Effectiveness of Blended Learning Approach on the Academic Achievements of Learners: A Meta-Analytical Study

Gautam Kumar[1],Sumit Gangwar[2] & Rashmi Mehrotra[3]

[1]Research Scholar, Faculty of Education, Teerthanker Mahaveer University, Moradabad

Email : gautamkumar.edu11@gmail.com

[2]Assistant Professor, Faculty of Education, Teerthanker Mahaveer University, Moradabad

[3]Professor & Principal, Faculty of Education, Teerthanker Mahaveer University, Moradabad

Abstract

This study's major goal was to conduct a meta-analysis of previous research on how well the blended learning strategy affected students' academic success. The samples for this analysis were chosen by the researcher using the purposive sampling method. Keeping in mind that Google search was used to get every study from 2015 to 2021. The researcher chose 20 of these articles to examine how well a blended learning method affected the student's academic successes. The average effect size was established after quantitative data was gathered from particular research publications and transformed into an industry-standard scale, i.e., effect size, using Meta Essentials software. The average impact size across all studies was determined to be 1.46. (large effect size). These results allow us to conclude that blended learning approaches significantly improve students' academic performance.

Keywords: Blended Learning, Meta-analysis, Effect Size

Learning is defined as the concepts of subject matter for students and lecturers, the nature of various concepts connected to the field of data, the objectives of teaching-learning, the nature of teaching, as well as the process of learning. In the traditional method of instruction, the teacher demonstrates to the students a wealth of information related to the subject and makes the erroneous assumption that they are the intended audience for the information. The term "teacher-centered" or "universal teaching method" is used to describe this form of instruction. Teaching methods, approaches, and strategies let the instructor select how to begin the instructional strategy in the classroom so that the student is fully engaged in the strategy (Science Pedagogy, 2018). The National Information Framework from 2005 placed a strong emphasis on learner-centered methods or combining learning techniques to achieve the information's goals. The course material and the technique of its exchange become simple, captivating, and successful with the aid of learner-centered approaches or a blended learning strategy, making it simple to form desired modifications in the behaviour of the learners.

The learner-centered blended learning strategy gives children a chance to gain knowledge and understanding through a variety of experiences, including chatting, listening, speaking, doing practical work, experimenting, observing, and having discussions. In order to satisfy all learners according to their interests, pace, need, aptitude, maturity, and skill, the instructor must

employ creative and learner-centered teaching methods when creating the learning environment. Learning interests, aptitudes, motivation, and student's capacity to apply knowledge to novel situations are all influenced by a variety of circumstances. The learning opportunities offered by student-centered pedagogy are adapted to the needs of students from different backgrounds (Science Pedagogy, 2018).

The main positive qualities of the blended learning technique are activity and usefulness. By doing so, both the student and the teacher actively collaborate to create new knowledge. The blended learning strategy makes teaching engaging and effective, which improves the teacher's effectiveness and aids in the achievement of the learning goals. Numerous blended learning strategies are now being used in the sector to enhance learning and raise the bar for education. In the classroom, no uniformity is encouraged rather than uniformity through the blending of various instructional strategies. The blended learning approach is individual, personalized for each learner, and appropriate for their backgrounds, aptitudes, and goals. It is important to use information adaptation techniques that take into account this diversity, including reward-based, project-based, multisensory learning, organizing teaching and learning by defining the required scope, working in teams, cooperative learning, learning through peer teams, team learning, inter-class grouping, multiple age teams, and teaching work that is done through self-learning. Associate degree individualized learning programmes are also established to enable this amount of exposure to the concept in the classroom before the teaching of any subject in blended learning. As a result, "alternative and augmented" communication aid students who are having problems acting on their own or without outside assistance (Science Pedagogy, 2018). The utilization of new techniques and activities by teachers during teaching-learning illustrates the relationship between the mixed-learning approach and new technologies. Additionally, the blended learning approach uses ICT and its fundamentally useful components, like package deals, PPTs, academic films, and learning management tools.

Rationale of the Study

There has been a lot of studies carried out on the meta-analysis in the different research areas. Voyer & Voyer (2014) carried out a study on Gender differences in scholastic achievement: A meta-analysis. Schiefele, Krapp & Winteler (1992) carried out a study on Interest as a predictor of academic achievement: A meta-analysis of research. Lomos, Hofman, & Bosker (2011) studied on Professional communities and student achievement – a meta-analysis. Mehana & Reynolds (2004) carried out a study on School mobility and achievement: a meta-analysis. Schroeder & et al. (2007) studied on A meta-analysis of national research: Effects of teaching strategies on student achievement in science in the United States. These researchers discovered that the results varied greatly, with some meta-analyses displaying moderate results, others displaying extraordinarily high results, and still others displaying very low results. The observation of these meta-analysis-related studies shows that the researcher has worked on projects in various areas. According to the limits of the researcher's knowledge, no researcher has conducted a meta-analysis in relation to the effectiveness of blended learning on academic achievement. As a result, it aroused the researcher's curiosity about what conclusions from his meta-analysis were presented in the study he was examining, which looked at the efficacy

of branded education. In an effort to learn more, the researcher tried looking for a meta-analysis of all the studies he had previously included in his study.

Operational Definitions

Blended Learning: Blended learning is learning that combines in-person instruction with online learning. The term "blended teaching strategy" in the current analysis study refers to the numerous teaching modalities in the elect analysis studies.

Effectiveness: Effectiveness is the capacity to produce the desired result or the power to produce it. When an object yields the desired or anticipated outcome, it is said to be effective. Effectiveness in the current analysis relates to the capacity of the blended learning strategy contained in the chosen analysis papers to provide desired results for the learners' educational success.

Meta-analysis: Meta-analysis refers to the methods of applied mathematics used to quantitatively integrate the findings of quantitative analytic assignments (Gupta and Gupta, 2018). Paper meta-analysis in the gift analysis suggests that quantitative integration be achieved by converting quantitative data from elect analysis articles into a uniform scale (effect size).

Research objective

The purpose of the current study was to carry out a meta-analytical assessment of the analysis work pertaining to the effectiveness of the blended learning strategy on students' academic progress. The phrase for the quantitative chemical examination of analytical data is "meta-analysis" (Gupta and Gupta, 2018).

Hypothesis

The blended learning approach has no discernible effect on students' academic achievement.

Sampling and Sampling Techniques

Purposive sampling was utilized in this analysis. As a result, phrases like "blended learning method," "meta-analysis," and "efficacy of mixed learning approach on accomplishment" were used. There were 90 papers available for download between 2015 and 2021. When the researchers started their review, they discovered that the notion had been the main focus of around forty-three investigations. Nobody has quantitative expertise on that. Even though there was a lack of comprehensive knowledge, the remaining twenty-seven pieces of research were detailed and supported this quantitative knowledge. With the use of these insights, a meta-analysis was not feasible. The remaining 20 studies, which gave the information the investigator needed for the meta-analysis, were annexed by the researcher. So that the researchers' analysts pick the final 20 analysis articles and compile a meta-analysis of their findings.

Table-1: Very brief description of selected research papers

S. No.	Publication Month & Year	Volume	Issue	Researcher (s)
1	July, 2015	05	09	M. Deivam and Dr. N. Devaki
2	2015	*Proceedings*		Dhanya Krishnan
3	September, 2016	05	09	Dr.P.S.Chitra and Dr.G.Singaravelu

4	2016	07	35	Khader and Nisreen Saleh Khader
5	December, 2016	13	03	Ya-Wen Lin, Chih-Lung Tseng and Po-Jui Chiang
6	July, 2018	05	01	Amosa Isiaka Gambari, Ahmed Tajudeen Shittu, O. Olufunmilola Ogunlade And Olourotimi Rufus Osunlade
7	November, 2018	*Proceedings*		Thelal Iqab Oweis
8	2018	42	27	Iga Setia Utami
9	September, 2019	05	09	Najeh Rajeh Alsalhi, Mohd. Elmagzoub Eltahir and Sami Sulieman Al-Qatawneh
10	November, 2019	1413	01	F M Hawi And P Sudira
11	December, 2019	19	01	Gie-Ok Noh And Dong Hee Kim
12	August, 2020	13	09	Omar Obaid Alrouji
13	December, 2020	04	02	Barıs Ciftci
14	July, 2020	08	08	Dr. Amaal Al Masri
15	March, 2021	17	04	Najeh Rajeh Alsalhi, Sami Al-Qatawneh, Mohd Eltahir And Khitam Aqel
16	September, 2021	16	09	Athira Balakrishnan1, Sreedharan Nair, Vijayanarayana Kunhikatta, Muhammed Rashid, M. K.Unnikrishnan, P. S. Jagannatha, Viji P. Chandran, Kanav Khera1, Girish Thungaid
17	September, 2021	03	03	Yassine Benhadj
18	November, 2021	12	--	Yuhong Jiang, Yingying Chen, Jiasheng Lu and Yiqing Wang
19	October, 2020	26	01	Cihad Senturk
20	July, 2021	12	07	Dr. Yousef Houssni Zrekat

A brief review of the chosen research papers for the study

Deivam and Devaki in 2015 studied on the efficiency of blended learning in teaching educational psychology to B.Ed. candidates. This study's main objective was to ascertain whether training improved trainees' academic performance in educational psychology. A quasi-experimental research design was adopted for this investigation. 100 student teacher were selected using simple random sampling. Equal randomization groups were created from the experimental group 50 and the control group 50. For the goal of acquiring information, the researcher created and prepared an achievement exam. The words mean, SD and t-test were applied to analyze the collected data. Following data analysis, it was found that student teachers' performance in educational psychology was significantly impacted by blended learning methodologies.

Krishnan (2015) carried out a study

on the Effect of a Blended Learning Strategy on Learning Science. Examining the effects of a mixed learning strategy on secondary-level scientific accomplishment and science process skills was the main objective of this study. In this quasi-experimental design were used, a pre-test, post-test non-randomized control group design adopted. An intentional sampling technique was used to choose an intact group of 36 students as the control group and an intact group of 38 children as the experimental group. A test of science process skills and a test of science achievement were developed and validated by the researcher, and the reliability coefficients (Cronbach Alfa) for each were 0.86 and 0.87, respectively. To better understand the difficulties students had when using the blended learning method, a schedule of interviews was developed. ANCOVA was used to analyse the data. Data analysis demonstrated that science achievement might be improved, and students could become global learners by successfully integrating in-person instruction with online learning.

Chitra and Singaravelu 2016 conducted a study named Potency of Blended Learning In Learning Science. The study's main objective was to evaluate the effectiveness of blended learning in scientific learning. A rational group experimental approach was adopted in the investigation. Sixty ninth-graders from Coimbatore's Gopal Naidu Higher Secondary School served as the study's sample. 30 more students were chosen for the control group, and 30 more were chosen for the experimental group. A self-created achievement test was employed by researchers as a research tool. Achievement contained 25 questions. Using the test-retest approach, the reliability in this study was computed, and the result was 0.76, which is highly significant. To establish the test's validity, the expert judgment

of the co-staff members was obtained. T-test, mean, and SD were adopted to analyze the data. After data analysis, it was discovered that blended learning is superior to third-place learning in learning science for learners in standard 9.

Khader (2016), studied on Effectiveness of Blended Learning in Improving Student Achievement in Bani Kenana. This study's main objective was to see if blended learning, as opposed to the traditional method, could boost kids' performance in the third grade. This research employed a quasi-experimental research design. With the aid of simple random sampling, 108 kids (both male and female) in third grade from one school were chosen for this study. For this study, the researcher created a self-made achievement test. There were 20 multiple-choice questions in the sample. A panel of 12 arbitrators examined the reliability of the test components. The taste reliability was examined by applying the taste to an exploratory sample, and the reliability was assessed using the Pearson correlation coefficient of 0.87. The researcher utilized ANCOVA, ETA square, and two-way to examine the data. After analysing the data, it was discovered that using blended learning as a teaching strategy helped students become less burdened by their academic obligations and gave them the opportunity to learn while having fun. This new approach to teaching gave students a chance to interact with others and enjoy themselves while learning.

Lin, Taseng, and Chiang (2016) carried out a study on the Effect of Blended Learning in Mathematics Courses. The main objective of the study was to investigate how the blended learning approach affected junior high school student's academic performance and attitude toward mathematics. The study

used a pre-test, post-test, and control group quasi-experimental research designs. Out of the total of 54 students, 27 students were selected for the experiment group and 27 students for the control group. Data was gathered using pre-and post-tests. ANCOVA and MANCOVA were used with SPSS 18.0 to analyze the data. The trial group's students benefited from the mixed learning experience by increasing their learning outcomes and also their attitudes toward studying mathematics in a blended learning atmosphere, it was found after data analysis.

Gambar, Shittu, Ogunlade, and Osunlade (2017) carried out a study entitled Effectiveness of Blender Learning and E-Learning Modes of Instruction on the Performance of Undergraduate. The study's main objective was to determine how well undergraduate students are in the Nigerian state of Kwara. In a quasi-experimental context, the study employed a pre-test, post-test control group design. 35 undergraduates were chosen for the sampling with the aid of randomization. 25 people were exposed to the control group, 30 to experimental group I, and another 30 to experimental group II. The Educational Materials and Methods Performance Test was adopted to collect data (EMPT). A reliability coefficient of 0.71 was generated by the Kuder-Richardson (KR-20) formula. Following data analysis, it was shown that exposing undergraduate students to a blended learning mode of instruction increased their performance.

Oweis (2018) studied the Effects of Using a Blended Learning Method on Students' Achievement and Motivation to Learn English. This study sought to determine how blended learning affected the academic performance and motivation of German Jordan University students to learn English. A pilot case study methodology was employed. 34

GJU third- and fourth-year students were chosen for the first semester based on purposive sampling. 16 students made comprised the experimental group, and the control group received other samples (18 students). Data gathering methods included an English proficiency exam and a scale for gauging enthusiasm to learn the language. By giving the achievement test to 24 University professors, the validity of the test was evaluated. Using the Pearson equation, the reliability of the accomplishment test was evaluated, and the dependability percentage was 0.83. ANCOVA and the mean SD were applied to analyze the data. After data analysis, it was shown that the experimental group did much better than the control group and that each group's motivation to learn English differed noticeably.

Utami (2018) studied on the Effect of the Blended Learning Model on Students' Achievement. The study's main objective was to determine how senior high school student's academic performance. A randomized control group pre-and post-test design was adopted in the investigation. 63 students enrolling in an ICT course were chosen at random. The information was gathered via an objective test with 35 questions. The mean, SD, and t-test were applied to analyze the data. After doing a data analysis, it was shown that the blended learning strategy raised student accomplishment levels over those of the conventional learning model.

Alsalhi, Eltehir, and Al-Qatawneh (2019) studied on the Effect of Blended Learning on the Achievement in Science and Attitude toward Its Use. The main aim of the study was to examine how 9th-grade students' attitudes and science achievement were impacted by blended learning. To conduct the study, a case study with a quasi-experimental design was used. Twelve ninth-grade students

were chosen at random. Two groups were made: the experimental group (n=61) and the control group (n=51). A questionnaire and achievement exam were created to collect data. The accomplishment test's reliability was examined by applying the test-retest method, and the coefficient value was 0.88ten members of the university teaching staff were given it to test the taste's veracity. Using SPSS software, Mean, SD, and ANCOVA were utilized to analyze the data. After data analysis, it was discovered that their attitude favored pupils who demonstrated a certain level of academic achievement in a science field.

Hawi and Sudira (2019) studied the Effect of the Blended Learning Model to Improve the Conceptual Understanding of Computer and Network Engineering Students. This study's primary goal was to determine how using a blended learning strategy improved students' conceptual knowledge. For this investigation, the researcher used a quasi-experimental research approach. 58 students were chosen at random; 30 of them were exposed to the experimental group and 28 to the control group. An exam called the essay was employed to collect the data. Data analysis was done using MANCOVA. After data analysis, it was discovered that students who were taught utilizing a blended learning paradigm had a superior grasp of the fundamentals of computer networks.

Noh and Kim (2019) undertook a study entitled Effectiveness of a Self-Directed Learning Program Using Blended Coaching among Nursing Students. The study's primary objective was to determine whether a self-directed learning approach incorporating blended teaching was helpful for nursing students engaged in clinical practise. This study employed a non-equivalent quasi-experimental pre-post-test non-synchronized intervention control group. Convenience sampling was used to select 92 students in total. 47 were regarded as the control group, and 44 as the experimental group. Data analysis revealed that a self-directed learning program with a blended teaching method is an effective educational technique to raise nursing students' happiness with their clinical practice experiences and their skill in putting self-directed learning into practice.

Alroji (2020) study entitled The Effectiveness of Blended Learning in Encouraging Competence in Metagraph Writing. This study's major objective was determining how well-blended learning at Shaqra University improved the English Metagraph writing skills. In this study, the experimental research design was employed. The use of random sampling enabled the selection of 70 students. The experimental group (35) and the control group (35) each received the same amount of the sample (35). (35). Data were gathered using the essay-writing pre- and post-tests given to the participants. Using SPSS, the data was evaluated (version 17). In this investigation, a P-value of 0.05 was regarded as the significant level. Following data analysis, it was found that the control group, which used the traditional teaching approach, performed far better than the experimental group, which used the blended teaching method. This highlights the importance of a blended approach in assisting Saudi students in developing their paragraph-writing skills.

Ciftci (2020) carried out a study on the Effect of Blended Learning on Academic Achievement and Attitude in Social Studies Courses. The study's primary objective was to investigate the efficacy and sustainability of the blended learning approach in social studies lessons. Data were gathered

using both the pre-test and the post-test. The data were analyzed using an ANOVA, mean, and SD. Following data analysis, it was shown that, in terms of student accomplishment persistence, blended learning is superior to face-to-face learning.

Masri (2020) studied on Effectiveness of Using Blended Learning for Teaching English Language Vocabulary to First Grade Students. This study's main objective was to evaluate the effects of implementing a blended learning approach in first-grade classes of public schools managed by the AI-Tafila directorate of education. 46 students were assigned to the experimental group, and 46 students were assigned to the control group out of 92 students who were randomly selected. Data were gathered using an English vocabulary exam that was created by the researcher. Using Abel's and Godard Richard coefficients, respectively, the validity and reliability were examined. The test's coefficient value was 0.762. Mean, SD and the t-test were employed to analyse the data. After data analysis, it was discovered that students who used the mixed-learning approach had greater grades than those who used the traditional approach.

Alsalhi, Al-Qatawneh, Eltehir, and Aqel (2021) carried out a study on Does Blended Learning Improves The Academic Achievement Of Undergraduates. The main objective of the study was to ascertain the effects of blended learning on undergraduate students' performance in mathematics (MTH 121) at Ajman University. In the investigation, a quasi-experimental methodology was adopted. Male and female students enrolled in mathematics classes totaling 196 were chosen and divided into experimental (99 students) and control groups (97 students). The researcher created an achievement test to collect data. The test's reliability was examined using the test-retest method, which yielded a coefficient value of 0.801. Also used were the average, standard deviation, the Independent Sample T-test, and one-way ANCOVA. The researchers used the SPSS tool to analyse the study's data. Following data analysis, it was shown that the experimental group had an advantage over the control group on the accomplishment exam due to measurably significant differences between the two groups.

Balakrishnan et al. (2021) conducted a study entitled Effectiveness of Blended Learning in Pharmacy Education. This study aimed to assess how well-blended learning works in pharmacy education. An experimental research design was employed. Using cluster randomization, a total of 241 individuals from 12 colleges were chosen. SPSS version 20 was used for all of the statistical analysis. The data analysis employed means standard deviation, the Sapiro-Wilks test, and the Games-Howell test. To determine the relationship between variables, use Spearman correlation. Mann The Whitney U-test was used to examine the differences in the students' opinions in the WEL and BL groups. The students in the mixed learning group employed all learning and motivational methods more frequently than the students in the didactic and web-based e-learning group, except intrinsic goal orientation, task value, control of learning belief, and help-seeking techniques.

Benhadj (2021) undertook a study entitled A Quasi-Experimental Study on the Impact of Blended Learning on EFL Students' Language Proficiency. The study sought to determine what impact blended learning has on Moroccan high school students' command of the English language. 79 Moroccan first-year bachelorettes in total conveniently, students between the ages of 16 and 18 were chosen to participate in this experiment. 39 students were chosen for

the control group, and 40 students were randomly assigned to the experimental group. Pre-tests and post-tests were employed to collect data. Maemillam Publisher created and validated the simple rapid placement and diagnostic test (placement test, 2012). With a score of 0.78, Cronbach Alpha was used to gauge consistency. It was thought to be highly reliable. Mean SD and ANCOVA were employed in this study to analyze the data. Following data analysis, it was shown that blended learning presents a significant chance to inspire students of any gender to study and advance their English proficiency skills.

Jiyang Chen and Wang (2021) carried out a study on the the Effect of the Online and Offline Blended Teaching Model On English as a Foreign Language. The study examined how online and offline mixed learning modes affected students' learning outcomes. The researcher used a hybrid approach to the study, combining qualitative and quantitative research. 95 participants were chosen by means of convenience and cluster sampling. 42 people were recruited for the experimental group, and 53 were chosen for the control group. The data T-test and paired sample test were used for analysis with SPSS 26.0. In this work, Pearson correlation analysis was used to pinpoint the variables influencing various EC and CC pre- and post-test components. After data analysis, it was discovered that the blended exercise was helpful in improving students' listening skills. Additionally, students' attitudes toward learning English by hearing have changed from a generally unfavorable enhancement to one that is more positive. At the same time, student interests have increased, and their learning strategies have become more varied.

Senturk (2020) studied the Effects of the Blended Learning Model on Pre-Service Teachers' Academic Achievements. The primary goal of the study was to investigate how pre-service teachers who had taken the teaching principles and technique courses fared academically and in terms of 21st-century skills. The study employed a pre-test and post-test quasi-experimental research design. A total of 172 pre-service teachers were selected through purposeful sampling. The experimental group was given 86 people, while the control group received 86 participants. The Multidimensional 21st Century Skill Scale and Academic Achievement Test were both used in this study to gather data. The data were analysed using Kolmogorov-Smirnov and Sapiro-Wilk Z-tests. When the data was analysed, it became clear that the experimental group had considerably more academic success and 21st-century abilities than the control group.

Zrekal (2021) studied on the Effectiveness Of Blended Learning In the EFI Context: An Experiment Study At Arab Open University KSA. The study's primary goal was to determine whether blended learning was beneficial, especially in terms of enhancing students' ability to speak English at an Arab institution in Saudi Arabia. They divided into two groups: a control group, which consisted of 30 pupils, and an experimental group (30 students). Data was gathered through an online assignment that was sent via email. The SPSS software was used for data analysis to calculate the Mean, SD, and percentage of achievement scores for each group. After data analysis, it was discovered that blended learning enhances students' informal foreign language acquisition while also helping to improve student learning results.

Data collection

The researcher gathered quantitative data for the current study project from all of the chosen research papers. The following table includes information about that:

Table-2: Details of Quantitative Data of Selected Research Papers

S. N.	Researcher	Group	N	Mean/ Adjusted Mean	SD	F/t
1	Deivan and Devaki (2015)	Experimental	50	38.46	2.22	t=15.11
		Control	50	32.98	1.38	
2	Krishnan (2015)	Experimental	35	38.12	–	F=16.632
		Control	36	33.80	–	
3	Chitra and Singaravelu (2016)	Experimental	30	36.32	3.64	t=14.80
		Control	30	23	3.32	
4	Khader (2016)	Experimental	54	18.13	2.26	F=21.004
		Control	54	15.78	3.10	
5	Lin, Tseng and Chiang (2016)	Experimental	27	64.30	24.39	F=5.23
		Control	27	54.70	28.58	
6	Gambar, Shittu, Ogunlade and Osunlade (2017)	Experimental	30	18.73	–	F=14.035
		Control	25	14.68	–	
7	Oweis (2018)	Experimental	16	32.269	6.609	F=6.253
		Control	18	29.456	5.995	
8	Utami (2018)	Experimental	31	82.5	6.117	t=5.657
		Control	32	72.9	7.328	
9	Alsalhi, Eltehir and Al-Qatawneh (2019)	Experimental	61	16.11	1.67	F=3.054
		Control	51	14.12	1.60	
10	Hawi and Sudira (2019)	Experimental	30	74.86	–	F= 29.063
		Control	28	67.89	–	
11	Noh and Kim (2019)	Experimental	91	8.13	1.17	t=3.10
		Control	91	7.10	1.88	
12	Alrouji (2020)	Experimental	35	30.86	5.801	t=-20.094
		Control	35	20.37	4.551	
13	Ciftci (2020)	Experimental	26	77.69	4.64	F=119.749
		Control	26	63.07	4.69	
14	Masri (2020)	Experimental	46	2.79	1.34	t=5.28
		Control	46	5.82	2.68	
15	Alsalhi, Al-Qatawneh, Eltehir and Aqel (2021)	Experimental	99	16.87	2.10	F=9.657
		Control	97	12.74	1.89	
16	Balakrishnan et. al. (2021)	Experimental	92	39.39	11.02	F=30.50
		Control	86	33.50	6.63	

17	Benhadj (2021)	Experimental	40	39.50	7.51	F=30.29
		Control	39	28.17	8.72	
18	Jiang, Chen, Lu and Wang (2021)	Experimental	42	22.74	2.61	t=7.069
		Control	53	18.77	2.79	
19	Senturk (2021)	Experimental	86	43.04	1.82	t=14.801
		Control	86	34.68	4.90	
20	Zrekat (2021)	Experimental	30	82.40	12.12	t=2.75
		Control	30	73.47	13.03	

The quantitative information gathered from the content analysis of a few chosen research publications is shown in the table above. Maximum data was gathered during the within-content analysis process, accounting for the sample size, mean or adjusted mean, standard deviation, t-value, and F-value.

Data analysis and interpretation

Quantitative information was acquired for the current study project in order to carry out a meta-analysis. Meta-objective analysis's is to statistically combine the results of related study types. Meta-analysis may calculate the average effect size by converting the numerical results from several studies into a consistent scale (Effect Size) (Gupta and Gupta, 2018). The current study used Meta Essentials software to do a meta-analysis on the collected quantitative data. The programme is freely available on the website of the Erasmus Research Institute of Management (ERIM), which is housed at the University of Rotterdam in the Netherlands. This software's unique feature is that it transforms the impact size into the average effect size using little quantitative data from a variety of research (Gangwar, 2022).

The following table displays the findings of the quantitative data analysis performed using Meta Essentials software.

**Table-3: Study-wise Individual Effect Size and Average Effect Size**

S. No.	Researcher(s)	Effect Size	Interpretation
1	Deivan and Devaki (2015)	3.00	Vary Large Effect Size
2	Krishnan (2015)	0.96	Large Effect Size
3	Chitra and Singaravelu (2016)	3.77	Vary Large Effect Size
4	Khader (2016)	0.88	Large Effect Size
5	Lin, Tseng and Chiang (2016)	0.61	Moderate Effect Size
6	Gambar, Shittu, Ogunlade and Osunlade (2017)	1.00	Large Effect Size
7	Oweis (2018)	0.84	Large Effect Size
8	Utami (2018)	1.41	Vary Large Effect Size
9	Alsalhi, Eltehir and Al-Qatawneh (2019)	0.33	Small Effect Size
10	Hawi and Sudira (2019)	1.40	Vary Large Effect Size
11	Noh and Kim (2019)	0.46	Small Effect Size

12	Alrouji (2020)	4.75	Vary Large Effect Size
13	Ciftci (2020)	2.99	Vary Large Effect Size
14	Masri (2020)	1.09	Large Effect Size
15	Alsalhi, Al-Qatawneh, Eltehir and Aqel (2021)	0.44	Small Effect Size
16	Balakrishnan et. al. (2021)	0.82	Large Effect Size
17	Benhadj (2021)	1.23	Large Effect Size
18	Jiang, Chen, Lu and Wang (2021)	1.45	Vary Large Effect Size
19	Senturk (2021)	2.25	Vary Large Effect Size
20	Zrekat (2021)	0.70	Moderate Effect Size
Average Effect Size		1.46	Vary Large Effect Size

It is evident from the observation of the aforementioned table that all investigations, with the exception of studies (9), (11) and (15), exhibit average to large effect sizes (Cohen, 1988). The average effect size across all studies is displayed in the table's final row with a value of 1.46. The Cohen effect size number displayed in the reference table is more than 1.2. (Cohen, 1988). That means the effect magnitude is really large. Thus, it can be drawn that the blended learning strategy significantly affects the academic achievement of the pupils.

Graph-1: Forrest Plot of Effect Size
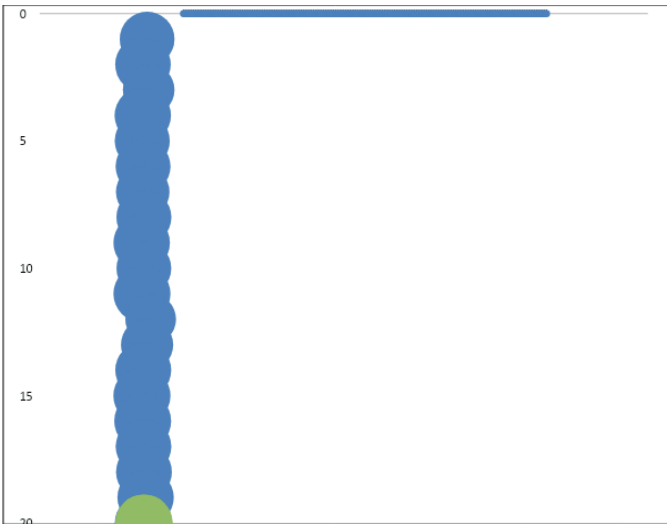
It is evident from looking at the effect size forest plot that the scale of the effect size is marked on the x-axis at the top of the plot. The Forest plot's midpoint, except the bottom row, indicates the effect size of a single research with a fidelity interval of 95 per cent. The outcome of the meta-analysis is shown by the lowest row (summary row) of the Forest plot. Two gaps are present around a midway in this Meta-analytical result of Meta-essentials (line 21 in graph 1). With a value of 1.46, this midpoint denotes the average impact size, also known as the combined effect size or the weighted average effect size.

Table-4: Z-value and Significance value

Z-value	5.62
One-tailed p-value	0.000
Two-tailed p-value	0.000

It is clear from Table 4 that the two-tailed significant value of 0.000 at the 0.05 significance level and the z-value of the mean impact size are both zero. This number is significant at the 0.05 significance level because it is less than 0.05. This makes it possible to reject the null hypothesis that the blended learning approach has no discernible effect on students' academic achievement. Therefore, it may be argued that the blended learning strategy significantly affects students' academic advancement.

Research Conclusion and Interpretation

The purpose of the current study was to undertake a meta-analytical investigation of previous research on the impact of blended learning on students' academic progress. The investigator discovered, after examining the quantitative data, that the learners' educational success is significantly impacted by the blended learning technique. In their many meta-analytical studies, these researchers also discovered that innovative and student-centered teaching strategies have a positive and pregnant influence on students' academic achievement at various levels and that these strategies' effects are also very large. The main factor influencing the scope of the current investigation is the organized and uncomplicated way in which the subject matter selected for instruction using a mixed learning strategy was presented while taking into account the learners' age, interest, attitude, and individual differences. Every learner is provided the opportunity and space

they need to explore the subject at their own speed. Kids are inherently active, and when learning through blended learning, the child stays active and employs the majority of his or her senses, which facilitates learning. One of the reasons for this analytical volume is also due to the involvement of young people. Additionally, the blended learning approach's concept, which considers both the role of the student and the teacher as a helper, is used in the classroom to construct learner-centered learning systems and learning efficiently in learning ecosystems where the learner is in the lead role. The outcomes of this analysis may even be attributable to this in a substantial way.

Educational Implications

The following are the educational consequences of this analysis work:

For policymakers

According to the study's findings, students improve their tutorial performance by demonstrating information-supported curiosity, self-discipline, and individual variety in a highly stimulating learning environment produced in their classrooms with the use of a blended learning strategy. In light of those findings, this study can provide a platform for increasing the knowledge of academic policymakers and disciplines, enabling them to create curricula that are supported by integrating learning principles while creating curricula for diverse courses.

For lecturers

The findings of the present study

can help instructors choose the most modern teaching techniques. For various subjects, the nature of the subject content is fundamentally different. that the instructor selects entirely unique teaching strategies. The results of the current analysis show that the mixed-learning approach will boost the student's academic accomplishment. Based on this assumption, the instructor will use the mixed learning method to create a significant improvement in the student's accomplishment.

For choosing the best methods for academic analysis

In place of old methods, a blended learning strategy is currently being applied to track students' educational progress. These assessment techniques let the teacher evaluate the student's academic progress as well as his or her own learning so that he can make the required adjustments to the teaching-learning process in his or her discipline (Gangwar and Singh, 2020). According to the National Policy on Education, 2020, professors should employ student-centered and innovative assessment strategies such as rubrics, portfolios, projects, and cluster activities to evaluate students' information in a manner comparable to how data is compiled. Recent research can introduce professors to a blended learning strategy that improves tutorial success. As a result, the instructor will incorporate the proper blended learning approaches, such as concept-related tasks, portfolios, rubrics, etc., at the side of the teaching-learning method for formative analysis of the students' many subject areas.

For book authors

According to the study's findings, a blended learning approach significantly affects how well pupils learn a subject. In this context, our analysis work will also serve as a foundation for book authors of many subject areas to organize the information included in their books in enticing, student-centered, systematic ways that make it simple for students to learn new things.

For alternative researchers

Researchers will also benefit from this analysis's methodology and scope. The World Health Organization is interested in and needs to use meta-analytical analysis research.

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