A Study of Blended Learning Attitude Towards Biology

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Abstract - This research looks at how Madhya Pradesh senior high school students' views about biology are affected by blended learning. A control group was instructed using conventional techniques, while an experimental group was exposed to blended learning tactics as part of a quasi-experimental study design. A validated Biology Attitude Questionnaire was used to gather data, and paired and independent sample t-tests were among the statistical tests used for analysis. The findings showed that both groups' views about biology had improved, with the experimental group having a little edge. The small overall impact size, however, indicates that while blended learning has promise, its efficacy relies on readiness and appropriate execution. The research emphasizes how crucial it is to include technology into teaching in order to improve learning results and cultivate positive attitudes.

Keywords: Biology, Attitude, Blended Learning, Teaching, Technology, Education.

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INTRODUCTION

When our species first emerged, we had no idea what any of the natural world had to offer. It was at this time that we began to glean knowledge from the natural world. We learned to persevere in the face of adversity from Mother Nature. They had to fight off wild creatures and destroy the environment at the same time.[1] They began developing their brains at a rapid pace and improved their adaptive capacity as a consequence of their experiences in a constantly changing environment. Individuals' efforts to stay alive; as a species, humans adapt to the natural world by following its rules. Along the way, they saw natural disasters and other phenomena that piqued their curiosity and eventually gave rise to science. This is where they learnt the most from mother nature. [2] From the invention of the wheel to the development of AI, science has taken us on a multi-faceted journey. We learnt about the Vedic education strategy throughout the Vedic time, and it was subsequently expanded upon in Gurukulam. The modern purpose of K-12 institutions, colleges, and universities is to educate future generations and help them become productive members of society. [3]

Personal development and maturation take place naturally and continuously throughout the educational process. The process really helps shape people into their unique selves while also making their lives more convenient, comfortable, culturally specific, and polite. The two most crucial aspects of education are learning and teaching. Acquiring information is the ultimate purpose of education, and this can only be achieved via a well-designed system that is time-bound, needs-based, and goal-oriented. [4] Better and more meaningful lives will be provided to the country and its people as a result of this. A key component of the education sector should include educational technology, according to the National Policy of Education (1986). In 2020, the Indian government unveiled its new national education policy. Through this education strategy, the Ministry of Human Resource Development (HRD) said that instructional technology should get particular attention. In universities with a wide range of academic programmes.[5]

Propose a Bachelor of Education (B.Ed.) degree programme that spans four years combined They may now provide high-quality B.Ed. programmes via blended learning thanks to their certification in open and remote learning. Blended learning in part-time special education courses is becoming the norm. [6] Blended learning has the potential to speed up activity-based and experiential learning while simultaneously covering the social, emotional, and psychomotor domains of learning; thus, all educational institutions with high-quality online resources and an open or distance learning model should switch to this approach. A focus on fostering digital literacy has been made. Both traditional classroom instruction and the ability to use technology effectively are emphasised in the national

strategy for education 2020 as critical to a child's holistic development. So, to get around both issues, blended mode is the way to go. [7]

What we call "blended learning" combines the best features of both online and traditional interactive learning environments. Blended learning techniques were defined as an approach to education that makes use of online delivery of some but not all course material in order to cut down on classroom time wasting. "The combining of the two different education models, traditional face to face learning and distance learning" was how) defined blended learning. The term "blended learning" may refer to a number of different approaches to education that combine face-to-face classroom time with online resources, use many learning theories, techniques, and tactics in a single context, and ultimately improve student learning. [8]

Blended learning combines online and offline components to provide a stable and effective learning environment that strikes a good balance between open communication and limitless access. [9] The first step in developing a well-balanced platform is the strategy, which must take into account the platform's requirements, aims, and objectives; the second step, operational planning, must address non-institutional items such as the availability of internet, an evaluation tool suite, and necessary resources. The findings of this study highlight the need for more research into the relationship between blended learning and student outcomes such as satisfaction, self-efficacy, accomplishment, and so on. [10]

RESEARCH METHODOLOGY

Class XI, or senior high school students in Madhya Pradesh, are the focus of this study because researchers want to understand more about their biological attitudes as well as the possible effects of blended learning methodologies on their academic performance. In order to get the intended results of the research, a quasi-experimental approach was used.

Here, the researcher need two sets of students: one to serve as a control and another to conduct the experiment. In order to determine if blended learning techniques had any impact on accomplishment scores in biology, and attitude towards biology, the experimental group was treated with these strategies. After that, we collected data and compared the two groups' mean scores on the pretest and posttest to arrive at our conclusion.

Method

There are a total of twenty-four questions in the final version of the Biology attitude questionnaire (Prokop, Tuncer&Chuda, 2007) that are organized along six dimensions: interest, career, significance, instructor, difficulty, and equipment. The result is obtained using a five-point Likert scale, with "strongly disagree" as the extreme end of the spectrum and "strongly agree" as the middle point. The first administration of the measure was part of a cross-age research including children in grades 5–9. Results for each of the six dimensions showed Cronbach's alpha values ranging from 0.69 to 0.36 after administration to students in Slovakia. Despite the relevance of the findings, two factors were identified as having poor reliability: the equipment dimension (0.36) and the difficulty dimension (0.46). In order to prevent the incorrect computation of the outcome, they were further investigated. There was excellent reliability shown by Cronbach's alpha for "interest (α =0.68), career (α = 0.62), importance (α = 0.69), and teacher (α = 0.62)".

The current research drew its data from five separate Madhya Pradesh Board of Higher Secondary Education high schools. The data used in this research came from 700 students, with 640 of those individuals being senior high school students. A total of 421 male students and 219 female students expressed their views on the subject of biology.

Results analysis

The current study's 640-person sample size yielded a sufficient KMO value of 0.916, a chi-square value of 2444.256, and a significant P value below 0.5.

Analyzing reliability

The study's dependability was determined to be 0.944 using Cronbach's alpha, a statistically significant metric. The Part A and Part B split half reliability coefficients were 0.885 and 0.938, respectively, while the Spearman Brown and Guttman split half coefficients were 0.817 and 0.813, respectively. The overall item correlation (Figure 1) ranged from 0.405 to 0.752, which is considered satisfactory as all 24 items had correlation values of 0.40 or above (Bosc, Dubini and Polin, 1997).

The following are the Cronbach Alpha values for all of the identified dimensions: The interest towards biology dimension has a mean score of 42.12, a variance of 174.408, and a standard deviation of 13.206 for a total of 12 items; the biology teacher dimension has a mean score of 13.62, a variance of 26.433, and a standard deviation of 5.141 for a total of 4 items; and lastly, the interest towards biology dimension has a score of 0.952. For the Biology dimension, the computed alpha is 0.897, the mean is 27.49, the variance is 75.339, and the standard deviation is 8.680. There are a total of 08 items in this dimension.

The end result was obtained by doing EFA and CFA. A reduction in RMSEA between 0.05 and 0.10 is considered a demaration of According to MacCallum et al. (1996), values below 0.10 indicate a good match, whereas values above demonstrate a poor fit. In this case, the result is 0.051, which meets the requirements. Figure displays the many indices that were discovered by EFA and CFA. Figure, which illustrate the results of principal component analysis, reveal that three predictable dimensions account for 66% of the variation. All values are acceptable since the communalities values (Table 3.20) are suitable

for 24 items with values between 0.36 and 0.81; values greater than 0.3 are also considered acceptable. Three dimensions with varimax rotation are also shown in the rotated component matrix of principle component analysis. A CFA analysis flowchart was generated using the factor loading value from Table as shown in Figure.

Table 1: Product-Level Data

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation
Q01	79.75	450.851	0.596
Q02	79.4	458.134	0.563
Q03	80.04	455.58	0.501
Q04	79.24	457.484	0.555
Q05	79.43	449.964	0.602
Q06	80.16	464.606	0.405
Q07	80.08	452.696	0.497
Q08	80.05	457.838	0.423
Q09	79.49	443.965	0.731
Q10	79.82	450.388	0.639
Q11	79.79	454.461	0.570
Q12	79.81	447.785	0.715
Q13	79.68	442.932	0.752
Q14	79.64	447.229	0.719
Q15	79.65	448.527	0.694
Q16	79.83	444.192	0.657
Q17	80.09	448.374	0.623
Q18	79.55	447.209	0.699
Q19	79.89	447.149	0.672
Q20	79.77	450.809	0.550
Q21	79.48	445.696	0.735
Q22	79.79	447.218	0.675
Q23	79.74	446.394	0.748
Q24	79.58	446.431	0.740

Confirmatory factor analysis was performed on the original six-dimensional scale and the results were determined to be insignificant for the current investigation. Repetition of the same procedure with 5 and 4 dimensions likewise yielded insignificant results. The result is an Indian adaptation of the Biology Attitude Questionnaire based on the scale's three-dimensional structure. The prior research identifies three components: 1. Passion, 2. Instructor, and 3. Challenge

Table 2: The test's consistency indices

| Consistency Index	Acceptable Range	Reference	Value	Result
χ^2/sd	<5 Medium consistent <3 well consistent	Atici and Midilli,2020	2444.256/639 = 3.82	High Medium consistent
CFI	>0.90	Atici and Midilli,2020	0.944	Acceptable
NFI	>0.90	Atici and Midilli,2020	0.931	Acceptable
RFI	>0.85	Atici and Midilli,2020	0.869	Acceptable
PCFI	>0.80	Atici and Midilli,2020	0.844	Acceptable
Pclose	>0.05	Atici and Midilli,2020	.073	Acceptable
RMSEA	<0.08	Atici and Midilli,2020	.051	Acceptable
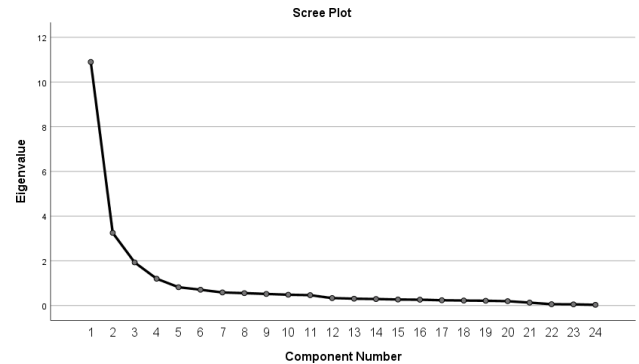
Figure 1: A three-dimensional scatter plot

Difficulty

The way a teacher presents the material in class is the most important element in shaping how Indian students perceive the difficulty of biology. In terms of difficulty, most students ranked biology around the top. The distribution of students who chose biology as a "easy" subject, however, was not random. Regardless of grade, biology was deemed an easy subject by students. In addition, many students have expressed satisfaction with the biology instruction they get at their school.

Table 3: Analyzing the difficulty dimension using univariate ANOVA

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	330.801a	14	23.629	12.530	.000
Intercept	1804.678	1	1804.678	957.025	.000
Presently studying	3.604	2	1.802	.956	.385
@Difficulty	129.226	4	32.306	17.132	.000
Presently studying * Difficulty	34.437	8	4.305	2.283	.021
Error	1178.573	625	1.886		
Total	9065.000	640			
Corrected Total	1509.373	639			

a. R Squared = .219 (Adjusted R Squared = .202)

Table 4: Dependability of the challenges dimension

Cronbach's Alpha	N of Items
.897	8

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Table 5: Dimension of difficulty mean and standard deviation

	Mean	Std. Deviation	N
Q01	3.46	1.428	640
Q02	3.81	1.222	640
Q03	3.16	1.464	640
Q04	3.96	1.263	640
Q05	3.77	1.448	640
Q06	3.04	1.331	640
Q07	3.12	1.598	640
Q08	3.15	1.585	640

Table 6: Total correlation of items

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item Total Correlation	Cronbach's Alpha if Item Deleted
Q01	24.03	57.400	.735	.879
Q02	23.68	60.052	.728	.881
Q03	24.32	58.438	.659	.886
Q04	23.53	60.068	.699	.883
Q05	23.71	56.912	.747	.877
Q06	24.44	62.926	.504	.899
Q07	24.36	55.434	.729	.879
Q08	24.33	57.012	.661	.886

RESULTS

Characteristic Statistics for Perspective of Biology

Each of the three factors attitude towards Biology, anxiety, and achievement was subjected to descriptive analysis. Before and after the exam, researchers compared the control and experimental groups on a measure of attitude towards biology. We used an adjusted Biology Attitude Questionnaire to get the results. In the survey, a score of 24 was considered very low and a score of 120 was considered very high. Scores between 24 and 56 on the attitude questionnaire indicate a lack of enthusiasm for biology, while scores between 57 and 87 indicate a moderate degree of enthusiasm, and scores over 88 indicate a strong level of enthusiasm. Table displays the results of the calculations for the accomplishments variable, including the mean, standard deviation, skewness, and kurtosis.

The distribution is likely to be normal, as the values of the Mean of pretest scores do not differ appreciably. For Skewness, the typical range is +1 to -1, while for Kurtosis, it's +2 to -2. Table displays the values that fall beneath the previously mentioned value. Therefore, it is reasonable to presume that the sample follows a normal distribution based on these numbers.

Table 7: Characteristic Statistics Principles for a mindset about biology

Dependent Variable	Group	Test	N	Mean	SD	Skewness	Kurtosis
Attitude towards Biology	Control	Pretest	35	50.54	19.55	0.758	-1.138
		Posttest	35	92.71	8.543	0.891	-1.420
	Experimental	Pretest	35	46.11	18.32	.301	1.390
		Posttest	35	93.37	11.44	.424	-.488

The results of the t-test are likewise consistent with the normal distribution assumption since all of the numbers in Table. demonstrate this.

Test of Normality for Attitude Relating to Biology Variable

The results of the parametric test for statistical analysis are confirmed by the normal distribution of the data. We used the Shapiro-Wilk and Kolmogorov-Smirnov tests of normalcy to find out. The present investigation makes use of 35 participants for the control and experimental groups, respectively. A tiny sample size is what this represents. Typically, the Shapiro-Wilk test is used for determining whether data is normally distributed when dealing with small samples. The results of the current research on attitudes towards biology are shown in Table, along with the results of the test of normalcy.

Table 8: Normality Test for Bioethics Attitude

Dependent Variable	Group	Test	Kolmogorov-Smirnov			Shapiro-Wilk			Distribution
			Statistic	Df	Sig.	Statistic	df	Sig.	
Attitude	Control group	Pretest	.339	35	.070	.770	35	.120	Normal
		Posttest	.115	35	.200	.921	35	.154	Normal
	Experimental	Pretest	.414	35	.2OO	.864	35	.159	Normal
		Posttest	.126	35	.179	.951	35	.121	Normal

How important the Shapiro-Wilk and Kolmogorov-Smirnov tests are A normalcy test result greater than 0.05 suggests that the sample is normal. All of the significance values in table 4.11 are more than 0.05. It follows that the data distribution is normal in this case. In light of this presumption, we computed parametric tests, namely t-tests (both independent and paired sample t-tests), to aid in our data analysis.

Independential Medication

Testing hypotheses relies heavily on inferential statistics. When comparing the results of the control and experimental groups in a quasi-experimental research, inferential statistics is a crucial tool. Parametric tests are often used for samples that are regularly distributed. determine the difference between two groups by comparing their means using a T-test; determine the difference between more than two groups by doing an ANOVA. Conversely, non-parametric tests are carried out for samples that do not follow a normal distribution.

Independential Statistics for a Biological Attitude

Here, parametric tests were used to compare the means of the Control group with the Experimental group with respect to the dependent variable, which is their attitude towards biology. In this investigation To determine the quantitative measurement from the same group, whether it is the control group or the experimental group, individually, a paired sample t-test is used. The comparison between the

experimental and control groups was determined using an independent sample test.

Paired Sample 'T' Test for Control Group Attitude towards Biology

The control group's pre- and post-test results are included in the paired sample t-test along with all measurements of descriptive statistics, such as mean, standard deviation, mean difference, data set number, p-value, and t-value. In this case, we use a paired sample t test to determine how the conventionally taught set of students feels about biology.

A substantial difference between the pretest and posttest scores of the control group treated with traditional methods of instruction was sought for in order to test the following null and alternative hypothesis.

H0(5): There is no significant impact of the usual approach used in the control group on the mean attitude score of XI standard biology students.

The control group's pre- and post-test scores do not vary significantly, according to the null hypothesis. Its purpose is to determine if there is a statistically significant difference between the control group's pre- and post-test results. So, we put the theory to the test and show you the findings in the table. The results of a paired sample t test were provided below for the variable attitude towards biology for the control group.

Table 9: Results of the Paired Sample t test for the control group's perspective on biology

Group	N	Test	Mean	SD	Mean Difference	t- Value	df	P (2 tailed)
Control	35	Pretest	50.54	19.55	42.17	10.671	34	.000*
	35	Posttest	92.71	8.543				

A paired sample t test reveals a statistically significant difference between the control group's pretest and posttest core means. To sum up, the null hypothesis is obviously false. There was a statistically significant change in the control group's attitude towards biology between the pretest and posttest scores.
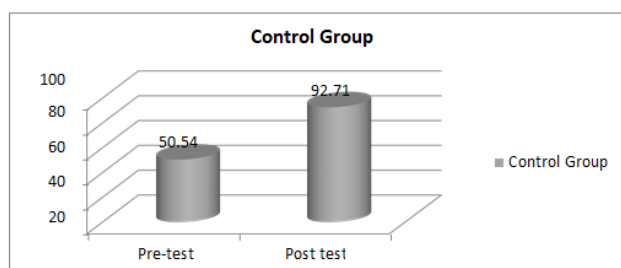

Figure 2: Mean results for the control group's attitude towards biology on the pretest and posttest.

Students in the control group had an average posttest score of 92.71, a pretest score of 50.54, and a t-value of 10.671 with a p-value of 0.00. This finding suggests that there is a significant difference in the way students in the control group approach biology when taught using the usual manner.

In the current research, the control group was taught using the standard manner. Their positive outlook on biology scores is strongly correlated with the results of the traditional classroom approach of instruction. Attitude scores towards biology improved in the control group subjected to the traditional way (t value=10.671 and p=0.00), according to the results.

Paired Sample 'T' Test for Experimental Group's Attitude towards Biology

The paired sample t-test incorporates all measurements of descriptive statistics, such as the experimental group's pre- and post-test means, standard deviations, data sets, p-values, and t-values. In this case, we use a paired sample t test to determine how the experimental group's blended-learning biology students felt about the subject.

H0(6): There is no significant difference regarding the experimental group's pupils in the XI standard's attitude towards biology on the pre- and posttest scores.

There is no statistically significant change in the experimental group's performance between the pre- and post-tests, according to the null hypothesis. Its purpose is to determine if there is a statistically significant difference between the experimental group's pre- and post-test results. So, we put the theory to the test and show you the findings in the table. The following are the findings of a paired sample t test on the experimental group's attitude towards biology as a variable.

Table 10: Results of the Paired Sample t test for the experimental group's perspective on biology

Group	N	Test	Mean	SD	Mean Difference	t- Value	df	P (2 tailed)
Experimental	35	Pretest	46.11	18.324	47.26	13.163	34	.000*
	35	Posttest	93.37	11.443				

At the 0.05 level, a paired sample t test for the experimental group reveals a significant difference between the control group's pretest and posttest core means. The findings of the experimental group's pretest and posttest differed significantly, leading to the rejection of the null hypothesis.
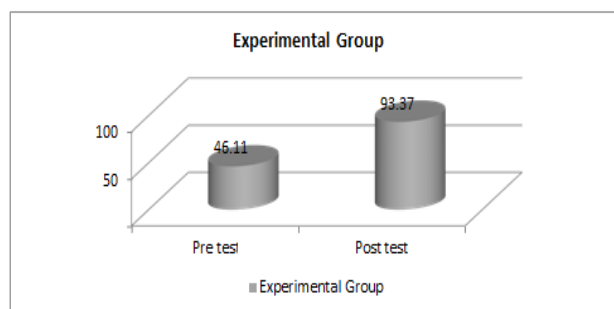
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Figure 3: Mean results for the experimental group's attitude towards biology on the pretest and posttest.

Students in the control group had an average posttest score of 93.37, a pretest score of 46.11, and a t-value of 13.163, with a p-value of 0.00. Students in the experimental group demonstrate a significant change in their attitude towards biology when exposed to the integrated learning technique, according to this finding.

In this research, the experimental group participated in a blended learning approach that combined traditional classroom instruction with online resources to foster student-teacher and instructor-student interaction. They were able to study more effectively because to the audiovisual materials used in the classroom. The current research found that the experimental groups' attitudes regarding the biology curriculum improved significantly after participating in the blended learning program. The efficacy of blended learning in fostering a growth mindset among students has been the subject of a great deal of prior study. Blended learning was determined to be helpful in fostering a positive attitude towards mathematics, according to the study's results, which evaluated its effectiveness in an introductory mathematics course. Designed to measure the impact of flipped classroom instruction on ninth grade biology students' study habits, interest in science, and academic performance. Blended learning was successful in increasing interest in and enthusiasm for biology and other STEM fields. Learning becomes more engaging when technology is included into the process, allowing for the expression of personality on the part of both the instructor and the students.

Self-Sample 'T' Test for Attitude Towards Biology For Expert Group And Control

In order to compare the two groups, researchers use an independent sample t test. When two groups are given different treatments, this test is used to see which one works best. In this research, the control group received traditional instruction while the experimental group received integrated learning techniques. Hence, to determine the efficacy of the blended learning program, we compare the two groups' means scores.

H0(7): There is no significant difference considering the pupils in the XI standard control and experimental

groups' pre- and posttest results regarding their attitudes towards biology.

Its purpose is to determine if there is a statistically significant difference between the control and experimental groups' means, i.e., their pre- and post-test scores. Thus, the hypothesis is put to the test, and the outcomes are laid up in a table. The following are the findings of an independent sample t test on the variable "attitude towards biology" for both the control and experimental groups.

Table 11: Results of an independent sample t test showing attitudes towards biology in the control and experimental groups

Test	Group	N	Mean	Standard Deviation	T	p
Pretest	Control	35	50.54	19.55	1.125	0.268
	Experimental	35	46.11	18.32		
Posttest	Control	35	92.71	8.543	0.272	0.786
	Experimental	35	93.37	11.44		

Pretest results for the experimental and control groups showed a t-value of 1.125 and a p-value of 0.268, both of which are more than the significance threshold of 0.05. Therefore, the null hypothesis is upheld. Hence, it is shown that there is no significant difference in the average pretest scores of the control and experimental groups of students.

In this research, we discovered no statistically significant difference between the control group's and the experimental group's post-test mean scores (t=0.272, p=0.786, which is larger than 0.05). Therefore, we accept the null hypothesis. The results show that there was no substantial change in students' attitudes towards Biology using the Blended approach, since the average scores on the attitude questionnaire in the posttest did not vary significantly between the control and experimental groups.
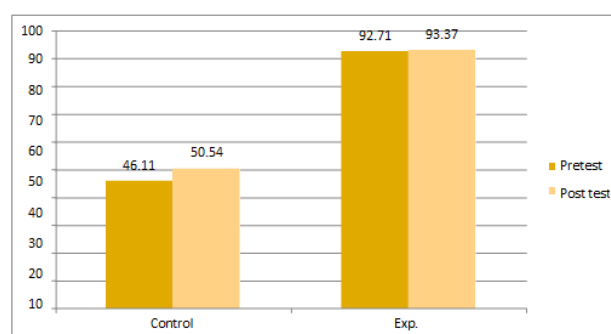

Figure 4: Mean pre- and posttest scores for the experimental group's and the control group's attitudes towards biology

For the experimental group, the mean scores on the pretest and posttest are 93.37 and 92.71, respectively. Students in the control group, in contrast, averaged 50.54 and 46.11 on the post- and pretests, respectively. Both groups demonstrate remarkable progress in fostering an optimistic

outlook on Biology, as seen in this data in Figure. The amount of improvement in results for both groups is practically the same, according to both the independent t test and the graphical results. So, it's safe to say that both approaches raise enthusiasm for the biological sciences; it would be unfair to claim that blended learning or the more traditional approach does a better job. Presumably as a result of ignorance, unreadiness, etc., both groups had much lower scores prior to therapy. Nevertheless, thorough examination shows that the experimental group taught via blended learning had a little higher improvement in score compared to the control group.

Analysis of the Effect Size of Attitude Relating to Biology Variable

The impact size for the attitude towards biology variable is determined using table no. 4.15. A paired sample t-test's mean and standard deviation, as well as an independent t-test's T value, were used to calculate the effect size.

Table 12: Program size's impact on the experimental group's and the control group's attitudes towards biology

Test		df	T	D	R	Effect Size
Paired Sample t test	Control group	34	10.67	0.079	0.0810	Medium
Paired Sample t test	Experimental group	34	13.163	0.0937	0.0839	Medium
Independent sample t test	Control and Experimental group	68	0.272	0.069	0.0329	Small

Group 1 M_1	Group 2 M_2
50.94	92.71
SD_1	SD_2
19.55	8.543
Compute	
Reset	
Cohen's d	effect-size r
0.0768760149582913	0.08106319924667806

Figure 5: computing Cohen's d and r values for the control group's attitude towards biology using the mean and SD values from the paired t test.

Group 1 M_1	Group 2 M_2
46.11	93.37
SD_1	SD_2
18.324	11.443
Compute	
Reset	
Cohen's d	effect-size r
0.093745552563973	0.08397973150946679

Figure 6: Computing Cohen's d and r values for the experimental group's attitude towards biology using the mean and SD values from the paired t test

t value	df
0.272	68
Compute	Reset
Cohen's d	effect-size r
0.06596969000988258	0.032966915878100356

Figure 7: Cohen's d and r values are calculated using the t value from an independent t test of the experimental and control groups' attitudes towards biology

The program had a tiny impact size of 0.03 on students' attitudes towards biology, as seen in the table. Although the control and experimental groups both had medium effect sizes (d=0.07, r = 0.08) in the paired t test, suggesting that students' attitudes towards biology may have improved slightly, the comparative test between the groups revealed only a small effect size (0.03), ruling out any overall beneficial impact. As a result, the impact is insignificant. This minor side effect can be the result of being unprepared for the treatment time or just plain ignorant. This research lends credence to the idea that positive attitudes towards biology are amenable to therapy with the right kind of instruction.

The experimental and control groups were compared using an independent sample t test, which looked at their pre-test and poster scores separately. The experimental group received instruction using blended learning, a method that integrates traditional classroom methods with online resources to provide a dynamic and collaborative learning atmosphere. The results show that the control and experimental groups do not vary significantly in their major scores at the 0.05 level in the pre-test (t =1.125 and p = 0.268, which is more than 0.05). Additionally, the results demonstrate that the control and experimental groups do not vary significantly from each other in terms of main score at the 0.05 level in the post test (t =0.272, p=0.786), thus accepting the null hypothesis. Students' capacity to learn has been enhanced by the use of technology into the classroom. Additionally, it has been discovered that traditional their outlook on biology scores may be improved by instruction. Additionally, the results reveal that students' academic attitude towards biology topic improved significantly in both the experimental and control groups when exposed to a blended learning program in addition to traditional teaching methodologies. The outcome was quite similar to what had been found in other studies. Examined how blended learning and social media-supported learning affected students' attitudes and abilities to study independently in a scientific classroom. In the 2011–2012 school year in Istanbul, 74 seventh graders participated in the in-house survey. This pre-test control group was The research design included a control group that received instruction only via face-to-face methods and the 5E learning cycle model, and an experimental group that received instruction using a hybrid approach that combined traditional classroom instruction with

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online resources. Scales measuring science teaching attitude and self-directed learning competence were used for the investigation. The findings showed that both the experimental and control groups developed a more favourable attitude towards science compared to the control group, although there was no significant difference in the effect size between the two groups. The statistical analysis was conducted using SPSS 17 software and included tests such as ANOVA, t-test, and Kolmogorov-Smirnov. Findings from this research corroborate those from the current investigation. The use of infographics and the implementation of a paperless classroom, sometimes known as a hybrid classroom, to facilitate English language acquisition was the subject of a separate experimental research involving 162 intermediate school pupils. The study's impact size is also not supported by the researchers' little positive outcome. Consequently, students' attitudes towards English language acquisition have improved, with no discernible difference between the groups in studies such as the one under consideration here.

CONCLUSION

The results show that students' attitudes toward biology may be favorably impacted by both conventional and mixed learning strategies, with blended learning having a slight edge. Comparable efficacy was shown by the comparison study, which revealed no statistically significant difference between the two groups' post-test results. The research emphasizes how teaching methods and technology integration might improve biology students' interest in the subject. In order to fully comprehend the potential of blended learning to enhance educational results, future research should concentrate on resolving implementation issues and investigating long-term effects.

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