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# Restoration of Quality in Engineering Colleges through Blended Mode of Teaching and Learning during Pandemic

**H. M. Naveen**
Assistant Professor, Department of Mechanical Engineering, RYM Engineering College, Ballari, Karnataka, India
Email: kasinathnaveen@gmail.com

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## Abstract:

The NEP, 2020 recognizes the challenge of providing technical education to millions of youth during the pandemic. Hence, it recommends for the use of blended modes of learning which is a mix of both online and direct mode. Even UGC proposes a blended mode of teaching and learning in HEIs. An attempt has been made in this article to present a theoretical background of blended mode with an emphasis on various structures and role of teachers and students. Further, the modalities of implementation considering some possible scenarios in BL as proposed by UGC are discussed. The paper has been concluded by describing various pedagogic approaches like online and F2F modes ; project based learning ; and integrating technology in online learning. A blended mode of learning is considered as a best approach, since it responds to all learning requirements and styles. Many international learning organizations have adopted this approach as a major tool and technique for imparting higher education, especially the technical courses like Engineering. Hope the present article gives some insights into classroom practices of blended mode.

Keywords: **Blended Learning, Theoretical Background, Modalities of Implementation, Pedagogic Approaches, Engineering Education, Pandemic**

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## I. INTRODUCTION

The National Education Policy, 2020 recognizes the challenge of providing technical and vocational education and training to millions of Indian youth during pandemic in disciplines related to agriculture, technical and healthcare education. For instance, agriculture education needs to be supplemented with skilled workers in many related areas such as horticulture, fertilizers and pesticides, food processing, fisheries and livestock. Similarly, technical education includes degree and diploma programmes in engineering, technology, management, architecture, town planning, pharmacy, hotel management and catering technology, while healthcare education includes a whole host of allied health staff such as radiologists, laboratory technicians, physiologists, home caregivers for the elderly, and many others that will total up to a projected 80 million jobs worldwide by 2030 according to the WHO. Many of these sectors are very critical to India's wellbeing and overall development. So in order to achieve this large target, the Governments, employers, the Sector Skill Councils (SSCs) and all other stakeholders are working together in order to address these challenges during pandemic. But the role of technical institutions and other academic institutions of higher learning will be very critical in achieving the stated targets during this period.

The evolution of the digital learning platforms and the emerging importance of leveraging technology for teaching–learning at all levels of education, the NEP, 2020 recommends for use of blended models of

learning which is a mix of online and face–to–face mode. The NEP envisages that while promoting digital learning, the importance of face–to–face learning is not ignored. *Blended Learning* (BL) is not just a combination of online and face–to–face mode. But it refers to a well–planned combination of meaningful activities in both the modes. The important features of BL environment are :

- Increased student engagement in learning
- Responsibility for learning
- Enhanced teacher and student interaction
- Improved student learning outcomes
- More flexible teaching and learning environment
- Better opportunities for experiential learning
- More liable for 'self' and continuous learning
- Time management and flexibility

The advantages of BL for students include : increased learning skills, greater access to information, improved learning outcomes and learners' satisfaction, as well as the opportunities for both 'to learn with others' and to 'teach others'.

Keeping in view the present pandemic situation the UGC proposes a blended mode of teaching and learning for HEIs. An attempt has been made in this article to present a theoretical background of the BL from the point of view of Engineering Colleges.

## II. BLENDED LEARNING (BL) : THEORETICAL BACKGROUND

In this backdrop, the UGC concept paper on blended mode of teaching and learning suggests the following structure of BL models :

### (a) Structures of BL Models

Many factors are to be considered while blending in-person and online teaching and learning activities.

- In some cases, most interactions between the students and the teacher takes place in person in the classroom, while the materials are delivered online.
- In other cases, most of the class activities occur online, with rare meetings in person to solve problems.
- In some other arrangements, students may choose which activities to complete online and which to complete in a classroom.

Ideally speaking, 'blends' are highly personalized so that individual student will have the choice that best fits their age, life circumstances and learning needs.

Teachers are the most experienced guides for helping students to manage in any learning situation. It is upto teachers and learning designers to offer blended activities that best suit the subject matter, the learners' needs and the curriculum requirements. Below are some sample configurations of BL activities for teaching and learning. These BL models are drawn from HEIs but can be shaped to fit any technical teaching and learning situation.

*i. Blended Face–to–Face Class*

This blended face–to–face class model is based on the classroom routine practice, however a significant amount of classroom time has been consumed by online activities. Seat time is required for this model, although online activities are used to supplement the in-person classes ; readings, quizzes or other

assessments are done through online at home. This model allows students and faculty to share instrumental time which has high value since much of the class time is used for higher–order learning activities, such as discussions and group projects.

*ii. Blended Online Class*

Sometimes this model is referred to as the 'online driver model' since it is the inverse of the blended face–to–face class. The class is mostly conducted online, but there are some required in–person activities such as lectures or labs.

*iii. Flipped Classroom*

This model classroom reverses the traditional class structure of listening to a lecture in a classroom, and completing assignment activities at home. Students in these classes watch a short lecture video online and enter the classroom to complete the activities, such as, group work, projects or other exercises. This model can be seen as a sub–model of the blended face–to–face or blended online class.

*iv. Rotation Model*

In this model, students in a course rotate between various modalities, one of which is online learning. There are various sub–models : station rotation, lab rotation, and individual rotation. Some of these sub–models are better suited to K–12 education ; station rotation, for example, requires students to rotate between stations in the classroom at an instructor's discretion. Others work well on a college campus ; the lab rotation model, for example, requires students in a course to rotate among locations on campus. In the individual rotation model, a student rotates through learning modalities on a regular schedule.

*v. Self–blended Model*

While many of the BL models discussed are at the course level, self–blending is a programme–level model, and is familiar to many engineering college students. Learners using this model are enrolled in a college, but take online courses in addition to their traditional face–to–face courses. They are not directed by any faculty member regarding the selection of courses either through online or in person.

*vi. Blended MOOC*

It is a form of flipped classroom using in–person class meetings to supplement a massive open online course. Students access MOOC materials–perhaps from another institution or instructor if the course is openly accessible–outside the classroom and then come to class for discussions or in–class activities.

*vii. Flexible–mode Course*

These courses will offer all instruction through multiple modes – in person as well as online, and students will choose their courses. An example of this model is San Francisco State University's hybrid flexible HyFlex) model, which offers both classroom–based and online options for all or most learning activities with the discretion of the students to attend classes : Online or in person.

***(b) Role of Teachers and Students in BL***

BL shifts the teacher's role form *knowledge provider* to *coach* and *mentor*. Traditionally, classroom instruction has largely been teacher–directed, top–down, and one technique of teaching suits all, but with BL, it now becomes more student–driven, bottom–up, and customized, with differentiation as a main feature. This new dynamics of learning is due to the enhanced role technology plays in instruction. BL provides an appropriate balance between *online instructions*, which offers the interactive, tech–based

learning, individualized pacing, and privacy that keep students continuously engaged and motivated whereas, *teacher–led instruction*, which personalizes the learning experience and adds the human element of encouragement, compassion, and caring guidance that only teachers can give.

BL benefits both the students as well as teachers. Giving students freedom to become active learners, to assume control over their learning helps them to become self-reliant. As students are working independently, teachers can provide face–to–face support, individualized instruction and thereby teachers can get a more accurate picture of how each student is doing. BL provides more frequent and more personal interaction with individual students. The trust that emerge with close relationships can give teachers insights into students' personal needs and problems. These insights empower teachers to be comfort and coach students through challenges. BL combines the best aspects of *online learning* with the best aspects of *direct instruction* helping teachers to develop the ability to rapidly analyze, review and give feedback to student work.

The use of eLearning materials increases a student's ability to set up appropriate learning goals and take charge of their own learning through exploration and research. Learners become self-driven and responsible, tracking their individual achievements. BL instills a sense of 'student ownership over learning' which can be a propelling force for learning.

## III. IMPLEMENTATION OF BL

The BL implementation notification of UGC states that the BL mode could be used for all the courses except for SWAYAM courses which are offered only through online modes.

All the universities across the country have implemented credit–based curricula. The weeks for credit hours generally range from 12 to 15. For instance, IIIT considers 12 weeks per credit, IIT considers 13 weeks per credit, whereas, UGC considers 15 weeks per credit. Total credits per Programme change as per UGC Guidelines and approvals to programmes by respective Academic Councils of the Universities. For example, in a particular university, M.Com. programme may be offered for 80 credits, whereas, M.Sc. programme may be offered for 96 credits. Considering a theoretical programme, where 15 hours classroom time is allotted per 1–credit (1–credit hour X 15 weeks). Thus, the total classroom hours are 4 X 15 = 60 per course. Total number of hours are 240 for these 16 credits are being taught in face–to–face mode. UGC is offering a choice of teaching these 240 hours in a Blended Mode, i.e., instead of attending 240 classroom hours, students can opt for certain hours for online interactions and for the remaining hours for F2F mode (face–to–face). Additional student work, such as self–study, revision, assignments, projects, examination preparations, etc.) are for 240 hours which remain unchanged.

A few possible scenarios in BL in Indian Higher Education as proposed by UGC in *it's* concept paper on BL are as follows :

### *i. Scenario – I : BL mode for Master Programme*

In this context, the UGC proposes a sample structure for one semester of a Masters programme offered by a State University is illustrated in the following table 1:

**Table 1 Sample Course Structure**

| Semester II : 5 Courses | Credits | Classroom Hours |
|---|---|---|
| **Courses :** | | |
| 201 Instructional System Design: Theories and Models | 4 | 60 |
| 202 Research Methodology | 4 | 60 |
| 203 eLearning | 4 | 60 |
| 204 OER Development | 4 | 120 (60) * |
| 205 Instructional Strategies for Face–to–Face Learning | 4 | 60 |
| * Practice Course, so double number of hours | | |

Course 204 is an optional course, which can be skipped by the students. Instead, they can opt for 4–credit SWAYAM course. Remaining four courses can be taught by using BL mode.

BL opportunity may be availed by the teachers in the following manners.

*i. Teacher A* (Course 201) is teaching 50% modules in online mode. There are four modules in this course, hence two modules are dealt in online mode.

*ii. Teacher B* (Course 202) is teaching all four modules of Research Methodology in Blended Mode allowing students to access online resources, complete activities in online mode for about 30 hours and be in the classroom for total 30 hours. These 30 classroom hours are being utilized for several activities, trouble–shooting, solving queries on the studied or viewed contents, problem–solving, etc.

*iii. Teacher C* (Course 203) has allowed students to join a MOOC on eLearning. While students are completing this external MOOC, teacher C has also joined this MOOC to keep track of teaching–learning process in the MOOC. Teacher is conducting a few activities, confirming students' regular access to MOOC and completion of assignments, discussing and allotting group activities in the class as well as in online mode. Students are submitting assignments of the teacher C simultaneously in online mode, and attending classes on the campus only for 25% of the total hours, i.e., there are only 15 campus hours for this course.

*iv. Teacher D* (Course 204) is dealing with OER development course. The teacher needs to assign a separate weightage of hours for every module. Last two modules require more lab hours where students themselves are developing the entire OER using the studio of the institute. The previous two modules aim at their own explorations of free tools and they can work more from their home. As per teacher's plan, students spend 80% time in online mode for module 1 and 2 ; whereas 40% time online ; and 60% time in the classroom is spent on module 3 and 4. Average 30% of the total time is spent in the classroom for this course.

However, all A, B, C and D teachers have submitted this proposed weightage to the Institution for information.

### *ii. Scenario – II : BL Mode for Teacher Training*

A national level institute is involved in teacher–training at a massive scale. The approaches used by them are also applicable even in case of thousands of students learning in HEIs or for common course taught across disciplines and/or in all affiliated colleges.

The national level institute offers training in ICT using the following three approaches :

*a. The Induction Course of 'ICT in Education'* Curriculum for teachers followed the flipped curriculum approach where the 18 sessions are conducted in face–to–face mode for 10 days followed up by reading materials online and doing activities like assignment submission, forum discussion and online quiz.

*b. Refresher Course on 'ICT Pedagogy Integration in Teacher–Learning'* followed the blended block model where a few modules are online and a few modules are completed in face–to–face mode. There are 15 modules.

- 8 modules are conducted in face–to–face mode
- 3 modules are completely through online only involving asynchronous communication
- 4 modules are online having live online sessions through video conferencing followed by online submissions.

*c. Refresher Course in 'Research in ICT'* uses maximum online modalities. The total number of hours planned are 120 LMS is being used along with synchronous sessions through virtual class. All resources are accessed through LMS. Synchronous classes are used for solving queries ; conducting expert talks ; online group activities. Participants attended face–to–face workshop only towards the end of the course and spent 30 hours in the Institute (5–day workshop) and finalized research proposals. They also had a hand–on experience of SPSS in the Institute's lab.

The training approaches for teachers discussed in this section will provide a few ideas for implementing BL mode.

## IV. PEDAGOGIC APPROACHES IN BL

Programme of action for implementation of BL requires a systematic, planned instructional process. An effective teaching–learning process in a blended environment calls for understanding as well as skills of using appropriate pedagogies with suitable technologies. In the following paragraphs various pedagogic approaches needed for effective implementation of BL as illustrated in the UGC concept paper are presented below :

### *(a) Pedagogies for Online and Face–to–Face Modes*

BL is a learner–centered approach which will enable the learners to be communicative, confident, creative and cooperative. Learners in this approach are active in cognitive processes generating ideas, assimilating knowledge individually or in a group. Once the learning resources are provided on an online platform, students can engage themselves in activities. Here are a few learning processes for both online as well as face–to–face mode.

*i. Generating Ideas*

Learners in BL can contribute by sharing their knowledge, ideas, views, either in the classroom or on online platforms. Online platforms, such as discussion forms, shared documents, blogs, etc., may be used to help them to share their ideas and knowledge on a common platform. BL mode may provide this opportunity to learners to a great extent. Resources can be uploaded and external links can be posted on

LMS prior to classroom sessions. Once the students study through the resources, classroom time can be fruitfully used for discussion.

*ii. Brainstorming*

This exercise will always help learners to think spontaneously ; drive solutions, ideas ; appreciate other' ideas and enjoy generation of several ideas by the entire group. It develops a sense of responsibility to think and learn themselves.

*iii. Concept–mapping / Mind–mapping*

Creating *'cognitive structure / schema'* of any topic in the mind is the best cognitive exercise for learners. These will help learners to understand the topic from all perspectives and to establish relationships among many concepts on their own. Features, such as inserting images, sticky–notes, sketches in such tools makes the exercise more interesting, and learners get engrossed in the process of meaningful learning.

*iv. Creative Presentations*

Education should develop creative thinking abilities among learners for innovation and growth. Engineering students can present their ideas, the concepts, the models by designing new and novel structures. Model/design creation tools in the respective branch labs helps learners of higher education for presenting their knowledge about the subject. Infographs, short videos, podcasts provide opportunity for the students to give a creative form to their knowledge of any topic. This will develop their expression skills and help them to present their ideas creatively.

*v. Exposure to the Real World*

Students of HEIs are just one step behind the reality of the field of work. Exposure to this real world during the students career itself will help them to get ready for this reality. Field visits to understand the processes, interviews with stakeholders, case studies, small surveys, etc., will help them to understand the functioning of the real world more closely. Instead of explaining the entire functioning verbally, let learners visit the organization, firms, industries, etc., to understand the processes or else let them acquire information through websites, portals, etc.

*vi. Case Study*

Teachers can also use case studies to bring in real world examples to the classroom. Case studies with thought provoking questions or exercises can be shared with them in classroom or else on online mode. Asking students to prepare a case study is one of the best exercises for learners to apply their understanding about the topic.

*vii. Cooperative Learning Strategies (CLS)*

Cooperative learning strategies, such as, Jigsaw, Team–Pair–Share, Tea–Pair–Solo, Fishbowl, Corners, One–stray, PQP, etc., have proven to be more effective in face–to–face modes. These strategies will help in developing a sense of responsibility of learning, interdependence, team–work, logical and analytical thinking. Synchronous and asynchronous online learning environments and other ICT tools will provide facility to discuss, chat work together in online CLS mode.

Teachers can generate many such ideas to engage learners in the classrooms as well as in online mode. Since several eResources are available and even teachers can develop Open Education Resources for their teaching–learning, lecturing can be minimized, and BL mode can be made more meaningful and effective by using such learner–centered pedagogies.

### *(b) Project Based Learning*

Blended Project–Based Leaning tries to club advantages of project based–learning with traditional online lecturing. The students master the conceptual learning through online resources, such as recorded lectures or live classes. In addition, the students will sharpen their practical skills by working on guided projects in a face–to–face mode. The workmanship produced during these projects are a part of the overall learning process, and are directed towards supplementing the conceptual learning of the students.

There are three types of solutions which can assist this type of learning:

*i. Delivering Online Lectures :* MOOC – Management Platforms can be useful in providing the essential knowledge to the students in the form of Online Lectures, Lectures Notes, and Live Tutoring sessions for clarifications. Platforms, such as SWAYAM, NPTEL and MOOKIT can be helpful in the process.

*ii. Managing Collaborative Projects :* Another part of such a learning process is planning, mentoring and evaluation of projects in a collaborative setting. Students can either meet periodically with a guide, or project–based learning platforms, such as Project Pals, Headrush, and Student Corner can be used for a fine–tuned project–based learning experience.

*iii. Student Assessment and Feedback :* Traditional solutions that are often categorized as LMS can be useful in continuous evaluation of students. Google Classroom and Canvas are two common examples of such systems. They can be helpful for a teacher in designing an evaluation–oriented learning experiences. Some solutions, such as Microsoft Flip grid, provide a feedback mechanism for students to share their experiences with the teacher as well as with their peers.

### *(c) Approaches of Integrating Technology*

This part presents the various approaches of integrating technology infrastructure as well as infrastructure requirements as suggested in the UGC concept paper on BL.

*i. Approaches Used in BL are presented in table 2 and table 3.*

**Table 2 Proctored Exam Solutions**

| Sl. No. | Exam Solutions | Website |
|---|---|---|
| 1 | MERCER METTL | www.mercer.com |
| 2 | MERRI TRAC (INDIA) | www.merittrac.com |
| 3 | JUPSOFT (INDIA) | www.jupsoft.com |
| 4 | DIGI PROCTOR | www.digiproctor.com |
| 5 | CAMPUS.TECHNOLOGY | www.campus.technology |
| 6 | MICROSOFT PARTNER SOLUTIONS (WHEE BOX) | www.wheebox.com |
| 7 | CAMPUSLAB (USA) | www.campuslabs.com |
| 8 | CHALK AND WIRE | www.chalkandwire.com |
| 9 | QUESTION MARK | www.questionmark.com |
| 10 | TEST MOZ | www.testmoz.com |
| 11 | CLASS MARKER | www.classmarker.com |
| 12 | M UNI PARIKSHA | www.municampus.com |

**Table 3 Virtual Labs**

| Title | Licensed / Open Source | Link |
|---|---|---|
| MERLOT(USA) | Licensed | https://virtuallabs.merlot.org/ |
| NASA Biolab(USA) | Licensed/Free (For Limited Users) | https://www.nasa.gov/offices/education/centers/kennedy/technology/Virtual_Lab.html |
| Phet Labs(USA) | Licensed | https://phet.colorado.edu/en/accessibilit |
| Shakshat(India) | | https://www.vlab.co.in/ |
| MacMillian Learning Lab Solution(UK) | Licensed | https://www.macmillanlearning.com/college/us/solutions/lab-solutions/labsimulations |
| Siemens(USA) | Licensed | https://new.siemens.com/global/en/products/automation/industrysoftware/automation-software/tiaportal/highlights/virtualcommissioning.html |

*ii. IT Infrastructure Support for BL*

Following is a list of hardware and software infrastructure requirements for BL :

**A. User Computing Devices (the following are the user devices primarily required :**

a. Personal Devices - Mobile Phones / TABs / Laptops / Desktops – are required for supporting end user computing needs
b. Lab Devices – Desktops – are required for Laboratory
c. Audio / Visual Devices – Projector, Smartboard, Conference Solution, Voice Recorder required to support the classroom
d. Graphics Board Tablet with Stylus – are required for do digital illustration work or photo retouching
e. TAB Based remote learning / remote examination
f. Satellite Based TV Channel – Mass Learning
g. Low Cost IOT devices – Raspberry PI – convert TV to a smart TV
h. Remote VPN – faculty / student can access school computers & work from home

**B. Core Network at Data–Centre**

*a. Router* – one router for each Inter link, suggested to take redundant link to optimize load & reduce downtime
*b. Link Load Balancer* – To optimize / balance between dual ILL connection
*c. Firewall* – is required to keep the internal organization safe from external threats
*d. Wireless Controller* – is required to control campus wide all access points
*e. Campus Core Switch* - the primary witches to connect all campus connections.
*f. IP CCTV* – is required to connect each observation location
*g. Storage (SAN for hosting application & NAS for Backup )* – Storage is required for storing servers /data & NAS required to keep the daily backups.

**C. Distribution Network**

a. Distribution Switches / Access Switches – to be placed in each building to support local LAN Connectivity to all required locations
b. Access Points – for Wi-Fi deployment

c. IP CCTV - for physical security

**D. Servers**

*a. On Campus*

- Microsoft Active Directory Server for Authentication
- Library Management Server
- Video Management System (VMS) for CCTV – recording hosting
- LMS – Learning Management Server
- Simulation based Virtual Labs on Cloud (i.e. AWS / Microsoft / Google)

*b. On Cloud*

- Opex Model / Pay As you Go / Anytime Scalability
- Backup Server – for disaster recovery
- Cloud server Parameters
  1. Compute Power – Amount of CPU core required to do the work
  2. Memory – Amount of RAM needed to run the Applications
  3. Savings – Power, Maintenance, ROI

*c. Internet Link*

- Internet Leased Link (ILL) – approx. 1GBPS for 1000 students
- ISDN – Internet on copper connection
- RF link – Internet on Radio Link
- MPLS – Link for multiple campus connect
- Connectivity through different ISPs for redundancy

*d. Studio Setup for Lecture Recording*

- HD Camera
- Lighting
- Backdrop
- Microphone
- Video Editing Software(Adobe Photoshop / 3D studio max / Movie Maker / Coral Draw

*e. Other Essential Software*

- Antivirus
- Microsoft Windows Server
- Network Monitoring Software
- Office tools (e.g. MS Office/Libre Office)
- Remote Support tools
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*f. Other Support Infrastructure*

- UPS
- Biometric
- Generators

An appropriate pedagogy approaches with suitable infrastructure facilities will enable and empower teachers and students to achieve desirable learning outcomes.

## V. CONCLUSION

A blended mode of teaching and learning provides an ultimate flexibility in many aspects. Over and above, this mode can be applied to any program which values both traditional learning and also incorporates digital media in that. This mode of learning and teaching is more effective and appreciable by both teachers and learners. Academicians, policy makers, teachers, students and all others related to classroom practices appreciate the prevailing freedom and flexibility in the practice of blended mode. Although there are many teaching methods and techniques, available resources indicate that blended learning mode is the '*best of all available modes of learning*'. It is the best approach, since it responds to all learning requirements and styles through a variety of mediums and techniques. At present, many international learning platforms have adopted blended learning approach as a major tool and technique in HEIs, especially in Engineering Colleges.

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