Facebook, WhatsApp, Telegram, Twitter, Instagram, Google Plus, etc.)* effectively in T-L situations	*Used two Social Media Account (Google meet,YouTube Facebook, WhatsApp, Telegram, Twitter, Instagram, Google Plus, etc.)* effectively inT-Lsituations	*Used one Social Media Account (Google meet, YouTube Facebook, WhatsApp, Telegram, Twitter, Instagram, Google Plus, etc.)* effectively inT-Lsituations	*Partially Used SocialMedia Account (Google meet, YouTube Facebook, WhatsApp, Telegram, Twitter, Instagram, Google Plus,etc.)* effectively in T-L situations
8	Development of ICT Policy Document for T-L situations	Developed the ICT Policy Documentfor T-L situations	Participated as a *team leader* in Developingthe ICT Policy Document for T-L situations	Participated as a *team member* inDeveloping the ICT Policy Document for T-L situations	Not prepared any ICT Policy Document

Table 2: Evidence to be maintained by faculty members

Sl. No.	Evidence maintained in e-portfolio files by the faculty member	Yes	No
1	Evidence of ICT tools used for Teaching		
2	Evidences of ICT Tools to developed		
3	Evidences of virtual laboratory practical's implemented		
4	Evidences of adopted ICT technologies in the classroom		
5	Evidences of Blended and Flipped Classroom adopted		
6	Evidences of Digital Literacy – Possess ORCID, SCOPUS ID, GOOGLE SCHOLAR, RESEARCH GATE		
7	Evidences of Completed MOOC		
8	Evidences of developed WEBINAR		
9	Evidences of used Social Media account and implementation in classroom		
10	Evidences of Developed Part in preparing ICT Policy Document.		

Conclusion:

After the pandemic, the educational ecosystem is transforming towards better kinds of learning aligned with the needs of the students. To accomplish this, we need to restructure the teaching to more learner-centric ways. To develop a student workforce as per the demand of industry 4.0, our education should be towards education 4.0, which adopts a technology enabled environment. To suit this environment, the faculty members are upskilled in techno-pedagogical skills with proper infrastructure, info structure and info culture. The study was carried out on 58102 faculty members and focused on engineering engineering education using technological tools. Mentors do mentoring for one semester to carry out meaningful change through the training. The training and mentoring provided a new perspective that promotes a systematic way for continual educational development. The impact was measurable when the online training was coupled with the live session with the mandatory requirement from the educational regulators. This created a cultural change in the ecosystem and was demonstrated through the mentor reports.

In view of the above, the present study adds value to the field of technology-enabled educational innovation. It also provides more scope in understanding the new perspectives for further research related to the MOOC and its impact on young and senior faculty members' acquisition of digital teaching skills. The evaluation of the programme's intricacy will benefit educational administrators to scale up such a programme for empowering faculty members in the latest thrust area.

Reference:

1. L. W. Anderson, *A taxonomy for learning, teaching, and assessing: A revision of Bloom's*. Essex: Pearson, 2014.
2. *AICTE Statistics*. [Online]. Available: https://app.powerbi.com/view?r=eyJrIjoiYTE4OWQ3NmEtOGIzNy00MzYzLTliMzYtNmUwMGI4YTg0OWE5IiwidCI6ImVkYjFiNjA2LWJlMzYtNDFlZi04ODRhLTJiMGMxNjY2OGU4NiJ9. [Accessed: 01-May-2023].

3. N. Albelbisi, F. D. Yusop, and U. K. Salleh, “Mapping the factors influencing success of Massive open online courses (MOOC) in higher education,” *EURASIA Journal of Mathematics, Science and Technology Education*, vol. 14, no. 7, 2018.
4. A. A. Al-Imarah and R. Shields, “MOOCs, disruptive innovation and the future of Higher Education: A conceptual analysis,” *Innovations in Education and Teaching International*, vol. 56, no. 3, pp. 258–269, 2018.
5. N. Alhazzani, “MOOC’s impact on higher education,” *Social Sciences & Humanities Open*, vol. 2, no. 1, p. 100030, 2020.
6. C. Amado, N. Dorotea, A. Pedro, and J. Piedade, “MOOCs design: A conceptual framework for continuous teacher training in Portugal,” *Education Sciences*, vol. 12, no. 5, p. 308, 2022.
7. M. Bali and A. Caines, “A call for promoting ownership, equity, and agency in Faculty Development via connected learning,” *International Journal of Educational Technology in Higher Education*, vol. 15, no. 1, 2018.
8. C. E. Brawner, R. M. Felder, R. Allen, and R. Brent, “A survey of faculty teaching practices and involvement in faculty development activities,” *Journal of Engineering Education*, vol. 91, no. 4, pp. 393–396, 2002.
9. J. P. Cerro Martínez, M. Guitert Catasús, and T. Romeu Fontanillas, “Impact of using learning analytics in asynchronous online discussions in Higher Education,” *International Journal of Educational Technology in Higher Education*, vol. 17, no. 1, 2020.
10. X. Chen, D. Zou, H. Xie, and F. L. Wang, “Past, present, and future of Smart Learning: A topic-based bibliometric analysis,” *International Journal of Educational Technology in Higher Education*, vol. 18, no. 1, 2021.
11. N. B. Dinh, C. Zhu, D. A. Nguyet, and Z. Qi, “Uncovering factors predicting the effectiveness of MOOC-based academic leadership training,” *Journal of Computers in Education*, 2022.
12. S. Dhawan, “Online learning: A panacea in the time of covid-19 crisis,” *Journal of Educational Technology Systems*, vol. 49, no. 1, pp. 5–22, 2020.
13. E. W. Ernst, “The Future for Engineering Education: Faculty Rewards and Incentives,” *Proceedings Frontiers in Education 1995 25th Annual Conference. Engineering Education for the 21st Century*.
14. Froyd, D. Fowler, J. Layne, and N. Simpson, “Frameworks for faculty development,” *Proceedings Frontiers in Education 35th Annual Conference*.
15. K. F. Hew, C. Jia, D. E. Gonda, and S. Bai, “Transitioning to the ‘New normal’ of learning in unpredictable times: Pedagogical practices and learning performance in fully online flipped classrooms,” *International Journal of Educational Technology in Higher Education*, vol. 17, no. 1, 2020
16. K. F. Hew and W. S. Cheung, “Students’ and instructors’ use of massive open online courses (moocs): Motivations and challenges,” *Educational Research Review*, vol. 12, pp. 45–58, 2014.
17. J. Gangathulasi and S. N. Panda, “Revitalizing teaching skills through blended mode of Faculty Development Programme,” *2019 IEEE Frontiers in Education Conference (FIE)*, 2019.
18. L. Kaminskienė, S. Järvelä, and E. Lehtinen, “How does technology challenge teacher education?,” *International Journal of Educational Technology in Higher Education*, vol. 19, no. 1, 2022.
19. K. Lu, H. H. Yang, Y. Shi, and X. Wang, “Examining the key influencing factors on college students’ higher-order thinking skills in The smart classroom environment,” *International Journal of Educational Technology in Higher Education*, vol. 18, no. 1, 2021.

20. V. I. Marín, O. Zawacki-Richter, C. H. Aydin, S. Bedenlier, M. Bond, A. Bozkurt, D. Conrad, I. Jung, Y. Kondakci, P. Prinsloo, J. Roberts, G. Veletsianos, J. Xiao, and J. Zhang, "Faculty perceptions, awareness and use of open educational resources for teaching and learning in higher education: A cross-comparative analysis," *Research and Practice in Technology Enhanced Learning*, vol. 17, no. 1, 2022.
21. S. Martínez-Pérez, J. Cabero-Almenara, J. Barroso-Osuna, and A. Palacios-Rodríguez, "T-MOOC for initial teacher training in digital competences: Technology and educational innovation," *Frontiers in Education*, vol. 7, 2022.
22. I. G. Ndukwe and B. K. Daniel, "Teaching analytics, value and tools for teacher Data Literacy: A systematic and tripartite approach," *International Journal of Educational Technology in Higher Education*, vol. 17, no. 1, 2020.
23. Otto, J., & Strimel, G. J. (2022, April), *A Collaborative Model of Teaching and Learning for Undergraduate Innovation Education* in *2022 ASEE Annual Conference & Exposition*, 2022.
24. F. Pajares, "Teachers' beliefs and educational research: Cleaning up a messy construct," *Review of Educational Research*, vol. 62, no. 3, pp. 307–332, 1992.
25. Paskins, Z., and Fink, D. (2015). Age and Interest in Faculty Development Programs Amongst Medical School Faculty Members. Journal of Faculty Development, 29(2), 51-58.
26. P. Peciuliauskiene, G. Tamoliune, and E. Trepule, "Exploring the roles of Information Search and Information Evaluation Literacy and pre-service teachers' ICT self-efficacy in teaching," *International Journal of Educational Technology in Higher Education*, vol. 19, no. 1, 2022.
27. L. W. Perna, A. Ruby, R. F. Boruch, N. Wang, J. Scull, S. Ahmad, and C. Evans, "Moving through moocs," *Educational Researcher*, vol. 43, no. 9, pp. 421–432, 2014.
28. Polmear and D. Simmons, 'A collaborative autoethnography: Examining professional formation and workplace sustainability in discipline-based engineering education research', in *2022 ASEE Annual Conference & Exposition*, 2022.
29. Pradeep Kashinath Waychal and Om Prakash Jain, "A framework for nurturing a symbiotic relationship between faculty development and institution building in the Indian context" in *2018 ASEE Annual Conference & Exposition*, 2018. Paper ID # 21457
30. Prince, "Does active learning work? A review of the research," *Journal of Engineering Education*, vol. 93, no. 3, pp. 223–231, 2004.
31. Rowbotham, M. A. (2015). *The impact of faculty development on teacher self-efficacy, skills and retention* (IERC FFR 2015-1). Edwardsville, IL: Illinois Education Research Council at Southern Illinois University Edwardsville.
32. T. C. Sandanayake, "Promoting open educational resources-based blended learning," *International Journal of Educational Technology in Higher Education*, vol. 16, no. 1, 2019.
33. K. Schulz and N. Schulz, "Faculty development the future of Engineering Education," *2004 Annual Conference Proceedings*.
34. D. A. Sprenger and A. Schwaninger, "Technology acceptance of four Digital Learning Technologies (classroom response system, classroom chat, e-lectures, and mobile virtual reality) after three months' usage," *International Journal of Educational Technology in Higher Education*, vol. 18, no. 1, 2021.
35. B. Yıldırım, "MOOCs in STEM education: Teacher preparation and views," *Technology, Knowledge and Learning*, vol. 27, no. 3, pp. 663–688, 2020.