EFFECT OF BLENDED LEARNING STRATEGY ON ACHIEVEMENT IN BIOLOGY AND SOCIAL AND ENVIRONMENTAL ATTITUDE OF STUDENTS AT SECONDARY LEVEL

By

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ABSTRACT

Blended Learning is mostly understood as the use of resources which combine e-learning with other educational resources. In this study, a blended learning strategy was designed with a variety of factors addressed to create a meaningful learning environment facilitated by a variety of modes, methods and moments through a combination of Objectives (Cognitive, Affective & Psychomotor), Methods (Exploratory, Guided Discovery, Self-paced learning) and Media - Synchronous – (Instructor-led Classrooms, Field visits) and Asynchronous - (Surveys, Web/Computer-Based Learning). The strategy encourages task-based learning which includes specific tasks for the pupil to be completed within a specific time through consequent events which are executed through specific activities. The purpose of the present study was to find out the effect of blended leaning strategy on achievement in Biology and social and environmental attitude of secondary school students of Kerala. Experimental cum survey method was adopted. The basic experimental design adopted was Pre-test, Post-test and Non - equivalent group Design. Survey method was used to find out the social and environmental attitude of secondary school students using attitude scales viz., Social Attitude Scale and Environmental Attitude Scale developed and standardized by the investigator. The findings reveal that Blended Learning strategy is an effective means for enhancing achievement in Biology, for improving Social Attitude and Environmental Attitude of secondary school students.

Keywords: Blended Learning, Blended Learning Strategy, Social Attitude, Environmental Attitude.

INTRODUCTION

Education has an important role to play in the process of changing society. This is clearly laid out by the UNESCO for the Decade of Education for Sustainable Development (UNDP, 2005), to promote an education in solidarity capable of generating responsible attitudes and commitments, and that prepares citizens to make well-founded decisions aimed at achieving culturally plural, socially just, and environmentally sustainable development, i.e. a profoundly humanistic education that will ensure the consolidation of these principles. According to Robottom (1987), this change of model requires diverse measures and instruments to transform our attitudes, lifestyles, patterns of social participation, and conceptions on how politics is done. They see that the challenge for environmental education and for educational research is to address a broad range of diagnostics in order to set objectives for progress and to evaluate results in the short, medium, and long terms.

To prepare our pupils to be citizens of the twenty-first century, it is important to search for exemplary practical proposals in which environmental and social education is integrated into the science curriculum. This requires a form of teaching in which the pupils acquire the courage, commitment, and desire to participate in social interests relating to environmental issues, thus learning to be active citizens. A key aspect then would be the acquisition of skills for alternative actions in which the pupils can choose whether or not to participate in issues both related to life and environment as well. The impact of human activities

on the environment as well as society and the evolution of new monstrous diseases and several other calamities can be controlled by making use of the knowledge of Biology judiciously. Biology education is needed not only for creating biologically literate citizens but also ecologically and socially sensitive human beings.

Need and Significance of the Study

Successful learning in Biology is closely related to methods used by the teacher and the learners. In research, hands-on inquiry-based learning is continually validated as an effective teaching methodology for nurturing the future inventors and scientists. Many forms of technology are also extremely effective in the biology learning. There are various uses of technology; some are straightforward and do not require much consideration in terms of whether it's best to use them. Others, which are more recent forms of technology, require deeper consideration as how to use them most effectively. In general, as long as technology is balanced with the teaching of social and traditional academic skills, it has the potential to revitalize a classroom by appealing to different intelligences in students so that learning is more effective. For this reason, the interaction of a number of approaches both traditional and modern should be used in Biology in connection with these tendencies and with changes in the way of biology teaching and students' interests is essential. This necessitates the need of a blended approach that combines teaching and learning methods from face-to-face, mobile and online learning and that it includes elements of both synchronous and asynchronous learning options. Blended learning integrates seemingly opposite approaches, such as formal and informal learning, face-to-face and online experiences, directed paths and reliance on self direction, and digital references and personal connections, in order to achieve individual and institutional goals. It refers to the systematic integration of several complementary informational delivery mechanisms in an effort to optimize learning and skill acquisition (Singh, 2003).

The engaging benefits of traditional instructor-led teaching with the advantages brought by the new technologies have evolved to what we call as 'Blended Learning'. Teachers have been using versions of it all the time, mostly used in a variety of terms like Hybrid Learning, Combined Resource Teaching, etc. As such this strategy identifies the use of several delivery modes for teaching and learning with the aim of optimizing instruction in terms of both its process and product. Examples of Blended Learning would be the combination of technology based resources and traditional print materials, group or individual study; or even structured pace study and self paced study (Bersin, 2004). But with today's prevalence of high technology, Blended Learning is mostly understood as the use of resources which combine e-learning with other educational resources. It now denotes the blending of traditional teaching approaches and the latest learning technologies using the internet.

The integration of new mobile technologies and online media is proving highly effective in helping schools meet the expectations of 21st century learners while addressing the challenges of limited resources and the individual needs of many students. Mass media and hypermedia shape new patterns and new values. It requires from teachers the use of various strategies leading to rebuilding the earlier structure of students' knowledge, creating different structures in connection with new students' concepts and needs in response to new information, i.e. 'to be able to search for information and work with information, to cope with the user's knowledge of information and communication technology', 'to acquire pedagogical communication aids' and to cope with challenges posed by the new ICTs. In the global scenario, no single strategy or method is earmarked for ensuring the expected behavioral outcomes and curricular standards especially in the realm of learning Biology in accordance with these new perspectives. Hence the need for combining many practices especially online approaches and live classroom methods which come under the umbrella of blended-in-practice is essential. Such a practice will definitely help the learner to develop learning excellence and thereby navigate an array of internal mental events, excellent

references and the like to analyze the present and face the future challenges especially related to developing a favorable environmental and social attitude.

Blended learning is portrayed as a marriage of interactions facilitated by a variety of modes, methods and moments through the use of technologies to extend and enhance the student learning opportunities and through the provision of tasks and materials which enrich, and are aligned with, face-to-face learning. A variety of factors are addressed to create a meaningful learning environment. Each dimension in the strategy represents a category of issues that help to organize thinking, and ensure that the resulting learning program creates a meaningful learning experience. It enriches the student experience and learning outcomes, in the form of achievement and attitudes. Providing a variety of ways to learn can help students to design their own learning experience.

A blended learning strategy is an integrated approach for using a range of resources and activities to provide individualized, student-centered learning experiences for students offering promises on learning and performance. As a combination of multiple approaches to teaching Biology with a view to enhance the social and environmental attitude of pupils self paced, collaborative and inquiry based activities are blended in the present study. These include blending of technology based resources with face-to-face situations between teacher and students like e-learning, self paced online learning using CD-ROMS, formal discussion groups, field visits and development of commonalties of practice as well as simple knowledge acquisition. Blended learning refers to the planned implementation of a learning strategy that integrates student-centered, traditional in-class learning with other flexible learning methodologies using web-based and online approaches in order to realize strategic advantages for the education system.

Studies have found that blended learning can improve learning/teaching (Osguthorpe & Graham, 2003, Bonk and Graham, 2005), increases attitudes (Al-Saai, Al-Kaabi, & Al-Muftah, 2011), Alseweed (2013). Akkoyunlu and Soylu (2008) concluded that students preferred blended learning over traditional learning. Even though the academic community, including curriculum planners, educationists and teachers are quite aware of the significance of constructive pedagogy utilizing multiple approaches, teaching/learning through Blended learning in Biology has neglected till recently. Globally, there is a growing environmental and social concern among all segments of society, but research on the effect of Blended Learning strategy in shaping the social and environmental attitude of students is lacking. It was assumed that a study of this nature would give some base line data for curriculum planners and educationists to develop suitable Blended Learning lessons in Biology at high school level catering to neo-millennial learning style through incorporating technology, encouraging learning through networks and fostering favorable attitude towards Nature in general and life in particular.

Statement of the Problem

The present study aimed at preparing Blended Learning Lessons in Biology in order to enhance the achievement of secondary school pupils in Biology and improve the Social and Environmental Attitude of secondary school students.

Definition of Key Terms

The key terms used in the study are explained below for the sake of clarity:

Effect: An effect is a change that result when something is done or happens: an event, condition, or state of affairs that is produced by a cause. In the present study, effect means the change that results when Blended Learning Strategy is administered to secondary school students statistically analyzed using Analysis of Covariance.

Blended Learning: The use of mixed delivery modes to increase learning opportunities; the combination of multiple approaches to learning like e-learning, face-to-face learning, inquiry based learning, etc. Heinze and Procter (2004) defines Blended learning as ' learning that is facilitated by the effective combination of different modes of delivery, models of teaching and styles of learning, and is based on transparent communication

amongst all parties involved with a course.'

Blended Learning Strategy: Blended Learning Strategy is a pedagogical approach that combines the effectiveness and socialization opportunities of the classroom with the technologically enhanced active learning possibilities of the online environment; and with the best features of classroom interaction and live instruction to personalize learning, allow thoughtful reflection, and differentiate instruction from student to student across a diverse group of learners.

Achievement in Biology: Accomplishment or proficiency of performance in that branch of Science which deals with the study of living things.

Social Attitude: Attitude of a person or group with respect to a social object or phenomenon such as a person, race, institution, or trait. Droba (1934) defines Social Attitude as 'a behavioral pattern, anticipatory set or tendency, predisposition to specific adjustment to designated social situations, or more simply conditioned response to social situations. In the present study, social attitude refers to the scores obtained from the Social Attitude Scale based on the components: viz., Co-operation, Responsibility, Democratic living, Empathy and Independence developed and standardized by the researcher.

Environmental Attitude: A set of emotionally toned ideas about the environment around. According to Hines et al. (1986) the term 'Environmental Attitude' refers to an individual's feelings, pro or con, favorable or unfavorable with regard to particular aspect of environment. In the present study, environmental attitude refers to the scores obtained from the Environmental Attitude Scale developed and standardized by the researcher based on the components: Regard for life and environment, Environmental issues, Equitable and judicious use of resources, Conservation of nature and natural resources, Ecological responsibility; and Sustainable development and eco-friendly lifestyle.

Students at Secondary Level: Students belonging to eighth and ninth standards affiliated to State Board of Education, Kerala.

Hypotheses Formulated for the Study

The hypotheses formulated for the study were as follows:

1. Blended Learning strategy is an effective means for enhancing achievement in Biology.

2. Blended Learning strategy is effective for improving Social Attitude of secondary school students.

3. Blended Learning strategy is effective for improving Environmental Attitude of secondary school students.

Objectives of the Study

The study had the following specific objectives in view:

1. To design a Blended Learning Strategy for learning Biology at secondary level.

2. To find the Achievement in Biology of secondary school students using Blended Learning Strategy developed.

3. To identify the Social Attitude of secondary school students.

4. To identify the Environmental Attitude of secondary school students.

5. To find the effect of Blended learning on achievement in Biology of secondary school students.

6. To find the effect of Blended learning on Social Attitude of secondary school students.

7. To find the effect of Blended learning on Environmental Attitude of secondary school students.

8. To identify the relation between Achievement in Biology through Blended Learning and Social Attitude of secondary school students.

9. To identify the relation between Achievement in Biology through Blended Learning and Environmental Attitude of secondary school students.

10. To analyze the ratings of teachers regarding the effectiveness of Blended Learning in Science at secondary level: cognitive aspects, affective aspects, process skills, environmental aspects, social aspects, interdisciplinary and teacher competency.

11. To assess the views of students regarding various aspects of blended learning:

a. Organization and Study skills

b. Investigation skills

c. Collaborative Skills

d. Teacher Support

Methodology in Brief

Method Adopted for the Study

The purpose of the present study was to find out the effect of blended leaning strategy on achievement in Biology and social and environmental attitude of secondary school students of Kerala. Hence the investigator adopted experimental cum survey method for the present investigation. The experimental method was used to study the effect of Blended Learning strategy in enhancing achievement of secondary school students in the subject Biology as well as in improving their social and environmental attitude. The survey method was used to identify the social and environmental attitudes of students as well as to collect the responses of teachers and students regarding the feasibility and practicability of the blended learning strategy.

Experimental Design

The basic experimental design adopted in the present investigation was Pre-test Post-test Non- equivalent group Design. Two groups were taken for the experimental study namely the experimental group and control group.

Variables Selected for the Study

The independent variables selected for the present study were Blended Learning strategy and Direct Instruction method and the dependent variables were Achievement in Biology and Attitudes viz., Environmental Attitude and Social Attitude of secondary school students.

Sample Selected for the Study

The population for the present study comprised of secondary school students of Kerala. Here a sample of 450 secondary school students of representative districts in Kerala had been selected for the survey. Stratified random sampling technique was used for selecting the sample giving due representation to gender, locality and type of school. Experimental method was used to determine the effect of Blended learning strategy on the achievement in Biology of secondary school pupils. For the experimental study, the researcher selected two groups of 84 students (42 as experimental group and 42 as control group) from an urban secondary school in Palakkad district following the state syllabus. The sample selected for the administration of questionnaire were the students in the experimental group (n=42). A sample of 50 teachers was selected for administering the judgment schedule.

Tools Used for the Study

The following tools developed and standardized by the researcher were used for collecting data:

Blended Learning Strategy for Teaching Biology

Blended Learning Strategy developed in this study is a combination of Objectives (Cognitive, Affective & Psychomotor), Methods (Exploratory, Guided Discovery, Self-paced learning), and Media-Synchronous– (Instructor-led Classrooms, Field visits) and Asynchronous- (Surveys, Web/Computer-Based Learning). The strategy encourages task-based learning which includes specific tasks for the pupil to be completed within a specific time through consequent events which are executed through specific activities. Each lesson in the strategy is assessed both qualitatively and quantitatively. This has proven to be effective in enhancing the achievement of secondary school pupils in Biology as well as improvement in their social and environmental attitude.

Blended learning Strategy was developed to teach the topic 'Biodiversity and its Conservation' based on the systematic integration of several complementary informational delivery mechanisms in an effort to optimize learning and acquisition of skills and attitudes. It offers an integration of multiple methods of information delivery into a single learning system. It promotes learning through Task Based Learning based on a structured approach to learning, which supports the notion that learning occurs most effectively when related to the real-life tasks undertaken by an individual. It encourages the development of the reflective learner, and accommodates a wide range of learning styles. Combinations of resources, media, technologies and facilities were used to support and facilitate learning, based upon the learning context, nature of student needs

and discipline requirements. The elements of the blended learning process included in this strategy are the following:

Live Events:

Synchronous, instructor-led learning events in which all learners participate at the same time, such as in a face to face or live "virtual classroom".

Self-paced Learning:

Learning experiences that the learner completes individually, at his own speed and on his own time, such as interactive, internet-based or CD-ROM learning. Self-paced learning helps to acquire knowledge and to support performance and practice skills.

Collaboration:

Environments, in which learners communicate with others, for example, groups of learners working together to solve a problem, complete a task, or create a product. Learners have the opportunity to converse with peers, present and defend ideas, exchange diverse beliefs, question other conceptual frameworks, and are actively engaged.

Performance Support Materials:

Reference materials that enhance learning retention and transfer, including Resource CDs, downloaded videos, and PDFs.

Assessment:

A measure of learners' knowledge utilizing both qualitative and quantitative methods (Cook, 2001). Pre-assessments can come before live or self-paced events, to determine prior knowledge, and post-assessments can occur following learning events, to measure learning transfer. Rubrics as an authentic assessment tool were used to measure students' work as a scoring guide that seeks to evaluate a student's performance based on the sum of a full range of criteria rather than a single numerical score.

What is "blended" in this study is the composition and sequence of learning activities that relate to the following blended learning cycle (Figure 1):

A preliminary try out of the strategy was undertaken to understand the effect of the strategy on the intended

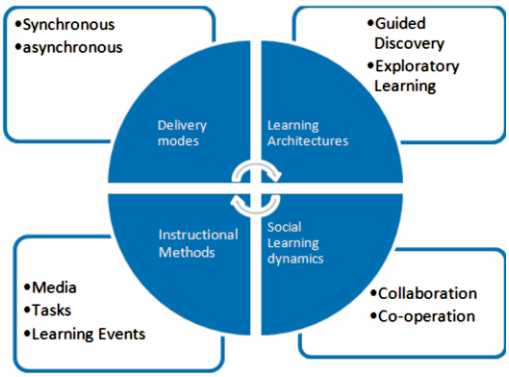

Figure 1. Blended Learning Cycle

population.

Procedure:

- Preliminary Phase: In the preliminary phase, which starts one week prior to the face-to-face session, students get basic information about blended learning. They have the first opportunity to get to know to their content delivery strategies. By doing so, they already get into contact with various requirements suitable for blended learning.
- Face-to-Face Session: In the face-to-face session, technical and instructional knowledge are transmitted by using different didactical methodologies. Moreover, a project work is initiated which will be finalized during the follow-up phase in blended learning.
- Creating Collaborative/Cooperative Learning Communities: A number of approaches can help engage learners in collaborative learning environments:

a. Clearly Define Roles – Describe the relationship between the different roles in the learning community (including the instructor, subgroups, group leaders/ facilitators, and individual learners) and outline their responsibilities and interdependencies.

b. Create Sub-Groups – Create sub-groupings of learners that have their own limitations for small group learning activities and group project collaboration.

c. Support Individuality – Provide a way for learners to create personal profiles that contain their collections and salient information to the topic at hand.

- Follow-up Phase: The students continue to work in face to face and collaborative blended learning

environments.

- Review Phase: The strategy adopted was reviewed with respect to its objectives and sufficient modifications made through revision after consultation with experts.

After the preliminary try out, a strategy was outlined based on the necessary modifications required for students by taking into consideration the benefits of different delivery modes, methods and media.

Lesson Plans in Biology based on Blended Learning Strategy on the topic 'Biodiversity and its Conservation':

The investigator prepared lesson transcripts based on the Blended Learning Strategy for teaching the topic 'Biodiversity and its Conservation'. The lessons selected and the objectives set for each unit was the same for experimental and control groups. Here, the investigator selected 18 topics from Standard VIII Biology of state syllabus. The investigator followed a sequence in the preparation of the lesson transcripts for blended learning method. Each lesson contained the Major Concept, Blended learning strategy including Objectives, Methods, and Media, Tasks and Events and finally Reflection.

Lesson transcripts based on Direct Instruction on the topic Biodiversity and its Conservation':

The Direct Instruction Method (DIM) provides the opportunity for students to receive information from the teacher through lecture, demonstration or presentations by providing students the opportunity to receive information directly about a subject and begin to cognitively apply that information to previous learning. Eighteen lesson transcripts were prepared by the investigator based on Direct Instruction Method. Each contained Lesson Title, Curricular Areas, Lesson Objectives, Learning Materials and Seven Phases: Gaining attention, Informing the learner objective, Stimulating recall of pre-requisite learning, Presenting the stimulus material, Eliciting the desired behavior, Providing feedback and Assessing the behavior. Each lesson was instructed within a span of 45 minutes.

Achievement Test on the topic 'Biodiversity and its Conservation':

An achievement test based on the topic "Biodiversity and its conservation" was designed for assessing the theoretical achievement of secondary school students. The items were prepared in accordance with a blue-print. After administering the draft test containing 60 items were analyzed to assess difficulty index and discriminating power to establish suitability of an item for inclusion in the final test (Ferguson, 1976). The final test containing 50 items was used as both pre-test and post-test. The content validity was established based on the judgment of teachers and teacher educators at secondary level. The empirical validity of the test was calculated by correlating the scores obtained in the scholastic achievement test with marks obtained in another class test. The correlation coefficient obtained was 0.78. The reliability of the achievement test was established using the split half method. The obtained score was 0.75 showing that the test has high reliability.

Social Attitude Scale:

The Social Attitude Scale is a device to measure attitude of a person or group with respect to a social object or phenomenon such as a person, race, institution, or trait. A Likert-type Scale consisting of 70 items, selected from five core areas of social concern viz., Co-operation, Responsibility, Democratic living, Empathy and Independence developed and standardized by the researcher was used which was highly sufficient to measure the social attitude of a secondary school student. The draft scale contained 80 statements with adequate representation given to both positive and negative items and the constructs selected. After computing the t-value, 70 items were selected for the final tool. The face validity of the Attitude Scale was ascertained by showing the prepared scale to experts for their assessment. The external validity of the attitude scale was established by correlating the scores on another established Scale of Social Attitude developed by Zodikoff (1967). The obtained co-efficient of correlation (validity co-efficient) was found to be 0.77 showing that the Attitude Scale is reasonably valid. The scale was designed to produce quantifiable data that may be subjected to statistical analysis in order to draw suitable inferences.

Environmental Attitude Scale:

The Environmental Attitude Scale prepared for the present study is intended to provide an objective measure of the environmental attitude of secondary school students in Kerala. A Likert-type scale which was developed and standardized by the researcher containing 74 items selected from six core areas of recent environmental concern viz., Regard for life and environment, Environmental issues, Equitable and judicious use of resources, Conservation of nature and natural resources, Ecological responsibility; and Sustainable development and eco-friendly life style, was used which the investigator considered to be highly sufficient to produce a valuable measure of the attitude of an individual towards the environment. The draft tool was tried out on a sample of 450 Secondary school students giving representations to their gender, type of school and locale of residence. The items having t-value equal or above 1.96 were selected, as the t-value is a measure of the extent to which a given statement differentiates between the high and low groups. After computing the t-value, 74 items were selected. The face validity of the Attitude Scale was ascertained by showing the prepared scale to experts for their assessment. The external validity of the attitude Scale was established by correlating the scores on another established Environmental Attitude Scale developed by Abraham & Arjunan (2005).

Judgment Schedule:

To analyze the ratings of teachers regarding the effectiveness of Blended Learning for teaching Science at secondary schools on select educational outcomes: cognitive aspects, affective aspects, process skills, environmental aspects, social aspects, interdisciplinary and teacher competency.

Questionnaire for Students:

To assess the views of students regarding the following aspects of blended learning: organizational and study skills, investigation skills, collaborative skills, teacher support, and overall level of satisfaction.

Procedure Adopted for the Study

Survey method was used to find out the social and environmental attitude of secondary school students using attitude scales viz., Social Attitude Scale and Environmental Attitude Scale developed and standardized by the investigator. 18 lessons based on the topic 'Biodiversity and its Conservation' from Biology identified by the researcher were taught using the Blended Learning Strategy developed. The strategy was administered on the experimental group. These lessons were taught at secondary level to find out whether they are suitable for increasing the achievement of students. An achievement test was administered as both pre-test and post-test to know the levels of achievement of students exposed to Blended Learning Strategy. Social Attitude Scale and Environmental Attitude Scales were also used to find the improvement in Social Attitude and Environmental Attitude of students before and after exposing students to Blended Learning Strategy. Achievement and attitude scores obtained through blended learning and direct instruction were analyzed in order to find out the effect of Blended Learning Strategy over Direct Instruction Method for enhancing achievement and improving attitudes respectively.

Statistical Techniques Used

The data collected were analyzed using appropriate statistical techniques like Computation of percentages, mean scores, standard deviation, t- Test for testing the significant differences and Analysis of Covariance.

Analysis and Interpretation of Data

Preliminary Analysis of the Variables viz., Social Attitude and Environmental for the Total Sample

The mean, median, mode, standard deviation, skewness and kurtosis for the total sample were analyzed for the variables viz., social and environmental attitude. This preliminary analysis was done to find out whether the samples are normally distributed as shown in Table 1.

From Table it is evident that the level of social and environmental attitude of secondary school students is average. The preliminary analysis of the sample demonstrated that both the variables are found to deviate slightly from normality.

Statistics	Social Attitude	Environmental Attitude
Mean	318.29	338.17
Median	318.50	340.00
Mode	317.87	334.51
Standard Deviation	17.102	7.351
Skewness	0.739	0.742
Kurtosis	3.541	0.144

Table 1. Descriptive Statistics of the variables viz., Social Attitude and Environmental Attitude for Total Sample (N=450)

Comparison of the Achievement Scores of Experimental and Control Groups

The post-test scores of the experimental group (BLG) were compared with that of the control group (DIG) by testing the significance of the difference between means of the two groups. The data and the results of the test of significance are given in Table 2.

The results reveal that there is a significant difference between the means of BLG and DIG with respect to their post-test scores. The difference can be attributed to the influence of Bended Learning Strategy. (M1 (BLG) = 46.809; M 2 (DIG) = 36.14; (CR= 16.34, p< 0.01).

Analysis Pertaining to Effect of Blended Learning Strategy on Achievement in Biology of Secondary School Students

The effect of Blended Learning Strategy over Direct Instruction Method for teaching the topic 'Biodiversity and its Conservation' in Biology at secondary level was computed. The pre test and post test scores obtained by the experimental (Blended Learning Group-BLG) and control group (Direct Instruction Group-DIG) were to get an idea about the performance of the students as shown in Table 3.

Group	No. of Pupils	Mean (M)	Standard Deviation	Critical Ratio	Level of Significance
Experimental group (BLG)	42	46.81	1.348	16.34	P<0.01 Significant
Control group (DIG)	42	36.14	3.205		

Table 2. Comparison of Post-test Achievement Scores of Experimental and Control Groups

Source of Variance	df	SSx	SSy	SSxy	SSy.x	MSy.x	SDy.x
Among Means	1	418.6	15440.6	4421.4	4839.6	4839.6	
Within Groups	82	11094.6	15440.6	10080.2	18827.7	400.6	20.01
Total	83	11513.2	57876.1		233667.3		

Table 3. Summary of Analysis of Covariance of Pre test and Post test Achievement Scores of the Experimental and Control Group

There is a significant difference between the two groups with regard to post-test achievement scores and that BLG is significantly superior to DIG. (Fy.x= 12.08, p<0.01). Hypothesis 1 states that Blended Learning Strategy is an effective means for enhancing achievement in Biology. The effect of Blended Learning Strategy on achievement reveals that it is significant at 0.01 level. Hence the hypothesis was accepted.

Analysis Pertaining to Effect of Blended Learning Strategy on Social Attitude of Secondary School Students

Comparison of Pre Test and Post Test Social Attitude Scores of Secondary School Students in the Experimental and Control Groups Using Analysis of Covariance were done. The total sum of squares, mean squares and F ratios for the pre test and post test social attitude scores of experimental group (BLG) and control group (DIG) of secondary school students were computed. The details of the analysis are given in Table4.

There is a significant difference between the two groups with regard to social attitude scores and that BLG is significantly superior to DIG in developing social attitude of secondary school students (F Ratio= 95.44, p <0.01). Hypothesis 2 states that Blended Learning Strategy is effective for improving Social Attitude of secondary school students. The effect of Blended Learning Strategy on social attitude reveals that it is significant at 0.01 level. Hence the hypothesis was accepted.

Analysis Pertaining to Effect of Blended Learning Strategy on Environmental Attitude of Secondary School Students

Source of Variance	df	SSx	SSy	SSxy	SSy.x	MSy.x	SDy.x
Among Means	1	424.3	46413.7	4288.6	36564.5	36564.5	
Within Groups	81	10979.8	17613.6	15469.3	31026.5	383.1	19.57
Total	83	11404.1	64027.3	19757.9			

Table 4. Summary of Analysis of Covariance of pre test and post test Social Attitude scores of the Experimental and Control Group

The comparison of Pre Test and Post Test Environmental Attitude Scores of Secondary School Students in the Experimental and Control Groups Using Analysis of Covariance was done. The analysis of the total sum of squares, mean squares and F ratios for the pre test and post test environmental attitude scores of experimental group (BLG) and control group (DIG) of secondary school students were computed. The details of the analysis are given in Table 5.

The results show that there is a significant difference between the two groups with regard to their environmental attitude scores. This further strengthens the effectiveness of Blended Learning Strategy in developing Environmental Attitude over Direct Instruction method (F Ratio= 87.71, $p<0.01$). Hypothesis 3 states that Blended Learning Strategy is effective for improving Environmental Attitude of secondary school students. The effect of Blended Learning Strategy on environmental attitude reveals that it is significant at 0.01 level. Hence the hypothesis was accepted.

Analysis of the Correlation among the variables viz, Achievement, Social Attitude and Environmental Attitude of Secondary School Students under Study

Correlation between Blended Learning, Social Attitude and Environmental Attitude of Secondary School Students in the Experimental Group was done using the Product Moment Correlation and the results are given in Table 6.

From Table 6, it can be seen that the correlation coefficients between the blended learning and social and environmental attitude are 0.659 and 0.809 respectively, which are significant at 0.01 level with df= 1/82. It reflects that blended learning and social attitude as well as blended learning and environmental attitude were positively and significantly related to each other. Further, the percentage of commonness between blended learning and social attitude, blended learning and environmental attitude was found to be 43.481% and 65.4481% respectively. The high value of the percentage of commonness shows the influence of the Blended Learning Strategy on improving the Social and Environmental Attitude of secondary school students.

Source of Variance	df	SSx	SSy	Msx	Msy
Among Means	1	396.3	41566.7	396.3	41566.7
Within Groups	82	10397.6	16432.8	126.8	200.4
Total	83	10793.9	57989.5		

Table 5. Summary of Analysis of Variance of Pre test and Post test Environmental Attitude scores of the Experimental and Control Group

Variable	Social Attitude Correlation Coefficient (r)	% of commonness (r^2x100)	Environmental Attitude Correlation Coefficient (r)	% of commonness (r^2x100)
Blended Learning	0.659**	43.481	0.809**	65.4481

Table 6. Correlation between Blended Learning, Social Attitude and Environmental Attitude of the Experimental Group

Analysis of the Correlation between Social Attitude and Environmental Attitude of Secondary School Students

The objective was to study the relation between Social Attitude and Environmental Attitude of secondary school students in the Experimental group before and after the treatment separately. The data were analyzed with the help of Product Moment Correlation and the results are given in Table 7.

From Table 7, it can be seen that the correlation coefficients between social attitude and environmental attitude before and after the treatment are 0.484 and 0.672 respectively which are significant at 0.01 level with df= 1/82. It reflects that both social attitude and environmental attitude were positively and significantly related to each other, both before as well as after the Treatment. Further, the percentage of commonness between social attitude and environmental attitude before and after the treatment was found to be 23.43% and 45.16% respectively. It reflects that there was 21.73% change in the commonness shared between social attitude and environmental attitude after the treatment.

Variable	Correlation Coefficient (r) (Before Treatment)	% of commonness (r^2x100)	Correlation Coefficient (r) (After Treatment)	% of commonness (r^2x100)
Social Attitude & Environmental Attitude	0.484**	23.43%	0.672**	45.16

Table 7. Correlation between Social Attitude and Environmental Attitude of the Experimental group before and after the Treatment separately

The high value of the percentage of commonness shows the influence of the Blended Learning Strategy on the experimental group with a greater significance at 0.01 level.

Analysis of the Ratings of Teachers regarding Effectiveness of Blended Learning

Analysis of the ratings of teachers on the suitability of Blended Learning Strategy for teaching Science at secondary schools for select educational outcomes revealed that the Blended Learning Strategy helped to establish cause-effect relationship than Direct Instruction method, trains learners to acquire knowledge independently and that it promotes easier transfer of learning. Majority of the teachers revealed that Blended Learning Strategy develops interest in learning science and develops research aptitude in learners. Regarding the development of skills, the teachers reported that Blended Learning Strategy promotes divergent thinking and helps to develop the following process skills: observation communication, classification, measurement, inference and prediction. A great majority of the teachers responded that Blended Learning Strategy develops ability to appreciate scientific phenomena in nature and helps to acquire knowledge through these experiences: first hand and vicarious experiences. With regard to social aspects of the Blended Learning Strategy, majority of the teachers responded that it promotes the following interactions: Learner-learner, Teacher-learner, and Content-learner. Teachers also viewed that Blended Learning Strategy provides opportunity to understand interdisciplinarity existing in nature. Majority of the teachers revealed that pre-planning is necessary for Blended Learning Strategy and that technology skills are required for Blended Learning Strategy.

Analysis of the Ratings of Pupils regarding Effectiveness of Blended Learning

The opinions of the students regarding the effectiveness of Blended Learning Strategy on various aspects were analyzed. The results indicate that majority of the students have developed Organization and Study Skills, they have understood the tasks and things to do to be successful for Blended Learning Strategy. The percentages revealed that Blended Learning Strategy helped to understand the subject matter, gave multiple options for taking in information, aided in making sense of ideas, helped for expressing what they have learned, entertained to watch and explore, promoted individualized study, and provided greater time-flexibility. Regarding Investigation Skills, 87% of the students responded that they had found sufficient resources they really wanted to access. 73% of them collected, recorded and organized data necessary for their work and 71% been able to make connections between what they learned with other areas of life. For Collaborative Skills, majority of the students (77%) opined that they got sufficient opportunities for face-to-face interaction and provides opportunities for meaningful collaborative learning. 85% of the students responded that they had got enough encouragement from the teacher. They revealed that the teacher provided opportunities for motivation (87%), promotion of reflection (89%), (79%) conceptual understanding and feedback. Regarding the overall level of satisfaction with Blended Learning majority of the students (74%) agreed that they were very satisfied with blended learning.

Major Findings of the Study

- Findings on the Social Attitude and Environmental Attitude of secondary school students for total sample (N=450) revealed that majority of the secondary school students have average level of social and environmental attitude.
- There is a significant difference between the means of experimental (Blended Learning Group-BLG) and control group (Direct Instruction Group-DIG) with respect to their post-test scores. The difference can be attributed to the influence of Bended Learning Strategy.
- There is a significant difference between the two groups: experimental (Blended Learning Group-BLG) and control group (Direct Instruction Group-DIG) with regard to social attitude scores and that BLG is significantly superior to DIG in developing social attitude of secondary school students.

- There is a significant difference between the two groups: experimental (Blended Learning Group-BLG) and control group (Direct Instruction Group-DIG) with regard to their environmental attitude scores. This further strengthens the effectiveness of Blended Learning Strategy in developing Environmental Attitude over Direct Instruction method.
- When the extent of relationship was identified between blended learning and environmental attitude, Pearson product moment correlation coefficient (r= 0.8086) was found between the variables and it was found to be positive and shows very high relationship between the two variables. This indicates that achievement in blended learning strategy leads to an increase in environmental attitude.
- The extent of relationship between blended learning and social attitude using Pearson Product Moment Correlation Coefficient (r= 0.6589) was found to be positive and shows moderate relationship between the two variables. This indicates that achievement in blended learning strategy leads to an improvement in social attitude.
- Analysis of the ratings of teachers on the suitability of Blended Learning Strategy for teaching Science at secondary schools for selected educational outcomes revealed that Blended Learning Strategy develops interest in learning science and develops research aptitude in learners.
- The opinions of the students regarding the effectiveness of Blended Learning Strategy on various aspects were analyzed. Regarding the overall level of satisfaction with Blended Learning, majority of the students agree that they are very satisfied with blended learning.

Outcomes of the Study

Blended Learning Strategy developed in this study provides a conceptual framework for selecting and combining a multitude of learning techniques. It aims to provide sustained behavioral change resting solidly on an instructional design model that acknowledges the learning stages, provides appropriate instructional strategies for those stages, and reinforces skills and attitude development through practice, feedback, and testing. By recognizing and carefully balancing the learner needs, preferred or common learning methods, and the available resources, blended learning provides a significant increase in the effectiveness of learning, bringing a greater experience facilitating activities, and helping to transform environmental theory into practice. The hypotheses formulated for this study have been accepted along these results which prove to be in favor of blended learning. Moving from standard instructor-led classrooms to more self-paced learning offers cost-effective approach for learning and achieving. It reduces boredom, decreases costs, and produces tangible results that relate to enhanced learner value and attitudes.

Conclusion

Blended learning as conceived in this study is a fundamental redesign that transforms the structure of, and approach to, teaching and learning and therefore must be approached with the awareness of the challenges of doing things differently. As blended learning brings together the familiar (classroom) and unfamiliar (online) environments, "the movement towards more blended learning opportunities is unfolding in an organic way, rather than an organized way. Blended learning offers learners the opportunity "to be both together and apart."Blended learning provides a 'good' mix of technologies and interactions, resulting in a socially supported, constructive, learning experience. The purpose of social presence in an educational context is to create the conditions for inquiry and quality intersection to collaboratively achieve worthwhile educational goals.

Implications of the Study

- The goal of blended learning is to unite the best features of in-class teaching with the best features of online learning, to promote active, self-directed learning opportunities for students. An instructional design for the blended learning strategy should naturally define the roles of the teacher and the students engaged in the instructional process.

- Meeting the learners' expectations and enriching their experiences is central to a blended learning system. So improper use of modalities and blends may lead to confusion and complexities and hence should be avoided.
- Consistent with the aim and requirements of an institution and to attend to the needs of its beneficiaries in its environment, authorities concerned can rely on the availability and stability of high quality instructional resources in the most varied areas of education.

Suggestions for Further Research

- The experimental study was limited to a small sample representing a single district and an urban locale. The study can be replicated on a large sample of many districts of both rural and urban locales.
- A study on the impact of Blended Learning Model on student's attitudes towards biology and their critical thinking dispositions and learning styles could be studied.
- Blended Learning Strategy including a variety of combinations such as real time collaborative interactions, either online or face-to-face, and self paced situations could be attempted. A strategy that combines several different delivery methods, such as collaboration software, Web-based courses, EPSS, and knowledge management practices could be studied.
- Effect of Blended Learning on the motivation and interest of Students in learning Biology could be attempted.

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