

Is Blended Learning Better than Online Learning for B.Ed Students?

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Abstract: Blended learning is a newly emerging area of research and practice in educational institutions. It is defined as a useful and reasonable combination of online and face-to-face learning and is acclaimed as a successful mode of teaching. The recent growth of online education, which is without classroom interaction, in a developing country like India therefore presents a reason to verify the relative effectiveness of these teaching modes. This study was an experimental study spread over two years, to compare the effectiveness of the blended learning mode and the online learning modes (including their specific teaching-learning strategies) for a B.Ed curriculum. A randomly selected sample of students with a comparable level of intelligence quotient (IQ) was subjected to both controlled (face-to-face) and experimental treatments (online and blended learning). The participants were the students of a predominantly face-to-face mode of a B.Ed Course. The researcher found that the average achievement scores of the blended learning mode were higher than the online learning mode. It appears that the interaction of the instructor and the learners was a critical factor for the better performance of blended learning. This research also suggests that blended learning resulted in better learning attainment and motivation. Blended learning has potential to support learner-centric teaching-learning endeavours. It is an important finding for the emerging trend towards online learning in India. It is also relevant in the context of the conditions created by the COVID-19 pandemic, which has put constraints on the face-to-face mode of teaching.

Keywords: blended learning, online learning, face-to-face learning, experimental study, Moodle.

Introduction

Before the “information age”, which the Merriam-Webster Dictionary defines as “a time in which information has become a commodity that is quickly and widely disseminated and easily available, especially through the use of technology”¹, the world of education was marked by two main modes of delivery of education: face-to-face (or regular mode) and distance mode. They were the two opposite ends of a continuum of modes of education. The continuum is visualised in Figure 1. These two modes differ in features like the degree of resource intensiveness, size of learner groups and commitment of the learners in the context of time and place. In the present time, the continuum is populated by different modes of learning. Computer labs or laptop instruction, web-enhanced learning, blended learning, and fully online instruction have emerged as alternatives to face-to-face learning. In earlier systems, the focus was at the two ends of the spectrum (regular mode and distance mode), and there was almost a dissection. Whereas, in the present era, the focus has shifted towards the centre with various emerging options. The terms, Hybrid Learning, Conversational Learning, and Complex Learning are styled names of the practices of blending face-to-face and online learning. With



emerging technologies and innovations in digital learning, the complexity of their structure is expected to grow further, and even more new nomenclature may pop up.

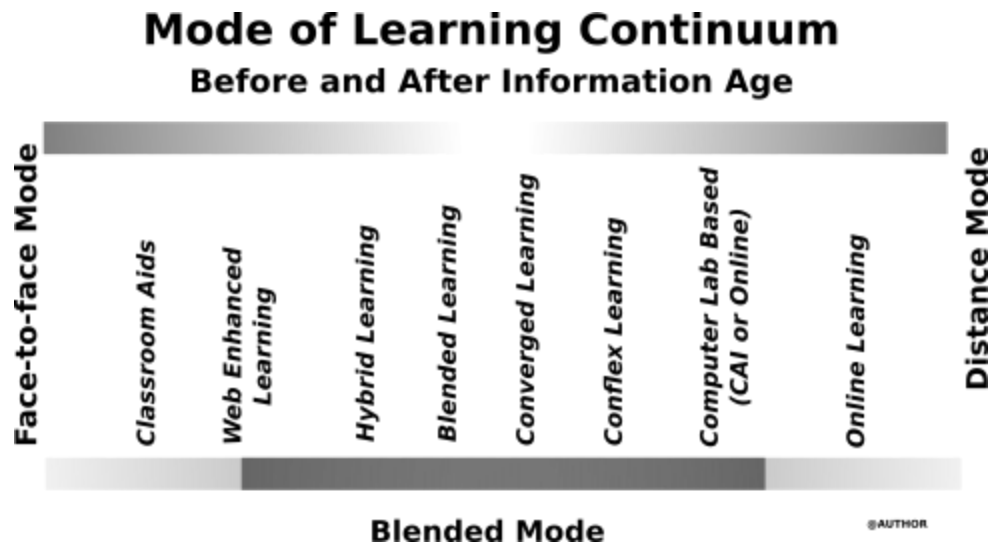


Figure 1: Spectrum of modes of learning (suggested by the researcher)

In the beginning, the design of online teaching-learning had only two influences: there were designs replicated from classroom teaching, and there were designs adapted from print or multimedia distance education courses. In the course of time, several new designs emerged which were capable of exploiting the different potentials of online learning but the primary forms also survived. Some of them involve classroom-type online learning like Massachusetts Institute of Technology Massive Open Online Courses (MIT MOOCs), platforms like Coursera, the ADDIE Model, Online Collaborative Learning (OCL), Community of Inquiry (COI), Competency-based learning (CbL), and Communities of practice (CoP). These models present the complexity of conditions for creating a universal definition of online learning. For example, Qura.com (<http://www.qura.com/>) is an example of a Connectivist MOOC or cMOOC.

Online learning is defined as the "use of the internet technologies to deliver a broad array of solutions that enhance knowledge and performance." (Rogenberg, 2001, p. 28) Online learning can be described as a type of resource-based learning in which the learners access learning content through learning materials rather than via teaching. "The term 'resource-based' is often used as an 'opposite' to 'taught' (Race, 2008, p. 19). In this case, the resource can be accessed through the Internet. "The learning that happens in resource-based learning usually opens up some freedom of time and pace, if not always that of place." (Race, 2008, p. 19) In such a type of resource-based learning, the learners themselves have to be more responsible for their learning than in traditional teaching-learning situations (Race, 2008, p. 18).

Blended learning is defined as a mixed-mode of learning in which both face-to-face and online learning are used. According to the Sloan Consortium (Sloan-C), a leading professional organisation dedicated to promoting and supporting online education, "a blended course is one in which 30 per cent to 70 per cent of the instruction is delivered via technology". Sloan-C further defines this type of

course as one "that blends online and face-to-face delivery. A substantial proportion of the content is delivered online, typically uses online discussions, and typically has some face-to-face meetings" (Sloan Consortium's Definition), (Dziuban et al, 2011). Thus, online learning and blended learning can be identified separately with reference to the use and non-use of face-to-face learning.

There are many changes in the demand side of an education system, influencing the quality of learning attainment. There has been much rhetoric on changing focus from exam-centric education to learner-centric education. The expanding needs of universalisation also demand inclusion of diversified learners.

In this research study, online learning is described as electronically mediated learning, facilitated and supported by the use of computers, networking and multimedia. In this perception of digital learning, use of networking (Internet or intranet) is crucial. The blended course is one in which a substantial part of the instruction was delivered via online modules but also with face-to-face activities. The online part of the blended learning is designed to be complemented by the teacher, who initiates, motivates and consolidates the learning of students through discussions in the classroom. Face-to-face learning is perceived as a lecture-discussion method with chalkboard and textbooks as teaching aids.

E-learning, specifically online learning, is a recently emerging trend in India. Indians are among the largest groups of registrants in Massive Open Online Courses (MOOCs). In an indigenous development, a National Programme on Technology Enhanced Learning (NPTEL) has been jointly initiated by the Indian Institute of Technologies (IIT) and the Indian Institute of Sciences (IISc). They offer online courses for free and certification at a nominal cost in various topics. IIT also developed MOOC software, MOOKIT, for others to launch new courses with the motto that "creating online courses should be as simple as taking them". A MOOC on MOOCs course has also been started to train teachers and other interested people to teach them the functioning and pedagogical facets of MOOCs. Courses relating to the sciences, engineering, humanities and social sciences have been developed. In addition, "agMOOCs" have been developed especially for the students of agriculture. IIMs and the Commonwealth Educational Media Centre for Asia are also involved in developing courses in India.

IIT Bombay in "Talk to a Teacher Programme" under the National Mission on Education through Information and Communication Technology, Community initiatives like Teach For India, Study Webs of Active-Learning for Young Aspiring Minds (SWAYAM), and SWAYAM Prabha are other examples. They also offer curriculum-based courses for life-long learners from India and abroad.

All the instances above aim to teach a large mass of students mostly without substantial supervision of a teacher. It is assumed that by putting learning material and labs on the Internet and making them available free of cost, the learner will start using them effectively. However, this perception is counter-intuitive, given the learning habit of "mugging up" for success in examination acquired by a large number of learners during their school education in the country. Various observers have remarked that Indian online learners prefer attainment of qualifications over development of deep learning.

There was a period of change in the teaching-learning of B.Ed courses recently. The B.Ed curriculum was converted from a one-year B.Ed. to a long-awaited two-year B.Ed course in 2015 with a compulsory semester-equivalent school internship based on a schematic structure designed by the National Council for Teacher Education (NCTE), the regulating body of teacher education in India.

Besides introduction of a four-year integrated B.Ed course for secondary school teachers, a four-year integrated BEEd for elementary school teachers, a three-year integrated B.Ed-M.Ed course for teacher educators, and making more areas of study (gender studies, inclusive education, ICT, and *yog shiksha*) compulsory for all kinds and levels of teacher education were also introduced. The two-year B.Ed curriculum had several new contents in comparison to the old one-year curriculum, including compulsory school internship. The new curriculum was an apt opportunity to introduce new teaching mode and methods, but it was not easy to come by.

Patna has over a century-old legacy of a teacher training programme, as one of the first training colleges of India was established in Patna. Over that period, a set of perceptions evolved among the teachers and the students about the transaction of B.Ed and other education programmes. These perceptions define the academic practices and culture of the B.Ed colleges and departments. Some of the common perceptions are as follows:

- B.Ed degree is a short duration "training programme". This is a colloquial reference to the insignificance of practice-in-school teaching for many students and even teachers.
- In this course, the teacher educators must teach methodology but supporting students' mastery of subject content is not their responsibility.
- The training of students is mostly for teaching through the lecture method. Other teaching strategies are taught theoretically as part of the pedagogy paper. The rationale is that there is a lot of new content in the B.Ed curriculum for students coming from diverse streams. The learners are unexposed but this content must be taught in a short period. Mostly, the lecture method is used in the transaction of the course. Other teaching strategies are rarely used.
- To summarise, a hurried theoretical discourse is followed by another set of hurried practical activities in a short duration of time.

These perceptions developed during the one-year B.Ed programme were seemingly unchallenged by the teacher educators in the new two-year programme. While many teachers speculate about the rationality of a two-year B.Ed course, in a study on professionalism of teacher educators in the state, 59% were of the view that one year is insufficient duration for a quality B.Ed course (Madhumita & Ranjan, 2014).

This study was conceived in light of these set perceptions. It assumed that the introduction of a new curriculum and a novel mode of teaching could change some old and long-standing perceptions and habits of students, as well as of teachers, that would result in better learning achievement.

Theoretical Background

The theory inherent in this study is the use of media for teaching-learning. McLuhan (1964) argued that "the medium is the message" (p. 23) and "media are extensions of mind, body and being (p. 121)". As a critique of media, McLuhan suggested being cautious about such extensions. He perceived them as not necessarily benevolent and suggested that we should be careful when using them. Thinking in the line of McLuhan, online learning is an extension of a teacher's mind (when it serves as a portal on new learning) and eye (when it records students' activity). The effectiveness of these extensions is debated in the Media Debate. The Media Debate, also known as the Clark-Kozma Debate, is related to the uniqueness of medium or media as a factor of enhancement in learning. Since the beginning of the

Media Debate in 1983, the new media (computer, Internet) has proved its significance, and the debate seems to be settled in favour of it. This study aimed to follow Kozmza's line of thinking (1994) while keeping the perspective in mind that a poorly managed online or blended course might confirm the views expressed by Clark (1994).

Significance of the Study

The study addressed some of the problems relating to the field outlined below:

- The regular mode of education has several unanswered issues relating to students' learning attainment.
- Modes of education are expanding but there is a dearth of study about their effectiveness.
- There is a lack of study about the comparative effectiveness of online learning and blended learning in the Indian context, especially in a poor state like Bihar.
- The emerging trend of online learning in India is uncritical about its effectiveness and unsure about its integration with regular teaching-learning practices.

Objective and Hypotheses

The objective of the study was:

O1 To compare the effectiveness of two different instructional modes, online learning and blended learning, in the context of the B.Ed curriculum.

To address the objective, three hypotheses were created:

H₀₁ There is no significant difference between the achievement scores of B.Ed students while studying in blended mode and face-to-face mode.

H₀₂ There is no significant difference between the achievement scores of B.Ed students while studying in online mode and face-to-face mode.

H₀₃ There is no significant difference between the achievement scores of B.Ed students while studying in online mode and blended learning mode.

Review of the Literature

Reviewing the experimental studies relating to online learning, we found continuity with the trends of distance research. There had been a long history of distance education, and several meta-analyses have been conducted about the comparative effectiveness of distance and face-to-face modes of study. The meta-analytical studies of research literature on distance education by Bernard et al (2004), Cavanaugh (2001), and Moore (1994) had not found any significant difference between distance education and face-to-face education. However, a close study of Bernard et al (2004) reveals that behind this general conclusion, the variation in results was very high. The effect sizes of the studies used for meta-analysis varied from -1.31 to +1.41. This was a trend that continued through the studies on online and blended learning.

The experimental research on online learning and face-to-face learning has shown that the learning achievements for students in purely online and those who studied in purely face-to-face were statistically equivalent. Means et al (2010, p. xv), in a meta-analytical study, found that in purely

online and purely face-to-face conditions, the average effect size was +0.05, (Min -0.796 to Max +0.790) $p = .46$, as depicted in Table 1.

Table 1: Effectiveness of online learning as compared to face-to-face learning (Source: Means et al (2010))

Researchers	Effect Size (g)	T-test (Z-Value)	Participants
Beeckman et al (2008)	+0.294	3.03	426 participants
Bello et al (2005)	+0.278	1.05	56 participants
Benjamin and Ward (2008)	+0.046	0.14	Unknown
Beyea et al (2008)	+0.790	1.756	17–20 participants
Caldwell (2006)	+0.132	0.43	60 students
Davis et al (arch)	-0.379	1.39	Unknown
Hairston (2007)	+0.028	0.18	168 participants
Jang et al (2005)	-0.530	-2.69	105 students
Lowry (2007)	-0.281	-0.84	53 students
Mentzer et al (2007)	-0.796	-2.35	36 participants
Nguyen et al (2008)	+0.292	0.93	39 participants
Ocker and Yaverbaum (1999)	-0.030	-0.14	43 participants
Padalino and Peres (2007)	0.115	0.41	49 participants
Peterson and Bond (2004)	-0.100	-0.47	4 sections
Schmeeckle (2003)	-0.106	-0.53	101 students
Schoenfeld-Tacher et al (2001)	+0.800	1.74	Unknown
Sexton et al (2002)	-0.422	-1.10	26 students
Turner et al (2006)	+0.242	0.66	30 students
Vandeweerd et al (2007)	+0.144	0.70	92 students
Wallace and Clariana (2000)	+0.109	0.53	4 sections
Zhang (2000)	+0.381	1.12	51 students
Zhang et al (2006)	+0.498	2.04	69 students

Bernard and Lundgren-Cayrol (2001) studied online learning in the context of the presence of an instructor as a moderator in online discussions. This study, conducted in a teacher education course on educational technology, was about the impact of moderation by an instructor. Students were randomly assigned to different groups with high intervention and low intervention. The study did not find a main effect for the moderator. The group for low moderator performed significantly better than the other group. De Wever et al (2008) also found that the group with student moderators, rather than the instructor moderator, was significantly better. However, in a study by Zhang (2004), the

effectiveness of instructor moderation of online asynchronous collaboration was significantly higher. In this study, a group of students had a private space for discussion, whereas, the instructor moderated the other group's discussion.

The review of literature on blended learning concentrated on the replacement model of blended learning. In this model, some of the face-to-face lectures are substituted by the online material and classes are reduced. Means et al (2010, p. xv) reported that the combination of purely face-to-face and online elements was more effective than face-to-face instruction alone. The mean effect size was +0.35, $p < .001$ (Table 2). At the same time, they cautioned that a larger effect size might be due to curriculum materials and differences in aspects of the instructional approach, besides the mode of instruction.

In the meta-analysis conducted by the US Department of Education (Means et al, 2010, p. 38), ten studies of blended and online learning were compared. These studies were levelled as "blended" or "purely online" based on their inclusion or exclusion of face-to-face learning but the content and quality of instruction across the two modes were also different.

Table 2: Effectiveness of blended learning as compared to face-to-face learning (Source: Means et al (2010))

Researchers	Effect Size (g)	T-test (Z-Value)	Participants
Aberson et al (2003)	+0.580	1.44	2 sections
Al-Jarf (2004)	+0.740	3.82	113 students
Caldwell (2006)	+0.251	-0.99	60 students
Davis et al (1999)	-0.335	-0.99	2 courses/classrooms
Day et al (1998)	+1.113	3.85	2 sections
DeBord et al (2004)	+0.110	0.69	112 students
El-Deghaidy and Nouby (2008)	+1.049	2.58	26 students
Frederickson et al (2005)	+0.138	0.40	2 sections
Midmer et al (2006)	+0.332	1.56	88 students
Schilling et al (2006)	+0.926	5.05	Unknown
Spires and Jackson (2001)	+0.571	1.60	31 students
Urban (2006)	+0.264	1.37	110 students
Zacharia (2007)	+0.570	2.64	88 students

The study referred to Keefe (2003), who compared a blended class, and an online class who watched narrated PowerPoint slides shown online or using CD-ROMs. The blended class had a classroom lecture in addition to the online class. Both groups could also use e-mail, online chat rooms, and threaded discussion forums. Keefe found that the scores of the purely online group were around eight per cent lower than the blended group.

Poirier and Feldman (2004) used two groups for his study which were exposed to predominantly face-to-face mode, but the face-to-face group was required to participate in at least three online discussions

during the course, whereas, the purely online group had to participate in two online discussions with the instructor each week. Poirier and Feldman found a significant effect in favour of the purely online course format for examination grades but there was no effect on student's performance in writing assignments.

Campbell et al (2008) studied a blended course in which students received online instruction and attended face-to-face discussions along with a purely online course where the students assessed instruction as well as participated in discussions online. Tutors were present in both formats of discussions. Students had the freedom to choose the blended or online format. In this case, the scores of the online discussion group were significantly higher than the blended group. Means et al (2010, pp. 38-39) observed that the relative effectiveness of the blended and purely online learning was dependent on the instructional element, as in these studies the instructional content was not controlled across the two modes.

Davis et al (1999) in their own study, attempted to equate the instructional content across three modes of delivery: blended, face-to-face and online. The students were randomly assigned to the three sections. There was no significant difference in post-test scores of the students (Means et al, 2010, p. 39).

Means et al (2010, p. 39) also reviewed six other studies (Beile & Boote, 2002; Ruchti & Odell, 2002; Gaddis et al, 2000; Caldwell, 2006; Scoville & Buskirk, 2007; McNamara et al, 2008) where the purely online groups were contrasted with the blended group but there was no significant difference. These studies also did not attempt to equate the learning content across the modes.

Methods

Research Methodology

With the background of studies discussed above the present study was designed as an experimental study.

Table 3: Variables of the study

Independent Variable	<p>Mode of teaching-learning along with their respective strategies:</p> <ul style="list-style-type: none"> • Blended Learning: Teaching-learning delivered through a combination of face-to-face and online delivery mode • Online Learning: Teaching-learning delivered through online delivery mode only • Face-to-face learning: Classroom teaching only
Dependent Variable	Learning outcome as measured by assessment tools
Confounding Variables	Intelligence Quotient, Age, ICT Awareness

One of the critical steps to design an experiment is to control the independent variable (IV) and extraneous variables. The challenges for experimental control in the present research were:

- The students of B.Ed were from diverse age group (from 20 to 39).

- The students were of different educational streams like arts, science, commerce and even professional disciplines like an MBA, Computer Science, etc. They have different levels of self-efficacy and exposure to different institutional cultures of teaching-learning.
- The students had studied a paper on ICT in their previous year curriculum, yet they had various degrees of expertise in using ICT tools.
- Given the vast difference in marks between the highest and lowest scores of students in the entrance test examination, they can be suspected of having a wide variety of IQs. Though a clear correlation had not been established between the IQ and the learning achievement of the students, yet they are confounding when the results of the experiment are dependent on the understanding and ability to apply new learning.

Besides, many other concerns need to be addressed. For example, novelty effect, the perception of students towards the new experience were different; instrumentation, changes that may occur over time in the measurement of a dependent variable due to variation in mechanical or human observer factors; and experimenter features, such as the researcher's expectancy or bias about the performance of the learning modes.

The present study, the comparison of online learning and blended learning was made by comparing the achievement scores of students studying in these modes with their achievement scores in face-to-face learning. The design adopted for the study was a hybrid design known as 'switching replication design' or 'matched group design'. In this design, the randomised groups are subjected to similar treatment subsequently. In other words, the control group becomes the experimental group and vice-versa. The switching-replications design is one of the strongest experimental designs (Trochin et al, 2016, p. 250). In this design, the randomised groups are subjected to similar treatment subsequently. In other words, the control group becomes the experimental group and vice-versa. By the end of the study, all participants would have received the treatment. This design is "most feasible in organizational contexts where programs are repeated at regular intervals" (Trochin et al, 2016, p. 50) like schools. "In randomized experiments, especially when the groups are aware of each other, there is the potential for social threats to internal validity; compensatory rivalry, compensatory equalization, and resentful demoralization are all likely to be present in educational contexts where programs are given to some students and not to others" (Trochin et al, 2016, p. 51). This design address these threats as everyone eventually receives the same treatment. It also allocates the groups to different types of treatment through random assignment.

The study was designed as a post-test, with two experimental random groups, and a control group design as illustrated in Table 4 and an elaborate setting of samples is described in Table 5.

Table 4: Experimental design

Group	Selection Process	Treatment	Observation
Experimental 1	R	X_1	O
Experimental 2	R	X_2	O
Control	R	X_0	O

R: Random selection and random assignment to groups; X_1 & X_2 : Treatments; X_0 : Control; O: Observation (Notations adopted from Gould (2001)).

Table 5: Distribution of sample for the experiment

Subjects	Subject-1 (S1)				Subject-1 (S1)			
Topics	Topic 1				Topic 2			
Sections	Section A		Section B		Section A		Section B	
Groups	GA	GB	GC	GD	GA	GB	GC	GD
Lesson 1-3	$X_1 (BL)$	$X_2 (OL)$	$X_0 (CL)$	$X_0 (CL)$	$X_0 (CL)$	$X_0 (CL)$	$X_1 (BL)$	$X_2 (OL)$
Evaluation	<i>Test-1 (O)</i>				<i>Test-2 (O)</i>			
Subjects	Subject-2 (S2)				Subject-2 (S2)			
Topics	Topic 1				Topic 2			
Sections	Section A		Section B		Section A		Section B	
Groups	GA	GB	GC	GD	GA	GB	GC	GD
Lesson 1-3	$X_2 (OL)$	$X_1 (BL)$	$X_0 (CL)$	$X_0 (CL)$	$X_0 (CL)$	$X_0 (CL)$	$X_2 (OL)$	$X_1 (BL)$
Evaluation	<i>Test-3 (O)</i>				<i>Test-4 (O)</i>			

X_1, X_2 = Experiment; X_0 = Control; O = Observation; GA, GB, GC and GD = Groups of students; BL = Blended Learning; OL = Online Learning; CL = Classroom Learning

Tools of Study

Intelligence Test: The Multidimensional Aptitude Battery (MAB-II), developed by Douglas N. Jackson and adapted for the Indian condition by Narender K. Chadhdha, was used for this study. This instrument is suitable for the assessment of intellectual abilities of both adults and adolescents aged 16 and older. It consists of two parts, namely, verbal and performance. The instrument provided norms for nine age groups ranging from 16 to 74. In this study, three of the norms for the age groups 20-24, 25-34, 35-44 were used. The Technical Manual of MAB-II reports internal consistency reliability for different age groups from 0.94 to 0.97 for the Verbal Scale, 0.95 to 0.98 for the Performance Scale, and 0.96 to 0.98 for the Full Scale.

We also calculated the internal consistency of the intelligence scores of our sample. We used Cronbach Alpha test (see Table 6). It is one of several estimates of the internal consistency of a test. It is the mean of all possible split-half reliability (corrected for test length). The results were as follows:

Table 6: Reliability scores (Alpha scores) of MAB II

Verbal (Standard Alpha Score): 0.81					Performance (Standard Alpha Score): 0.68				
INF	COM	ARI	SIM	VOC	DS	PC	SPA	PA	OA
0.79	0.73	0.83	0.73	0.75	0.68	0.55	0.62	0.65	0.61

The verbal scores were used for creating groups as their reliability scores were high.

Computer Attitude Scale (CAS): The other tool used for checking attitude towards using computers was the Computer Attitude Scale (CAS). A self-reporting questionnaire reporting details on the use and skills in digital technologies was developed, and a computer attitude scale was adapted from the Computer Attitude Scale (CAS) that was initially developed by Jones and Clarke (1994). We also incorporated the modifications suggested by Smalley et al (2001) in the tool. The tool had three parts consisting of affective, cognitive and behavioural attitudes. We used only the affective part questions as the Computer Attitude Scale (CAS) had 15 items with Alpha Score 0.84.

Achievement Test: As mentioned in Table 8, four achievements tests were created. They were developed in different phases. In the first phase, the investigators set the objectives of teaching-learning. They analysed the content and divided them into different learning levels. They identified the vital information and ideas and used them for designing the teaching-learning modules. In the second phase, they developed lesson plans for teaching-learning. Based on the objectives, they developed achievement tests for unit end examination.

The following steps were taken for the validity and reliability of the tool:

- The selected list of items, along with the learning objectives, were reviewed by three experts.
- The experts also reviewed the relevant points as probable answers to the questions, and an answer schedule (guideline) along with the key to objective questions were created.
- A language expert reviewed a translation of the tool.

For testing the reliability, we conducted the Cronbach Alpha Test. The scores were reasonably high. The item was reliable. The result of the Alpha Test was as follows (see Table 7):

Table 7: Alpha scores of the four achievement tests

Items	Total Alpha Scores
Test 1	0.76
Test 2	0.79
Test 3	0.77
Test 4	0.76

Preparation for the Experiment

A website based on the Learning Management System (LMS) Moodle was created (<http://www.gloaledu.org/elearning> [see Internet Archive <https://web.archive.org/web/20190131060436/http://gloaledu.org:80/elearning/>]) and used to develop

content relating to the study. Moodle is used for blended learning, distance education, flipped classroom and other e-learning projects in schools, universities, workplaces and other sectors.

The sample for the study was selected based on the Intelligent Quotient of the students. At the same time, there was a minimum score criterion relating to an ICT competency tool and Learning and Study Strategies Inventory (LASSI). The participants were matched based on their intelligence quotient (IQ). As depicted in Figure 3, all the participants of eight groups distributed over two years were of a similar level of IQ (Figure 3). The range of attitude scale of students is depicted in Table 8.

Table 8: CAS scores of students

A1	A2	B1	B2	C1	C2	D1	D2
35-42	32-34	33-38	36-41	34-39	32-37	36-38	34-39

*Highest score could be 60.

The experiment was conducted at the Department of Education, Patna Women's College, Patna in the months July to September 2017 in the first phase and again during the same months in the year 2018.

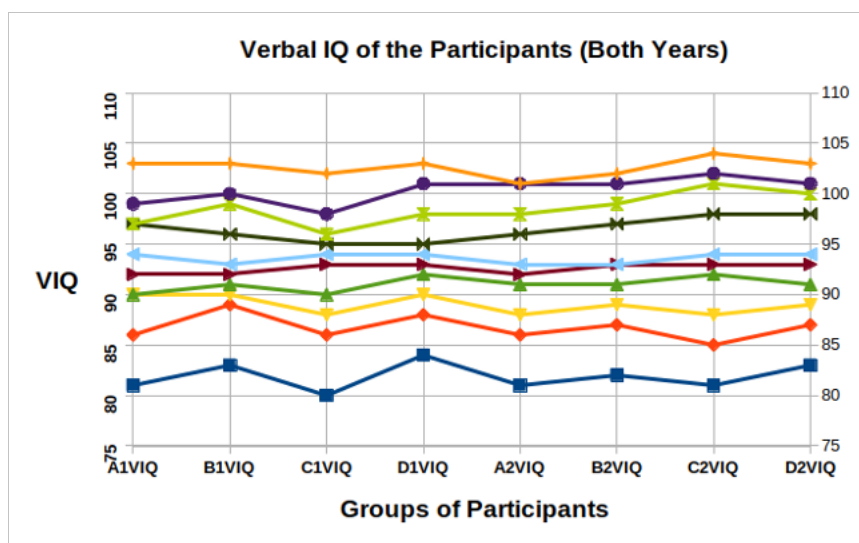


Figure 2: IQ of the participants across two years

Development of Modules and Lesson Plan

A Moodle-based website was developed for the study. The modules were designed considering the Community of Inquiry model of online learning. This model considers three components as essential for a successful online or blended education – social presence, cognitive presence and teacher presence – and was developed by Garrison et al (2008). The face-to-face lessons were planned considering the Herbertian model of lesson planning and Bloom's Taxonomy.

Statistical Analysis

The analysis was conducted using RStudio, which is a free and open-source integrated development environment (IDE) for Software R, version 3.4.4 (2018-03-15), named as 'Someone to Lean On'. R is a programming language for statistical computing and graphics. Z-score, t-test, Factor Analysis,

Cronbach Alpha and effect size calculation were used for different purposes of the research. Effect size (Hedge's g was calculated). The formula used was:

$$\text{Hedges' } g = \frac{M_1 - M_2}{SD^*_{pooled}}$$

Where M is the Mean; SD*pooled = Standard deviation of combined data; and N = Number of samples.

Ethical Issues

Some ethical practices need to be observed in experimental studies. To address this need, primary evaluations of the students, i.e., IQ scores, were not shared with other students or other faculty members. All students were informed that it would be used for research purposes only. Precautionary measures were taken to avoid any adverse effect on the curriculum transaction. No student was deprived of information for the benefit of the research. After the topic evaluation test, the online modules were made available to all the students. No student was denied the opportunity to benefit from the new technology and the experience of the innovative mode of learning.

Results

For testing the hypothesis H_{01} , a paired t-test was used. The marks scores were converted into z-scores and combined for analysis. The standardised achievement scores of students in blended mode (M = 0.93, SD = 0.85) were higher than their achievement in face-to-face mode (M = -0.58, SD = 0.71), $t(72) = 16.69$, p-value = 0. The effect size (Hedges' g) was 1.93.

For testing the hypothesis H_{02} , a paired t-test was used. The standardised achievement scores of students in online learning mode (M = 0.115, SD = 0.82) were higher than their achievement in face-to-face mode (M = -0.58, SD = 0.71), $t(72) = 11.66$, p-value = 0. The effect size was 0.91.

For testing the hypothesis H_{03} , a paired t-test was used. The standardised achievement scores of students in blended mode (M = 0.93, SD = 0.85) were higher than their achievement in online learning mode (M = 0.115, SD = 0.82), $t(72) = 8.50$, p-value = 0. The effect size was 0.98.

Table 9: Summary of results

	Mean (z scores)	SD (z scores)	df	t value	p-value	Effect Size (Hedge's g)
Blended Mode	0.93	0.85	72	16.69	0	1.93
Face-to-Face Mode	-0.58	0.71				
Online Mode	0.115	0.82	72	11.66	0	0.91
Face-to-Face Mode	-0.58	0.71				
Blended Mode	0.93	0.85	72	8.5	0	0.98
Online Mode	0.115	0.82				

As compared to Table 1, depicting the list of studies on online learning where the most considerable effects were observed by Schoenfeld-Tacher et al (2001) who found an effect size of 0.8, Beyea et al

(2008) who found an effect size of 0.790, and Zhang et al (2006) who found an effect size of 0.498, the effect size found in the present study is significant. Many others found a positive effect size varying between +0.028 and +0.381. If we look at the upper limit of the confidence interval of these studies, they vary from 0.209 to 1.756. Their studies also showed a possibility for a higher score. However, the main reason for a lower score in the context is attributed to the ineffective learning habits of students learning in face-to-face mode.

The findings in the context of blended learning were also similar. As depicted in Table 2, Day et al (1998) found an effect size of +1.113. El-Deghaidy and Nouby (2008) found an effect size of +1.049; Schilling et al (2006) found an effect size of +0.926 against face-to-face learning. Al-Jarf (2004) found an effect size of +0.740; Aberson et al (2003) found an effect size of +0.580. Others varied between +0.110 and +0.571. The finding of the present study suggested an effect size of around two sigma scores. The upper limit of the results mentioned in Table 2 varied between 0.468 and 1.845 on the positive side. Hence, the findings of the present study were not inconsistent with the literature.

Thus, there was a considerable difference of almost one sigma (one SD) of effect size when compared to the online learning mode.

Discussion

In the context of the B.Ed curriculum, the following considerations are critical for understanding the importance of the findings:

- As a general observation, many of the learners had under-developed learning skills. They considered collecting new information for preparing for the final examination as the only necessity. In other words, they were looking for a degree rather than for learning. While learning in the face-to-face mode during the present study, they were aware of the test at the end. Though they took notes and consulted the list of reading materials, they did not use them for effective self-study. They used them only for review during the days just before the examination. Often, they tried to do that without understanding the content. This represents the flaw of learning in the traditional mode of the B.Ed programme.
- The online modules on Moodle that were used for online and blended learning were designed in such a way that students had to answer several questions before moving from one section to the other. That made the online learners revise their understanding. This is crucial for a better understanding of an intensive course like the B.Ed.
- The students in blended learning got an additional chance to discuss the topic in the classroom. For the online learners, the parallel was the online forum on Moodle. However, the forum was not as active as the classroom discussion. The blended mode students were able to grasp the essence of the topic in considerably more depth.
- Though it is considered a responsibility of the teacher to motivate, the long-term experience of the students in the teacher-centric mode has made them examination-oriented learners. That is the limitation of teacher-centric education. We consider it an effective strategy when supported by an enthusiastic teacher and a group of highly motivated learners. Whereas, in the online and blended mode, the students are motivated systematically and sometimes forced to involve themselves in a deeper understanding of the content.

In this study, as discussed before, the different types of learning modes included relevant teaching-learning strategies. Any attempt to separate the modes from the relevant strategies did not produce a conclusive result. In other words, the mode means not only the media by which the content was being delivered but also the strategy for using them. This is consistent with Clark's line of argument (1994) in the Media Debate. This study followed Kozma's line of argument when it emphasised the way modes were used along with the teaching-learning strategies using various types of media.

Conclusion

By the second decade of the 21st century, the use of Information and Communication Technology (ICT) for education is many decades old. Introduction of new *technologies for education* consequently influences the *technology of education*. In other words, the technology that helps to impart education influences how it should be imparted. This raises new questions and creates new problems. Nevertheless, it is also important to see how the long-standing questions and challenges of education are being addressed. Low learning attainment by students in formal education (in a classroom setting) is one such long-standing problem. Especially in a populous country like India, formal education is highly challenged due to lack of facilities, qualified teachers and quality education. Even in the best conditions, formal education imparted in the traditional way is not efficient to cater to the needs of diverse learners. The present study suggests that blended learning, if executed correctly, can address the need in the context of the B.Ed curriculum.

The study suggested a considerable effect size of difference among face-to-face learning, blended learning, and online learning while transacting the B.Ed curriculum. Both online and blended learning were unambiguously more effective than the traditional face-to-face mode. Thus, theoretically speaking, the learning achievement in learner-centric education is higher than in teacher-centric mode, and the combination of online media and traditional media is superior to any of them alone. Kozma's line of argument (1994) that use of media, if combined effectively, positively affects learning can be considered consistent with the results. It is a promising result in the context of low learning achievement in the face-to-face mode of education.

Limitations and Suggestions

As mentioned earlier, the content used for the study was limited to a small part of a paper. Another limitation was that the study did not sample the actual online learners studying in distance mode. They were the learners in face-to-face mode who were given instructions online. This limited the applicability of the study to the regular mode students only. At the same time, it is very relevant for the conditions created by the COVID-19 pandemic in which the academic institutions are facing limitations in organising face-to-face meetings and are forced to look for innovative modes of education. A third limitation was that the students did not fully support the execution of the online forum discussion. Furthermore, a fourth limitation was that face-to-face learners had limited learning strategies, and they did not use the full potential of teacher-centric education.

It is suggested that the study should be replicated with a larger group and a full academic programme should be considered for the experiment. The online learners may be selected from the distance mode learners. The teaching modules should be designed considering the principles of Community of Inquiry (COI) rather the online video mode. The present MOOCs are almost a limited replica of teacher-centric education.

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Note

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