Blended Mode of Teaching and Learning: Concept Note

University Grants Commission
New Delhi

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Chapter I

Background

1.1 Introduction

It is an instructional methodology, a teaching and learning approach that combines face-to-face classroom methods with computer mediated activities to deliver instruction. This pedagogical approach means a mixture of face-to-face and online activities and the integration of synchronous and asynchronous learning tools, thus providing an optimal possibility for the arrangement of effective learning processes. Blended learning is the term given to the educational practice of combining digital learning tools with more traditional classroom face to face teaching. In a true blended learning environment, both the student and the teacher should be physically located in the same space. Despite this, the digital tools used should be able to be utilised by the students in order to enforce some control over the speed or topics of their learning. The flipped classroom model is a similar program that aims to utilise technology in order to rearrange the learning experience and maximise the effectiveness of valuable face to face time in the classroom. In a flipped classroom programme, students would be encouraged to access digital learning materials via a cloud-based learning platform during their own time.

Resources such as video lectures, podcasts, recordings and articles would be provided in order to transfer the main bulk of the necessary knowledge from teacher to student *before* each class. This then frees up time in class for teachers to support students in activities, lead discussions and facilitate engagement

1.2 Need for Flexibility to Students / Learners Centricity

The National Education Policy has given a rare glimpse in what can be achieved through the transformation of education. The new NEP clearly states that it is time to take on a policy that is undoubtedly student centric, or what can be safely put down as Education 4.0! The time has indeed come to recognize the fact that the student is the main stakeholder and that efforts must be taken to make the system respond to their dreams and aspirations. In this line of thinking the new policy gives the acceptability of many modes of learning including that of face to face learning, online learning and distance or virtual mode. It also promotes use of vocational courses, multi-disciplinary courses and multi-modal approaches there by focussing on Blended teaching-learning.

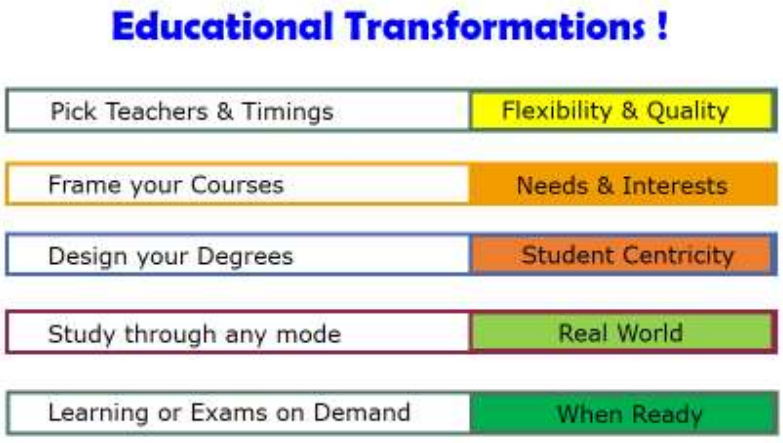
The student centricity means that availability of multiple entry and exit points; promotion of the mother tongue and other languages; focus on the arts and humanities; reforming the examination systems with open book testing and group exams; the ready support for mature learners; and above all the concept of the ABC (Academic Bank of

Credit) that factors in the potential of time, place, mode, speed and language that in many ways is going to be the new approach of education.

In the realm of educational transformation, the Academic Bank of Credit gives sufficient elbow room for many things, especially keeping in mind such areas as flexibility and quality; interests and needs; student centricity; the real worlds of study and taking up examinations when ready. In other words, the student has been given the chance to pick teachers and timings; framing their own courses; designing degrees; studying through any mode and with learning and examinations literally on demand and at will. Fig. 1.1 presents the idea.

Figure 1.1

Educational Transformations



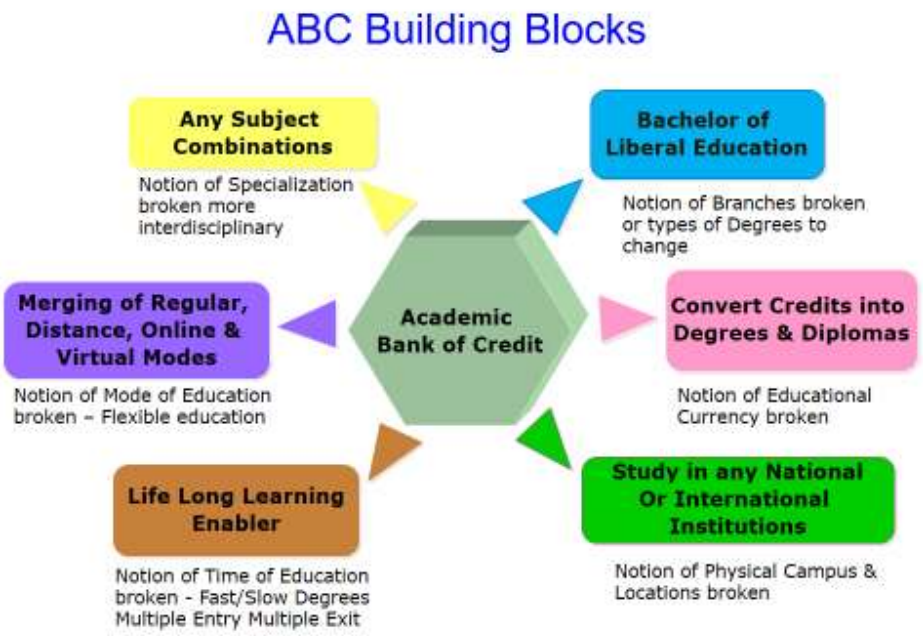
Technology is a critical element in the whole process and the ABC as currently being evolved understands that. The new teaching –learning and educational processes of the NEP 2020 policy will have to be backed by adequate technologies and blended modes of acquiring knowledge.

ABC is a carefully laid out set of building blocks that has flexibility for everybody—for the top level higher learner to go on fast track while the slow learner would require extra time and assistance to meet their academic targets. Keeping this mind the ABC can mainly be understood through six building blocks: 1. any subject combinations that would include specializations that are inter-disciplinary factoring in normal and skill or vocational courses at par; 2. flexible education or the merging of regular, distance, online and virtual modes; 3. the flexibility would be given to students to study in any national or international institutions; 4. converting credits into degrees and diplomas; 5. enabling a lifelong learning process so that the notion of a fixed time for education is done away with option of multiple entry and exit points; 6. the opportunity for the student to indulge in a potpourri or types of course leading to something called a Bachelor of Liberal Education in the event of credits not adding up to a specific discipline.

Undoubtedly there are some key advantages or take-aways of the ABC is in favour of the young mind who can blend education as they like. A student can change specializations or institutions in mid-course; choose own subjects and courses along with degrees and diplomas; courses can be lined up according to strength of institutions and professors; utilize online mode which offers a round the clock facility eliminating the time limitations. Fig. 1.2 presents ABC framework.

Figure 1.2

ABC Building Blocks



A blended learning mode provides ultimate flexibility in many aspects. And most of all, it can be applied to any program which holds on to the values of traditional learning and incorporates digital media with that. It is a lot more effective and likeable than anything that has been ever before. Students, academicians, policy makers etc. appreciate the needed freedom/flexibility. Only a well-crafted blended solution can provide a seamless transition from classroom to computer or vice-versa. Though there are many teaching methods and techniques, available resources indicate that blended learning mode is the "best of all worlds". It is the best because it helps all learning requirements and styles through a variety of mediums and techniques. Recently many learning platforms globally have adopted blended learning and is also one of the most adopted learning tools.

Chapter II

Blended Learning (BL): Theoretical Background

2.1 Introduction

The world is changing constantly and the various domains are also influenced by the change. There is no exemption even in the education domain. The evolution of the digital learning platforms has a huge impact in educational institutions and has eventually put the traditional methods in the back seat. However, there are demands for both technology and traditional learning methods. As a result of this, the art of combining digital learning tools with more traditional classroom face to face teaching gave birth to the term "Blended Learning". This chapter deals about the educational transformations and the prerequisite for Blended Learning.

BL is not a mere mix of online and face-to-face mode, but it refers to a well-planned combination of meaningful activities in both the modes. The blend demands consideration of several factors, mainly focussing on learning outcomes and the learner-centred instructional environment.

Given the emergence of digital technologies and the emerging importance of leveraging technology for teaching-learning at all levels from school to higher education, the NEP 2020 recommends for use of blended models of learning. The NEP-2020 states that while promoting digital learning and education, the importance of face-to-face in-person learning is fully recognized. Accordingly, different effective models of blended learning will be identified for appropriate replication for different subjects.

The important features of Blended Learning (hereafter referred to as BL) environment are:

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

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

Recent research identifies the following key benefits of BL:

- Opportunity for collaboration at a distance: Individual students work together virtually in an intellectual endeavour as a learning practice.
- Increased flexibility: Technology-enabled learning allows for learning anytime and anywhere, letting students learn without the barriers of time and location but with the possible support of in-person engagement. (Any speed, any mode, any language)

- Increased interaction: BL offers a platform to facilitate greater interactivity between students, as well as between students and teachers.
- Enhanced learning: Additional types of learning activities improve engagement and can help students achieve higher and more meaningful levels of learning.
- Learning to be virtual citizens: Learners practice the ability to project themselves socially and academically in an online community of inquiry. Digital learning skills are becoming essential to be a lifelong learner, and blended courses help learners master the skills for using a variety of technologies.
- Making BL Work Technology integration in itself is not necessarily BL.
- BL provides making learning resources and experiences repeatable, reliable and reproducible.

2.2 Role of Teachers in BL Environment

BL shifts the teacher's role from knowledge provider to coach and mentor. This shift does not mean that teachers play a passive or less important role in students' education. Quite the contrary—with BL, teachers can have an even more profound influence and effect on students' learning. Traditionally, classroom instruction has largely been teacher-directed, top-down, and one-size-fits-all, with a bit of differentiation thrown in, but with BL, it now becomes more student-driven, bottom-up, and customized, with differentiation as a main feature. Much of this new learning dynamic 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, and teacher-led instruction, which personalizes the learning experience and adds the human elements of encouragement, compassion, and caring guidance that only teachers can give.

This new learning dynamic benefits students and teachers alike. Giving students permission and space to become active learners who gain knowledge directly lets them assume some control over their learning and helps them develop self-reliance. As more students are working independently, time opens up for teachers to provide face-to-face support and individualized instruction more frequently for more students, effectively improving differentiation. BL provides teachers with a fuller, more accurate picture of how each student is doing. BL yields more frequent and more personal teacher

interaction with individual students, teachers have the opportunity to deepen and strengthen student/teacher relationships. The trust that comes with close relationships can give teachers insights into students' personal struggles and needs -insights which empower teachers to comfort and coach students through challenges that often serve as obstacles to learning. In summary, BL combines the best aspects of online learning with the best aspects of direct instruction, helping teachers easily manage to do much more to meet student needs without adding to an already weighty workload.

2.3 Role of a Learner in the BL Environment

Increase student interest:
When technology is integrated into school lessons, learners are more likely to be interested in, focused on, and excited about the subjects they are studying.

Keep students focused for longer:
The use of computers to look up information & data is a tremendous lifesaver, combined with access to resources such as the internet to conduct research. This engagement and interaction with the resources keeps students focused for longer periods then they would be with books or paper resources, this engagement also helps develop learning through exploration and research.

Provides student autonomy:
The use of eLearning materials increases a student's ability to set appropriate learning goals and take charge of his or her own learning, which develops an ability that will be translatable across all subjects.

Instill a disposition of self-advocacy:
Students become self-driven and responsible, tracking their individual achievements**,** which helps develop the ability to find the resources or get the help they need, self-advocating so they can reach their goals.

Promote student ownership:
BL instills a sense of 'student ownership over learning' which can be a powerful force propelling the learning, It's this feeling of responsibility that helps the feeling of ownership.

Allow instant diagnostic information and student feedback:
The ability to rapidly analyze, review and give feedback to student work, gives the teacher the ability to tailor his teaching methods and feedback for each student while improving time efficiency.

Enables students to learn at their own pace:
Due to the flexibility of BL and the ability to access internet resources allows students to learn at their own pace, meaning a teacher can help speed up the learning process or give more advanced resources if necessary.

Prepares students for the future:
BL offers a multitude of real-world skills, that directly translate into life skills, from:

- Research skills
- Self-learning
- Self-engagement
- Helps to develop a 'self-driving force'
- Better decision making
- Offers a larger sense of responsibility
- Computer literacy

2.4 BL Structures in Education

Many factors must be considered when choosing how to blend in-person and online teaching and learning activities. In some cases, most interactions between students and the teacher, as well as the direct delivery of instruction, take place in person in the classroom, while materials and possibly some additional activities are delivered online. In other cases, most of the class activities occur online, with infrequent meetings in person to solve problems and support community building. In some blended arrangements, students may choose which activities to complete online and which to complete in a classroom. Ideally, blends are personalised so individual students have the blend that best fits their age, life circumstances and learning needs. These are called à la carte models. Students choose what to take fully online, what to take fully in person and, when the design is available, blended courses where they choose when to go to in-person classes and when to watch videos, download readings and complete assignments online. This kind of personalisation is not always available. Most important is ensuring that students are able to function well as learners with any delivery method, single-mode or blended, even if it is not their preference or the best situation for them.

Teachers are valuable coaches for helping students manage in any learning situation; it is up to teachers and learning designers to offer blended activities that best suit the subject, the learners' needs and the curriculum requirements. Not all unique and interesting BL designs are one-size-fits-all model. Below are seven sample configurations of BL activities to consider for BL teaching situation. These examples of BL are drawn from higher education but can be shaped to fit any teaching and learning situation.

- **Blended face-to-face class**

Also sometimes called the "face-to-face driver model," the blended face-to-face class model is based in the classroom, although a significant amount of classroom time has

been replaced by online activities. Seat time is required for this model, while online activities are used to supplement the in-person classes; readings, quizzes or other assessments are done online at home. This model allows students and faculty to share more high-value instructional time because class time is used for higher-order learning activities such as discussions and group projects.

- **Blended online class**

Sometimes referred to as the "online driver model," this class 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.

- **The flipped classroom**

The flipped classroom reverses the traditional class structure of listening to a lecture in class and completing homework activities at home. Students in flipped classes watch a short lecture video online and come into the classroom to complete activities such as group work, projects or other exercises. The flipped classroom model can be seen as a sub-model of the blended face-to-face or blended online class.

- **The 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 (at least one of which is an online learning lab). In the individual rotation model, a student rotates through learning modalities on a customised schedule.

- **The self-blend model**

While many of the BL models on this list are at the course level, self-blending is a programme-level model and is familiar to many college students. Learners using this model are enrolled in a school but take online courses in addition to their traditional face-to-face courses. They are not directed by a faculty member and choose which courses they will take online and which they will take in person.

- **The blended MOOC**

The blended MOOC 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 of class and then come to a class meeting for discussions or in-class activities. In 2012, San Jose State University piloted a blended MOOC using MIT's Circuits and Electronics course, with students taking the MOOC out of class while face-to-face time was used for additional problem solving.

- **Flexible-mode courses**

Flexible-mode courses offer all instruction in multiple modes - in person and online and students choose how to take their course. An example of this is San Francisco State University's hybrid flexible (HyFlex) model, which offers classroom-based and online options for all or most learning activities, allowing students the ability to choose how they will attend classes: online or in person.

Reading resources for BL are provided in Appendix A.

2.5 Scenarios in BL

BL is an effective blend of online and face-to-face mode in teaching-learning. The BL Implementation notification of UGC states the BL mode could be used for all the courses except of SWAYAM courses which are purely in online modes.

The curricula across the country are now credit-based. Weeks for credit hours generally range from 12 to 15. e.g. 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 Academic Councils of the Universities. e.g. In a particular University, M.Com. programme may be offered of 80 credits whereas M.Sc. programme may be of 96 credits. Considering a theoretical programme, where 15 hours classroom time is allotted per 1-credit (1-credit hour * 15 weeks), total classroom hours are 4 * 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 spend upto a certain hours in online interactions and be present in F2F mode (face-to-face) for the remaining hours. Additional student work (self-study, revision, assignments, projects, assessment preparations, etc.) are of 240 hours which remain unchanged.

Let us study a few possible scenarios in BL in Indian Higher Education.

2.5.1 Scenario I: BL Mode for a 80-credit Master programme

A sample structure of one semester of a Masters programme offered by a State University is provided in Table 2.1:

Table 2.1

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
		* Practical course, so double number of hours	

Course 204 is an optional course, which can be skipped by the students and instead any 4-credit SWAYAM course can be completed. Remaining 4 courses can be taught using BL mode.

BL opportunity is being exploited in the following manners by each of the course teachers:

1. Teacher A teaching course 201 is teaching 50% modules in online mode. There are 4 modules in this course, so 2 modules are dealt in online mode.

2. Teacher B teaching course 202 (Research Methodology) is teaching all 4 modules 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 utilised for several activities, trouble-shooting, solving queries on the read or viewed contents, problem-solving, etc.

3. Teacher C teaching course 203 (eLearning) 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 happening in the MOOC. S/he 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 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.

4. Teacher D is dealing with OER development course (204). S/he needed to assign a separate weightage of hours for every module. Last 2 modules require more lab

hours where students themselves are developing the entire OER using the studio of the institute. The previous 2 modules aim at their own explorations of free tools and they can work more from 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 for module 3 and 4. Average 30% of the total time is spent in the classroom for this course.

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

2.5.2 Scenario II: BL Mode for training used by a National Level Institute

A national level institute is involved in teacher-training at a massive scale. The approaches used by them are applicable even in case of thousands of students learning in higher education institutions (HEIs) or for common courses taught across disciplines and/or in all affiliated colleges.

The national level institute offers training in ICT using the following 3 approaches:

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

b. Refresher course on 'ICT Pedagogy Integration in Teaching Learning' followed the blended block model where a few modules were online and a few modules were completed in face-to face mode. There are 15 modules.
   - 8 modules were conducted in face to face mode.
   - 3 modules as completely through online only involving asynchronous communication
   - 4 modules were 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 alongwith 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 finalised research proposals. They also had a hands-on experience of SPSS in the institute's lab.

The scenarios discussed in this section provide a few ideas or implementing BL mode.

Chapter III

ICT Initiatives and Tools

Significant ICT initiatives useful for the higher education teachers of our country while implementing BL are discussed in the following sections.

3.1 OER: NMEICT, NPTEL, ePG, NDL

Open educational resources (OER) are defined by the United Nations as any type of educational materials in the public domain or introduced with an open license. Critical to supporting open knowledge and open access, OER are learning materials supporting legal and free (a) copying, (b) usage, (c) adaptation and (d) sharing.

These resources can be anything from textbooks to syllabi, lecture notes, tests, videos or animations. OER offer the opportunity to provide access, quality GUIDE TO BL and cost-effectiveness in education delivery and have led to significant dialogue around policies for knowledge sharing and capacity building in the social and economic global world.

While OER are not a necessity for successful BL, these two education innovations combine to make a powerful contribution to high-quality, accessible and affordable education. Using well-designed, available OER can free up resources that can then be used to design and deliver BL opportunities.

Creative Commons is a global, collaborative movement for the sharing of free, international, easy-to-use materials. The goal of this international community is to enable greater access and equality; it supports education for everyone. Those who created and now support and use Creative Commons believe in sharing and collaborating on materials such that the full potential of the Web will be realised; most importantly, this will also be true for the individuals who will use it. Creative Commons provides a set of licenses for anyone to use while releasing any teaching or learning resources as OER. The licences also provide a technical solution to tag the resources with a machine-readable language to identify them as OER. This allows potential users to filter their searches by "usage rights" in Google Advanced Search. There are many platforms through which we can find and share OER.

3.2 MOOCs and SWAYAM

MOOCs

MOOC stands for massive open online course (MOOC) which is an online education system providing various courses, which aims at large-scale interactive participation and open access via web. MOOC aims to provide real time education online with the help of

various features like videos, study materials, quizzes and online exams and also tries to make it more efficient than the real time education in class rooms by removing time constraints and location constraints. MOOCs also provide interactive discussion sessions for the user through interactive discussion forums that help to build a community for the students and professors.

SWAYAM

SWAYAM is a programme initiated by Government of India and designed to achieve the three cardinal principles of Education Policy viz., access, equity and quality. The objective of this effort is to take the best teaching learning resources to all, including the most disadvantaged.

3.3 Platforms: Learning and Evaluation: LMS

LMSs are web applications, meaning that they run on a server and are accessed by using a web browser. LMSs give educators tools to create a course web site and provide access control so only enrolled students can view it. LMSs also offer a wide variety of tools that can make your course more effective. They provide an easy way to upload and share materials, hold online discussions and chats, give quizzes and surveys, gather and review assignments, and record grades.

LMS can be installed in cloud & all faculty can upload to share all the particular class related documents, video, MP3 etc.

A few of the most used LMS are listed in Table 3.1.

Table 3.1

Most Used LMS

Title	Licensed/OpenSource	Link
Moodle (Australia)	OpenSource	www.moodle.org
Google Class Rooms (USA)	Licensed/Free (For Limited Users)	http://classroom.google.com
ILIAS (Clogne)	OpenSource	https://www.ilias.de/en/
NEO (India)	OpenSource	https://www.neolms.com/india
ProProfs LMS (USA)	OpenSource	https://www.proprofs.com/c/category/lms/
Eduwave	OpenSource	https://www.capterra.com/p/133877/EduWave/
Eliademy	OpenSource	https:// www.eliademy.com
Zoom Learn	OpenSource	https://zoomlearn.com

Canvas(Australia)	Licensed/Free (For Single Users)	https://www.instructure.com
D2L (Australia, Brazil, Europe)	Licensed	https://www.d2l.com
TVS (India)	Licensed	www.tvslms.com
BlackBoard (USA)	Licensed	https://www.blackboard.com
Totara Learn (New Zealand)	Licensed	https://www.totaralearning.com/
CLANED (Finland)	Licensed	https://claned.com/
Matrix (Europe)	Licensed	https://www.matrixlms.com/india
CALF (USA)	Licensed	https://nuvedalearning.com/calf/
SYNAP	Licensed	https://synap.ac/
Adobe Captivate Prime (USA)	Licensed	https://www.adobe.com
SPOT(France)	Licensed	https://www.spotlms.us

3.4 Other Innovative Initiatives

A few effective technologies are suggested in the following paragraphs.

3.4.1 SimLab+

www.simlab-soft.com : Licensed Tool

SimLab is a process-oriented multidisciplinary simulation environment to accurately analyze the performance of complex assemblies. SimLab is designed as a powerful 3D visualization and communication platform with a rich set of built-in workbenches. As general multi-purpose 3D software Solution it helps users to simplify complex work-flow through simple GUI and easy-to-figure tools.

Sim lab provides AR/VR headset and its supports android/win/ios. SimLab's VR Viewer is a stand-alone application that can view, edit and share interactive VR experiences.

3.4.2 Virtual Lab

www.vlab.co.in : Open Source / Support

Virtual labs provide remote-access to Labs in all major disciplines of Science and Engineering. These Virtual Labs can cater to students at the UG & PG levels as well as to research scholars. Use of these labs can cut down the effective cost by 24x7uses and providing better reliability, repeatability and access.

Allows us to share costly equipment and resources, which are otherwise would be available to limited number of users due to constraints of cost (including the initial cost, maintainability and the ROI)

It helps student to conduct experiments by arousing their curiosity and learning basic and advanced concepts through remote experimentation but with more safety, security.
Can be considered as a part of Learning Management System where the students can avail the various tools for learning, including additional web-resources, video-lectures, animated demonstrations and self-evaluation.

3.4.3 Robotics

https://www.e-yantra.org/ : NMEICT Project
https://www.sc.iitb.ac.in/robotics/index.html

Robotics is a branch of engineering and science that includes electronics engineering, mechanical engineering and computer science and so on. This branch deals with the design, construction, and use to control **robots**, sensory feedback and information processing.

The use of robots is rapidly growing and becoming more common across workplaces, homes, and educational institutions. Institutions have also started using teaching robots, to impart knowledge to their students. These robots can help in delivering lessons in Science, Technology, Engineering, and Mathematics concepts that are essential in the educational curriculum.

The use of robotics in learning is ideal for interaction in classrooms as it can improve and encourages collaboration among students. Playing (and learning) with robots also offer additional benefits for students with disabilities. Students can undertake challenging tasks by designing, creating and programming their own robots.

3.4.4 FOSSEE

www.fossee.in : Open Source
FOSSEE (Free/Libre and Open Source Software for Education) project promotes the use of educational tools in academia and research. The FOSSEE project is part of the National Mission on Education through Information and Communication Technology (NMEICT), Ministry of Education, Government of India. Below is the list of some of the projects which are promoted by FOSSEE.

E-sim: eSim is an open source EDA tool for circuit design, simulation, analysis and PCB design.
Osadag: Osdag is a cross-platform open-source software for the design of steel structures, using the Indian Standard.

DWSIM: DWSIM allows chemical engineering students and practicing engineers to model process plants by using rigorous thermodynamic and unit operations models.
PLC: Provides training and skilling for PLCs.
SBHS: The single board heater system (SBHS) is a lab-in-a-box setup useful for teaching and learning control systems.
R: R is a language and environment for statistical computing and graphics.
QGIS: QGIS (Quantum GIS) is a desktop Geographic Information System (GIS) application.
PYTHON: Easy to read and learn, useful for scientific computing.

3.5 ICT Tools for Collaboration and User-generated content

It is evident that learner-centred learning has always helped the learners achieve curriculum outcomes and more than that adds to their skills to function effectively as the 21st Century learners. Collaboration, and not competition at individual level, needs to be encouraged for a teacher's contribution towards a productive society. Studies also emphasize that active participation of learners in the co-creation of knowledge leads to the increased level of learner satisfaction and motivation. At one hand, cooperative learning strategies, group-work, group-projects in the classroom environments help teachers in creation of the conducive learning environments, whereas collaborative ICT tools prove a great aid to the teacher in co-creation of knowledge by learners.

BL may not turn into teacher-centred classroom scenarios in face-to-face and online mode. On the contrary, the learners can be engaged in creative and productive activities through several ICT tools.

Collaborative contribution of learners may be planned by teachers through free ICT tools. Some of the indicative ICT tools are listed below as some examples, though teachers are expected to explore many other tools achieving learner collaboration:

3.5.1 Blogging

A blog can be created by the teacher, and then students can be added as contributors to the blog. A problem, theme, issue may be provided with a few resources and learners' views, ideas, opinions, examples, scenarios, etc. can be invited as contribution to the blog. Blogging can be given as an asynchronous activity and the teacher can be facilitator to guide them throughout the posting process.

3.5.2 Stickynotes

Stickynote tools such as IdeaFlip, Lino.it, Jamboard, etc. can be used for online brainstorming. Brainstorming activity can be done as a synchronous activity in live online

class or else an assignment of such idea generation can be given as asynchronous activity.

3.5.3 Shared documents

Students can be told to come out with a product after working in small groups of 2 to 5 students. Tools such as Google Doc, Google slides, etherpad, ScatterSpoke, ideaboardz, etc. can be introduced to them. Most of these tools are free and students get chance of being online at their own convenience and internet availability.

3.5.4 Concept-mapping, Mindmapping, infograph tools

Collaborative Concept-mapping and Mindmapping ICT tools such as Miro, Google Drawing, Conceptboard, Coggle, Bubble.us, etc. help learners come together online, discuss and establish relationships of concepts related to a topic/theme. Online tools avail features of adding videos, images, sketches, links to other files, hyperlinks, etc.

3.5.5 Comprehensive activity tools

Comprehensive activity platforms such as Padlet, Miro, Whimsical, etc. may prove effective virtual workspaces. Features such as wireframe will enable learners to develop project management, team-work abilities needed in 21st Century learners.

Many more ICT tools and platforms can be explored, experimented by teachers and students. Use of Free and Open Source tools may be encouraged. Mobile Apps of many tools will be useful for easy access and availability to students. Computer labs on the campus may be made available for needy students to perform online activities. The next chapter describes different ways of using these tools.

Chapter IV

Implementation of BL

4.1 Introduction

Implementing BL requires a systematic, planned instructional process. An effective teaching learning process in a blended environment calls for understanding and skills of using appropriate pedagogies with suitable technologies. The following paragraphs provide guidelines for implementation of BL.

4.2 Pedagogies for Online and Face-to-face Modes

Learner-centred teaching-learning activities include several cognitive processes which enable learners to be communicative, confident, creative and cooperative. Learners in BL environments are not visualised as passive learners, but active learners generating ideas, assimilating knowledge individually and in teams. Once learning resources are provided on an online platform, students sitting in the classroom need not again listen to the instructor. The time, then, can be used for engaging them in activities. Even their online time can be used innovatively for making online sessions more effective and interesting. Here are a few learning processes for both online and face-to-face mode.

4.2.1 Generating ideas

Higher education learners are adult learners who come with their own world of experience, previous knowledge gained at schooling level and previous years of education, exposure to other sources of knowledge, etc. Even pre-session resources suggested by teachers help them some knowledge, information. Lecturing of teacher assuming the learners are empty boxes is no more a preferred pedagogy. Learners, instead, can contribute by sharing their knowledge, ideas, views, either in the classroom or else on online platforms.

BL mode may provide this opportunity to learners to a great extent. Resources can be uploaded and external links can be posted on Learning Management systems prior to classroom sessions. These Out-of-class resources prove useful at least for acquiring information. Once the students study through the resources, classroom time can be utilized fruitfully in discussions.

Online platforms such as discussion forums, shared documents, blogs, etc. may be used to help them share their ideas and knowledge on a common platform.

4.2.2 Brainstorming

Brainstorming exercise always helps learners to think spontaneously; derive solutions, ideas; appreciate others' ideas and enjoy generation of several ideas by the whole group instead of listening to only teachers' ideas and views. It develops a sense of responsibility to think and learn ourselves. Brainstorming

4.2.3 Concept-mapping/Mind-mapping

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

4.2.4 Creative Presentations

Education, at any level, and of any subject, should develop creative thinking abilities of the learners. Microbiology or Sociology learners can present their concepts through creating cartoon-strips. Story-creation tools are helping learners of higher education for presenting their knowledge of a subject instead of merely making presentations in the class. Infographs, short videos, podcasts provide them opportunity to give a creative form to their knowledge of any topic. This will develop their expression skill and help them present their ideas creatively even after in the field of work after education.

4.2.5 Exposure to the real world

Higher education students are just a few steps behind the field of work, i.e. the real world. Exposure to this real world while studying in colleges/universities will help them get ready for this real world. Field visits to understand the processes, interviews of stakeholders, case studies, small surveys, etc. will help them interact with the real world closely. Instead of explaining every process, let learners visit the organisation to understand the processes or else acquire information from websites, portals. e.g. Elaborating rules and regulations of any organisation in the classroom by yourselves, let the learners visit the organisation physically or else study the rules and regulations from the website of the organisation.

4.2.6 Case Study

Though learners cannot be exposed to every real world scenario, teachers can use case studies to bring such real world examples to the classroom. Case studies with though provoking questions, exercises can be shared with them in classroom or else in online mode. Giving exercise of preparing case studies is one of the best exercises for learners to apply their understanding of the topic. e.g. Assignment of writing case studies of one

type of Experimental Design or Sampling Techniques help teachers understand how well the learners have understood these Research Methodology topics.

Teachers are expected to 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 Educational Resources for their teaching-learning, lecturing can be minimised and BL mode can be made truly meaningful and effective by using such learner-centred pedagogies.

4.2.7 Cooperative Learning Strategies (CLS)

Cooperative Learning Strategies such as Jigsaw, Team-Pair-Share, Team-Pair-Solo, Fishbowl, Corners, One-stray, PQP, etc. (there are many more, which can be explored by teachers) have proven effective in face-to-face modes. These strategies help in developing sense of responsibility of learning, interdependence, team-work, logical and analytical thinking and teacher can ensure participation of all learners in the meaningful learning process. Synchronous and asynchronous online learning environments and some of the ICT tools for collaboration providing facility to discuss, chat, work together can be exploited to use CLS in online mode.

4.3 Project Based Learning and Project Management Platforms

Blended Project-Based Learning tries to wed advantages of project based-learning with traditional online lecturing. The students attain the conceptual learning through online resources such as recorded lectures or live classes. In addition, the students hone their practical skills by working on guided projects in a face- to-face setting. The artefacts 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 aid this type of learning:

Platforms for 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.

Platforms for managing collaborative projects:
Another part of such a learning process is creation, 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.

Platforms for student assessment and feedback:
Traditional solutions that are often categorised as Learning Management System 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 experience. Some solutions, such as Microsoft Flipgrid, provide a feedback mechanism to students to share their experiences with the teacher as well as their peers.

An apt Curriculum is at the heart of designing any blended-learning program [2]. Thus, it is essential is to come up with a curriculum that can support such pedagogical approaches. Traditional curriculum, which expects students to learn in a classroom environment may not align well with this learning paradigm. Some researchers have come up with guidelines to design the curriculum for such setting [3] [1] [4], however, detailed instructions may have to be formulated separately for different areas of educations.

4.4 Technology Infrastructure for Implementation

The section discusses the approaches of integrating technology infrastructure and infrastructure requirements.

4.4.1 Approaches likely to be used in BL are as follows:

Face-to-face Video Lectures – Shared to the students for the entire course (Pen Drive / CD) - e-textbook experience but not dependent on broadband

Internet Based Learning (IBL) – Internet based projects (search & learn) to promote self-learning

Project Based Learning – integrating multiple peer group for the project, students to collaboratively generate ideas

TAB based remote learning / remote examination & evaluation / touch screens and digital pens appeal to tactile learners / portable learning

Satellite based TV Channel – mass learning / adult education / farmer education (different timings)

*Online Assessments – Quiz, Assignments, Test, Examinations – at regular intervals to measure learning outcome. Table 4.1 presents a few examples of proctored examination solutions.

Table 4.1

Proctored Examination solutions

MERCER METTL	www.mercer.com
MERRI TRAC (INDIA)	www.merittrac.com
JUPSOFT (INDIA)	www.jupsoft.com
DIGI PROCTOR	www.digiproctor.com
CAMPUS.TECHNOLOGY	www.campus.technology
MICROSOFT PARTNER SOLUTIONS (WHEE BOX)	www.wheebox.com
CAMPUSLAB (USA)	www.campuslabs.com
CHALK AND WIRE	www.chalkandwire.com
QUESTION MARK	www.questionmark.com
TEST MOZ	www.testmoz.com
CLASS MARKER	www.classmarker.com
M UNI PARIKSHA	www.municampus.com

A few more examples of technology based evaluation techniques can be:
Online Peer Interaction through webinar / Conference, Online Internships, Virtual Labs (Simulation based)for subjects with laboratory experiments, etc. A few examples of Virtual labs can be referred from the Table 4.2

Table 4.2

Virtual Labs

Title	**Licensed/OpenSource**	**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/lab-simulations
Siemens(USA)	Licensed	https://new.siemens.com/global/en/products/automation/industry-software/automation-software/tia-portal/highlights/virtual-commissioning.html

Virtual Lab on AWS / Microsoft Azure / Google Cloud for cloud based IT services experiments – enabling Students remotely working on assignments on virtual desktops.
Feedback system – Online / SMS Based / Call centre

Low cost computer - Raspberry PI – low cost IOT based computer can be connected to TV for usage as computer

Remote VPN – for Faculty accessing school computers to work from home

Educational Resource Planning / University Resource Planning with integration of various resources

4.4.2 Support IT Infrastructure (Typical Hardware and Software Requirements) for BL

Following is a list of infrastructure requirements essential for BL

A. User Computing Devices – 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 to be placed 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 for each building

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 – Servers can be taken on campus or on cloud

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

d. Studio Setup for Lecture Recording
    a. HD Camera
    b. Lighting
    c. Backdrop
    d. Microphone
    e. Video Editing Software(Adobe Photoshop / 3D studio max / Movie Maker / Coral Draw

e. Other Essential Software
    a. Antivirus
    b. Microsoft Windows Server
    c. Network Monitoring Software
    d. Office tools (e.g. MS Office/Libre Office)

e. Remote Support tools

f. Other Support Infrastructure
   a. UPS
   b. Biometric
   c. Generators

An appropriate pedagogy approaches with suitable infrastructure facilities will enable and empower teachers and students to achieve desirable learning outcomes. The next chapter discusses need of appropriate assessment and evaluation strategies for ensuring achievement of learning outcomes.

Chapter V

Assessment and Evaluation

UGC suggests implementing BL as a new mode of teaching-learning in higher education and hence the area of assessment and evaluation needs to be explored again in the light of BL mode.

5.1 Continuous Comprehensive Evaluation

Continuous Comprehensive Evaluation should be encouraged in universities and colleges. Focus of new national education policy is learner centred education systems. Summative evaluation will not suffice the need of testing all levels of learning outcomes. Modular curriculum demands assessment at several intervals during and after achievement of learning outcomes specified for every module. Cognitive skills such as logical thinking application of knowledge and skills, analysis and synthesis of concepts and rules demands evaluation strategies other than summative paper pencil tests. Innovative evaluation strategies are to be used by teachers during the semester. Increased weightage of internal evaluation should be encouraged by including innovative assessment and evaluation strategies.

5.2 Innovative trends in Evaluation and Assessment

Out-of-box thinking about summative as well as formative evaluation is expected from the teacher implementing BL mode. The following paragraphs throw light on a few innovative strategies. The list is not exhaustive but mentions a few points with the expectation of continuous exploration of such strategies by the teachers.

5.2.1 Summative Evaluation Strategies

Open book examination:

It is a right way to move away from the conventional approach of examination where remembering and reproducing is prime. In real functioning beyond formal education, life is all about open book examination. Hence in Higher Education system, we must prepare students for work life by making them acquainted with open book examinations. It will also facilitate better understanding and application of the knowledge with a better potential for its positive impact.

Group examinations even for conventional theory papers:

Such an approach is followed some time for project and also laboratory assessments. But for theory type examinations it is generally not followed. The group examinations once introduced for theory papers can improve the average performance of a class as

students would be encouraged to share their knowledge with each other and also help them improve their general understanding.

Spoken / Speaking examinations:
These types different approached can be introduced now with the support of new generation of technologies. They can make examination faster and easier and also can be helpful to students with different abilities

On demand examinations:
In most cases students are forced to write examination in a single go and collectively. However, with advent of new methods which are technology based and also blending of teaching-learning and examinations in new form, it would be a good approach to offer examination on demand to offer more flexibility and student centricity.

5.2.2 Formative Evaluation Strategies

ePortfolio
ePortfolio is not only a compilation of a few best assignments, activities of a learner throughout the programme, but his/her reflections about the assignments, experience and challenges faced during the process of working on these assignments, overall approach, attitude, philosophy towards life as a learner and also his/her academic resume. ePortfolio is a comprehensive tool which becomes a mirror to ta learner for the world.

Creative Products
Innovative Pedagogies and relevant ICT tools enable learners to come out with creative products as an individual or group learning activities. These products are learning experiences in the beginning, but learners should always be given corrective feedback about their outputs. Once feedback is sought, learners need to be given chance to improve on their products and then can be considered for formative evaluation. e.g. preliminary concept-map can be revised after discussion of the topic, summarization and feedback. Revised concept-map can be assessed.

One creative/collaborative activity may then be led towards the another product which can be an assessment activity. e.g. Group or individual presentations by self-learning would be a learning activity and not an assessment activity. (Many teachers make mistake of giving marks to the first presentations made by learners after self-study). Once teacher provided corrective feedback during such presentations, learners can be expected to revise the same presentations, add a small write-up/infograph/video to it and submit as an assignment.

Creative assignments such as digital stories, Cartoon strips, drama scripts, eNewsletter, eMagazine, Recorded interviews of stakeholders, Case studies, etc. can be used for formative assessment.

Classroom/Online Quizzes

Though paper-pencil tests, over-use of question-answers may be discouraged for formative assessments, a few ICT tools for quizzes and games can be used eventually for formative assessment.

Use of AI tools for Proctoring as well as assessments:

During the Covid time, many exams were forced to be conducted in an online mode. These were supported by variety of tools which came into being in recent times and were based on proctoring through Artificial Intelligence tools. However, AI as technology can be used for many more assessments like, attention levels, speed of learning, level of learning etc. Hence new tools should be experimented with for examinations and assessments.

Chapter VI

Suggestive Framework for BL Pedagogy

6.1 Background

'BL' is a meaningful blend of Online and On-campus (Face-to-face) learning environments. UGC encourages higher education teachers in India to create such BL environments for at least some or else for all courses being taught in the HEIs. Though such BL environments help Indian higher education teachers and institutes in the development of the twenty first century learners, it will demand rigorous planning and effectors n the part of institutes and teachers.

Theoretical background as well as implementation related guidelines are discussed in detail in the previous chapters. Online and On-campus environments are elaborated in these chapters.

This chapter discusses broad framework for BL environments in Indian HEIs. The chapter proposes the framework keeping in mind minimum expectations from non-technology subjects with the expectation to achieve high-end technology infrastructure and resources for Science and Technology programme implementations.

6.2 BL Learning Environments

Online mode of learning refers to several synchronous and asynchronous learning activities such as:

- accessing eResources, mainly in the form of Open Educational Resources (consisting formats such as text, graphics, animations, simulations, gaming, interactive multimedia, etc.) uploaded on LMS by the instructor
- accessing links, eResources, digital libraries suggested by the instructor as well as explored individually or in groups.
- studying MOOCs/ SMOCs, etc. by the learner as per guidelines by the instructor (e.g. Instructor may connect students to a successful ongoing MOOC but plan several on-campus activities alongwith it.)
- attending online virtual sessions of the instructor
- performing individual or group activities using any ICT tool or platform
- participating in the workshops/webinars as per suggested by the instructor related to the curriculum
- completing assignments and uploading on LMS / submitting to the instructor using other ICT platforms
- attempting tests/quizzes
- engaging into virtual labs, simulations, museums, etc.

- engaging in webinars, e-conferences, online short term training programmes, etc.
- engaging in online internships/ projects, etc.
- engaging in any activity directly related to the course curriculum for which learner is not needed to visit the classroom physically but needs to use digital devices and internet connectivity

Face-to-face (F2F) Mode refers to several activities to be performed by meeting in the classroom such as:

- attending instructor's short duration lecturettes for introducing or summarizing topics, understanding complex concepts
- resolving queries based on self-learning or group-learning
- participating ingroup activities in the classroom with peers, mainly for analyzing and applying information sought through eResources,
- collaborating and co-creating new knowledge
- borrowing and accessing books and periodicals from the library,
- field visits, sports, etc.
- face-to-face training, physical training, apprenticeships, internships, etc.
- physical labs, hackathons, working in maker spaces, etc.
- appearing for periodical assessments, summative tests on-campus, etc.

- Any instructional activity for which students and teachers physically meet on the campus or else out of campus in the same geographical environments in the light of learning outcomes.

6.3 IPSIT: Indian Framework for BL

BL has been implemented across the world successfully. Several models are so far proposed and researched for BL implementation.

We propose IPSIT Model for the higher education institutes in India. We propose that every higher education teacher planning to offer his/her course in BL Mode should necessarily follow all phases of the IPSIT Model.

IPSIT Stands for:

Identify Resources and Learner-centred Activities
Provide resources and announce activities on LMS
Scaffolding and Support to learners
Identification of learning gaps and feedback
Testing

6.3.1 Identify Resources and Learner-centred Activities

BL is an appropriate blend of online and face-to-face teaching-learning environments. Planning is the inevitable for such an appropriate and meaningful blend of the environments. It should be ensured that required infrastructure for online systems such as accessibility of internet, bandwidth, hardware, space and other related resources be made easily available for the smooth execution of blended teaching-learning process. What is to be done in online mode and inside classrooms or labs need to be planned in advance. Learners need to be provided appropriate learning resources. BL should necessarily be active learning environments and not one-way lecturing by teachers. Teachers planning to implement BL, therefore, will first identify resources and plan activities for online and on-campus environments. Chapters 3 and 4 discuss about resources and activities in detail. Learner collaboration and co-creation of knowledge should be attended carefully while planning learning environments. A suggestive generic template for planning BL learning environments of a course is presented in Appendix B.

6.3.2 Provide resources and announce activities on LMS

Implementation of such a rigorous plan requires a concrete digital environment.
LMS, therefore, becomes an essential component of BL. Making LMS ready with all necessary eResources will be needed. Teachers can announce various online activities on LMS which can be further supported by other ICT tools. Chapter 2 discusses various ICT tools and platforms apart from suggestive LMS. Syllabus, Learning Outcomes, reading/viewing resources, announcements and instructions for individual as well as group activities, etc. will be uploaded on LMS in advance.

6.3.3 Scaffolding and Support to learners

Higher education teacher will shift his/her role from 'teach' to 'facilitator' once decides to implement BL. Though the learner is accessing resources and getting engaged in activities, continuous scaffolding will be required. Even classroom environments will not remain teacher-centred. Classroom discussions will revolve around resolving queries; analysis and application of knowledge sought and creative outputs under the supervision and guidance of the teacher.

There must be a support mechanism for digital literacy for students and facilitators. Training should be provided to teachers as well as students to make the best use of various online platforms and ICT tools used for BL.

6.3.4 Identification of learning gaps and feedback

Awareness of the progress of every learner on the individual learning path is essential for any effective learning. Learners should be made aware about their achievements at the appropriate stages before the official completion of the course. Quizzes, presentations,

formative assessments, assignments and projects help to identify if learner/s have gaps in the learning. Corrective Feedback on their work will enable learners to achieve learning outcomes successfully.

6.3.5 Testing: assessment and evaluation

Testing for summative assessment ensures achievement of learning outcomes. Considering the innovative approaches higher education teachers are expected to adopt, nature of summative assessment will also change to a great extent. 'Recall' level test items will not suffice the need of true assessment. Chapter 5 discusses the assessment and evaluation strategies. Testing of all levels of learning outcomes and skills need to be planned and executed.

Though pedagogy of BL environments is discussed in the Chapter 4 in detail, considering diversity in the nature of institutional infrastructures, disciplines and pedagogy practices, The essential framework components of IPSIT are proposed.

6.4 Essential Technology and Resources for IPSIT

A framework for BL should take both the teaching perspective and learning perspective into consideration. Infrastructure related considerations for the IPSIT are provided below:

6.4.1 Infrastructure:

Availability of infrastructure is fundamental to teaching and learning. It must be ensured that required infrastructure for online systems such as accessibility of internet, bandwidth, hardware, space and other related resources be made easily available for the smooth execution of blended teaching-learning process. The financial aid required to develop the infrastructure and resources must also be taken care of. The minimum or suggestive requirements for a University/ College/ Institution are indicated in table 6.1.

Table 6.1

Infrastructure

Aspects	Minimum Standards	Desirable Standards
1. LMS	LMS at least on a shared server for maximum 500 students and on dedicated server for maximum 1000 students	Cloud-based LMS with institutional domain name is recommended
2. ERP	Automation of student life cycle should be initiated	Fully Integrated (Admission to Placement) ERP should be in place. LMS should also be integrated in the ERP.
3. Bandwidth	1 Gbps	5 – 10 Gbps
4. WiFi& Campus Intranet	Wifi should be available for classes involved in BL. Necessary firewalls should be in place not restricting student access to ICT tools and Social media being used by teachers.	The entire campus should be fully Connected. All teachers and students alongwith the admin staff should be able to use Wifi. Necessary firewalls should be in place not restricting student access to ICT tools and Social media being used by teachers.
5. Electronic Devices (Computer)	Devices (desktops/laptops) in the ratio of 1:2 for technology/professional programmes and 1:4 for non-technology programmes under BL Low-cost access devices and N-computing solutions may be used for institutes with financial challenges	Fully Functional, Networked & Internet enabled Computer Labs with 1:1 ratio Integration of personalised devices should be provided. Classrooms/ labs equipped with desktops/laptops/tablets are recommended for BL environments where integration of ICT can be possible during classroom sessions

6. Data Centre Services	Shared / Dedicated Secured Server with adequate Storage Space	Dedicate, Secured Cloud based Data Centre to support BL and storage of ePortfolios
7. Smart Class Room	One shared infrastructure per 1000 students to start with is recommended. All BL classes should have at least a projection facilitywith internet connectivity. Virtual classroom software with recording facility is a must for teachers involved in BL	Every Class room Connected with the Smart class
8. Studio Facility	One Studio with Pre & Post Production facilities for Cluster of minimum 10 neighbourhood HEIs on time & resource sharing basis Video and screencast content development software with such as Camtasia, OBS and training to use the same is a must for teachers involved in BL	Each HEI should have a studio with Pre & Post Production facilities for Development & launching of professional courses
9. Software Support i) Plagiarism Check Software ii) Domain Specific Software for CAD, CAL etc.	At least one set Anti-Plagiarism Check Software [e.g. Urkund, Turn-it-in] domain-specific software for specific subjects (ARC, SPSS, CAD etc.) are essential for launching BL in that subject. FOSS are recommended in all possible cases.	Institutes should be equipped with all necessary FOSS or a few Licensed versions (if FOSS is not adequate) related to the subjects being taught in that institute.

*Infrastructural requirements will vary as per the the size and nature of the institutes as well as the nature of subjects and learning outcomes

Updated versions of hardware and software should be maintained.

6.4.2 Resources:

The pedagogy in BL must revolve around the availability of resources, especially online resources. These resources should be organized according to the courses. In case of unavailability of online resources, new content should be created keeping in mind the needs of the students. Co-creation of contents by students will support student learning. The minimum or suggestive requirements for a University / College / Institution are indicated in table 6.2

Table 6.2

Resources

Aspects	Minimum Standards	Desirable Standards
1. MOOCs/SMOCs	Teachers can explore and suggest students to subscribe [preferably Free] to various MOOCs. (e.g. SWAYAM/Coursera/UDEMI) These MOOCs or SMOCs are to be used only as resources and not be replacing teaching-learning activities to 100%. Teacher scaffolding and face-to-face sessions are mandatory components alongwith MOOCs/SMOCs for BL.	Institutional MOOCs and SMOCs are recommended in the long run.
2. Virtual Lab	At least one per subject in the area of Science and Technology. Relevant virtual labs for Social Sciences could be explored.	More to be added as per requirement
3. Distance / Online		Distance / Online courses as per UGC approvals can be offered by the institute. Collaboration with such course implementations would help in BL implementation of face-to-face formal programmes.

4. Training of Teachers/ Trainers / Educators	Teacher planning to use BL mode should have acquired himself/herself or provided training to others for at least 45-50 hour in BL / Online Teaching within the last 3 years The training from FDP/STTP/FIP scheme, ATAL, TLCs, HRDCs, NITTR, etc. is recommended.	Engagement of the teachers and institutional leaders in National and International level training programmes in the areas of BL/ ICT enabled teaching-learning/ Online learning, etc.

6.5 Essential Pedagogy for IPSIT

The essential framework components related to teaching-learning activities for the implementation of IPSIT are proposed.

6.5.1 Teaching-Learning in BL

BL implementation requires stage-wise plan of execution with innovative teaching-learning activities. Guidelines for such teaching-learning processes are provided in Table 6.3.

Table 6.3

Essential Pedagogy Requirements for IPSIT

Aspects	Minimum Standards	Desirable Standards
1. Planning Online-Face-to-face Ratio of any course/syllabus of one semester	Minimum 30% face-to-face Minimum 30% online learning should be planned.	Maximum 70% online mode for a programme per semester (Less than 30% total face-to-face be disallowed for a programme)
2. Approval to offer BL	Approval of Academic Council or equivalent committee Approval to one single course or a single teacher should also be encouraged. Number of courses or teachers is not important for the initiative.	All programmes of a particular institutes can be granted the approval by if minimum infrastructure conditions are fulfilled and teachers are competent to offer BL mode.

3. Nature of Online Mode	Combination of synchronous-asynchronous ratio will help learners study, collaborate and seek guidance from the instructor Considering hours allotted to online mode of BL, minimum 30% weightage for both ssynchronous and asynchronous mode should be given in online learning.	Considering hours allotted to online mode of BL, maximum 70% weightage for both ssynchronous and asynchronous mode should be given in online learning.
4. Synchronous Online Mode	Minimum 30% of the total synchronous time should be utilized in learner-centred synchronous activities. Synchronous sessions should be utilized for trouble-shooting, guidance, query-solving, demonstrations, synchronous collaborative activities of learners. Learner presentations, etc. rather than only lecturing during all synchronous classes. Lecturing may be replaced by pre-recorded videos.	Instructor's lecture 'talk' through virtual class should not exceed beyond 50% of the total synchronous time.

5. Asynchronous Online Mode	At least 30% of the total asynchronous time should be utilized in learner-centred activities. Learning from various eResources and engagement in collaborative-cooperative activities are to be planned for engaging learners asynchronously. Asynchronous work is as important as online synchronous classes and instructors need to be planned for such activities. Activity time is to be considered as teaching-learning time.	Passive accessing eResources should not consume more than 50% of the total asynchronous time.
6. Face-to-face time	At least 30% of the total face-to-face (classroom) time should be utilized for learner-centred activities rather than lecture method. Cooperative and collaborative activities need to be planned. The percentage of learner-centred activities could be increased gradually with proper planning.	Not more than 40% of the total classroom time for instructor's lecture is recommended. Since resources are to be uploaded on LMS, classroom time need to be used for learner-centred activities.
7. Use of LMS	Resources for the topics to be dealt in online as well as on-campus mode should be uploaded on LMS. Instructions for online activities can be posted on LMS. Online as well as face-to-face activities should be reflected on LMS.	All learning resources and activities would be reflected through LMS (direct uploads or else links to the processes and/or outputs. LMS would not only facilitate all teaching-learning activities but also prove as a facesheet of the BL mode.

6.5.2 Assessment and Evaluation in BL

Continuous assessment and evaluation play a major role in a learning process. Students can be informed about their performance in online assignments and quizzes through technology. They may be given constant access to their online reports for them to monitor their growth over the time against their individual learning goals.

There should be good means to assess the performance of students. Well defined tools to assess the student's growth and accomplishments should be used. Objectivity and standardization should gain significance. This will also encourage students to participate in self-assessment and peer assessment activities. The minimum or suggestive requirements for a University / College / Institution are indicated in table 6.4 given below:

Table 6.4

Essential Guidelines for Evaluation in IPSIT

Aspects	Minimum Standards	Desirable Standards
1. Online assessment	Online assessment strategies should be introduced at least to some extent.	Online assessment strategies should be used at least partially for all subjects.
2. Product and process evaluation	Analysis, Application and Create level learning outcomes should be defined for all subjects under BL. These higher level outcomes should be evaluated through internal evaluation. Process and product evaluation should be encouraged. At least 2 rubrics per course of 3-4 credit should be designed for subjects under BL Process evaluation through grading of synchronous group-chats, discussion forum posts, collaborative infographs, etc. can be achieved. Grading of concept-maps, mind-maps, stories, infographs, etc.	Rubrics should be developed for all courses. All possible cognitive learning processes and creative products to be evaluated.

	created by students can be used for product evaluation.	
3. Continuous Comprehensive Evaluation (CCE)	Modes of CCE should be innovative, learner-centred and competency-based.	Necessary evaluation systems should be in place and all evidences of internal evaluations to be maintained. Paper-pencil tests, unit-end exams to be completely discouraged for CCE. Instead, other modes of evaluation should be used.
4. Open Book/Closed Book	Both models to be followed selectively for courses under BL.	Both models to be followed selectively for all courses under BL.
5. Group Examinations and Evaluation	At least one group-work activity should be evaluated per course of 3-4 credit under BL.	Group-work evaluation and Group Examinations should be encouraged for all subjects
6. Viva Voce	Viva-voce for at least 70% experiments, group-projects should be mandatory	Viva-voce for all experiments, research projects, group-projects should be mandatory
7. Project Presentations	Presentations to be planned against evaluation of projects and dissertations at least 2 times per course.	Presentations to be planned for evaluation of projects and dissertations at least 3-4 times per course. Evaluation Rubrics to be developed for such presentations.
8. ePortfolio	ePortfolio in any easiest form should be encouraged for at least one subject, preferably for the professional subject.	ePortfolio should be encouraged for all students.

6.5.3 Effective Feedback:

Continuous feedback and support are essential for effective learning. Apart from face-to-face feedback, online technologies and methods can be used to provide feedback to support learning. Instructors can use audio and video inputs, written texts or in-text comments to provide feedback. Maximum feedback for all student work would help in encouraging learners to achieve learning outcomes.

Students can also engage in providing peer feedback by reviewing each other's work and commenting on blogs or discussion forums. Similarly, students can also give feedback to the instructors. The minimum or suggestive requirements for an institute/ University are indicated in table 6.5 given below:

Table 6.5

Essential Guidelines for Feedback in IPSIT

Aspects	Minimum Standards	Desirable Standards
1. Self-Feedback	Course related feedback on monthly basis or unit-wise, primarily for teaching-learning plans and efficacy of classroom activities	Course related feedback on weekly basis
2. Peer Group Feedback	At least once in a Semester (preferably within the given department/ school in the middle of the semester) Feedback from different levels of operations need to be planned at least once in a year	360 Degree Feedback at least once in a semester
3. Teaching-Learning Process, Learning Resources and Instructor	Student Feedback regarding T-L processes, Learning Resources and the Instructor at least once a semester for every course under BL.	Student Feedback regarding T-L processes, Learning Resources and the Instructor at least 2-3 times a semester for every course under BL.
4. Learner activities/ outcomes	corrective feedback on at least 50% of the learner activities and assignments	Feedback on at least 75% learner work

6.6 Conclusion

The chapter provides detailed guidelines communicating minimum recommendations from UGC for implementation of BL. Universities and parent bodies need to ensure checking essential requirements to begin with and them should monitor processes to ensure successful implementation of BL. BL mode is to be used nation-wide to help learners develop 21st century skills alongwith the effective learning and skill-development related to the subject-domains. BL should be carefully implemented and should not be replacing classroom time as a privilege. Every institute should strive to be a model institute to demonstrate a successful implementation of BL in the higher education of our country.

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Appendix A
List of Online Study Material/Resources in Open Access

1. National Digital Library of India (NDL)*	https://www.ndl.gov.in/
2. SWAYAM	https://www.swayam.gov.in
3. Directory of Open Access Journals (DOAJ)*	https://doaj.org/
4. Directory of Open Access Books*	https://www.doabooks.org/
5. National Programme on Technology Enhanced Learning (NPTEL)*	https://nptel.ac.in/
6. Shodhganga-a reservoir of Indian Theses*	https://shodhganga.inflibnet.ac.in/
7. e-PG Pathshala	https://epgp.inflibnet.ac.in/
8. Open Access Thesis & Dissertations*	https://oatd.org/
9. Open Knowledge Repository-World Bank*	https://openknowledge.worldbank.org/
10. The OAPEN Foundation*	http://www.oapen.org/content/
11. PubMed Central (PMC)*	https://www.ncbi.nlm.nih.gov/pmc/?cmd=search&term
12. Project Gutenberg*	https://dev.gutenberg.org/
13. HighWire	https://www.highwirepress.com/
14. Southern Connecticut State University	https://libguides.southernct.edu/openaccess
15. AGRIS	http://agris.fao.org/agris-search/index.do
16. ScienceDirect Open Access Content	https://www.sciencedirect.com/#open-access
17. AidData	https://www.aiddata.org/
18. ILOSTAT	https://ilostat.ilo.org/
19. Oxford Open	https://academic.oup.com/journals/pages/open_access
20. Project Euclid	https://www.projecteuclid.org/librarians/lib_oa
21. SpringerOpen Journals	https://www.springeropen.com/journals
22. Taylor & Francis Open Access	https://www.tandfonline.com/openaccess/openjournals
23. Cambridge University Press	https://www.cambridge.org/core/what-we-publish/open-access
24. Free Open Access Books	https://www.freetechbooks.com/
25. SWAYAM Online Courses	http://storage.googleapis.com/uniquecourses/online.html

26. UG/PG UGC-MOOCs	http://ugcmoocs.inflibnet.ac.in/ugcmoocs/moocs_courses.php
27. e-PG Pathshala	https://epgp.inflibnet.ac.in/
28. e-Content Courseware in UG Subjects	http://cec.nic.in/cec/

Appendix B
Template for Detailed Course Planning in Blended Learning Mode

Faculty/Instructor:
Institute (Dept/College/Institute):
Programme:
Course: Sem:
Credits: Marks: Class size:

Prerequisites:

Objectives of the course:
1. ….
2. …

Course Structure
(Please add columns and rows as per the course structure)

	Module 1 (Credit: 1)		Module 2 (Credit:)
1.1		2.1	
1.2		2.2	
	Module 3 (Credit:)		Module 4 (Credit:)
3.1		4.1	
3.2			

Detailed Plan

- Mention whether Resources/ Communication/ Collaboration/ Co-operative strategy, etc.
- Type of Resource (OER /URL/IM/CP: OER/ Reference URL/ Instructor-made / Copyrighted with permission)
- Describe nature of IM, i.e. instructor-made resources (PPT/ Screen-cast/ Video/Interactive module/ PDF, etc.)
- Describe activities in detail

Sr No of Module	Number of related Learning Objective	Week/ Dates	Online Mode		ICT Tool/ Platform/ LMS	Face-to-face Mode		Duration in Minutes
			Resource (OER /URL/IM/CP)	Activity (Describe activity in detail)		Resource (OER /URL/IM/CP)	Activity	
Module 1 1.1								
1.2								
1.3								
1.4								
Module 2 2.1								