EFFECTIVENESS OF BLENDED LEARNING IN BIOLOGY ON ACHIEVEMENT, ANXIETY AND ATTITUDE OF SENIOR SECONDARY SCHOOL STUDENTS OF WEST BENGAL

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in

EDUCATION

By

Piyali Sarkar

Registration Number: 41800055

Supervised By

Dr. Sonia Sharma (23776)

Department of Education (Assistant Professor)

Lovely Professional University

LOVELY PROFESSIONAL UNIVERSITY, PUNJAB

2023

DECLARATION

I, hereby declared that the presented work in the thesis entitled **"Effectiveness of Blended learning in biology on achievement, anxiety and attitude of senior secondary school students of West Bengal"** in fulfilment of degree of **Doctor of Philosophy (Ph.D.)** is outcome of research work carried out by me under the supervision of Dr. Sonia Sharma, working as Assistant Professor, in the School of Education of Lovely Professional University, Punjab, India.

In keeping with general practice of reporting scientific observations, due acknowledgements have been made whenever work described here has been based on findings of other investigator. This work has not been submitted in part or full to any other University or Institute for the award of any degree.

Name of the Scholar: Piyali Sarkar
Registration No.: 41800055
Department/school: School of Education
Lovely Professional University,
Punjab, India

CERTIFICATE

This is to certify that the work reported in the Ph.D. thesis entitled **"Effectiveness of Blended learning in biology on achievement, anxiety and attitude of senior secondary school students of West Bengal"** submitted in fulfillment of the requirement for the reward of degree of **Doctor of Philosophy (Ph.D.)** in the Department of Education, is a research work carried out by Piyali Sarkar(41800055), is bonafide record of her original work carried out under my supervision and that no part of thesis has been submitted for any other degree, diploma or equivalent course.

Name of supervisor: Dr. Sonia Sharma
Designation: Assistant Professor
Department/school: School of Education
University: Lovely Professional University

ABSTRACT

This study aimed to look into the effect of blended learning strategies on students of 11th standard on their achievement, attitude and anxiety towards biology. To determine the effectiveness of blended learning techniques on the topics of biology (collected by pilot study) where students feel anxiety with respect to difficulty level selected topics. A quasi-experimental design was applied to conduct the research. The participants of the study (N=70) were divided into two groups: an experimental group (n = 35) and control group (n = 35). Participants belongs to Bengali medium senior secondary (Class 11) Govt. Sponsored school and who opted biology as their elective subject and belongs to science stream. An achievement test questionnaire was constructed and standardized by researcher and its validity and reliability were also determined. To determine the attitude of learners, Biology attitude questionnaire of Prokop, Tuncer and Chuda (2007) was used, and this scale was adapted by investigator with Indian context. Treatment was given in Bengali language and contents were made bilingual i.e., Bengali and English. Data analysis was done with SPSS 26.0 software. The research findings explore that, significant differences seen between two groups, the achievement towards biology of the students of experimental groups was better as compared to the pupils taught by conventional method. Similarly, the findings also shown that significant difference found among the experimental and the control groups and the anxiety towards biology of the students of experimental group was seen low in comparison to the students taught by conventional method of teaching. While in case of attitude towards biology, there were no significant difference found within the experimental and the control groups respectively. There was no statistical significance difference found with respect to interaction effect of blended learning strategies and gender towards all the three variables namely achievement, anxiety and attitude towards biology. The study advocates beyond research of the use of blended learning at elementary or mid school level.

Keywords: Blended learning, anxiety, attitude, achievement in biology.

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CHAPTER – 1

INTRODUCTION

"Technology is just a tool,
In term of getting the kids working together and motivating them,
The teacher is the most important"

- Bill Gates

At the dawn of the emergence of human race, when the entire world was unknown to us, from that period humanoid started to learn from nature. Mother Nature taught us how to survive between all odds. They struggled against wild animals and devastated nature as well. Their journey with ever changing environment results in better adaptive power as well as development of brain started very fast in them. Own effort for survive; to sustain their existence humanoid evolves in human obeying law of nature. During this journey they learned most from their mother nature, they saw natural calamities and other natural phenomenon which increased inquisitiveness among themselves which gave birth to science. Journey with science explored many dimensions from discovery of wheel to artificial intelligence. In Vedic period we learned about Veda Education policy, later it extended in Gurukulam. Now school, College and Universities are formed to teach a child or to convert them into a successful Human Resource.

Education is a spontaneous and dynamic process of internal growth and development. In actual sense it is a process to make humans what they are and to make life easier, cozy, ethnic and well-mannered. Learning and teaching are the two most important factors of education. The highest motive of education is to get knowledge which can be acquired only with an appropriate goal oriented, need based and time-based education system. This will help the nation and its people to provide better and purposive life. The National Policy of Education (1986) "has emphasized that educational technology should play important role in Education Sector".

Recently the Government of India introduced a National Education Policy (2020). The Ministry of HRD declared through this education policy that special efforts should be given in educational technology. In multidisciplinary higher education institutions who

offer 4 years integrated B.Ed. program having an open and distance learning accreditation, now they are able to offer high quality B.Ed. programs through blended mode. In the case of special educator's training, blended mode in part time courses is accepted now. All institutes having open and distance learning mode of learning and have high quality online resources, they are now advised to convert them into blended mode as blended mode can accelerate the activity based and experiential learning and can cover social, affective, and psychomotor domains of learning. Emphasis has been given in promoting digital literacy. It is clearly stated in the national policy of education 2020 that face-to-face education is very much important to complete all round development of a child as well as digital literacy is also very much needed to complete the total process. So blended mode is the way out to overcome both problems.

With the emergence of Technology in education it became more machine dependent so that role of teachers becoming day by day lesser. "In the past 10 years, web accesses, the nature of the Web, and contexts for learning have been transformed, along with the emergence of desired technological competencies for learners, teachers, and administrators. Internet connectivity in schools, homes, neighborhoods, and communities has become increasingly pervasive. Since the mid-1990s, the percentage of public schools connected to the internet exploded from 35% to 100%. Public instructional classrooms with Internet access grew to 94%, up from 14% a decade earlier, and the ratio of students per Internet-connected instructional computer decreased from 12:1 to 3.8:1" (Wells and Lewis, 2006).

The term effectiveness refers to the results we get, the progress a student makes towards some specified goals of education. Learning effectiveness or learning ability can be defined as the comfort and pace by which students can receive the needed information, knowledge and skill (Khamparia and Pandey, 2018). Learning effectiveness refers to the degree to which online program graduates obtain educations that reflect the specific qualities of the institution, particularly when compared to learning received through the university's more traditional face-to-face classroom-based instruction. the program or course is made to be at least as good as face-to-face classes provided by the same university. If there isn't a face-to-face course that is similar, the normative benchmark of the institution is not fulfilled. Learning media (books, notes, software, CD-ROMs, and so

forth), faculty who teach the class and are available outside of class, and students who interact with the faculty and with each other are typically the same learning resources in online courses as they are in traditional face-to-face courses at the institution (Janetmoore, 2004). Learning effectiveness can also be understood by distinctiveness of quality of education of online learning from a traditional classroom system. The motto of online learning is different from that of institution based or other delivery modes of teaching and it also remarkably differs from face-to-face, conventional teaching-learning system as it totally lacks the interaction part (Swan, 2003).

1.1. BLENDED LEARNING

Blended learning is the fine mixing of the good and positive parts of online learning and conventional interactive learning (Horton, 2002; Osguthorpe and Graham, 2003). Graham (2013) explained blended learning strategies as a learning process in which one of part of whole content or activities is delivered with an online arrangement and by which the time wastage in classroom is reduced. Graham (2006) expressed blended learning as "the combining of the two different education models, traditional face to face learning and distance learning". Blended learning can also be described as combining in-person instruction with online or remote learning, employing diverse learning theories, methodologies, and strategies in one setting, and enhancing classroom instruction with a variety of online tools. (Rossett, 2002; Discroll,2002; Singh, 2003).

Garrison and Kanuka (2004) mentioned blended learning are a mixture of online and offline learning which provides compatible effects which is stable and can balance the open communication and unlimited access in teaching learning system. It requires two efforts to plan a proper blended platform i.e., strategic planning which includes 3 sub categories namely needs, goals and objectives of the platform and operational planning which encounters non institutional items like provisions of internet connectivity, arrangement of evaluation tools, arrangement of resources etc. the conclusion of this study reveals more works are needed to measure effectiveness of blended learning with student satisfaction, self-efficacy, achievement etc.

Singh (2013) found that blended learning strategies are the most effective combination of different learning approaches which can supplement each other to provide desired and

meaningful outcomes. Driscoll (2012) found four different ways to define blended learning. They are -

- A mixture of different modes of e-resources
- A mixture of constructivism, behaviourism, cognitivism etc. i.e., different instructional approaches.
- A blending of online and offline i.e.,conventional resources
- A perfect mixture of learning and working together.

Now coming to blended leaning concept –*"Digital Learning means not being confined to Brick and Mortar Classrooms; Using Blended learning platforms to differentiate experiences"* – Mark Quinn

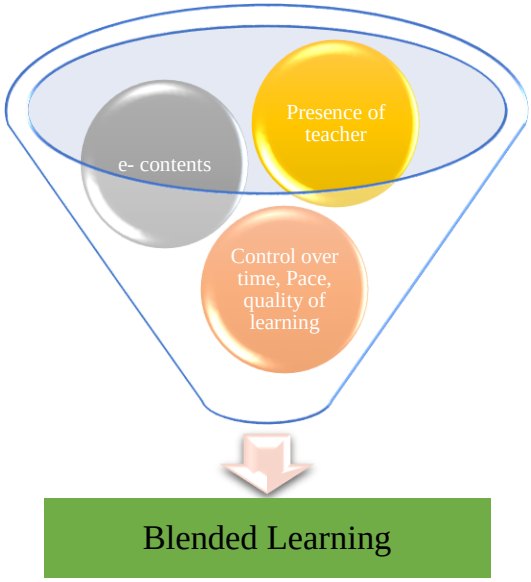


Figure1.1: Blended learning inclusions

The central idea of Blended learning was first established in 1960s. But the term was coined by Bonk and Graham. Some synonyms of blended learning are –"Hybrid Learning", "Mixed–mode instruction", "web-enhanced instruction" etc. In late 60s, University of Illinois developed Programmed Logic for Automatic Teaching Operations (PLATO) technique, which can be the example of first blended learning initiative in the

world. The proper definition of blended learning was come to forth after release of "Handbook of Blended Learning" by Bonk and Graham in the year 2006.

"Blended learning provides an opportunity to move from the traditional, rigid teacher-centered classroom to a more open, learner-centered environment."- Sheri Edwards

Blended learning is a method of instruction that mixes traditional, in-person classroom methods with online learning opportunities and educational resources. The student may have some control over the time, place, path, or pace if both the teacher and the student are there physically. Today, there are numerous virtual schools operating in the United States, China, Japan and the United Kingdom with K-12 curricula using pre-built blended learning software. Blended learning uses a variety of techniques.

When in a classroom situation more than 80% of the contents are delivered with online resources that classroom can be said e-learning or online learning class and the percentage of online content when used below 29% it is considered as conventional offline class. When the amount of e resources is maintained from 30-79% that classroom comes under the category of blended learning (Allen, Seaman and Garrett, 2007).

Ossiannilsson et al., (2015) found total 6 dimensions, namely: students, teachers, curriculum, educational technology, course pattern and classroom situations are the key factors to make a successful blended learning program. Bates (2016) found many challenges in implementation of blended learning program and they proposed several ways to solve the problems like: time management, adopt a proper methodology, support students, keep students motivated and most importantly increasing the scope of research in blended learning.

1.1.1 DIFFERENT MODELS OF BLENDED LEARNING

There are different models of blended learning evolved at different times. By the progression of time the methods and practice of blended learning increasing day by day. Many scientists used and proposed many models for correct implementation of blended learning strategies. Some of them are as follows:

1.1.1.1Khan's Octagonal Framework (Khan, 2005)

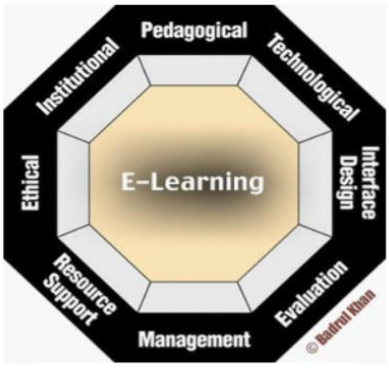
The Khan's Octagonal framework is very famous among all blended learning frameworks. It can be used very easily in case of school education, vocational education and general education. It has 8 distinct dimensions. They are: institutional, pedagogical, technological, interface design, evaluation, management, resource support and ethical. Institutional: this dimension includes different infrastructure affairs administrative issues and various student services which may require assisting e-learning process. Management: this dimension covers the management section which involves per maintenance and quality control of environment of e-learning. Technology: technology dimension discusses the infrastructure background related to technology in e-learning. Technology related planning hardware software etc. comes under this section. Pedagogical: Pedagogical dimension cover stitching and learning section. It includes-content analysis, goal orientation, need based analysis, study designing, media analytics, learning strategies and organizations target analysis. Ethical: This dimension includes different social, political, cultural, geographical, legal issues related to e-learning which may affect the teaching learning process. Interface design: designing a proper interface is one of the most important challenges for e-learning. The loop and strategy of learning program, page designing, website designing, content incorporation, reach ability, access, usefulness, user friendliness, testing of designed interface etc. comes under this dimension. Resource support: In this dimension the maintenance and required technical support is given to students and instructors to run the program properly. It helps to maintain the flow of learning by removing barriers. Evaluation: This part includes the assessment of teachers, interface, and learners. It judges the efficiency of e-learning program. Table 1.1 showing the dimensions of Khan's Octagonal framework.

Table 1.1: Dimensions of Khan's Octagonal framework

Serial No	Dimensions of E-Learning	Descriptions
1	Institutional	this dimension includes different infrastructure affairs administrative issues and various student services which may require assisting e-learning process

2	Management	This dimension covers the management section which involves per maintenance and quality control of environment of e-learning.
3	Technological	The technological aspect of online learning looks at challenges with technology infrastructure in those settings. Hardware, software, and infrastructure planning are all included in this.
4	Pedagogical	Pedagogical dimension cover stitching and learning section. It includes- content analysis, goal orientation, need based analysis, study designing, media analytics, learning strategies and organizations target analysis.
5	Ethical	This dimension includes different social, political, cultural, geographical, legal issues related to e-learning which may affect the teaching learning process.
6	Interface design	Designing a proper interface is one of the challenges for e-learning. The loop and strategy of learning program, page designing, website designing, content incorporation, reach ability, access, usefulness, user friendliness, testing of designed interface etc. comes under this dimension.
7	Resource support	In this dimension the maintenance and required technical support is given to students and instructors to run the program properly. It helps to maintain the flow of learning by removing barriers.
8	Evaluation	This part includes the assessment of teachers, interface, and learners. It judges the efficiency of e-learning program as a whole.

Each dimension of Khan's Octagonal Framework contains many sub dimensions. Every sub dimension specifies the pros and cons of the mother dimension. It also includes practical example of each case, why and how to resolve the same. Here the author depicted several ways to overcome the problems related to stakeholders like learner teacher's technical staff and other issues. By which a proper e-Learning environment can be constructed and implicated in any institute.



*Sources: Khan's Octagonal framework, 2005

Figure 1.2: Khan's octagonal 8-dimension framework

Elameer and Edrus (2010) reconstructed Khan's octagonal model. Most of the foreign universities were adopting that model for creating successful e-learning platform; the need for its reconstruction was needed. The investigators modified the framework in University Saint Malaysia by a distance learning program. They used the mixing of self-learning text, Video Conferencing Learning Environment (VCLE) process and learning activity management system (LAMS) for their experimentation.

1.1.1.2.K-12 Models of Blended Learning (Horn and Stalker, 2011)

Horn and Stalker (2011) proposed the six models of hybrid learning including rotation, flex, online lab, self-blend, online driver and face to face driver. At the time of discovery of this concept in 2009, the models were formed as follows:

Rotation is the very first one where students rotate through various mode of learning. Here students are first divided into three to four groups and they are instructed rotationally with both human and e-resources. This is a very effective technique because at a time a student can directly get instruction from his or her mentor or teacher as well as from computer-based programs.

Flex mode is mostly regulated with computer; teacher here keeps total control over class and acts as a supervisor there. Students uses computer by their own under teacher's supervision and can clear their doubts by the help of teachers at a time.

A La Carte is wholesome online process where instructor is also present online. This is a method which is totally regulated online. This can be done though preprogrammed online courses.

Enriched Virtual method contains one-on-one sessions of students with their instructors. Here students are free to complete their tasks with the help of teacher and also gets opportunity to complete their study by themselves also.

Face to face driver includes where teacher plays most vital role. He or she drives instructions and class management by him or herself and with the help of digital tools.

Labs are the method where the entire curriculum is delivered through a pre-established lab and via online platform.

Self-Blending is the technique which includes the student can choose to how to accelerate their learning process by keeping balance with online part along with conventional learning method.

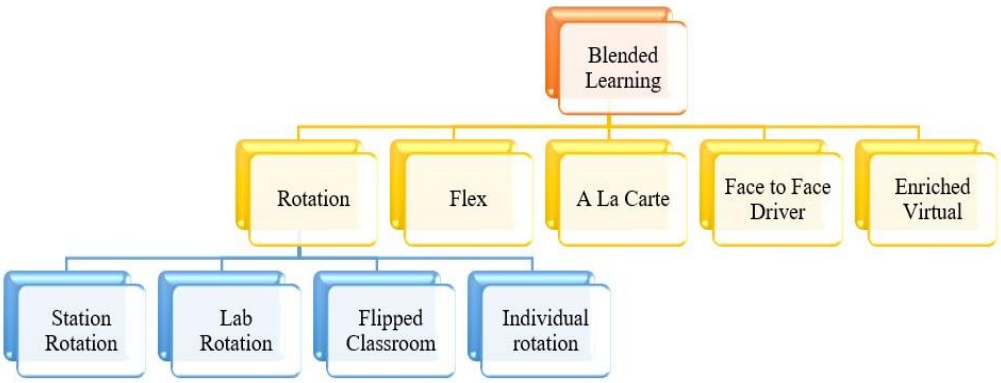


Figure1.3: Blended Learning Model (Horn and Stalker, 2009)

Later in 2011, it was evolved as:

Model 1: Face-to-Face Driver: The majority of the curricula are still taught by face-to-face teachers in all of the programs that fall under the category of face-to-face drivers. On a case-by-case basis, the physical teacher uses online learning to supplement or correct, frequently in the back of the classroom or in a technology lab.

Model 2: Rotation The rotation model shares the common characteristic that students in a specific course alternate on a set schedule between learning one-on-one online at their own speed and in a traditional classroom setting with a face-to-face instructor. Because it incorporates a division between the two and, in some situations, between remote and onsite learning, it is the model that is closest to the traditional face-to-face classroom and online learning. The online work is typically supervised by the in-person instructor.

Model 3: The majority of the curriculums are delivered online in flex programs with a flex approach. Through one-on-one tutoring sessions and small group sessions, teachers offer on-site support in a flexible and adaptable manner as needed. Numerous hybrid dropout recovery and credit recovery programs suit this concept.

Model 4: Programs that use an online platform to provide the whole course but in a physical lab setting are known as online-lab programs. These schools typically offer online instructors. While supervising, paraprofessionals don't have much subject matter knowledge. Students who take part in online lab programs frequently also enroll in traditional courses and follow standard block schedules.

Model 5: Self-Blend the most prevalent version of blended learning in American high schools is the self-blend model. This complements the traditional school catalog whenever a student takes one or more of her courses online. Unlike the online lab model, online learning is always done remotely, whereas traditional learning takes place in a brick-and-mortar system. A complementary online school that offers a la carte courses to individual students facilitates self-shuffling.

Model 6: Online Driver The online driver model includes an online platform and teachers who deliver the full curriculum. Most students work remotely. Personal check-in may be optional or required. Some of these programs also offer fixed components such as: Extracurricular Activities.

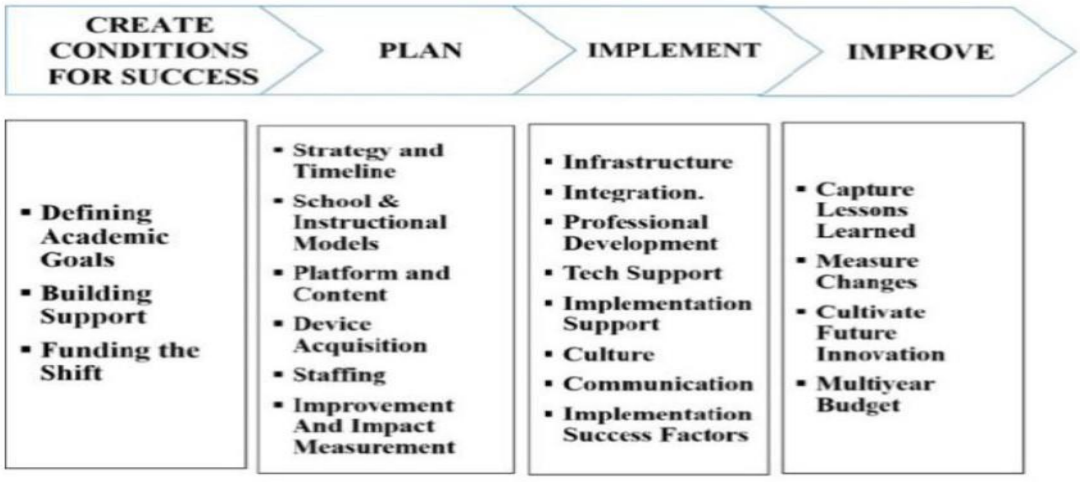
Blended Learning Models Six Phase Face to Face

*Sources:https://www.christenseninstitute.org/

Figure 1.4: Revised blended learning model (Horn and Stalker, 2011)

1.1.1.3. Blended Learning Guide (Bailey, Schneider and Ark, 2013)

This blended learning model was constructed by Bailey, Schneider and Ark, 2013. This model helps in promoting digital learning framework can be useful in every sector of education. It has four stages make environment for getting success, planning, implementation and improvement.



*Sources: Blended Learning guide (Bailey, Schneider and Ark, 2013)

Figure 1.5: Blended Learning guide (Bailey, Schneider and Ark, 2013)

Digital learning framework guide 3 contains four separate phases. First phase i.e., create atmosphere for success includes goal orientation of the authority, creating major support system, arrangement of fund, institutional infrastructure monitoring, creating objective of the study etc. The second phase is planning which includes the strategy of study and time bound education system. It includes planning and development of instructional strategies, different models of learning, the platform of the study, content construction and analysis, device adequacy, recruitment of efficient staff, spontaneous and continuous feedback system and overall improvement and impact measuring system. The third phase implementation includes starting of the program and its maintenance. It includes infrastructural development, professional development of instructors; need based follow up and gradual development of the course contents keeping an eye on cultural, ethical and social aspects and finally incorporation of all these things which could bring the course in its topmost success. The fourth and final phase is improvement. It includes capturing the lessons already taught, measuring the learning outcomes of the people, multi-layer budgeting according to the need and incorporation of innovative thoughts as per need of the course.

1.1.1.4. Instructional Model (Dewi et al., 2018)

Dewi et al. (2018) established this model which is focused on 4 basic principles.

- Learning methods are designed as per the learner's needs.
- Evaluation and feedback in mixed methods.
- Classroom interaction and students' engagement in learning are facilitated by the use of online channels through the internet.
- A huge collection of resources is supplied to the students.

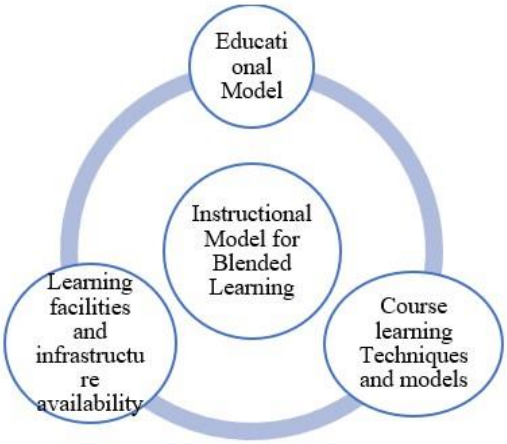


Figure 1.6: The Scheme of Instructional Model (Dewi et al., 2018)

*Sources : Instructional Model (Dewi et al., 2018)

According to the investigators by following the four criteria above any kind of vocational education or blended learning program in conventional education with the present standard can be maintained.

1.1.1.5. Vocational Blended Learning Model (2020)

Vocational Blended Learning (VBL) model is one of the recent most concepts in blended learning studies. This concept is mostly proven useful in the case of vocational education. The concept includes the planning, analysis and implementation phase. The framework of the same is as follows:

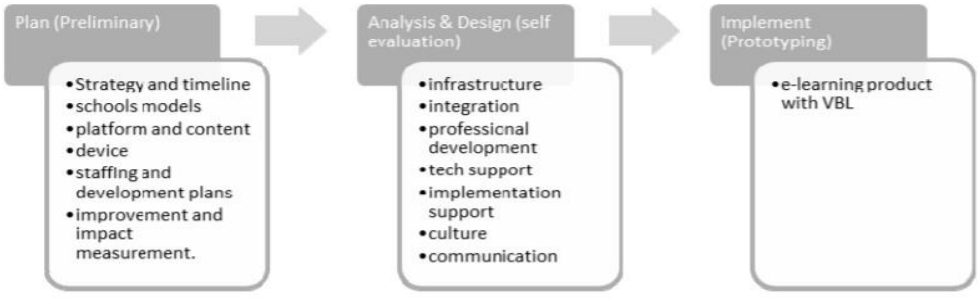


Figure 1.7: Vocational Blended Learning model (2020)

*Source: Vocational Blended Learning model (2020)

This is one of the most recent learning models of blended learning, mainly used for vocational education. The researchers found that a learning model can be useful only if it has excellence, proper teaching techniques and methods and facilities. The framework of the Vocational Blended Learning Model includes three steps:

Planning: it includes the whole planning thing i.e., infrastructure monitoring, timing and strategies of teaching, device availability, availability of computers and internet connectivity, arrangements of proper software and hardware, integration of ICT, platforms of teaching, recruitment of efficient staff and technical support team, and finally wholesome management system.

Analysis and design: this phase include the professional development of all teaching staff, infrastructure monitoring, an inspection of integration of technology, policy-making, financial budgeting, funding, making proper communication with the students, making them more engaged in class, measurement of readiness, attitude, technology fondness, etc. and overall having to maintain the environment according to the culture and need of students.

Implementation: This is the experimental phase. Here the implementation of previously mentioned topics occurs, and evaluation is done and feedback is taken for further proceedings.

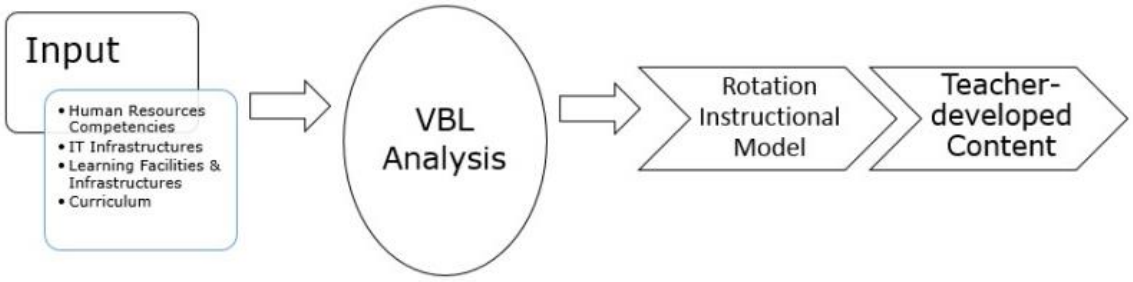


Figure 1.8: Phases of Vocational Blended learning model

*Sources: Vocational Blended Learning model (2020)

Among all aforesaid strategies, rotation and face-to-face driver are the techniques which are chosen for the present study. Alsahi, Eltahir and Al-Qatawneh (2019) researched to know the effects of blended learning on 9th graders' achievement in science and their attitude toward using it. In a quasi-experimental study design of a case study, the included

112 students and divided into 2 groups: experimental (n=61) and control (n=51). Achievement test questions here and the scale were designed as a research tool to get validity and reliability of the research. A more positive attitude was seen to grow within the blended learning experimental group taught with the station rotation technique and face-to-face driver technique.

Rotation and Face-to-face strategies as blended learning strategies

Among all blended learning strategies station rotation and face-to-face driver strategies were chosen as blended learning strategies i.e., learning strategies used for the experimental group's treatment. Students remains more active throughout the class, as in station rotation strategy involves movement between different station, which ultimately leads to academic success among students, as per UGC blended learning concept guideline 2021, the use of blended learning should have strategical way to in which an institute have to use less resources in a compact space. By rotation and face-to-face driver this goal can be achieved. Following are some reasons why these two strategies were chosen:

- Rotation strategy of blended learning is considered one of the most commonly used blended learning.
- Among all other blended learning strategies, the least resources are needed for the face-to-face driver. As the present study was framed for Govt. sponsored schools where resources are very limited, the strategy chosen.
- In comparison to other strategies like enriched virtual or a la carte, both rotation and face-to-face driver strategies need less internet use and the least internet speed.
- The study was framed in poor economy based, mainly tea belt area. As per 2020 data, only a single school contains ICT facilities, so, the need for the least internet use and still having virtual experience could bring better learning outcomes for students. Both face-to-face and station rotation strategies are useful in this method.

- Station rotation strategy helps every student to access information one by one with the help of e-resources and teachers. Equity in class was maintained easily using this process.
- Face-to-face strategy allows a teacher to interact more with her student. So, the opportunity to interact and actively learn increases more with this strategy (Malinina, 2012; Christensen et. al,2013).

Leeuwen et al. (2018), used two different blended learning models to complete their study. The chief aim of the study was to find out the effectiveness of blended learning strategies and discover if any differences were found between using two different blended strategies. Two different blended strategies used for studies were flipped classroom and enriched virtual techniques. 150 students at university (114 females and 36 males) were chosen as a sample for flipped classroom techniques and 470 students (216 females and 216 males). Results found that an enriched virtual classroom setup has a better impact in comparison to flipped classroom model of blended learning. It was also found from the study that the combined effect of both strategies has a better impact in comparison to an individual model.

Simonova and Kostolanyova (2016) also conducted their study with two different techniques but not found significant results with any particular method. So, as the present study is framed in sponsored school, where the resources are limited but available, as per that availability basis these two methods were chosen. Another reason for choosing these two methods of blended learning is rigorous literature review reveals that with limited resources and to know the effectiveness of blended learning, rotation and face-to-face driver are very convenient (Horn and Stalker, 2011; Simonova and Kostolanyova, 2016; Nida, Usudo and Saputro, 2020).

Many previous researchers used Station rotation (Walne, 2012; Nair,2014; Eddeen et al., 2014; Powell et. al., 2015; Khader, 2016; Truitt, 2016; Govindraj and Silvarajah, 2017; Ceylan, 2017; Isti'anah, 2017; Oweis, 2018; Utami, 2018) and many of them chose face-to-face driver (Sana, Fenesi and Kim, 2011; Malinina, 2012; Christensen et. al,2013; FAuzan, 2018; Erade et. al., 2019) as their blended learning model for their studies. This study was conducted in rural areas of West Bengal, in Govt. Sponsored School. For

Blended Learning Classes, the K-Yan machine (provided by the Govt. of West Bengal) was used.

1.1.2. STATION ROTATION

Definition: The rotation model of blended learning includes some fixed stations with e-learning and conventional learning facilities and a compact schedule made by the instructor, within which students rotate from one station to another to complete their pre-programmed lesson in a stipulated time.

The station rotation technique is one of the widely used blended learning strategies worldwide. Many previous researchers like Eddeen et al., (2014); Powell et. al (2015); Khader (2016); Truitt (2016); Govindraj and Silvarajah (2017); Ceylan (2017); Isti'anah (2017); Oweis (2018); Utami (2018); Alsahi, Eltahir and Al-Qatawneh (2019); Nida, Usodo and Saputro (2020), etc. used station rotation technique for their respective studies. This method includes a cycle of activities, has proven very competent for higher student-teacher ratios containing classrooms, and larger class sizes, and promotes satisfaction for both teachers and students, this is a very effective technique for classroom teaching, also very easy to implement (Walne, 2012).

Truitt (2016) found that there was a 21% increase in the performance of students during math block lessons using the station rotation model of blended learning. 31 students participated in the study. The researcher found some excellent conclusions in his study which includes five positive points of the Blended learning Station Rotation model as well as two negative points of it. The overall concept of the Station Rotation blended learning model was found very positive.

Govindraj and Silverajah (2017) used a blended flip classroom and station model in Physics learning among students at Sunway College of Malaysia. A survey question here was distributed among 150 physics students which included a 5-point Likert scale and an open-ended questionnaire. Researchers found that students' perception of the blended learning approach employed 5 major domains including access interaction response result and facilitation. Researchers found that blended learning program is to some extent useful for physics learners.

Ayob et al., (2020) describe the station rotation model of blended learning very vividly in their review-based study. They describe station rotation as a within-classroom method that can be scheduled to the teacher's wish and can be completed within a computer lab-based single session. Researchers conducted a rigorous review of ten previous research works conducted by different researchers and found it is good to imply a model for blended learning.

Nida, Usodo and Saputro (2020) used two kinds of blended learning strategies in their research namely flipped classroom model and the station rotation model. This research aimed to examine the effect of blended learning on creative thinking skills in mathematics and anxiety in mathematics among junior high school students in Central Java. According to the researchers' blended learning is a flexible learning model which aggregates offline and online learning together. The investigators used WhatsApp as an online learning resource. A stratified cluster random sampling technique was used in this quasi-experimental study by the researcher. Three public schools were chosen for this research. Achievement test and questionnaire was the tool to collect the data after giving treatment. In the statistical analysis part, the researcher used a one-way multivariate analysis of variance. Research results found that both blended learning models were good enough in comparison to conventional study methods in the process of creative thinking skill development in mathematics. But in the case of lowering anxiety in mathematics direct approach or conventional method proved better than blended learning models i.e., station rotation and flipped classroom methods.

Figure 1.9: Station rotation at the time of Experimentation

Ideal station rotation package includes 3 stations:

Station: I – Individual Online resources

Station: II – Teacher based face-to-face instruction

Station: III – Group work, tasks by students

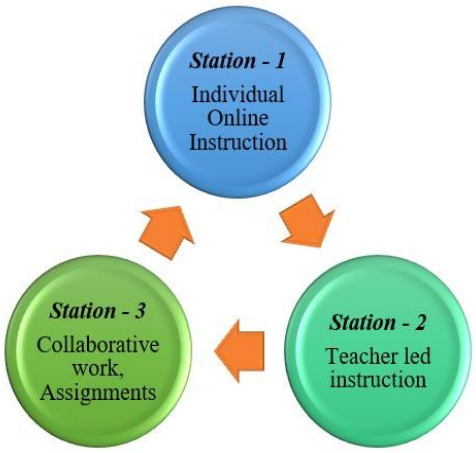


Figure 1.10. Station rotation model

1.1.3. FACE TO FACE DRIVER

Definition: "The programs that fit in the face-to-face-driver category all retain face-to-face teachers to deliver most of their curricula. The physical teacher deploys online learning on a case-by-case basis to supplement or remediate, often in the back of the classroom or in a technology lab".

Figure 1.11: Students attending face-to-face driver mode of blended learning during experimentation

This model of blended learning includes teacher-led instructions along with e-resources this technique includes a speedy increase in achievement graphs and student satisfaction also. It includes learning the have a part of a curriculum with the help of classroom interaction techniques between teachers and students. The chief portion of the course is completed within the classroom and with the help of face-to-face interaction. Online content is not rigid, used to support the teaching-learning process and it involves some students as per their needs. (Malinina, 2012; Christensen et. al,2013).

Sana, Fenesi and Kim (2011) conducted case study-based research on the efficiency of blended learning in the psychology blended learning model at Mcmaster University and found that face to face driver mode of blended learning was proven efficient in introductory psychology classes. Stalker and Horn (2012) used face to face driver technique of the blended learning model to conduct their study at Sun Francisco Academy and found tremendous, good results in performance among students. They have extended their study among 6 to 12 graders in the Pennsylvania district and found good results with blended learning strategies.

Powell et. al (2015) summed up the evolution of online and face-to-face education from 2008 to 2015 to know the potential of different blended learning strategies. This is a huge repository of many case studies with different blended learning models like station rotation, flex, face-to-face driver, enriched virtual, etc. More than 20 case studies were included to know the worth of the face-to-face driver technique, they found it a useful and minimal resource-taking technique among all other models of blended learning.

Whereas Fauzan (2018) By applying the face-to-face driver model composite learning model, it was discovered that pupils' cognitive capacity rises. The blended learning type face-to-face driver model is a face-to-face learning approach in a school setting with traditional teaching that makes use of online learning as correction or supplemental training. (Malinina, 2012).

Erade et al. (2019) systematically reviewed 48 quality papers and found the efficiency of a blended learning program with MOOC. In their study, they found that the flex technique is mostly used among researchers and face to face driver technique is most easy to apply

technique among all blended learning models with MOOC. The success rate entries in academic achievement found 17% in the face-to-face driver technique of blended learning

Zafirah, Basori and Maryono (2021) conducted an interesting study to see the effect of blended learning strategies on the interest of the student and their learning outcomes for same they used face to face driver model. The sample size for the study was 70, 35 each for the experimental and control group. A questionnaire and achievement test questions were distributed among 10th-grade sample students to get the result. A gain score was obtained to conclude the study. Results found in increased gain score in the experimental group in comparison to the control group, the researchers concluded that face to face driver model is efficient in increasing the level of interest and learning outcomes among the students.

Figure1.12: Face-to-face driver process

1.1.4. Blended learning as an instructional strategy

Blended learning is a fine mixture of offline and online resources together to get the best learning outcomes. Many concerning issues can affect the process of successful implementation of blended learning programs in a school education system such as time management, activities of students and teachers, resource management, balancing between different learning modes, the role of teachers in blended classrooms, etc. Different theories and models of blended learning have already been discussed in the earlier part of this chapter. Period of research in length at learning discovered how

different curricular assumptions of blended learning from previous conceptual thoughts of teaching and learning. Some of them are as follows:

- Transformation of the existing monotonous teaching-learning process
- Enhancement and speeding up the teaching-learning process of the existing system
- Student-centric learning process which can meet the newly arising needs of students instantly
- The Association of technology with a face-to-face environment felicitated the learning process and can provide the expected learning outcome.
- Promotes active learning process
- Can provide diversification in the learning experience through the application of different techniques of blended learning.
- Teachers can become an accelerator rather than knowledge Banks.
- Learners can shape their learning process by themselves.
- Blended learning processes provide flexibility in transferring knowledge

The most important thing in a blended learning environment is – a teacher can be a moderator, mentor, instructor, and facilitator at a time. The models are two flexible and easily adaptive so teachers can create their instruction environment to provide their students comfortable to work together and can explore their interest areas and promote opportunities for social learning (Eduviews,2009).

Blended learning has a bright side in that it can provide emphasis on individual learning needs and styles. Learners can be able to choose their preferences as their needs up to an extent because some contents are compulsory for obvious reasons (Harding, Kaczynski and Wood, 2005). For the same reason, the engagement of students in class becomes more active, and motivation toward group activity also increases through this process. Thus, can build a community sense among children and promotes socialization through the education system, and helps in the growth of higher-order thinking and self-efficacy (Garrison and Kanuka, 2004).

1.2. ACHIEVEMENT IN BIOLOGY

Achievement is a process of achieving something with effort and skills. Hurlock (1969) found that achievement is a way to enhance skill and knowledge and brings a desired change in behavior or outcome in learning. Ladson (1999) defined achievement as an increase in intellect and taking part in the knowledge production process. Achievement refers to knowledge acquired, and abilities gained during a student's academic career that is evaluated with the aid of teacher-made or standardized assessments and serves as a status of the student's learning (Arora,2016). Achievement in Biology means the gain of skills in the subject of Biology. An achievement test is one of the easiest ways to measure the effectiveness of a variable implied as an intervention. Many factors can affect the achievement scores of a student. They are caliber, habits of a student, behavior, goal orientation, self-efficacy, level of motivation, personality, family background, social status, economic conditions of the family, parental encouragement, school environment, teaching-learning climate of the school, classroom environment, the attitude of the student, etc. (Sharma,2005; Parveen et al. 2013).

Achievement is the method and mostly used criteria to measure students' potential. Though Sharma (2005) told this kind of system as a "necessary evil" because of its bindings and it exert pressure on the teacher also.

1.2.1. Achievement in Biology by blended learning

Enhancement of achievement can be possible through the promotion of blended learning, which was proved by many researchers before (El-Deghaidy and Nouby, 2008; Picciano, 2012; Yapici and Akbayin, 2012; Porter et.al, 2014; Kumar, 2014; Aldalalah et.al 2014; Kassab et al, 2015; Nazarenko 2015; Gohil, 2018; Harahap et al. 2019; Ayob et al. 2020; Polhun et al. 2021). Samikwo (2013) found that maximum students have a positive attitude toward biology which motivates them to work hard and the reflection of which can be found through achievement.

Soltani and Nasr (2011) proved that a positive attitude toward biology accelerates the achievement of a student. As blended learning is an active learning process, it helps students to be motivated and keeps them motivated in a classroom situation thus, helps them to do better in achievement tests. Many researchers found blended learning

intervention affects self-learning skills, higher-order thinking, and synchronous and asynchronous learning positively. Islam et al. (2018) performed their research with a quasi-experimental design specifically with a nonequivalent control group design. Two experimental groups were taken who were exposed to blended materials and a single control group was taken and taught with a direct method of teaching. The sample size taken for the study was 120. A questionnaire sheet to measure the motivation level of students and a multiple-choice type achievement test questionnaire were used as tools for the present study. The 6-week intervention was given to students with an experimental group by blended learning face-to-face technique. Data was collected and analyzed with SPSS V. 20. f-parametric test, t-test and univariate test were conducted to fetch the result. The result found that students exposed to blended mode showed higher motivation levels and more increase in academic scores in achievement tests after treatment. It is an effective strategy that can be applied to increase achievement scores in Biology (Yapici and Akbayin, 2012; Kazu and Demirkol 2014; Nair and Bindu, 2016; Tahmir, Junda and Bena, 2018).

1.3. ANXIETY TOWARDS BIOLOGY

Anxiety is a kind of psychological disorder mostly seen in all students. Poor academic scores, irregularity, achievement, flow management of the study, bullying, ragging, competition among students, pressure from guardians, result expectation, peer grouping maladjustment, etc. are some causes of anxiety. Aldalalah and Gesaymeh (2014) carried out their experimentation with two independent variables i.e., locus of control and anxiety level. Locus of control was further divided into external and internal parts and anxiety level was divided into three levels low anxiety, moderate and high anxiety. They have taken blended learning strategies capabilities and obstacles as dependent variables for this study. A total of 107 students of the undergraduate level were chosen as a sample of the study. The study was designed on an educational technology course. The result of the study shows that the students with an internal locus of control achieved better in comparison to an external locus of control students in blended learning compatibilities like knowledge and technology progress and also in blended learning implementation problems. The result also revealed that the student with a moderate amount of anxiety performed better than low and high-anxiety students with both dependent variables. The

study also revealed that there was no difference between low and high anxiety in students with blended learning problems. Cimen and Yilmaz (2015) found that self-efficacy and anxiety are the most important factors which affect the performance in case of biology. The study was conducted through a survey model with 160 students of class 9th, 10th and XIthgrade of 4 different High schools in Ankara, Turkey. One of the purposes of this study was to measure the amount of anxiety towards Biology concerning gender, grade, interest towards biology, nugatory experience related to classes and teachers' approach in the biology class. They constructed a Biology anxiety scale to collect the data and applied ANOVA and Pearson correlation for statistical measurements. They concluded that interest in biology and negative previous experience were significant predictors of anxiety towards biology. They also suggested that the relationship between anxiety and self-efficacy activities must be organized at each school to reduce anxiety toward the subject of biology. Here, in this study, the investigator wants to judge if the blended learning strategies can reduce anxiety about achievement and academic scores or not. Steenkamp (2021) formulated a research work to measure the effect of blended learning programs on anxiety among second-year journalism course-pursuing students. The study is quantitative. Interviews were used as a tool for research. After completion of the result calculation, the researcher found that anxiety is the chief barrier to the way of implementation of blended programs among second-year Journalism students. Anxiety reduction can cause success and improvement in performance in a blended program. Alghamdi (2022) conducted research work to find out the impact of blended learning on test anxiety among students of Saudi Arab. 138 students participated in this study. A questionnaire was used to compare the levels of anxiety in pen-paper-based physical tests and online tests. The result showed that students showed higher anxiety in pen-paper-based physical tests in comparison to online tests. So, the researcher suggested online tests and blended modes of learning for the reduction of Exam anxiety among students.

1.3.1. Reduction of anxiety in biology by blended learning intervention

England et al. (2019) pointed out that anxiety is a kind of emotion that negatively affects the performance and quality of students. They found that anxiety can serve as a barrier to the academic performance of students. In an introductory biology class, the students were identified with classroom anxiety, test anxiety, communication anxiety, and social

anxiety. The study result shows that females have higher anxiety in biology courses and they found a major number of students (N=122) drop the course at the end of the semester. This remarkable study also reveals that a moderate amount of anxiety turns into a success factor for some students in their achievement scores. Though too many works are found in the field of biology, Sharma and Sarkar (2020) conducted a study on the pick time of corona pandemic when the blended mode was introduced on a large scale in many schools in India. The study aims to know the impact of blended learning in reducing anxiety among students. Investigators used a self-made questionnaire-based survey method with 56 school children. Students were taken from different schools with blended learning facilities. Results found that most of the students like to take lessons in science in blended mode whereas they are least interested in taking lessons in social science through blended platforms. Almost 73% of the students like blended learning platforms to complete their studies and most of them believe that it helped them to reduce academic anxiety.

1.4. ATTITUDE TOWARDS BIOLOGY

Attitude is a positive psychological variable. Attitude toward biology means the growth of positive thoughts for the subject of biology. Human beings have a strong connection with science in their everyday life. Even ordinary person uses science in their daily life simultaneously. So, it is very necessary to grow scientific attitude among children. On the other hand, Artino (2010) found that online courses are more effective in growing positive attitudes toward English in comparison to blended or conventional courses. Behjat, Yamini and Bagheri (2012) conducted their study in Iran and compared blended learning classroom situations with conventional classes. They measured the reading comprehension and attitude of the students in an experimental study. They found that conventional classes are more effective in comparison to blended classes in growing positive attitudes. Also, it was revealed from this study that scientific attitude grows in both students and teachers through this process. Jaashan (2015) conducted his study at the University of Bisha, Saudi Arabia to know the effectiveness of the blended learning program on attitudes toward English. In a questionnaire-based study, 130 students responded and found a growth in a positive attitude towards English. But it was also revealed that positive attitudes grew due to learning experience, confidence, the joy of learning, eagerness, and motivation of the students. A major effect of teachers is also

found in a growing positive attitude towards English. Lalima and Dangwal (2017) addressed blended learning as a beneficial process as it encloses both conventional and online settings together. they showed blended learning has many faces where students can get many advantages at a time like they can access e-resources and physical resources at a time, new perspective of learning content opens to them, the presence of human resources makes it more perfect, student-centric approach, knowledge building occurs, professional development of teachers occurs. It is one of the best methods to be introduced in school because it helps in formative evaluation very much. For that sake in our present study, we are going to check if blended learning strategies have any potential towards a positive change in the case of attitude towards biology.

1.4.1. Increasing positive attitude towards biology by blended learning

Many previous workers recommended that renovation of methodology in teaching biology should be done for the sake of growth in attitude towards biology (Odubunmi, 1983; Bajah, 1986; Yapici and Akbayin, 2012; Juweto, 2015). Wang et al. (2007) found that the factors affecting the level of learning of concepts of biology among senior-level students are their perspective towards biology. They concluded that attitude towards values and motivation affects mostly concept building in biology. Students are shown a high level of motivation and attitude towards biology positively retained among senior secondary level learning concepts in biology.

Yapici (2012) conducted a study with 9th-grade students in biology in a High School and found blended learning is an effective technique than the conventional one in increasing positive attitudes towards biology. Rosa (2017) found the efficiency of blended learning was measured in an introductory mathematics course, Blended Learning proved effective in growing positive attitudes towards mathematics. McCall (2017) conducted to detect the effects of Individual Versus Cooperative Testing in a Flipped Classroom on Academic Achievement, Motivation toward Science, and study time for 9th Grade biology Students. Blended learning proved effective in growing a positive attitude toward biology and growing motivation in science. Integration of technology in the learning process makes learning more interesting where both learner and teacher can express their individuality.

1.4.2. Achievement, Anxiety, and attitude towards biology with blended learning

At the time of framing of present study, rigorous literature reviews were conducted. As a result of review of literature, the following results were found like, Deghaidy and Nouby (2008) was to determine the effect of the learning programme on the attitude and success of aspiring teachers in blended learning. The study used a total of 26 student instructors from the Egyptian University. For this study project, flex and self-blending approaches were employed. Higher accomplishment test scores and a more favourable attitude towards the mixed learning environment were demonstrated in the posttest group that had been exposed to blended learning methodologies.

So and Brush (2008) and Ozkan and Koseler (2009) performed a similar study, which showed that blended learning interventions were utilized to evaluate student qualities including motivation, confidence, enthusiasm, and anxiety. In every instance, blended learning tactics have been shown to be useful, and students' anxiety has also been found to be lower.

Alshwiah (2009) conducted a study sought to determine the impact of a mixed learning technique on a few learning outcomes at Arabian Gulf University when teaching medical vocabulary. The study made an effort to evaluate how the suggested technique would affect the performance, attitudes towards the English language, and unit satisfaction of pre-medical students. 50 students with an English Language Entry test scores below 60% made up the research sample. The sample was divided into two groups at random, with 28 students in the experimental group and 22 students in the control group. The English language unit tests in English 151, attitude assessments for the unit that were created by the researcher, and satisfaction scales for the unit were all used as research tools. Data analysis showed that, except for the second midterm exam total score, where the control group significantly outperformed the experimental group, there were no statistically significant differences between the experimental and control groups in terms of achievement or attitude towards the English language. The outcomes also showed that the members of the experimental group expressed high levels of satisfaction with the online unit in three dimensions of the scale and moderate satisfaction in one. Although it

was said that students were happy with the online course, there was little administrative assistance, which was blamed for the lack of vocabulary growth.

Brand and Kinash (2010) used a quasi-experimental research approach for their study. They were interested in discovering whether or not mobile technology use may affect students' learning outcomes. The factors they took into account for their study were attitudes towards technology, anxiety associated with technology, and success after utilizing technology. They conducted a comparison group with traditional teaching across a sample size of 150 students over the course of two semesters, and they treated the experimental group with mobile and iPad-based blended learning sessions. Software like SPSS and NVIVO were used for statistical analysis, which was carried out through MANCOVA. They came to the conclusion that since students found mobile learning to be so engaging, it should boost interest levels, improve student satisfaction, and lowers anxiety.

Alseweed (2013) compared the efficacy of three teaching methods: traditional teaching, blended learning, and online learning. 34 students in all were divided into three groups and instructed using those three methods. In comparison to the other two ways, the results showed that the blended strategy was more successful in boosting academic achievement scores and attitudes towards the course.

Henrie et al. (2015) performed a study to determine how blended learning affects students' emotional involvement, self-regulated learning, and anxiety. They discovered that anxiety was negatively impacted by blended learning. Given that anxiety is a harmful psychological condition, it may be said that blended learning assisted students in lowering their anxiety.

Banditvilai (2016) assessed the impact of blended learning on students' language proficiency in the areas of hearing, speaking, reading, and writing was examined. 60 pupils were used as the study's sample. The experimental group, which was taught using a blended learning approach, had more successful outcomes than the control group, which was taught using a traditional approach. With the use of the blended learning intervention, students' levels of motivation were also observed to have grown.

Ikhwan and Widodo (2019) performed research to determine the effectiveness of blended learning in enhancing student success in environmental science and attitude towards the topic. According to the study's findings, blended learning is superior to traditional methods in that it significantly increases student achievement and somewhat improves their attitude.

Seitan, Ajlouni and Al Shra'h (2020) finished their education at a Jordanian institution. They have completed their study with a sample size of 40. The purpose of the study was to determine how blended learning methodologies affected students' academic performance and attitudes. Only the experimental group was exposed to the attitude scale; the accomplishment test was administered to both the experimental and control groups. Students in the experimental group who were exposed to blended learning methodologies had a favourable attitude towards the teaching environment and the educational process. On the other hand, on the accomplishment test, the students in the experimental group performed better than those in the control group.

Al-Osaimi and Fawaz (2022) did their research on Saudi Arabia following the Covid pandemic catastrophe. A mixed nursing course with 20 nursing students was selected as the study's sample. Researchers discovered that students are losing motivation as a result of taking online courses, which has a significant negative impact on both their academic performance and attitude towards the nursing programme. According to the findings, nursing students' motivation levels, attitudes, and accomplishment scores may all be raised by enhancing the quality of their education.

Many more researchers conducted their studies to encompass the effect of blended learning strategies with achievement and attitude towards a subject (Deghyaidy and Nouby, 2008; Brand and Kinash,2010; Alseweed, 2013; Banditylai, 2016; Ikhwan and Widodo, 2019; Seitan, Ailouni and Al Shra'h, 2020; Al-Osaimi and Fawaz, 2022). Some of the designs were quasi experimental in nature (Grace et al., 2004; Ali and Awen,2013; Seitan, Ailouni and Al Shra'h, 2020; Grolein et al., 2021; Al-Osaimi and Fawaz, 2022) and most of the investigators found that blended learning strategies proven effective in improvement of academic score as well as promotes positive attitude towards a subject. On the other hand, many studies found to know the role of blended learning in reducing

anxiety and academic anxiety (Brand and Kinash, 2010; Aldalalah, 2014; Henrie et al., 2015; Baloran, 2020; Grolein et al., 2021).

Blended learning methodologies are more or less successful for lowering anxiety, raising academic performance (Henrie et al., 2015; Brand et al., 2016) , and fostering a positive attitude towards any topic, according to certain research that additionally includes anxiety and attitude towards a subject. As a result, it was discovered from the aforementioned literature that achievement, attitude, and anxiety may be used as factors to determine the efficacy of blended learning for the current study. Academic anxiety, achievement, and attitude towards a topic were ultimately chosen as variables for the current study since studies with individual variables also supported the selection of variables.

1.5. SIGNIFICANCE OF THE STUDY

Now a day, Blended learning is one of the most interesting and emerging innovative pedagogical techniques in India, so experimentation with blended learning is chosen for the present study.

Rural areas are chosen strictly for the current study to get its finest result as the resources and funding are very limited there. Because of the high student-teacher ratio in Govt. and sponsored schools in West Bengal, the teaching-learning process cannot run as per requirement and quality, also teachers cannot get proper learning outcomes from students. Some of these schools have well-developed computer labs and internet connections but still no use of those web resources in the subjective teaching-learning process. So, this study intended to pursue to know if the process of implementation of blended learning is possible or not and also if it is efficient or not in the enhancement of the teaching-learning process without lots of investments and with the help of limited resources.

Pupil teacher ratio in West Bengal

	2013-14	2014-15	2015-16
All India	41	38	37
West Bengal	57	56	57

**Source: National Institute of Educational Planning & Administration, New Delhi, 2018

Figure 1.13: Pupil teacher ratio in West Bengal

Students of Class XI and XII, come under the adolescent age group. Many previous studies prove that children of adolescent periods have shown the most amount of anxiety (Hishinuma et. al, 2000; Ozkan and Koseler, 2009; Henrie et. al, 2015) due to academic pressure, hormonal changes, other pressure, etc. than another age group. So, it is decided to take the adolescent age group as our study group.

Failure in achievement leads to less student satisfaction; increasing anxiety in them also embarks fear, especially in biology learning (Deb et. al, 2015). This project can justify if some blended learning strategies introduced in classrooms of a high-student volume school are helpful or not in a growing interest in biology. Those dreams to become a doctor but because of conventional teaching methods, they have anxiety towards certain topics where their clarity is required for further exposure, so to reduce anxiety and boost pupils' minds to get more satisfactory learning support in biology teaching with the help of available human and e-resources.

The main purpose of this study is to discover the differences between conventional learning and blended classes concerning Achievement, Anxiety towards biology, and Attitude toward biology among Senior Secondary students in rural areas in West Bengal.

biology is taken as an experimental subject because the investigator is an experienced biology teacher at a Govt. The school (14 years' Experience), due to mastery in biology, the subject is chosen for the present study. At present, the need for an efficient doctor is in the pick. Entrance exams related to Medical have the most weightage of 50% in biology. Higher Secondary or senior secondary is the preparative stage for such competitive exams. So, growth of confidence and a positive attitude towards biology is

very much needed in this stage. These are the chief causes to choose biology and senior secondary Students in this study.

1.6. RATIONALE OF THE STUDY

Learning is a never-ending process – "It is a journey from cradle to grave" (Crow and Crow, 1973). To make learning more meaningful, Mathew (2017) pointed out that it is very important to maintain the teaching-learning quality, teachers' efficiency for fruitful learning in and outside the school, and positive learning outcomes. These are the basic need of the hour.

So, the effectiveness of engaging the learners in the new pedagogical strategy (Singh, 2003) which is blended learning in this study, to boost their positive attitude towards biology, reducing their anxiety and motivating them to get higher achievement scores.

In the present study, the investigator tried to perform research on the effectiveness of blended learning, to see if the strategy is worthy or not in reducing anxiety, growing a positive attitude towards biology, and achievement in biology. As blended learning is an innovative strategy it might be helpful to get a positive answer to the current teaching-learning problem. Lalima and Dangwal (2017) suggested that the implementation of blended learning should be done from elementary schools to higher education is a necessary need today. blended learning strategies can be the solution to problems of the present education system. Initiation of blended learning in a regular classroom can solve the solution in gaps in the classroom environment.

Many previous studies have shown that a positive attitude towards any subject alters interest in that subject and improves achievement in students. These are the challenges of today that the investigator tried to work on. Research has been done by different investigators in different countries in the world, who have different educational infrastructures, curricula, and various subjects – these give us insights and scope to identify the relationships between the attitude of students and instructional strategies. Most of the studies are found concerned about the attitude towards learning in general, only some studies are found focused on attitude towards a particular discipline like English, Hindi, chemistry, math, physics, etc.

Much research on anxiety in general academic anxiety and anxiety disorders is found. But the least number of papers were found to see the effect of blended learning in reducing anxiety. Also, many papers were found to see the effect of blended Learning on achievement. Taking into consideration all the above the investigator decided to evaluate the effect of blended learning on achievement, anxiety, and attitude toward biology.

1.7. THEORETICAL FRAMEWORK

The theoretical framework of a study is like the backbone of a body. The structure that may retain or support a research study's hypothesis is known as the theoretical framework. The theory that explains why the research problem under investigation occurs is introduced and explained in the theoretical framework. (Abend, 2013). It responds to three crucial issues:

- The researcher's opinions or feelings on the subject under investigation?
- The purpose of a researcher's use of variables: to interpret, describe, explain, critique, support, or find information?
- What possible negative effects can such work have?

This study aimed to investigate the effect of blended learning strategies on students of XI^{th} standard on their achievement, attitude, and anxiety toward biology. To determine the effectiveness of blended learning strategies on the topics of biology (collected by pilot study) where students feel anxiety with respect to the difficulty level selected topics.

Blended learning is also called hybrid learning. It means the mixing of online and offline resources together to get perfect learning outcomes (Garrison and Kanuka, 2004). Blended learning is an innovative technique by which students and teachers are benefited equally at a time. Because time, place, speed of study, mode, or techniques of study are flexible here (Dziuban et al, 2015) it causes an increase in the quality of teaching as well as brings better learning outcomes also(Poon, 2012).

Proper mixing of the beneficial and strong parts of e-learning along with conventional face-to-face learning gives birth to blended learning (Horton, 2002; Osguthorpe and Graham, 2003). Garnham and Kaleta (2002) defined blended learning as an active

classroom situation where teaching-learning activities are done partially online and partly through offline mode and by which adequate time is saved. Graham (2006) defines blended learning as “the combining of the two different education models, traditional face-to-face learning and distance learning”.

Anxiety is a negative psychological disorder; it is the expression of excessive emotional fear, unpleasant feeling of uncomforting, affright, dubitation, palpitation, dreadfulness, concern, or worry (Barlow and Cohen, 2002). Anxiety has many dimensions fear of cognitive anxiety, social anxiety, physical anxiety (Cushway, Tyler and Nolan, 1996), educational anxiety, physiological anxiety, and academic anxiety (Jegede, 2015). Academic anxiety is a serious matter of concern and it should not be ignored. It directly affects the performance of a student. Long-time exposure and ignorance of academic anxiety can lead to poor academic performance and withdrawal from the socialization process in school as well as from society (Mattoo and Nabi, 2012).

Science anxiety involves feelings of anxiousness and palpitation that may hamper the normal classroom situation in science classes. The use of different scientific equipment may also lead to science anxiety. It is actually a condition of discomfort that generally occurs at the time of scientific instrument handling or in response to the scientific tasks given by the teacher. It gradually lowers self-esteem. It may lead to panic attacks, helplessness, nervousness, blotting in the stomach, restlessness, and badly affects concentration (Seligman, Walker and Rossenhan, 2001).

Anxiety has many dimensions fear of cognitive anxiety, social anxiety, physical anxiety (Cushway, Tyler and Nolan, 1996), educational anxiety, physiological anxiety, and academic anxiety (Jegede, 2015).

Attitude is a positive psychological variable. It means a tendency to react continuously to some particular object, subject, matter, or situation. Attitude towards biology means studying the level of motivation; self-directed efforts being taken by learners and their perceptions as well as the level of enjoying reading Biological terms and of course positive changes in the case of attitude towards biology. Attitude toward biology indicates the fondness of students for the subject of biology in terms of intellectual, recreational values and moral values (Prokop et. al, 2007).

According to some previous investigators motivation toward biology is one of the most important factors that influence students' achievement in biology. For the improvement of achievement in biology, it is very important to grow a positive attitude towards biology first (Cimer and Cimer, 2012; Ekici,2012) Although the definition or conception of an attitude to science is fuzzy and cryptic, an attitude is a conception that sketches an emotional inclination toward a problem, person, place, event or thought. Thus, an expression such as "I like science" and "I like science class" are attitudes. (Simpson and Oliver, 1990).

biology is a basic branch of science. This is the science of life and living organisms. According to Wikipedia, "biology is the natural science that studies life and living organisms, including their physical structure, chemical process, molecular interactions, physiological mechanisms, development, and evolution." Some chapters, some lessons which are relevant to everyday life are seen as quite difficult for understanding by the students (Staeck, 1995; Yesilyurt, 2010).

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Science anxiety involves feelings of anxiousness and palpitation that may hamper the normal classroom situation in science classes. The use of different scientific equipment may also lead to science anxiety. It is actually a condition of discomfort that generally occurs at the time of scientific instrument handling or in response to the scientific tasks given by the teacher. It gradually lowers self-esteem. It may lead to panic attacks, helplessness, nervousness, blotting in the stomach, restlessness, and badly affects concentration (Seligman, Walker and Rossenhan, 2001).

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Anxiety has many dimensions fear of cognitive anxiety, social anxiety, physical anxiety (Cushway, Tyler and Nolan, 1996), educational anxiety, physiological anxiety, and academic anxiety (Jegede, 2015).

Attitude is a positive psychological variable. It means a tendency to react continuously to some particular object, subject, matter, or situation. Attitude towards Biology means studying the level of motivation; self-directed efforts being taken by learners and their perceptions as well as the level of enjoying reading Biological terms and of course positive changes in the case of attitude towards biology. Attitude toward biology indicates the fondness of students for the subject of biology in terms of intellectual, recreational values and moral values (Prokop et. al, 2007).

According to some previous investigators motivation toward biology is one of the most important factors that influence students' achievement in biology. For the improvement of achievement in biology, it is very important to grow a positive attitude towards biology first (Cimer and Cimer, 2012; Ekici,2012) Although the definition or conception of an attitude to science is fuzzy and cryptic, an attitude is a conception that sketches an emotional inclination toward a problem, person, place, event or thought. Thus, an expression such as "I like science" and "I like science class" are attitudes. (Simpson and Oliver, 1990).

Biology is a basic branch of science. This is the science of life and living organisms. According to Wikipedia, "Biology is the natural science that studies life and living organisms, including their physical structure, chemical process, molecular interactions, physiological mechanisms, development, and evolution." Some chapters, some lessons which are relevant to everyday life are seen as quite difficult for understanding by the students (Staeck, 1995; Yesilyurt, 2010).

There are different theories present to run e-learning or blended learning programs. Some of them are as follows:

E-moderating: The five-stage procedure described by Gilly Salmon's e-moderating paradigm (Salmon, 2000) involves the student using online communication technologies. It is founded on the idea that for learning by technology to function well, a number of conditions must be met. The usage of activities to get students talking to one other and the E-moderator instead of just reading handouts and presentation material is one of the underlying problems in this situation. The E-moderating model's prescriptive approach is one of its shortcomings. According to Lisewski and Joyce (2003), this model does not adequately account for the necessity for flexibility in practice. Due to the absence of the face-to-face component in this framework, the application of this paradigm to blended learning is constrained.

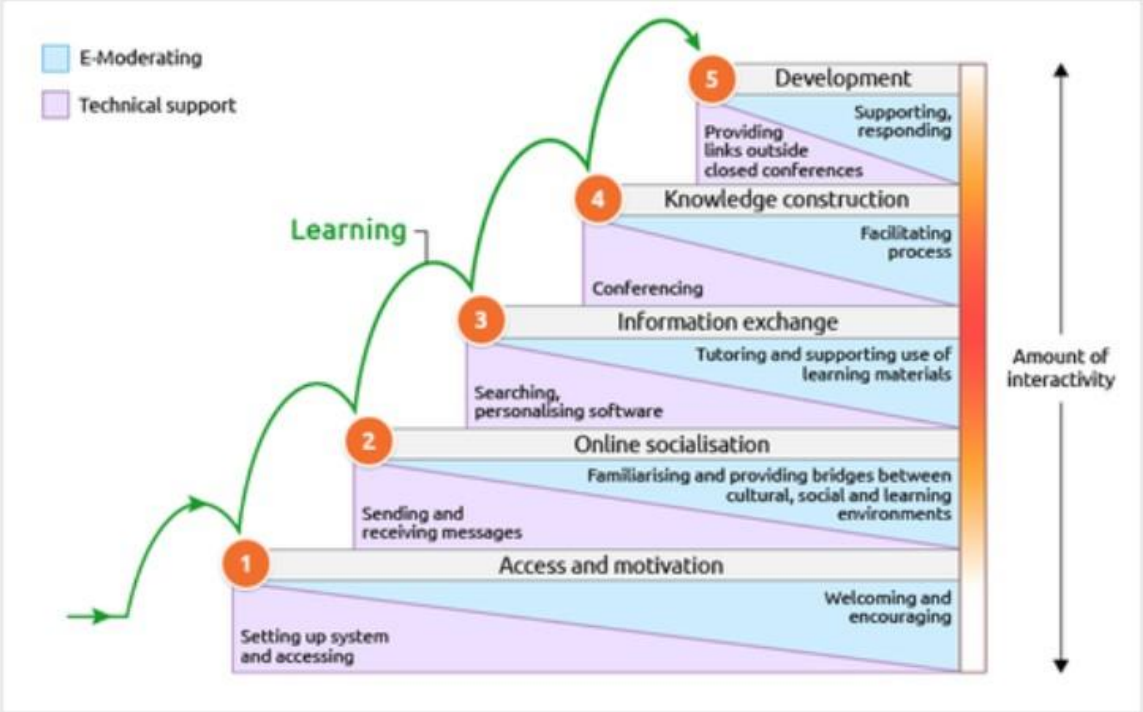


Figure 1.14.: E-moderating model of Salmon 2000

Retrieved from: https://www.gillysalmon.com/five-stage-model.html

Conversational Framework: To improve teaching and learning, Diana Laurillard used the fundamental principles of conversation put out by psychologists and educators including Pask (1976) and Ramsden (1992). The lecturer and student's communication process as it relates to the growth of the students' knowledge is shown by the conversational framework. Figure 1.15 depicts this framework's 2002 iteration. The 12 steps that should be followed while instructing pupils are shown in Figure no. 1.15. There

are three opportunities for communication with the teacher throughout each of these cycles. In turn, the instructor gets the chance to assess pupils' comprehension at an early stage and rectify it if there are any misunderstandings.

The learning connection becomes more visible and open to both student and instructor when dialogue is used as the foundation for instruction. The conversational framework has shown two significant difficulties, which are: 1) The model's iterative dialogue structure, which calls for at least three interactions with a single topic, means that a students have the chance to get better at the same activity. 2) There is no one ideal medium for delivery; each has its own shortcomings. The work of Draper (1997), who contends that there is a lack of attention to the management of learning and the necessity for learning negotiation between the students and the instructor, is a subsequent critique of the conversational framework. The use of conversational framework in online group learning is another restriction (Britain and Liber, 1999). Rosa Michaelson discusses further criticisms (2002).

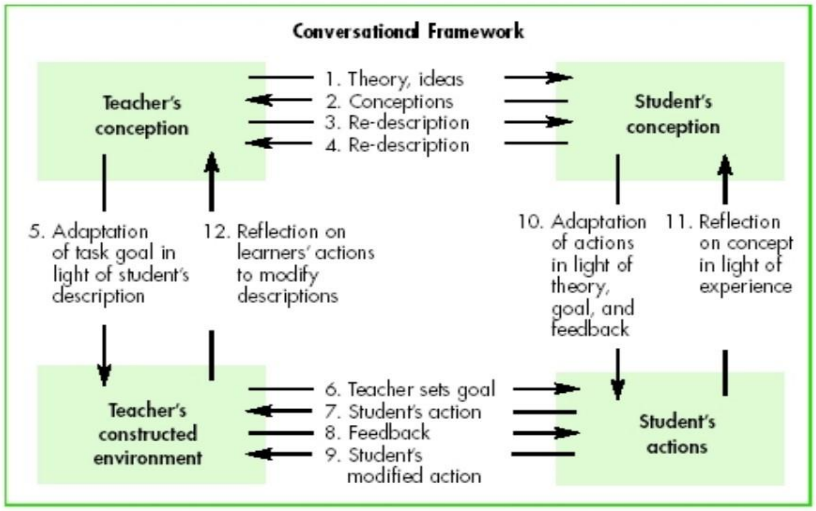


Figure 1.15: **Laurillard's Conversational Framework** (Source: Quinn & Reid, 2003) Retrieved from: https://files.eric.ed.gov/fulltext/EJ1016940.pdf

Technological Pedagogical Content Knowledge (TPACK): Technological Pedagogical Content Knowledge (TPACK), which is based on Shulman's concept of Pedagogical Content Knowledge, has become a valuable framework for outlining and comprehending the objectives of technology usage in education. As a theoretical framework for understanding the teacher knowledge necessary for successful technology integration, technological pedagogical content knowledge (TPCK) was presented to the

field of educational research (Mishra & Koehler, 2006). The acronym for the three types of knowledge addressed—technology, pedagogy, and content—was changed to TPACK (pronounced "tee-pack") to make it simpler to remember and to create a more cohesive whole. (Thompson and Mishra, 2007–2008). By include technological knowledge as placed within content and pedagogical knowledge, the TPACK paradigm expands on Shulman's concept of Pedagogical Content Knowledge. TPACK has been conceptualized for some time. A brief reference of the triad of content, theory (as opposed to pedagogy), and technology in Mishra (1998), however within the context of educational software design, served as a forerunner to the TPCK concept.

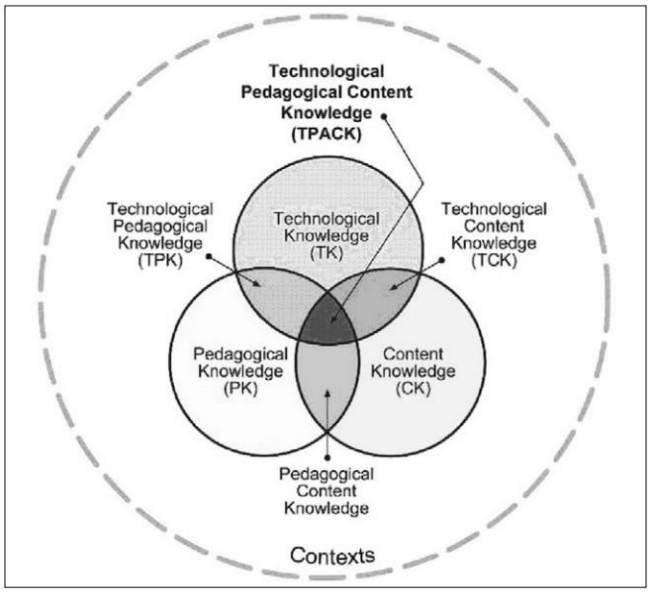


Figure 1.16: TPACK framework

Retrieved from: https://files.eric.ed.gov/fulltext/EJ868626.pdf

The connections between technology, content, and pedagogy are similarly described by Zhao (2003), Keating and Evans (2001), and Pierson (1999, 2001). In addition to integration literacy (Gunter and Bumbach, 2004), information and communication (ICT)-related Pedagogical Content Knowledge, technological content knowledge, and electronic Pedagogical Content Knowledge or e- Pedagogical Content Knowledge have all been discussed by other academics, though frequently under various labelling systems. those who have shown an awareness of the connections between curriculum, instruction, and technology. It exclusively includes interrelation between 3 components i.e., technology, pedagogy, and content of study. It comprises 7 basic points:

Table 1.2: Components of TPACK framework

Sl. No.	Points	Explanation
1	Knowledge of technology	The term "technology knowledge" describes the understanding of a variety of technologies, from low-tech ones like pencil and paper to digital ones like the Internet, digital video, interactive whiteboards, and software.
2	Knowledge of content	"Knowledge about the actual subject matter that is to be learned or taught" is referred to as "content knowledge." Teachers need to be aware of the material they are teaching and how different curriculum areas require different types of expertise.
3	Knowledge of pedagogy	Knowledge of classroom management, assessment, lesson planning, and student learning is included in the term "pedagogical knowledge," which refers to the techniques and procedures of teaching.
4	Pedagogical content knowledge	Knowledge of the subject matter as it relates to the teaching process is referred to as pedagogical content knowledge. (Shulman, 1986). Since it combines both content and pedagogy with the aim of improving teaching methods in the topic areas, pedagogical content knowledge differs for distinct content areas.
5	Knowledge of Technological content	Knowledge of the new representations that technology can provide for a certain piece of material is referred to as technological content knowledge. It implies that educators are aware of how a certain technology might alter how students practice and comprehend ideas in a particular subject area.
6	Technological pedagogical knowledge	The term "technological pedagogical knowledge" refers to the understanding of how various technologies may be employed in teaching and the possibility that doing so could alter how teachers deliver their lessons.
7	Technological pedagogical content knowledge	Knowledge needed by instructors to incorporate technology into their instruction in any subject area is referred to as technological pedagogical content knowledge. When teaching material using the proper pedagogical techniques and technological tools, teachers have an intuitive awareness

Sl. No.	Points	Explanation
		of the intricate interactions between the three fundamental components of knowledge.

According to the framework (AACTE Committee on Innovation and Technology, 2008), the emphasis is on developing and accessing teacher expertise that is focussed on efficient student learning across a range of curriculum areas. As a result, TPACK is a useful framework for considering what knowledge instructors should possess and potential paths for acquiring it. The kind of training and professional development experiences created for technology-based education may be influenced by the use of TPACK as a framework for assessing teaching knowledge.

Among all above mentioned theories, TPACK model seems to be the most important and applicable for present study. Many previous investigators (Maor and Roberts,2011; Philipsen, Tondeur and Zhu, 2015; Qasem and Viswanathappa, 2016; Sintawati and Abdurrahman, 2020; Mulyadi et. al., 2020; Dakhi, Jama, and Irfan (2020); Anthony et. al., (2022)) used TPACK framework to complete the theoretical framework of their study. Investigators like Philipsen, Tondeur and Zhu, (2015), Qasem and Viswanathappa, (2016) and Sintawati and Abdurrahman, (2020) worked with TPACK model to know the effectiveness of blended learning on academic achievement and result found that blended learning proven effective in improving achievement scores in students. Dakhi, Jama and Irfan (2020) and Anthony et. al., (2022), Juwandani et. al., (2022) investigated the effect of blended learning with attitude towards a subject among students. So, following basic components of technology pedagogical content knowledge theoretical framework of current study were formulated. Present study is delimited for subject Biology and the area of study was delimited in a particular area of West Bengal, India. Also, only XI standard students with science stream and who have taken biology as elective subject were chosen as sample of study.

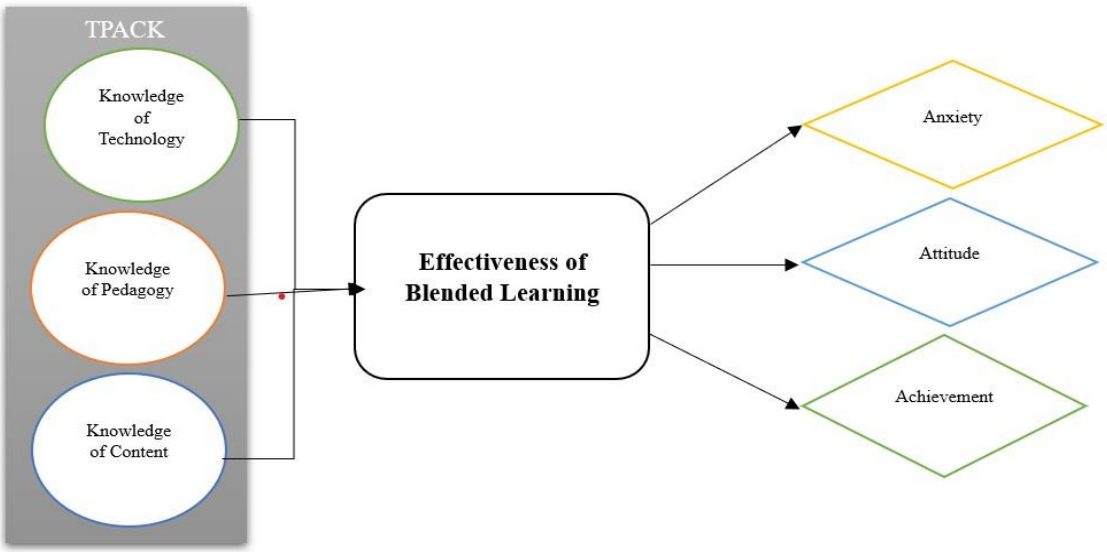


Figure 1.17: Theoretical Framework of the study.

1.8. STATEMENT OF THE PROBLEM

The problem under investigation is entitled as:

"EFFECTIVENESS OF BLENDED LEARNING IN BIOLOGY ON ACHIEVEMENT, ANXIETY AND ATTITUDE OF SENIOR SECONDARY STUDENTS OF WEST BENGAL"

1.9. OPERATIONAL DEFINITIONS

Effectiveness of blended learning, achievement, anxiety and attitude towards biology and senior secondary level are the key terms related to the present study.

Effectiveness of Blended learning

Effectiveness of Blended learning defines as a measure to study the impact of blended learning inventions, which is the combination of face to face and rotation techniques, on students learning.

Achievement in biology:

Achievement in biology is measured on the basis of knowledge, comprehension, application and skills of scientific facts, ideas, laws, theories and principles related to the chosen topics from the curriculum of biology taught to eleventh grader of WBBSE.

Anxiety towards biology

In present study anxiety towards biology is measured with respect to test anxiety, classroom anxiety and laboratory anxiety.

Attitude towards biology

In the present study the attitude towards biology is measured with respect to interest, difficulty and importance.

Senior Secondary School Students:

Senior secondary school students mean the students of XI standard.

1.10. RESEARCH OBJECTIVES

1. To prepare and validate the Blended Learning content for class XI students of Biology.
2. To prepare the achievement test for the content for Class XI students of Biology.
3. To prepare the lesson plans for blended learning and conventional learning approaches for the content in Biology.
4. To study the effect of Blended Learning strategies (BLS) on students of XI standard with respect to

a. Achievement in Biology.

b. Anxiety towards Biology.

c. Attitude towards Biology.

5. To study the interaction effect of Blended Learning strategies (BLS) and gender on students of XI standard with respect to

a. Achievement in Biology

b. Anxiety towards Biology

c. Attitude towards Biology.

1.11. HYPOTHESES

The hypotheses of this study are presented as follows:

1. There is no significant difference between pre and post test score in biology among class XI students of control group taught by conventional method.
2. There is no significant difference between pre and post test score in biology among class XI students of experimental group taught by blended learning method.
3. There is no significant difference between post test score in biology among class XI students of control and experimental group.
4. There is no significant interaction effect of Blended Learning Strategies and conventional method with respect to gender on the mean score of achievement in Biology.
5. There is no significant effect of control group conventional method on the mean score of attitude towards Biology among the students of XI standard.
6. There is no significant difference of pre and posttest scores of attitude towards Biology among the students of XI standard of experimental group.
7. There is no significant difference of pre and posttest scores of attitude towards Biology among the students of XI standard of control and experimental group.
8. There is no significant interaction effect of Blended Learning Strategies and conventional method with respect to gender on the mean score of attitude towards Biology.
9. There is no significant difference of pre and posttest scores of anxiety towards Biology among the students of XI standard of control group.
10. There is no significant difference of pre and posttest scores of anxiety towards Biology among the students of XI standard of experimental group.
11. There is no significant difference of pre and posttest scores of anxiety towards Biology among the students of XI standard of control and experimental group.
12. There is no significant interaction effect of Blended Learning Strategies and conventional method with respect to gender on the mean score of anxiety towards Biology.

1.12. DELIMITATION

The study has the following delimitations:

- **Area:** The study is confined to schools following the WBCHSE syllabus of a particular area.
- **Grade and size of the sample**: The study is delimited to only 70 senior secondary students, especially of Class XI.
- **Subject:** Only teaching-learning of Biology is considered for the study.
- **Medium of study:** Only Bengali medium students are considered here in this study, Achievement and treatment were delivered in Bengali.
- Among all Blended learning strategies, only rotation and face-to-face driver are limited for the present study.

CHAPTER – 2

REVIEW OF LITERATURE

2.1. INTRODUCTION

A review of Literature is one of the most necessary parts of a thesis because it provides the reference and grounding of A study. It also helps in supplying information about the experimental basis for the development of a hypothesis in a study. It emphasizes general ideas of relevant work previously designed. Finally, a review of the literature explores the basic theoretical framework of a study as well as its logical explanation also. Dharani (2013) mentioned literature review includes finding ways to point out and analyze definite problems of a topic, it can be collected from various books, journals, articles, and other reliable resources. It helps a researcher to find out a particular problem from a bigger aspect.

The current study is framed to evaluate the efficiency of blended learning in decreasing anxiety in Biology and gaining a positive attitude towards Biology and positive results in achievement tests in Biology. Blended learning is one of the most discussed topics nowadays. Much research related to blended learning was conducted at different times by different researchers in India and abroad. But the assembly of 3 variables namely anxiety, attitude and, achievement together with a blended learning perspective is quite a new approach. A review of literature for the present study includes many works of foreign researchers on different blended learning models and their implementation in foreign countries as well as in India are discussed here. A review of the literature was contacted with the help of books, dissertations, periodicals, journals, etc. This chapter includes many sub-chapters to cover the whole topic of research and vivid illustration of previous works from which research gap and statement of the problem was found.

2.2. BLENDED LEARNING

To find out the efficiency of Blended Learning strategies, some investigators followed a conceptual framework, called the 3C concept includes the ‘content’ of learning resources, two ways of ‘communication’ between instructor and pupil, and results in the

‘construction’ of learners positive outcome in the teaching process (Kerres and De Witt 2003). It plays a role as an anchor between conventional learning and e-learning (Rovai and Jordon, 2004).

Cooney, Gupton and O'Laughlin (2000) looked at how kids perceived play in prekindergarten and K/1 classrooms discovered a brand-new class of activities that blended play and work. The blurred boundaries between play and work, shared control over classroom activities, and element of spontaneity in the learning process were the defining characteristics of these blended learning activities.

Mavrotheris, Engh and Meletiou-Mavrotheris (2000) presents an introduction of the Eurolearn-European Welder project, which is supported by EUREKA and intends to create and verify a novel pedagogical framework for planning and delivering training in blended learning for the development of vocational skills. The project created training for welding engineers that blends an online learning environment with lab practice, using an application from the welding industry and harmonised training criteria from industry standards agencies. This article outlines the train-the-trainer programme that is based on LAMS and provides an analysis of the feedback that was obtained from its evaluation across many EU member states.

The authors contend that several industry sectors may implement the same training methods. A study with a blended and collaborative learning approach with student-teacher training courses found successful positive results in achievement tests (El-Deghaidy and Nouby, 2008).

Garrison and Kanuka (2004) mentioned that blended learning is a mixture of online and offline learning which provides compatible effects which is stable and can balance open communication and unlimited access in the teaching-learning system. It requires two efforts to plan a proper blended platform i.e., strategic planning which includes 3 sub-categories namely needs, goals, and objectives of the platform, and operational planning which encounters noninstitutional items like provisions of internet connectivity, arrangement of evaluation tools, arrangement of resources, etc. the conclusion of this study reveals more works are needed to measure the effectiveness of blended learning with student satisfaction, self-efficacy, achievement, etc.

Rovai and Jordon (2004) formulated a comparative study of traditional, total online, and blended classrooms and measured the efficiency of each technique. Experimentation was conducted with 68 students. Of them, 26 students with traditional teaching methods, 28 with the blended platform, and 25 with an online mode of learning. The classroom community scale constructed by Rovai, (2002) was used as a tool to measure the classroom connectivity and learning of the pupil. This scale consisted of 20 self-reported items measurable with a 5-point Likert scale. A higher score indicates more classroom community sense among students. The result of the study reveals that blended learning has an extreme potential to change the future of the teaching-learning paradigm.

Ellem and McLaughlin (2004) conducted a study on 1st-year Biology students of the University of Newcastle. Notes, lab instruction manual, and other materials were delivered online mode. Interactive classes were also taken. The result of 1st semester shows that though the students got higher grades their level of satisfaction is very low. Then the investigators lowered their workload and reduced the cost by about 40% and then the result found the highest increase in the satisfaction level of students. They concluded that a blended learning program can be effective even with low-cost resources when it can be done in presence of properly skilled and trained instructors.

Ellis and Calvo (2007) found that to maintain an optimum standard in a blended system, some indices are mostly required. They have identified the indicators by working with seven universities that are using a common learning management system for their pupil. A questionnaire was prepared and used to get information about policymaking, skill development, assessment, and building leadership among students. The comparison was drawn with the face-to-face learning experience along with the blended learning management system of the students. This research was conducted to make sure about the quality of blended learning by a learning management system. The result assures the same.

According to some investigators, study the amount of e-studying on the University Degree to be used in studying context wherein online sports are used to supplement face-to-face studies additionally to talk about the advantages and demanding situations of comparing components about wholes in approaches that tell the carriers of the component

and to develop a quick e-studying scale. The e-studying scale rankings correlated with vital standards utilized in preceding examinations and inferences drawn. As a whole degree quality and self-rankings of Generic Skills development amongst students, furnished proof of the criterion validity of the scale. Inter-rater settlement analyses indicated the suitability of aggregating e studying scale rankings as much as the school degree from the diploma degree, a vital locating given the obligations of schools inside our university for enhancing the pupil experience. (Ginns and Ellis, 2009).

Quality was validated with inside the impact of various variables and their mediating techniques influencing students' mastering inside combined mastering surroundings with the use of rotation and self-blending in university education, selling a higher stage of mastering has emerged as a high hobby amongst teachers as more universities and schools try and broaden and supply excellent combined educational courses. Working with the variables include (1) the excellent of the instructor, (2) mastering activities, (3) mastering support, and (4) study workload, with the aid of using regression analysis, the effect of learner, educational, and positively motivational indices on mastering effects discovered to be consolidated around one variable in mastering application. The selection of the study result is drawn via way of means of are classified in parts, i.e. Macro and Micro. The macro element is the identity of educational techniques for combined training and accommodating character studying variations to decide on mixing blends amongst exclusive shipping methods. Micro selection is inferred as learner interactions and studying sports and assessing the impact of earner traits together with demographic information, studying choices, and learners' studying motivation previous to attending combined training courses (Lim and Morris, 2009).

There is much evidence of the positive outcome of Blended learning like – full use of limited low-cost resources, it provides scopes of individual improvement, improving student's engagement and motivation in the learning process, enhancing the ability to personalize learning, etc (National Educational Technology Plan, U.S.A., 2010).

Blended learning is a way of rethinking the conventional pedagogical process by which we can get a more structured class with full utilization of limited resources (Bailey et. al, 2013). Blended learning is a modern traditional education system by which students can

learn from online resources in the least amount and they can utilize their instructor's knowledge fully as an offline resource because of their physical presence there. Also, students have some control over the time, position, and speed of their learning content. It offers true and successful incorporation of face-to-face and online modes of learning together (Garrison and Kanuka, 2004), as the main motto of blended learning is to combine the worthiest physical and e-resources at the same time to deliver students the finest learning experience (Gilbert and Flores-Zambada, 2011).

The researchers assessed a combined system that mixes e-learning knowledge and character-to-character interplay. The application provided the scholars a hands-on gaining knowledge of revel primarily based totally on self-reflection, getting admission to technology, a two-way method of gaining knowledge of, common interplay with the multidisciplinary team, greater exposure to patients, and ordinary remarks and eventually their remarks surveys and their pre and post-tests. Results suggest that the scholars recognize this device as a wealthy and effective studying revel in verified through their nice remarks and their widespread development in know-how assessed on the give up in their rotation. Applying an interactive mixed device is a useful method for coaching geriatric medication in clinical faculties as they inferred that, as in-clinic stories with the e-log book, cellular app and so on can reason boom in the hobby a few of the college students with interactive studying technique, may be beneficial for them. They tremendously recommended coaching and getting ready now no longer most effective our destiny physicians however additionally different contributors of the multidisciplinary group who will take care of the growing older adult population. (Duque et al, 2013).

New York's Randolph Central School department adopted blended learning 'Rotation' strategy to improve the quality of education. They implemented the rotation strategy in math and English Language subjects of K-6 grade. The students of the same grade followed the teacher's instruction and keep rotating between e-learning with the help of the internet, a small number of printable learning materials, and teacher-driven offline guidance and assessment process finally. Authority found positive outcomes in Math and English language subjects and also discovered the development of collaborative leadership quality and constantly increasing communication skills among pupils. Lake City School district was in loss of 10% students every year before adopting 'Flex' strategy

of Blended learning in the year 2013 – 14. Following 'A La Carte' strategy, Spokane Public School's leaders found gradual improvement in the dropout rate and student achievement. Finally, Commonwealth Connections Academy in the U.S.A implemented successfully "Enriched Virtual' Strategy (Powell et. al, 2015)

A study by El-Dziuban et al. (2015) was done in the higher education sector of language learning, to see the effect of blended learning on learning satisfaction. Flex and face-to-face driver techniques were used for blended classes. The study was conducted with academicians, faculties of Higher Education and with students also. Learning engagement and interactional value was identified as a component of the study. A survey method was used to carry out experimentation and to find out the result a 5-points Likert scale attached questionnaire was constructed. The questionnaire justifies the samples as a whole experience of blended learning, satisfaction level, capability to accept the introduction of technology in their learning, self-paced learning, study capability, power to reach their educational goals, eagerness to attain another blended learning course, and overall instructor-based questions (about their efficiency and quality). Positive results were found in student satisfaction and interaction with the blended learning program.

Peterson (2015) used a quasi-experimental design for his study comparing student outcomes from the flipped classroom or inverted classroom in the planning method to more traditional lecture formats. He took 19 students in the control group and 24 students in the experimental group. The experimental group was given treatment by blended learning flip classroom method and the control group was taught with the conventional method. It is followed by an achievement test. Statistical analysis was done by t test. Test results found that the experimental group had shown a significant difference in their mean score in comparison to the control group.

Lee and Liu (2016) proved that flipped classroom systems are very much important and useful in the case of learning outcomes of the students. The study was performed to find out the definite differential outcomes in subject sociology among blended learning classrooms and conventional teaching-learning systems. The study was performed concerning male and female students. Total size outcome measures were considered for this study - pretest, posttest, quiz with ten items about course satisfaction, quiz related to

gender with ten items in it, quiz about their ethnicity of ten items and finally with much greater order thinking ability containing achievement test to find out their retention power of the course with sixty-five items multiple choice questions. Experimental groups were estimated positively significant and greater in comparison to the control group. The conclusion of this study indicates that the use of social networking sites to support or enhance classroom activities positively affects the achievements of students.

Lalima and Dangwal (2017) addressed blended learning as a beneficial process as it encloses both conventional and online settings together. they showed that blended learning has many faces where students can get many advantages at the time like they can access e-resources and physical resources at a time, new perspective of learning contents opens to them, the presence of human resources makes it more perfect, student-centric approach, knowledge building occurs, professional development of teachers occurs. Also, it was revealed from this study that scientific attitude grows in both students and teachers through this process. it is one of the best methods to be introduced in school because it helps in formative evaluation very much.

Dove and Dove (2017) completed their study with trainee Teacher's anxiety and overall anxiety at the time of teaching in mathematics subject. Three different strategies of learning like a teacher-led classroom flipped classroom settings with videos made by the teacher and the same settings with videos made by Khan Academy. The response was collected through a survey and questionnaire and interview of students. The study result suggests that in three methods level of anxiety was reduced among students. But the flip classroom settings with videos created by their teachers have a more positive impact and score in comparison to the other two groups in reducing anxiety and anxiety in teaching mathematics. The result also reveals that that setting with teacher-created videos grows more positive attitude among them during class.

Pima et al, (2018) constructed a review-based paper that discusses the role of blended learning in transforming the higher education system from 2000 to 2016. The objective of the study was to find out the role of blended learning in higher education within 2000-2016, the chief areas covered for blended studies within this period, and upcoming sub-areas with which blended learning studies can be compared in the case of higher

Education. The result of the study depicts that the major sub-areas in blended studies from 2000 to 2016 were study design, behavior, inspection, technology related to blended learning, interaction among different areas, development of professionalism, demographic variables, etc. They have explored many areas of blended learning frameworks and suggested the areas of anxiety, attitude, goal orientation, etc are needed for future studies.

Khan (2018) worked with Self-efficacy, learning effectiveness, and student engagement as variables to study the effectiveness of BL with the help of EDUSAT for BLS classes. BLS proved effective in enhancing self-efficacy, effective learning, and student engagement in said study.

Seman et. al (2018) framed a study with millennial learners who are very much interested in learning designed with technology. The chief aim of the research was to find the level of satisfaction and acceptance of blended Learning courses in form of a learning management system among millennial students. A survey method was used to fetch the result. A total of 167 students in the first year who are new to the term blended learning were engaged as a sample of the study. This study also explores the quality of the system, service, information and teacher. A partial least square structural modeling technique was used to get the result. At the end of the study, the investigators suggested that the quality of teachers the service quality and the quality of the course are the chief controller of a blended learning LMS system. To create a perfect environment for blended learning courses these factors should be taken care of properly.

Hawi and Sudira (2019) performed a quasi-experimental study to see the effect of blended learning on the conceptual understanding of high school students. A nonequivalent control group design was employed for the study a total of 58 students were selected as the research sample. The experimental group with 30 students was taught with blended learning strategies and 28 students of the control group were treated with a conventional teaching method. Essay-type questions containing tests were conducted for data collection. By using MANCOVA all data analysis was done and found remarkable difference exists between the two research groups. The experimental group taught with

blended learning strategies found improvement in conceptual understanding of the study in comparison to the control group.

Caird and Roy (2019) came to the conclusion that the conception of blended learning began in the 1960s when new technology- intermediated literacy options came available to round traditional approaches to face to- face tutoring in advanced education and other settings. In HE institutions, mixed learning is now so wide that numerous consider it to be the" new normal" in describing the HE approaches to tutoring and literacy. Still, the ubiquity of the conception of blended learning in HE is problematic for establishing a common understanding of the conception, which is necessary to fete how it contributes to sustainable development. Blended learning can be defined as the design of learning gests that combine face- to- face, distance, or online delivery styles, learning technologies, delivery multimedia, and communication to achieve a blend of learning issues in educational or training surrounds. Grounded on a combination of pedagogical styles, Blended literacy designs can support sustainable development, which includes social, profitable and environmental confines of sustainability and protects global environmental coffers to meet the requirements of present and unborn generations.

Wang et al., (2020) designed a quasi-experimental study to judge the efficiency of a special Blended learning program called Green Food and Beverage. Total 99 students were used as the sample for this study. Experimental group was taught with blended learning package till eighteen weeks and control group was exposed to teacher led classroom system. Learning capabilities, achievement test score ability to transform etc. were calculated to get the result. Study reveals that students have a more positive experience with blended learning strategies. Researchers also suggested that blended learning strategies strengthen the psychological empowerment of pupils of the study.

Bozkurt and Sharma (2021) conducted a review-based study. This review-based study aims to define blended learning in the current context and the purpose of the same in the present situation. The researchers found that time, place, way of teaching, design of the study, interaction techniques, and communication strategy, etc. affects the whole blended system. They also found that in COVID 19 pandemic situation blended learning proved one of the most successful strategies of learning in improving academic achievement

among students. The strategy helps in promoting equity and justice in class and due to its flexibility, it gives enough time to its readers to navigate their problems and resolve them. Finally, the researchers found that blended learning helps not only in the classroom context but also helps in improving social situations.

A mixed- method study was conducted by Yang and Kuo (2021) to report on a blended learning program that used cross-cultural communication to improves the global literacy of EFL college scholars. A sample of 97 EFL college students offered to share in a large-scale onsite English course involving online face- to- face conversations between scholars and teachers from different countries. Content analysis was used to collect and analyse scores from the students' reflective journals and open- concluded questionnaires. Blended literacy conditioning encourages EFL College scholars to develop global knowledge as a result of engaging in cross-cultural communication and structure online social connections with English teachers from different cultural backgrounds. In terms of intellectual skills and knowledge, social/ cultural capabilities, and moral disposition, these scholars can construct new knowledge. Grounded on these, scholars also handed formative (suggestion) and critical (argument and analysis) feedback on global issues (global knowledge). Pre- and post-test results verified their tone- reported articulation from intelligent journals that went on with their English tuning and reading capability. Scholars enrolled in an English as a Foreign Language (EFL) program gain access to the world through this blended learning program, allowing them to acquire, apply, and partake new knowledge with global knowledge. As a result, students gain autonomy and improve their English proficiency.

Widjaja and Aslan (2022) conducted a study about the efficiency of the blended learning method in learning Geography among students at the postgraduate level. The researcher concluded that this is an age of digitalization and technological progress. So in this situation, it is very important to apply blended learning in the regular classroom to improve the teaching-learning qualities of a normal classroom. As it is the proper combination of traditional teaching methods with modern technology-based education it is the best way to resolve the critical areas of present-day learning situations. Blended learning could be a way to enhance effectiveness creativity and efficiency among students.

Kundu and Bej (2022) investigated the efficiency of blended learning programs on the attitude and critical thinking of elementary-level students in India. The study was formulated with fifty 5th-standard students of a government elementary school. Irrespective of gender, all students showed a growth of positive attitude toward blended learning strategies after ten weeks of the experimental session. Blended learning improved the performance of the students. Students of the control group showed fewer achievements code in comparison to the experimental group taught with blended learning programs. The researchers concluded that even with a poor infrastructure system, the successful implementation of a blended learning program can be done.

Gloria and Adams (2022) conducted an experiment to determine the viability of adopting a blended learning approach in secondary school science instruction. In the current research, a quasi-experimental design was employed. The Center for Distance Learning and Continuing Education (CDL&CE) at the University of Abuja chose 120 university students for this research. The Blended Model Achievement Test and the Blended Model Retention Test were the instruments used for data gathering. The experimental group's pupils received instruction using blended learning strategies for eight weeks. Three tests—the Pre-test, Post-test I, and Post-test II—were given to six groups. The Statistical Package for the Social Sciences (SPSS) version 26 is used to assess the estimates and provide mean scores, standard deviations, and responses to the questions. Students who were receiving science instruction through blended learning had significant difference between mean pre- and post-test achievement and retention capacities, according to the findings. According to the research, blended learning models greatly raise science student retention and achievement. Blended learning approaches should be used when teaching science because they increase student retention and academic success.

Du et al., (2022) described that numerous empirical studies, including meta-analyses, have demonstrated that students' academic achievement in traditional or face-to-face learning environments is impacted by self-regulated learning (SRL). However, the impact of SRL interventions on academic achievement in online or blended education in elementary, secondary, higher, and adult education was rarely examined in previous meta-analyses. As a result, the focus of this meta-analysis is on the impact of SRL interventions on students' performance on academic tests in online and blended learning

environments, as well as informal learning environments, in elementary, secondary, and higher education settings. The SRL phase, SRL scaffolds, and SRL strategies of the treatment and control groups are compared in this meta-analysis. We also looked into the possibility that the included studies' substantive features, such as the different educational levels of learners (e.g., elementary, secondary, and higher education), academic subjects (STEM vs. non-STEM), and learning contexts (e.g., online learning, blended learning, web-based learning, mobile learning), could result in different levels of effectiveness. The present meta-analysis confirmed a positive and moderate effect of SRL intervention (ES = 0.69) on students' academic achievement in online and blended environments for learners in informal adult education settings as well as elementary, secondary, and adult education settings.

Syafruddin and Suparman (2023) examined the implementation of blended learning-based physical education and sports learning. Ten articles on the topic of the integration of blended learning into physical education instruction were retrieved from Google Scholar media published in the previous ten years. This review's conclusion is that blended learning makes it easier for students to access a variety of materials related to physical education learning and that it makes it more efficient to implement physical education learning. The following conclusions can be drawn from a review of ten (10) articles on the use of blended learning in physical education and sports instruction: 1) Because, in practice, blended learning can be done anytime and anywhere by utilizing a variety of existing online learning media, it provides convenience and efficiency in the implementation of physical education learning; 2) It makes it simple for students to access a variety of physical education-related materials through blended learning. Because there are a variety of online learning resources that can be easily accessed with a smartphone or laptop; 3) There are a number of educational issues that blended learning can address. Because the implementation method adds a variety of conveniences to the learning process, empowers students to be more independent, and creates a modern and innovative learning environment.

A systematic literature search was carried out by Muhria, Supriatna, and Nurfirdaus (2023) to identify obstacles to the online components of blended learning from the perspective of students. Problems with self-regulation and the difficulty of learning

technology are the biggest obstacles for students. This study emphasizes the need for additional research to address the issue of blended learning among students. The author of this study searched the literature on technical implementations in higher education, particularly for the provision of blended learning, in order to respond to the research questions. Numerous issues have arisen as a result of the rapid expansion of technology to meet the demands of society, and the digital transformations of today are increasing the strain on higher education systems. The findings of this study indicate that students struggle with self-regulation and are unable to effectively utilize technology in their academic pursuits. As a result, you can use this review study to get your blended learning studies in the right direction and find solutions to the issues that students in blended learning have identified as limiting the model's potential.

Shakeel, Haolader and Sultana (2023) created and approved a mixed learning preparation scale for Bangladeshi TVET understudies. The validity of this validated scale was also examined in this study by measuring six blended learning readiness dimensions. The blended learning readiness scale's construct validity was assessed using the Content Validity Index, Exploratory Factor Analysis, and Confirmatory Factor Analysis in this study. A total of 235 students from six Institutes of Marine Technology who participated in a semester-long blended learning session were sent questionnaires. The findings of this study suggest that students at Bangladeshi polytechnics are more likely to be prepared for blended learning, as well as to be open to new technology, to online learning, and to the traditional classroom setting. On the other side, there were significant negative correlations between readiness for blended learning, learning flexibility, and basic technological abilities. Furthermore, this research indicated that gender and prior academic achievement are not reliable indicators of readiness for blended learning in the technical and vocational education and training context of Bangladesh. This mixed learning status scale would assist with flowing architects, teachers, administrators, and policymakers of Bangladesh to work on the nature of the mixed learning climate by tending to the understudies' interests about different mixed learning parts.

Buhl-Wiggersa, Kjærgaard and Munk (2023) examined evidence from 59 experimental studies that were carried out in settings associated with higher education to find out what makes face-to-face components of blended learning effective. The findings reveal which

face- to- face activities help scholars achieve higher- order processing, social interaction and classroom engagement. Positive effects on pupil learning were set up associated with a wide variety of face- to- face activities with no studies reporting negative effect. Anyhow of educational purpose, the findings suggest that group work and conversations are the most common face- to- face activities. The main conclusion of the assessment of the available literature in this review is to establish a foundation for further methodical exploration on the face- to- face aspect of blended learning in higher education to round the extensive online aspect.

Royyan, Supadi, and Arbah (2023) analyzed the concept of blended learning management that has been applied to Madrasah Tsanawiyah during the Covid-19 Pandemic. The CIPP model (context, input, process, and product) evaluation method was used in the qualitative research. At MTs Umdatur Rasikhien Jakarta, the study was conducted. The samples were chosen using the purposive sampling method. Fifty individuals joined in, including administrators, educators, understudies, and authoritative staff. Documents, interviews, and observation were used as data collection methods. In this study, data were reduced, presented, discussed, and concluded through data analysis. According to the findings of the study, MTs Umdatur Rasikhien had extremely stable blended learning management. It was demonstrated that schools strengthened management systems during the Covid-19 pandemic, particularly in ICT operations and human resources. There has been systematic development of technology management, the foundation, support from school management, awareness among members of the blended learning system, and technological infrastructure readiness. The school made preparations so that teachers and teachers could use the learning management system properly and parents could support students studying at home, despite the fact that the use of the system was less common at the junior high level. Additionally, student learning outcomes remained stable, and forty percent of students achieved greater success. Therefore, management of the school must consider the school's strength and current requirements for providing education in any circumstance.

According to Ali (2023), blended learning (BL) is a popular method of teaching courses in higher education that aims to improve students' learning experiences by combining digital technology with face-to-face instruction. However, teachers may find it difficult

to provide students with consistent learning experiences due to a lack of knowledge regarding how students perceive blended learning cross-disciplines, resulting in inequity in learning experiences. The purpose of this study is to compare how different subjects perceive BL and how university students perceive it. Members were 407 college understudies from eight subject disciplines. A questionnaire was used to collect the data, which were then analyzed with SPSS. To compare the differences between the groups, a one-way ANOVA was used. Despite encountering numerous obstacles, students were generally pleased with the use of BL, according to the findings. In addition, the findings revealed that, in comparison to the rest of the university, students in the faculties of science and Islamic studies were more open to BL while students in the faculties of tourism/hospitality and business were more critical of BL.

According to Eltayar et al., (2023), the concepts of online and blended education gained prominence in the 19th century. The ideas grew over time, reaching their zenith in 2021 in response to the COVID-19 lockdown. Monitoring the performance of distant learners is one of the difficulties. During the regular meetings of face-to-face courses, an instructor can quickly identify struggling students. The variables that can predict early online learning student academic achievement were the focus of this study. Despite the lack of agreement, the factors were still hypothesized to be academic achievement predictors. To test the hypothesis, a quasi-experimental study was carried out. A blended trauma course was attended by 33 graduate students. The pre-test scores, the number of log-ins to the online platform, the age of the students, and their prior experiences with online education were all examined. In the context of the course's online component, these aspects were thought to be indicators of academic success. The results showed that there was no statistically significant correlation between the number of logs in the first two weeks, the pre-test scores, the age, or previous experience with online education. However, there was a statistically significant correlation between the students' academic achievement and the number of log-ins to the online platform during the first three weeks of study. In addition, a statistically significant predictor of academic achievement in online education was the number of logs in the first three weeks. Instructors may be able to identify and assist struggling students thanks to this early prediction. Students' online activity logs

during the first three weeks of class can be used to predict their academic success earlier. Pretest scores, age, and prior online education were not statistically significant predictors.

Bursa (2023) conducted a study to find out how prospective social studies teachers felt about blended learning. In accordance with the fundamental qualitative research design, semi-structured interviews were used to collect the study's data. NVivo12 was used for the inductive analysis of the data. The study reveals that blended learning facilitates multidimensional learning and saves time. This strategy, on the other hand, is seen as having some drawbacks due to a lack of socialization and technological deficiencies. When students' and teachers' responsibilities rise, they claim that a variety of tools can be utilized in this approach. All of the participants claim that their undergraduate education is insufficient in this regard, and that they lack sufficient knowledge of the application process and blended learning models. The study's findings support the recommendation to incorporate blended teaching methods into teacher education.

Conclusion and critical engagement

Many studies from the 2000s to the present day 2022 discuss the effectiveness of blended learning strategies in class situations in different countries and different cultures, different perspectives and different arreys of subjects. It offers true and successful incorporation of face-to-face and online modes of learning together (Garrison and Kanuka, 2004), as the main motto of blended learning is to combine the worthiest physical and e-resources at the same time to deliver students the finest learning experience (Gilbert and Flores-Zambada, 2011).Peterson (2015), Lee and Liu (2016) , Kundu and Bej (2022) found that t even with a poor infrastructure system, the successful implementation of a blended learning program can be done. Lalima and Dangwal (2017) and Pima et al, (2018) explored many areas of blended learning frameworks and suggested the areas of anxiety, attitude, goal orientation, etc are needed for future studies. New York's Randolph Central School department adopted blended learning 'Rotation' strategy to improve the quality of education. They implemented the rotation strategy in math and English Language subjects of K-6 grade. It can be said that blended learning is very much effective in solving present days different learning problems. The researchers like assessed a

combined system that mixes e-learning knowledge and character-to-character interplay Presently NEP 2020 also given emphasis on implementation of blended learning in different educational instituitions. Even it is seen from present studies that blended learning can be effective in poor infrastructural conditions also. With the help of minimal e-resources, a proper blended learning program can be designed and can be implied in regular classroom situations. So, blended learning strategies were chosen for the present study as interventional instructional strategies for the experimental group.

2.3. BLENDED LEARNING WITH ACHIEVEMENT

Yen and Lee (2011) conducted a combined blended learning approach that includes mobile learning web-based learning and classroom teaching to provide students realistic and practical op infinitives at a time. The motif of the study was to be discover the problem-solving patterns and their effect on learning achievement in a blended learning environment. By content analysis and content analysis they distributed the total sample into three groups hybrid learning group (N=17), technology-based learning group (N=12), efficiency-based learning group (N=5) in total the sample size of 34, researchers were conducted their study. Hybrid group was taught by e-learning and face to face learning techniques both. Technology based group were taught mostly through e learning process. And efficiency-oriented group were taught by task-oriented teaching. Efficiency oriented group shown higher amount of success in achievement test than other groups. Hybrid group shown higher success rate than technology group.

Picciano et al. (2012) performed research work to know the efficiency of blended learning in school education in America. Students interested in online learning participated in this study. “Alfred P. Sloan Foundation” began this study from 2005 to 2008. Results found that 47% percent of students from 2005 to 2006 and 2007 to 2008 showed positive results with blended learning. It was also found that secondary-level students showed the most effective results with blended learning strategies.

Porter et. al (2014) conducted a qualitative study with a total of eleven universities that adopted blended learning in a next-generation learning challenge module to know the impact of blended learning in education. Recommendations given by the researchers like

enough pedagogical and technical support are provided not only for the students but also for the teachers, skill development programs are not adequately done, so skill development is required among instructors. Institutes' structure strategy and funding systems are the most important things to be monitored. Awareness and scope of blended learning should be increased in the early implementation phase are also required. the significance of the perceived excellent of mixed gaining knowledge of guides on the motivation of students on SRL techniques, adopting self-law of attempt, time and observe the environment, and cognition can influence the instructional fulfillment of scientific college students.

Nazarenko (2015) performed research that was a case study based. The study was conducted in the Department of foreign language and area studies of Moscow State University. The introduction of blended learning strategies was done in the same department and responses of students by subject-wise achievement were collected and analyzed. Results found that students have grown more positive results in achievement who were taught with blended learning strategies. The researcher suggested the development of ICT skills, critical thinking abilities, etc. Interest in technology is another important topic for the success of blended learning programs.

Peterson (2016) designed to look at the effects of a combined gaining knowledge of study room on scholar fulfillment via way of means of imposing the flipped study room paired with tiered sports. Throughout the twenty-day look, 4 sixth-grade arithmetic school rooms have been requested to view and take notes on teacher-created instructional videos of the outlets of the study in the classroom and whole character-selected sports for a unique letter grade. Collected data covering pre-tests, reviews of video crowning glory, and lesson exams via using schoology.com, post-test, and survey. Results confirmed an increase in scholar fulfillment over chapters in everyday lesson exams and quizzes. The combined gaining knowledge of the method proved to be very a success in one chapter's post-evaluation, even as extra assistance become wanted for the second chapter. This look confirmed the significance of stabilities in the era and direct and direct guidance and its outcomes on scholar fulfillment in the arithmetic study room. Further implication consists of investigating different differentiated sports that may be paired with the flipped study room. He carried out studies in the flipped study room with tiered sports in a public center

school putting in 04(Four) sixth-grade arithmetic school rooms. Initially, study room baseline statistics become accumulated, after which the flipped study room with tiered sports look to become carried out, and observations have been made even as statistics become accumulated over twenty days. Types of evaluation and measurement equipment have been carried out at some stage in the movement studies project. The statistics analysis covered: pre-tests for every chapter, reviews of video crowning glory and lesson exams via using Schoology.com, post-tests, and a scholar survey. The indexed statistics results have been designed to look at the effect of the flipped study room, paired with tiered sports, on scholar fulfillment.

Ceylan and Kesici (2017) conducted an experimental study with 6th-grade students of the year 2014- 2015 in the Southwest side of Turkey. The study was carried out with 53 students who were distributed into control and experimental groups to complete the study. The control group was taught the conventional method of learning and blended experimental groups were exposed to "problems solving, computer programming and development of software products" and other developed tools like learning management systems, blogs, video conferencing, and other materials and related software. The whole study was completed within 7 weeks of intervention time, resulting that blended learning programs have a deep impact on student's achievement. So, the experimental group showed higher achievement scores in comparison to the control group. Thus, researchers concluded that blended learning has the potential to improve academic scores among students in 6th grade in Turkey.

Sukhmani (2018) did experimentation to justify the efficiency of Blended Learning on Student satisfaction and achievement in Commerce Cognitive Style at the senior secondary level in Commerce subject with web-based materials as tools for blended classes and found that blended learning can enhance the same in the study group.

Islam et al., (2018) performed their research with a quasi-experimental design specifically with a nonequivalent control group design. Two experimental groups were taken who were exposed to blended materials and a single control group was taken and taught with a direct method of teaching. The sample size taken for the study was 120. A questionnaire sheet to measure the motivation level of students and a multiple-choice type of

achievement test questionnaire were used as tools for the present study. A 6-week intervention was given to students in experimental group by blended learning face-to-face technique. Data was collected and analyzed with SPSS V. 20. f-parametric test, t-test and univariate test were conducted to fetch the result. The result found that students exposed to blended mode showed higher motivation levels and more increase in academic scores in achievement tests after treatment.

Utami (2018) conducted a study to explore the effect of blended learning model on achievement of senior high school students. The design of the study was randomized control group pretest- posttest. The sample of the study comprised of 63 students of information and communication technology course. 31 students of experimental group were taught through blended earning model while 32 students of control group were taught through traditional teaching model. The data was collected with the help of a objective type test with 35 questions. The result indicated that the achievement of experimental group is higher than the control group. It can be concluded that the blended learning model contributes more to the students' achievement.

Wahyuni (2018) carried out a study to know the effect of blended learning model on the writing ability of the XI Grade students of SMAN6 Pekanbaru. The research sample was determined by the random sampling method. 10 classes were selected randomly. It consisted of two classes, XI IPA 1 as an experimental class and XI IPA 2 as a control class. Then for the experimental group blended learning mode was used and for control group the traditional lecture method was used. A written test was performed to obtain data. t test was performed to calculate the mean scores of the pre-test and post-test. Findings revealed that there were significant differences between the means of experimental and control group. Experimental group achieved better results in the post-test and there is a significant effect of blended learning model on writing ability of students.

Harahap et al., (2019) executed another quasi-experimental study to measure the effect of blended learning on academic achievement and process skills in science among university-going biology tissue culture course students at the University of Negeri Medan, Indonesia. A total of 94 students were taken by random cluster sampling method.

51 students were chosen for the experimental group and 43 students were taken in the control group. Both classes were taught by researchers. After the treatment, it was found that the experimental group showed much better achievement scores and enhanced science processing skills in comparison to the control group.

Ayob et al., (2020) researched to know the effect of the blended learning station rotation model on the academic achievement of students from past papers. The researchers concluded an in-depth analysis of the past papers and found that the blended learning rotation model has the potential to turn a positive outcome in the academic achievement of the students. So, they concluded that this model can be used in the future in the classroom.

Seage and Türegün (2020) chose 3rd, 4th and fifth grader 129 students with a poor social and financial background and conducted their research on STEM i.e., "Science, Technology, Engineering and Mathematics". Achievement scores were calculated after its application. By using MANCOVA technique, data analysis is done and found that blended learning has a significant effect on STEM learning and the academic achievement of students.

In the study Rafiola et al., (2020), they have discussed the effect of blended learning strategies and learning motivation, and self-efficacy on students' achievement. The study was formulated to increase the quality of education, the type of service provided in the educational sector and the efficiency of graduates. The complete research was conducted in a public High School in Padang. The partial least square technique was used to calculate data. Data analysis results revealed that learning motivation and blended learning has a positive and significant effect on academic achievement among students. Whereas, in the case of self-efficacy, no changes were found in the achievement of students. The most important finding of the study was motivation, self-efficacy, and blended learning together have a positive impact on the academic achievement of students.

Burakova et al., (2021) conducted a test to find out the effect of blended learning on academic achievement in the 2019-20 session in a foreign language learning course at a Technical University in Russia. Among a total of 234 students, 120 students were kept in

the control group and 112 students were considered as experimental group. Control group was taught with conventional chalk-and-talk method of teaching and experimental group was exposed to blended mode of teaching. The result showed that the experimental group taught with the blended program has shown higher marks in comparison to the control group in the achievement test. The researcher concluded that video monologue as a part of blended program showed promising results in comparison to control group.

Kundu, Bej and Dey (2021) This research sought to determine how blended learning affected children's academic performance, how instructors felt about working in a mixed environment, and lastly, what its potential may be in underfunded primary schools. Design-based research techniques were employed with 50 students from a fifth standard class in an Indian elementary school since this study was carried out in an atypical setting with researchers acting as agents of change. These techniques comprised data collection and analysis throughout two cycles—the preblended implantation stage and the post-blended stage. The gathering of data was done using a mixed method technique. An achievement exam was used to acquire quantitative data, while teacher interviews were used to gain qualitative data. The post-blended implantation stage was shown to have significantly higher performance levels between the two cycles, and this difference was determined to be gender-neutral. To understand more about how three instructors introduced and implemented blended learning in their classes, interviews with them were also conducted. The study concludes that blended learning environments boost kids' academic success levels in primary school settings when instructors are given the required guidelines and skills.

Alsalhi et al. (2021) design their study to see the effect of blended learning strategies on the achievement of physics courses at Ajman University, UAE. A total of 116 students were distributed into the control group with 57 students and the experimental group with 59 students. Achievement test questionnaires were supplied to students to get results. By using SPSS results were analyzed and found that blended learning strategies found positive in increasing achievement test scores, especially for females. The study recommended that there is a high need for the implementation of blended learning programs in higher education sectors for the overall improvement of the teaching-learning system.

Budhyani et al. (2022) investigated the effect of learning by synchronized and synchronized setups on learning achievement. 4 Schools were selected with 115 students as the sample of the study. Multiple choice type questions were supplied to the students as a tool for research after treatment with blended settings. The result found that blended learning showed a significant effect on the academic achievement of the children and hence researchers concluded that blended learning made the lessons joyful and more accurate, so the results were affected.

Kusuma, Murtono and Utomo (2022) performed their research to know the effect of blended learning programs on the achievement of 6th-grade students at elementary schools in the Bintarum district of Indonesia. Two elementary schools were chosen as the experimental group three elementary schools were chosen as control group. Achievement test questionnaire with multiple choice questions supplied to the students as a tool for study and found that a blended learning program designed with powerpoint presentations proved effective in increasing achievement scores in the experimental group.

Conclusions and critical engagement:

Achievement is the measure of learning effectiveness. By assessing achievement, we can estimate the level of understanding of a student and also evaluate that the teaching was successful or not. So, it can be said that by evaluating through achievement test, we can also prove the efficiency of the teaching method. From all the above-mentioned literature reviews we can estimate that blended learning is proven as one of the most important and successful strategies of teaching for the betterment of the academic performance of students. It not only enhances academic achievement among children but also proved helpful in problem-solving, retention of motivation, students' satisfaction, learning outcome, self-efficacy etc. Yen and Lee (2011), Porter et al (2014), Nazarenko (2015), Sukhmani (2018), Utami (2018) found that blended learning is effective in problem solving and much more effective in improving achievement scores. Picciano et al. (2012) found that 47% percent of students from 2005 to 2006 and 2007 to 2008 of "Alfred P. Sloan Foundation" showed more positive results with blended learning. It was also found that senior secondary-level students showed the most effective results with blended

learning strategies. Ceylan and Kesici (2017), Rafiola et al., (2020) discovered blended stategies are proved useful in improving scores in “problems solving, computer programming and development of software products”. Seage and Türegün (2020) chose 3rd, 4th and fifth grader with a poor social and financial background and conducted their research on STEM i.e., “Science, Technology, Engineering and Mathematics” and found that motivation, self-efficacy, and blended learning together have a positive impact on the academic achievement of students. Design-based research techniques were employed by Kundu, Bej and Dey (2021) and Budhyani et al. (2022) recommended that there is a high need for the implementation of blended learning programs in higher education sectors for the overall improvement of the teaching-learning system. Previous research has shown that research works done with all kinds of students from elementary level to higher education level. And almost at every level, it was proven useful in increasing academic achievement. Most of the studies have shown that due to the rigidity of e-learning and conventional learning techniques blended learning is better because both the resources (offline and online) are present here. Pupils get more involved in class due to the presence of e-resources and problem-solving and other hazards are solved by teacher or instructors at a time. So, retention of learning occurs in this method which ultimately leads to academic success using achievement. It was also shown that achievement measurement is the easiest way to prove the effectiveness of a teaching-learning program (Nazarenko, 2015; Ceylan and Kesici, 2017; Sukhmani, 2018; Harahap et al., 2019; Rafiola et al., 2020); Alsalhi et al.,2021; Budhyani et al., 2022). So, for the present study, achievement was chosen as an independent variable.

2.4. BLENDED LEARNING WITH ANXIETY

Anxiety is a mental illness that has a detrimental impact on people. There seem to be numerous varieties of anxiety. One of them is concern over school. Academic anxiety can reduce academic performance, interfere with peer learning, impair students’ concentration, and hinder their ability to socialize. So, if improperly handled, it could be dangerous for kids. Hishinuma et al, (2001) formulated a study to form state trait anxiety inventory which is a diagnostic tool for academic anxiety for children.

Sahin (2008) conducted a study with a total of 249 students of 4th and 5th standard to evaluate their anxiety towards mathematics subject. “The mathematics anxiety scale for elementary school students” was used to collect the data. Results found that anxiety in mathematics is different for different variables. According to gender female students found significantly higher anxiety in mathematics in comparison to male students. Higher achievement scores found the cause of reduction in anxiety in mathematics. Good and well-trained instructor can cause reduction of anxiety among children.

Deb et al, (2010) continued their study to know about the anxiety among the adolescent students in Kolkata city in India. The anxiety level of students wear measured along with gender, type of school, socio economic status of students, maternal employment etc. Total 460 students of 13-17 years were taken as sample for study. Results collected through state trait anxiety inventory, a psychological test and a self reported semi structured questionnaire made by investigators. The result shows that almost 20% of the boys (among 220 boys) and 18% of the girls (among 240 girls) found affected with high anxiety. On the other hand, it was found that the students who are in Bengali medium schools suffering from higher anxiety in comparison to English medium school students.

Al busaidi and Al-shihi (2011) Institutions can manage their educational resources and support both regular classroom instruction and online learning with the use of learning management systems (LMS). LMS survival depends on teachers’ ongoing use, which could be strongly correlated with their degree of satisfaction with the LMS. So, in order to determine whether instructors will continue to use LMS in mixed learning and only for distant learning, this study looked at the major variables that affect educators’ satisfaction with LMS in blended learning. These elements were examined in relation to the personal traits of the teachers (computer anxiety, technological experience, and personal inventiveness), the LMS traits (system quality, information quality, and service quality), and the organisational traits (management support, incentives policy and training). The results showed that significant elements influencing instructors’ satisfaction with LMS in blended learning include anxiety level, personal inventiveness, system usage, quality of information, leadership structure, reward policy, and training. Additionally, teachers’ satisfaction plays a crucial role in determining whether they will continue to use LMS for blended learning or only for online courses.

Abal, (2013) performed a study on English language learners in United States of America on language speaking anxiety and its remedy through blended learning strategies. Two different programs called Task Based Language Teaching (TBLT) and Multi User Virtual Environment (MUVE) were used as blended learning platforms. Control group was treated with conventional teaching learning method where as experimental group was exposed with TBLT and MUVE method. Result found that experiment group found with rapid reduction in anxiety level in comparison to control group. Researcher suggested that these two techniques could be very useful for language learners decreasing their level of anxiety in language learning.

Aldalalah and Gesaymeh (2014) carried out their experimentation with two independent variables i.e. locus of control and anxiety level. Locus of control was further divided into external and internal part and anxiety level was divided into three levels like low anxiety, moderate and high anxiety. They have taken blended learning strategies capabilities and obstacles as dependant variable for this study. Total 107 students of undergraduate level were chosen as sample of the study. The study was designed on an educational technology course. Result of the study shows that the students with internal locus of control achieved better in comparison to external locus of control students in blended learning compatibilities like knowledge and technology progress and also in blended learning implementation problems. The result also revealed that the student with moderate amount of anxiety is performed better than low and high anxiety students with both depended variables. The study also revealed that there was no difference among low and high anxiety is students in blended learning problems.

Wentao et al. (2016) formulated their study on Library science. They compared efficiency of blended learning strategies along with traditional learning method with learning outcomes, different intervening factors and gender. Responses were collected with a self-made questionnaire from almost 1000 University students. They concluded that the rate of achievement scores increased remarkably with blended learning strategies and drop-out rate decreased with the same platform. Gender does not affect student's performance in blended or traditional teaching method. Intervening factors for blended learning strategies found more useful in comparison to traditional teaching method. Attitude, self-

efficacy of male students found more positive and anxiety level found more reduced after blended learning intervention.

Owens (2017) designed this quantitative research to know the effect of gender and the anxiety level among the students of statistics students of school level over learning methods. Control group was treated with conventional teaching method whereas the experiment to group was taught with blender learning strategies. Investigator pointed out that increased anxiety in mathematics, lowering in achievement scores, level of self-efficacy and self-confidence found in most of female students in United States and other countries in comparison to male students. Total 228 student's records were collected from eight schools in USA and found that blended learning strategies and more effective in comparison to conventional teaching method in case of achievement and gender. The researcher found that students have a general anxiety in mathematics subject also very low confidence in the same. The study results also found that the anxiety level of students decreased a lot with blended learning method and remarkable increase found in self-efficacy.

Bervell (2018) performed a study in Ghana to understand the cause of anxiety among instructors in learning management system based blended learning program in distance education. Survey method was used for the study and a self-made questionnaire was used to collect data from 267 distance education instructors from different part of Ghana. Three most important factors were found which can change the learning management system based blended learning program are: influence of co-workers, future prospects and support by user. The researcher identified these three indicators affects most the educators of LMS based blended program.

According to Chang and Lin (2019) flipped classroom technique has the potential to transform the regular pedagogical situations in classroom environment. They have conducted their study in English language learning of university level. Among 85 universities students 45 was gathered in experimental group and taught with interactive classes and pair-and-share flipped based blended technique and remaining 40 students were kept in control group and taught with conventional method. Students in experimental group, shown in reduction in learning anxiety after treatment. So, the study

results shown that, experimental groups treated with interactive class and pair and share flipped based blended method are more effective for language learners.

England et al., (2019) pointed out that anxiety is a kind of emotion which negatively affects the performance and the quality of students. They found that anxiety can serve as a barrier in academic performance of students. In an introductory biology class the students were identified with classroom anxiety, test anxiety, their communication anxiety and social anxiety. The study result shows that female have higher anxiety in biology course and they found a major number of students (N=122) with intention to drop the course at the end of semester. This remarkable study also reveals that a moderate amount of anxiety turns as a success factor for some students in their achievements scores.

Nida et al. (2020) used flipped classroom and rotation technique of blended learning for their study and used WhatsApp as their social media platform to complete their study. Study design was quasi experimental and the motto of the study was to find out the impact of blended learning strategies on innovative thoughts and learning mathematics anxiety among students. Three schools were chosen for this study and control group was taught with direct teaching method and experimental group was taught by blended method. Data were collected from students with a questionnaire and written test after treatment. Result shown that students taught with blended learning method shown betterment in innovative thinking and have reduced anxiety in mathematics.

Sharma and Sarkar (2020) conducted a study on the pick time of corona pandemic when blended mode was introduced in a large scale in many schools in India. Aim of the study is to know the impact of blended learning in reducing anxiety among students. Investigators used self-made questionnaire-based survey-based method with 56 school children. Students were taken from different schools with blended learning facilities. Results found that most of the students like to take lessons in science in blended mode whereas they are least interested in taking lessons in social science through blended platform. Almost 73% of the students likes blended learning platform to complete their studies and most of them believes that it will help them to reduce academic anxiety.

Steenkamp (2021) formulated a research work to measure the effect of blended learning program on anxiety among second year journalism course pursuing students. The study

is quantitative in nature. Interviews were used as tool for research. After completion of result calculation, researcher found that anxiety is the chief barrier in the way of implementation of blended program among second year Journalism students. Reduction in anxiety can cause the success and improvement in performance in blended program.

Alghamdi (2022) conducted a research work to find out the impact of blended learning on test anxiety among students of Saudi Arab. 138 students were participated in this study. A questionnaire was used to compare the levels of anxiety in pen paper based physical test and online test. Result shown that students showed higher anxiety in pen paper based physical test in comparison to online test. So, the researcher suggested online test and blended mode of learning for reduction of Exam anxiety among students.

Conclusion and critical engagement:

According to some investigators, in case of unsatisfactory science learning outcomes, it leads to the way of anxiety of failure; there blended learning can be a way to overcome it. Anxiety is a kind of psychological disorder mostly seen in all students. A study with 460 students results that anxiety was found dominantly among the sample with less than $1/5^{th}$ of the girls and less than $1/5^{th}$ among the boys (Deb et. al, 2010). Their study was based on four variables i.e., Gender, Socio – economic background of the student, medium of instruction and parent's employment status. The study was conducted by semi – structured Questionnaire of 3 types – Demographic and socio-economic information, Parental profile, time spent with parents and they also have used State Trait anxiety Inventory (Spielberger et. al, 1971), it is mostly used inventory (Hishinuma et. al, 2000). It is also found by work of some previous scientists, pupils whom mother working, are showing a bit of more anxiety than having the non-working mother students, also shown significant difference with socio – economic criteria. Hishinuma et al, (2001), Sahin (2008), Deb et al, (2010), Al busaidi and Al-shihi (2011), Aldalalah and Gesaymeh (2014) and many other scientists constructed different scales and LMS to measure different subjective anxieties among students. Abal (2013) conducted a research on speaking anxiety and found blended learning is efficient to reduce it. Another important discovery from the current literature review found that most of the studies revealed that gender does

not affect performance of students in reducing anxiety by blended learning method. But the study of Owens (2017) reveals that self confidence grown more positively by application of blended learning among female students. According to Yushau (2006), Blended learning discovered very successful strategy in math learning among students of King Fahd University of Petroleum & Minerals (KFUPM), Dhahran. Teaching anatomy is also proved advantageous with blended learning platform in comparison to conventional learning methods (Pereira et. al 2007)

2.5. BLENDED LEARNING AND ATTITUDE TOWARDS A SUBJECT

Samsa et al. (2010) conducted research to measure the experience gained at the teacher experience course with blended learning program on the attitude of 37 trainee technology instructors. A pretest posttest quasi experimental design was used in this study. A predeveloped questionnaire developed by Ustuner (2006) containing 34 items countable with a 5point likert scale was used for the study. After completing 10 weeks intervention period, data collection done with posttest. Result found that blended learning shown positive impact on attitude of trainee technology teachers.

Behjat, Yamini and Bagheri (2012) conducted their study in Iran and compared blended learning classroom situations with conventional classes. They measured reading comprehension and attitude of the students in an experimental study. They found that conventional classes are more effective in comparison to blended classes in growing of positive attitude.

Czaplewski (2014) performed case study-based research on a public University located in Southeastern Minnesota, USA, in a graduation level blended mathematics course. The aim was to find out the effect of blended learning on students' achievement and impact of blended learning on the attitude of students towards mathematics. A tool developed by Tapia and Marsh (2010) was used to measure the attitude towards mathematics. Result showed that students have grown more positive attitude towards mathematics after taught with blended learning strategies. The study also revealed that blended instruction planning increases the interaction among themselves, and discussion and activity-based learning increased remarkably with the blended learning treatment.

Jaashan (2015) conducted his study on University of Bisha, Saudi Arabia to know the effectiveness of blended learning program on attitude towards English. In a questionnaire-based study 130 students responded and found the growth of positive attitude towards English. But it was also revealed that positive attitude grown due to learning experience, confidence, joy of learning, eagerness and motivation of the students. A major effect of teachers also found in growing positive attitude towards English. On the other hand, Artino (2010) found that online courses are more effective in growing positive attitude towards English in comparison to blended or conventional courses.

Qasem and Nathappa (2016) performed their study with 60 science teachers in Yemen to know the attitude of the teachers towards incorporation of ICT in normal classes. The teachers were trained with a blended module enriched with digital contents and results recorded with a questionnaire having 25 items. For the purpose of interpretation of data t test and ANCOVA methods were used. Research result showed that experimental group trained with blended learning method grown more positive attitude in comparison to control group trained with conventional method. Is the church also suggested that the incorporation of ICT should be maintained as per the need of the teacher and requirement of curriculum.

Rosa (2017) found that due to the absence of efficiency in mathematics course many students specially minority students, were dropping out without completing their higher education. Researcher wanted to measure the attitude towards mathematics and the dropout rate with the intervention of blended learning. Data were collected from 390 graduate Level mathematics students enrolled with conventional and hybrid blended mode containing algebra course. Data were collected by using 3 pre-formed tools. Result found that students with hybrid learning course shown more positive attitude towards mathematics course than that of conventionally treated group and the dropout rates are also lower in blended group.

In the study of McCall (2017), 9th grade biology students' academic performance, interest in science, and study habits were compared between cooperative testing and traditional or individual testing, as well as their influence on these factors. 13 weeks of

weekly tests that were administered in a flipped classroom format served as the basis for the research questions. The research design for the study incorporated quantitative and qualitative data collection methodologies. In three parts of a ninth-grade biology course at a private K–12 school, 66 students were enrolled. Groups of three or four students were chosen at random from the student body. Weekly tests on content from the normally prescribed curriculum were offered using the flipped classroom videos. For each class, six tests were chosen at random to be administered in a cooperative manner, and six tests were chosen at random to be administered alone or in a traditional fashion. No quiz was given during Week 7 because that week was set aside for the distribution of the mid-study questionnaire. The 12 weekly quiz results from the students were included in the quantitative data gathered. Additionally, pre-, mid-, and post-study questionnaires as well as semi-structured one-on-one interviews and one focus group were used to gather qualitative data. For five of the nine quizzes studied, cooperative testing groups outperformed students who took the tests alone in terms of test results. When taking quizzes individually rather than in groups, students' scores were not noticeably higher than the top scorer. The highest scorer outperformed the collaborative groups on one question. Although the effect was not constant throughout all quiz weeks, cooperatively tested groups occasionally outperformed groups completing the exams alone in terms of average score. The conflicting results could be attributed to a variety of factors, including the material's degree of difficulty, the setting, and ceiling effects. Depending on the component of motivation looked at, motivation for science either remained the same or increased during the study. The study found that student attitudes regarding group work, cooperative testing, and general satisfaction were all favorable. According to the student responses, they felt that participating in cooperative testing was helpful to their individual learning and important for future professional achievement. The amount of study time was constant throughout the study and matched the weekly video session duration.

Alzahrani and O'Toole (2017) conducted the study to ascertain the impact of experiences and attitudes on students' perceptions of the use of blended learning, this study aims to evaluate students' Internet usage experiences and attitudes. An online survey was used to gather information from 142 Saudi students at one of the top universities in Saudi Arabia. The findings show that kids are comfortable utilizing the Internet and have a favorable

view toward it. These opinions were not impacted by demographic factors, but experience factors had a noticeable impact. Interesting exchanges surrounding the student study year included both positive and negative responses to Internet usage and a preference for the use of integrated learning. However, age, study year, and views about the Internet related to favorable attitudes toward blended learning. Neither Internet experience nor program of study appeared to influence students' desire for blended learning. Students in the current study were supportive of the use of mixed learning, but not only online learning. Students' general opinions toward the Internet appeared to have an impact on how they felt about learning strategies in blended learning environments that use the Internet. Discussion of these findings is provided, along with potential consequences.

The purpose of the research conducted by Akbarov, Gönen and Aydoğan (2018), was to investigate how students feel about blended learning and associated ideas (blended and conventional classroom). 100 males and 62 females, total 162 students took part in this investigation. According to the study, in an EFL setting, pupils favor integrated learning over regular classroom instruction. However, they preferred taking paper-and-pencil tests for English rather than online ones. They disagreed on whether English coursework should be turned in personally or electronically. They had a similar level of confidence in analogue and digital English teaching and learning resources. Within an EFL environment, students' attitudes toward infographics and paperless classrooms were moderately good. Their choices for blended learning for EFL purposes were positively correlated with their English language skill levels and attitude towards English.

Taghizadeh and Hajhosseini, (2021) performed their study with 140 students to discover the attitude, pattern of interaction and level of satisfaction and how it affected by giving blended learning intervention. The study was performed in University of Science and Technology in Iran. 4 different types of questionnaires were supplied to students to know about attitude, satisfaction level, type of interaction and gratification level after treated with blended learning method. The study reveals positive attitude towards blended learning method among technology students after multiple regression analysis. Another major finding of the study shows that knowledge, skill, technology competency and strategy are the chief things which are needed for an instructor to make a successful blended learning program.

Hamzah et al. (2021) found that worldwide adoption of the blended learning methodology has increased interest in blended English language instruction. A concern about the students' preparation arose because of the method being used by several higher education institutions. The study sought to determine how prepared the pupils were for integrated English language instruction. The study included 137 participants from a public university in Melaka who were enrolled in various courses. They were required to respond to a questionnaire that measured their preparation for English language blended learning in five different ways, including their technical skills, technology accessibility, self-directed learning style, attitude toward traditional classroom settings, and attitude toward blended classroom settings. They were required to respond to a questionnaire that included five questions to assess their readiness for English language blended learning, including their technical skills, technological accessibility, level of self-direction in their learning, and attitudes toward both traditional and blended classroom settings. After that, six students were chosen to participate in semi-structured interviews to find out what they thought about English language blended learning. According to the survey, students' attitudes toward mixed classroom settings ranged from 3.28 to 3.54, which is lower than their scores for attitudes toward regular classroom settings, which are all above 4.00. This indicates that students are not as prepared for English language blended learning as they are for traditional classroom settings. The use of blended learning is becoming more common. They love studying English in a traditional classroom because face-to-face interaction with their teachers helps them recall information better and helps them grasp a lesson more thoroughly, according to the interviews that explained the reasoning for the answers from the questionnaire.

Tuguic (2021) conducted research on Kalinga State University, India on a flexible blended course which involves inclusion of regular and distance mode of learning. The study aimed about the difficulties faced by the students during the course and to find out their attitude and readiness towards blended course. A google form was made to collect online responses and total 508 responses were gathered. Along with that virtual interview was taken with 25 students. Two sets of data collection done and then they were merged scientifically to get the result. Students shown medium amount of positive readiness

towards the blended program but shown negative result in attitude towards blended environment.

Akbarov, Gonen and Aydogan (2022) seen that attitude towards when blended learning among 162 students in a English language course. In the study they found medium amount of positive response in attitude towards English language among students treated with blended learning method.

Hafiza, Siska and Putri (2022) conducted a study to know the effect of a blended program on cognitive, affective, and behavioral components of English learning course. Total 57 students participated in this study. Questionnaires and field notes were used as tools of study. 4 steps were followed to complete the data analysis process: collection, description, classification, and interpretation. It was concluded by the researchers that students shown positive attitude in affective and cognitive parts of English course by blended learning and shown negative attitude in behavioral elements of the same course.

Yudt, Sawyer and Shera (2022) investigated whether blended learning improved attitudes and mathematical achievement of preservice elementary teachers more than traditional face to face instruction in a quasi experimental mixed method. The secondary aim was to determine which specific aspects of blended learning were considered most beneficial to prospective teachers' learning of mathematics. 63 prospective teachers took foundational mathematics course in either traditional face- to- face or blended learning format. Participants filled the Dutton station Scale and a researcher developed mathematics achievement test at pre and post test. In addition, they also completed a researcher developed questionnaire about their comprehensions of blended learning after the course. It was found that participants in blended learning format scored significantly advanced on the post-test than participants in the face to face format, but there were no condition difference in calculation performance. Feting that time operation and low physical educator attendance presented challenges, participants in blended learning valued the rigidity of course structure and control over the pace of instruction. When designing blended learning courses, these findings suggest important aspects to take into account.

Hong et al., (2022) investigated the impact of blended learning toward high achieving students' attitude toward mathematics; their perceptions of learning mathematics through

blended learning, and their achievement in mathematics were affected by blended learning. Purposive sampling was used to select high-achieving secondary school students who attended two daily schools in Bachok, Kelantan—school B and school C—with 100 students each. The elucidating measurement utilized in examining the finding. The finding indicates that blended learning has a beneficial effect on the mindset of mathematics-focused high achievers. However, the findings demonstrate that students preferred traditional instruction over blended learning for mathematics instruction. In addition, the findings demonstrate that during blended learning, the majority of students receive lower grades and the achievement of high achievers decreases.

Conclusions and critical engagment:

Attitude is a positive variable. Increase in positive attitude could be possible with suitable intervention. Many researchers (Czaplewski, 2014; Jaashan,2015; Rosa,2017; Hamzah et al., 2021) found increase of positivity in attitude towards a subject with blended learning intervention, some researchers (Tuguic 2021; Behjat, Yamini and Bagheri, 2012; Akbarov, Gonen and Aydogan,2022) found minimum or intermediate level of growth in positive attitude with blended learning interventions. Some chapters, some lessons which are relevant to regular life are found as complicated for understanding by the students (Staeck, 1995; Gill and Yesilyurt, 2010). Transportation of water, photosynthesis, respiration, genetics (Bahar, Jhonstone and Hansell, 1999), chromosomes cell cycle hormone neural system and mentally and genetics (Tekkaya, Ozkan and Sungur, 2001) are some facts in which students have difficulties in understanding during their learning. Some previous researchers found that inspiration towards biology is one of the most important factors that influence student's achievement in the field of Biology. Tapia and Marsh (2010) , Behjat, Yamini and Bagheri (2012), Jaashan (2015) revealed that positive attitude grown due to learning experience, confidence, joy of learning, eagerness and motivation of the students. Rosa (2017), Akbarov, Gönen and Aydoğan (2018), found that blended learning helped them in lowering dropout rates thus increasing positive attitude towards science subects. Hamzah et al. (2021) found that worldwide adoption of the blended learning methodology has increased interest in blended English language instruction including their technical skills, technological accessibility, level of self-direction in their learning, and attitudes toward both traditional and blended classroom

settings. For the improvement of achievement in biology it is very important to grow positive attitude towards biology first (Cimer,2012; Ekici ,2012). Wang et al. (2007) found that the factors affecting level of learning of concepts of biology among the senior level of students their perspective towards biology. So, attitude toward biology was chosen as a variable for present study.

2.6. STUDY OF BLENDED LEARNING WITH ALL VARIABLES (ACHIEVEMENT, ANXIETY AND ATTITUDE)

Deghaidy and Nouby (2008) was intended to know the impact of learning program on rainy teacher's attitude and achievement towards blended learning. Total 26 student teachers from Egyptian University were taken as sample of the study. Flex and self-blending methods were used for this research work. Post with blender learning strategies shown higher scores in achievement test as well as shown more positive attitude towards blended learning environment.

So and Brush (2008) and Ozkan and Koseler (2009) conducted similar kind of study and revealed that in order to assess learner traits including motivation, confidence, excitement, and anxiety, blended learning interventions were used. Blended learning strategies are proved beneficial in all cases and students' anxiety also reported as reduced.

Brand and Kinash (2010) conducted their research with quasi experimental Research design. They wanted to know that use of technologies via mobile are able or not to make a difference in learning outcome among the students. Attitude towards technology, technology related anxiety and achievement after using technology were the variables they have considered in their study. With 150 sample size over 2 semesters they have administered comparison group with traditional teaching and given treatment through mobile and iPad based blended learning classes to experimental group. Statistical analysis was done by MANCOVA and analyzed by software like SPSS and NVIVO. They concluded that mobile learning proven very interesting to the students thus it should increase in interest attitude student satisfaction and helped in reducing anxiety.

Kumar (2010) in a true experimental study, investigated about potential of Blended Learning in enhancing learning retention and attitude towards English Language and used ICT tools for Blended Learning Classes, found positive result with blended learning

intervention. Blended learning strategies proved effective in Critical thinking, Problem solving, Science process skill and in Science Achievement in a quasi-experimental study by Krishnan (2017).

Hsu and Hsieh (2011) in their quasi-experimental study judged effect of blended learning on nursing student's achievement and attitude. They have taken a sample of 233 students. By "case analysis attitude scale, case analysis self-evaluation scale, blended learning satisfaction scale, metacognition scale and achievement test" they have completed their study. Experimental group who was taught with blended learning shows higher level of achievement score than the control group taught with conventional way. Similar study was framed by Shorey et.al (2017) they also got positive results amongst experimental group as they were given intervention with Blended learning.

Alseweed (2013) compared the effectiveness of three strategies i.e., conventional teaching method, blended method and online method of learning method. Total 34 students were distributed in three groups and taught with those three techniques. Results found that blended method proven effective in comparison to other two methods in improving academic achievement scores and attitude towards the course.

Macher et al., (2011) performed their study to find out relationship among academic anxiety, academic achievement, and learnings strategies. The study was framed with 147 statistical psychology courses. By filling questionnaire, responses were collected from the students. Study result discovers that higher statistical anxiety leaves negative impact on academic achievement scores and academic performance, on the other hand it was also found that proper learning strategy reduced level of academic anxiety among students (Yaghoobi et al., 2014).

Aldalalah (2014) found that pupils' varying degrees of anxiety and provide help through blended learning. He discovered that the pupils were reserved, which shows that their levels of competency in dealing with their fear varied significantly. He found that anxious pupils were far less likely to be engaged in blended learning. However, blended learning interventions made a difference in how their attitudes about optimism changed.

Henrie et al. (2015) conducted research to find out the role of blended learning in reducing anxiety in self-regulated learning and emotional engagement of students. They found that

blended learning had a negative impact on anxiety. As anxiety is a negative psychological state, it can be concluded that blended learning helped students in reducing anxiety.

Banditvilai (2016) investigated the effect of blended learning on achievement and attitude in students' language skills like hearing, speaking, reading, and writing. 60 students were taken as sample of study. Result found that experimental group taught with blended learning method shown more positive results in comparison to control group taught with conventional method. Level of motivation was also found increased with the application of blended learning intervention among students.

Ikhwan and Widodo (2019) conducted a study to know the efficiency of blended learning in improving attitude towards a subject and achievement in environmental science. Study result reveals that blended learning was better than traditional technique, achievement increased remarkably with blended method and attitude slightly increased in students by blended method.

Alsalhi et al., (2019) investigated the impact of blended learning on academic achievement and attitude towards science among the students of 9th grade. Researchers used quasi experimental design to complete their study. The research was case study based and had 112 participants in total. A questionnaire was made and validated to get the result. Analysis of result was done by SPSS. Results found that experimental group (n=61) taught with blended learning strategies shown more positive attitude than control group (n=51).

Baloran (2020) conducted an online survey-based study with 530 senior secondary and college students to know the impact of students' attitude and anxiety and coping strategies during covid 19 pandemic period. A google form was constructed and distributed to collect the responses. Results revealed that students do not like blended mode of classes very much and that increased their anxiety level and causes negative impact on attitude.

Seitan, Ajlouni and Al Shra'h (2020) completed their study in a school in Jordan. With 40 sample size they have completed their study. The study was aimed to find the impact of blended learning strategies over academic achievement and attitude of the students. Both experimental and control group were exposed with achievement test and only experimental group was exposed with attitude scale. Students of experimental group

treated with blended learning strategies shown positive attitude towards teachers' environment and the process of learning. On the other hand, the students of experimental group shown better results than control group in achievement test.

Grolien et al. (2021) found that in the field of Bioscience, some topics like anatomy, physiology, biochemistry considered as most tough topics. So, the researchers decided to study the effect of blended learning on those topics among 1st year nursing students of Norway by a quasi-experimental study design. Results shown that students taught with blended learning strategies shown positive result in comparison to control group taught with conventional method. Students considered that e-resources enhanced their performance in academic achievement and attitude towards those topics in Bioscience.

Al-Osaimi and Fawaz (2022) conducted their study on Saudi Arab after Covid pandemic disaster occurred. 20 nursing students enrolled for a blended nursing course chosen as the sample for the study. Researcher found that students are losing motivation due to online courses and thus it is highly affecting their achievements scores and attitude towards nursing course also. Result found that by improving education quality among nursing student's motivation level, attitude and achievement scores can be improved.

Conclusions and critical engagement:

Many researchers conducted their studies to encompass the effect of blended learning strategies with achievement and attitude towards a subject (Deghyaidy and Nouby, 2008; Brand and Kinash,2010; Alseweed, 2013; Banditylai, 2016; Ikhwan and Widodo, 2019; Seitan, Ailouni and Al Shra'h, 2020; Al-Osaimi and Fawaz, 2022). Some of the designs were quasi experimental in nature (Grace et al., 2004; Ali and Awen,2013; Seitan, Ailouni and Al Shra'h, 2020; Grolein et al., 2021; Al-Osaimi and Fawaz, 2022) and most of the investigators found that blended learning strategies proven effective in improvement of academic score as well as promotes positive attitude towards a subject. On the other hand, many studies found to know the role of blended learning in reducing anxiety and academic anxiety (Brand and Kinash, 2010; Aldalalah, 2014; Henrie et al., 2015; Baloran, 2020; Grolein et al., 2021). Some of the studies also framed with attitude towards a subject and anxiety together with blended learning (Henrie et al., 2015; Brand et al., 2016)

shows that blended learning strategies are more or less effective for reducing anxiety, improving academic scores and promotion of positive attitude towards any subject. So, it was found from above literature that academic achievement, attitude and anxiety can be taken as the variables to know the effectiveness of blended learning for present study. Studies with individual variable also supported the selection of variables and finally academic anxiety, academic achievement and attitude towards a subject was chosen as variables for present study.

2.7 STUDY OF BIOLOGY WITH ALL VARIABLES (BLENDED LEARNING, ACHIEVEMENT, ANXIETY AND ATTITUDE)

Osborne et al., (2003) reviewed the literature of twenty years to find out the factors that can affect the attitude towards science among students. Rigorous review of literature reveals that attitude towards science depends on many factors like instructor, his abilities, skill, syllabus of study, achievement test score, anxiety towards science, cultural and social background of student etc. Academic anxiety is found one of the most important predictors of attitude towards science.

Grace, Okorodudu and Ossai (2004) examined the effect of academic anxiety on achievement level of students of psychology course. Total 150 university level students were the sample of study. By multiple regression analysis it was found that academic anxiety negatively correlates with achievement, so, it can be concluded from this study that higher academic anxiety causes lowering achievement scores among students and low academic anxiety indicates higher achievement in psychology course.

Nasr and Soltani (2011) investigated the relationship between attitude towards biology and academic achievement. A 30-items questionnaire was distributed to collect the answer. This study findings reveals that only one dimension of supplied questionnaire shown positive result of attitude towards biology in respect to achievement in biology. The study also reveals that no significant difference found among boys and girls in attitude towards biology and girls shown comparatively improved result in comparison to achievement in biology.

Yapici and Akbayin (2012) examined the role of blended learning in Biology course of high school students. Total 47 students of 9th grade chosen as the sample for the study. By the application of moodle learning management system full process of experimentation was done. Upto 10 weeks, intervention were given to children. A scale measuring student's view on blended learning was applied and interview also conducted, and found that the application of blended learning can be useful with a proper infrastructure and attitude of both students and teachers in the field of Biology.

Ali and Awan (2013) studied the effect of attitude towards science subjects with achievement result of Biology, Physics, Chemistry and biology. Total 1885 students were used as sample of the study. 42 items containing "Test of Science-related Attitudes" scale constructed by Fraser, 1981 was adapted and 31 items containing revised scale is made and used. It was found that significant difference found in academic achievement in biology and attitude towards biology.

Samikwo (2013) discussed different issues related to academic achievement in biology among students. 215 high school students were chosen as study sample. A descriptive survey design was used to complete the present study. Interview questionnaires were supplied, and responses received from students. Study result explores that attitude towards biology is one of the most important factors that affects academic achievement in biology. More positive attitude towards biology shows better in achievement result in students.

Nurhikmah et al., (2018) performed their study with XIthgrade high schools students and measured the role of blended learning in self learning skill in biology. ICT based learning aids were made to execute the experimentation. Result found that blended learning enhanced the self-learning skill in biology among students.

Musengimana, Kampire and Ntawiha (2020) conducted a review-based study to find out the factors affecting the attitude towards chemistry subject. The investigators concluded from their study that interest towards a subject, syllabus of a subject, achievement, strategies of learning, self-paced learning etc are the driving factors which affects the attitude towards chemistry among students.

Aivelo and Uitto (2021) conducted their study to understand the issues affecting the attitude towards biology, specifically genetics and genetic determination part of biology. With 421 sample size and pre-formed attitude questionnaire, the research work was done. Result found that gender is one of the most important predictors for attitude in genetics and attitude towards genetics affects positively the achievement scores of students. Also, teaching approach is another very important factor that can affect the attitude of students in genetics.

Conclusions and critical enegagement:

Studies from different times and studies by different researchers shows that Biology is an important subject (Ali and Awen, 2013) and this is the era of biology (England et al., 2018), and it is very important to maintain a positive attitude towards biology for success in academic achievement (Samikwo, 2013). On the other hand, it was also found that a positive attitude towards biology can lead into reduction of academic anxiety towards biology (Cimer and Yilmaz, 2016; England et al., 2018). It was also found that high achievers generally encountered with low academic anxiety as well as do achievers mostly caught by academic anxiety (Aldelalah, 2014). Studies previous studies also tried to establish the fact that proper teaching learning strategy can improve academic score and also attitude towards the subject can be improved (Osborne et al., 2003; Grace, Okorodudu and Ossai, 2004;). It was also found in some cases that anxiety was Biology can be decreased by the application of blender learning so Biology was chosen for present study.

2.8. RESEARCH GAP

- Many studies are conducted to find out efficiency of blended learning with task value, Goal orientation, self regulated learning, achievement tests and self-efficacy but a few studies are conducted with lowering anxiety in India.
- Though previous studies were conducted with other streams in higher secondary level, its implementation with Biology at Higher Secondary School Level is still not adequate in India.

- Published studies related to acquisition and implementations of Blended Learning in West Bengal's educational background are a few till the date.
- Insufficient number of researches are there to guide Govt. aided and sponsored institutions of higher education in strategically adopting and implementing blended learning on campus especially in India.
- Rarely experimental studies were found in West Bengal with blended learning giving special emphasis on Govt. aided and Sponsored schools. Where need is more and resources limited.

CHAPTER – 3

METHODOLOGY

3.1. INTRODUCTION

Research is a well ordered multi step investigation process about a topic for the purpose of acquiring sufficient knowledge. Research is systematic process which includes exploring different direction of a known fact or phenomenon. Thyer (2001) described research as – "the word research is composed of two syllables, re and search. re is a prefix meaning again, anew or over again search is a verb meaning to examine closely and carefully, to test and try, or to probe. Together they form a noun describing a careful, systematic, patient study and investigation in some field of knowledge, undertaken to establish facts or principles".

The Research methodology is the systematic process of conducting research. It is a well-planned effort to find out answer to a research question. It is a manual of resolving a specific problem in respect to a particular techniques and tools. In a word Research methodology is a path to solve research problem.

Following proper methods are most important to conduct a successful research work. Research is a multi-step process which includes finding of broad area of a problem, extensive reviewing of previously available similar research work, finding research gap, extracting new research problem from it, formulation of precise research problem, selection of proper methodology, definition of used terms, vivid idea of variables, theoretical framework, construction or arrangement of tools to use in study, calculation of reliability and validity of tool, data collection, proper analysis and interpretation of data by using proper statistical method, prediction of its future uses and generalization of research result (Koul, 1998; Kohari, 2004; Martens, 2010; Pereira, 2016).

Selection of methodology is another important aspect of a systematic research. It is just like a functional key to a lock. Proper adoption of methodology can unlock the solved equation of a research problem. Method of research depends on the nature of formulated problem. Reliability and validity of a research also reclines on accurate methodology. In present study, Chapter 3 gives a detailed step-wise idea followed to conduct the process.

This chapter represents Design of research, Sample and sampling details, ideas about tools construction and validation, process of research, statistical techniques used, operational definitions and most importantly objectives and Hypotheses of the present study.

To reveal the research problem entitled as – **"EFFECTIVENESS OF BLENDED LEARNING IN BIOLOGY ON ACHIEVEMENT, ANXIETY AND ATTITUDE OF SENIOR SECONDARY SCHOOL STUDENTS OF WEST BENGAL".**

3.2. DESIGN OF THE STUDY

Research design is a planned way to execute research. It can be defined as a blueprint or master plan of a research. A planned and well elaborated method of research delivers the investigator a systematic and scientific way for formulating and resolving a research problem (Pereira, 2016). Gay and Airsian (2003) classified research in various ways –

According to their application, i.e., Basic and Applied Research. Where basic research conducted generally to develop a theory and applied research includes application of theory in a real-life situation.

The chief objective of this research is to construct and validate blended learning lesson plans and blended learning contents. Construction and validation of Biology anxiety scale was done to measure the biology anxiety present in senior secondary students. "Biology attitude questionnaire" constructed by Prokop, Tuncer and Chuda (2007) which was adapted by investigator with respect to Indian context. Achievement test questionnaire in biology was constructed and validated. This total process needs the collection of huge data from groups of students. Data collection process includes answering of questionnaire, scale and achievement test and also includes rigorous process of statistical data analysis. To fulfil the demand of research objectives in present research, several hypotheses were formulated. When a statistical hypothesis formed to conduct research and its process includes the verification of the fact of statistical hypothesis related to a research problem, the phenomenon is called an experiment. Experimentation is a logical and chained method of hypothesis testing under minute-controlled observation. Here the

experimentation is conducted to know the effectiveness of blended learning. For the present study to groups were formed namely: control group treated with conventional method of teaching during experimentation, and another experimental group treated with blended learning method to know the efficiency of the process. As the present study needs experimentation to complete by the investigator, so, here, the method adopted is quantitative and experimental method.

Quasi experimental design is almost similar in comparison to true experimental design. It only differs with experimental design that the participants are not randomly assigned in quasi experimental studies (Martens, 1998). But quasi experimental designs provide control over when and whom measurement is applied. It lies in between the pre-experimental designs and the true-experimental designs. The quasi-experimental, non-equivalent [may be same in number but not by quality. (Martens, 1998) pre-test, post-test, follow-up test, control group design was employed using only the senior secondary biology students. The design was most appropriate since two intact classes were used and no randomization was done in the selection of subjects. As a rule, when any of the research procedures required in true experimental condition is absent, the design is best described as quasi-experimental (Patrick, 2011).

The investigator taught both the groups to remove the effects of any other teacher influences on teaching effectiveness. Present study was considered quasi experimental in nature specifically pretest-posttest not equivalent group design was employed. As the present study was framed to conduct by classroom experiment situation, both the control and experimental groups were such naturally assembled groups as intact classes, which may be similar (Best and Kahn, 2006).

O_1 X O_2

O_3 C O_4

Where,

O_1 and O_3 represent pre-test of Experimental and Control Group

X represents treatment of the Experimental Group

O_2 and O_4 represents post-test of Experimental and Control Group

Experimental mortality

Jurs and Glass (1971) suggested that there is no such concrete way to avoid experimental mortality totally. It could be minimized by certain methods. By offering students attractive tasks, shorter treatment period, announcement of rewards, prize or gifts on completion of treatment period etc. When there is a little mortality, the analysis of mortality is not mandatory. Another way to reduce experimental mortality is to arrange more sample size than are needed so the desired number will have completed the data.

Slack and Draugalis (2019) stated that, by equating the groups of experiment i.e., control and experimental groups, the problem of experimental mortality can be reduced. Marginal scores exclusion can be another way out to prevent the same.

Top of the high and the lowest scores were excluded to avoid mortalities. Subject points were dropped out or were missing from any of the groups during the whole pre test-treatment/control-posttest stages. All the students of control groups and experimental group were present throughout the whole experimentation (Hiett, 2016; Deb et. al, 2015; Chang, 2014). The study was conducted with 5% significance level that means with 95% confidence level.

3.3. METHODOLOGY OF RESEARCH

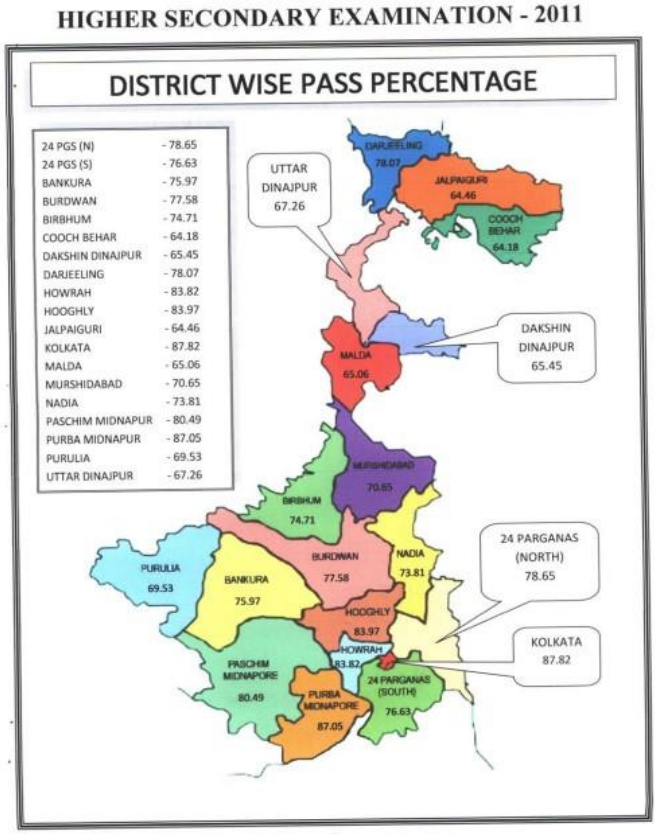
The purpose of present study is to draw a clear picture about effectiveness or potential of blended learning strategies (BLS) on the achievement scores, to study the level of anxiety and to assess attitude towards Biology among class XI, i.e., Higher Secondary level students of West Bengal. A Quasi-experimental design was followed to get the desired outcome of the study.

Here the investigator needs two groups of students, one control group and other one experimental group. Treatment with blended learning strategies was given to the experimental group to infer blended learning strategies have any effect on achievement scores in biology, reduction of anxiety in biology and to access the attitude towards biology. Then the data collection was done and mean scores of two group of both pretest and posttests were compared to get final result.

3.4. SAMPLE AND SAMPLING TECHNIQUE

Population and Sample for the present study

The population of the present study was the XIth standard science students who have taken Biology as their optional elective subject. The investigator had delimited this study to WBCHSE students of XIthstandard in science stream with biology. So, the sample for study consisted of XIthstandard Govt. sponsored students under "West Bengal council of Higher Secondary Education" taken Science stream and Biology as their subject of Kumargram block of Alipurduar district of West Bengal. Figure 3.1. represents district wise pass percentage of West Bengal according to 2011 census report.

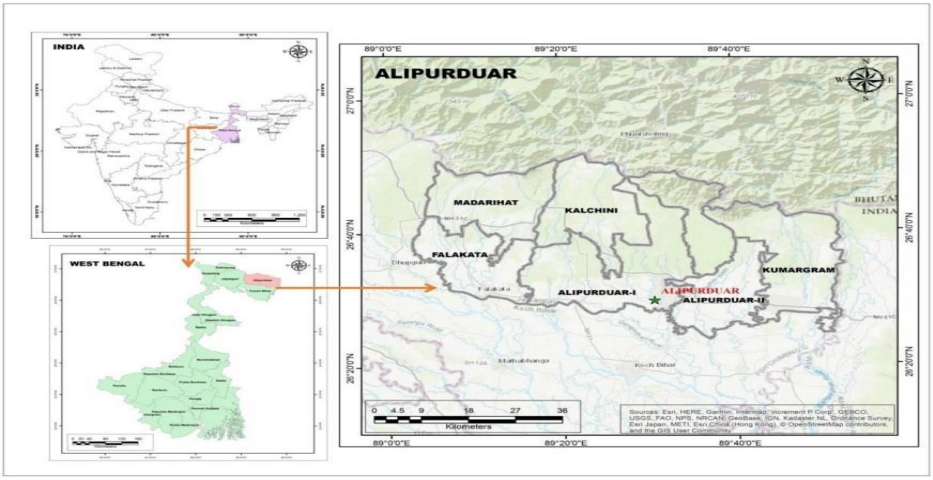


*Sources:https://wbchse.nic.in/pdfs/result_statistics_2011/dist_wise_percentage.pdf

Figure 3.1. District wise pass percentage of West Bengal according to 2011 census report.

According to 2011 census report Northern part of West Bengal is comparatively weak in Higher Secondary result in comparison to southern part (Pass percentage in undivided Jalpaiguri district:64%). In 2014 Jalpaiguri district was divided as Alipurduar and

Jalpaiguri on the geographical accessibility. According to the geographical distribution, Alipurduar district is considered as the furthest district which is surrounded by Bhutan in North, Assam in East and Bangladesh in South and Kochbihar and Jalpaiguri district in West. This is considered as Himalayan region Dooars and belongs to tea belt. Most of the people belongs to tribes (Mech, Rava, Garo, toto etc.) or schedule caste (Rajbangshi, Koch etc.) So, these area covers tea garden parts and belongs to poor economic status and most of the learners are first generation learners. So, Alipurduar district was chosen for present study. Secondly, choice of district for the present study has been done based on result trend of published data in 2019by West Bengal Council for Higher Secondary Education. Alipurduar district has been chosen because only 69.83% students qualified Higher Secondary Examination in the year 2019 from this district (though this district has computer literacy and infrastructure) whereas the overall pass percentage is 90.13%. Conditions of availability, presence of infrastructure are the priorities as per present research. As the present study requires a computer lab facility and well-developed electric supply and internet connection, the school is chosen as per that basis. The accessible population consisted of all male and female candidates of all Government sponsored schools of Alipurduar district. The figure 3.2. represents the geographical location of West Bengal, Alipurduar district and Kumargram block.



*Source:https://alipurduar.gov.in/DISTRICTMAP.jpg

Figure 3.2. Location of Alipurduar district of West Bengal

Sample and Sampling technique

Alipurduar district contains six blocks: Alipurduar-I, Alipurduar-II, Falakata, Kumargram, Kalchini, Madarihat. The investigator randomly selected Kumargram block for present study. Kumargram block has 23 Govt. sponsored Higher Secondary Schools under WBCHSE. Of them only two schools have Science stream. According to Ebeedat et al., (2005) sample is "A part of the study main population, chosen by the researcher using various techniques, which includes members of the main population". In this study, purposive sampling techniques has been used to select schools to participate in this study based on the following criteria:

- School that has access to computers and the students are computer literate.
- Schools that have access to steady internet and ICT support.

Based on above two criteria only one school was found; information collected from District Inspector of Schools (SE), Alipurduar that this district has six blocks, each having one ICT based school. Figure 3.3 showing sampling procedure.

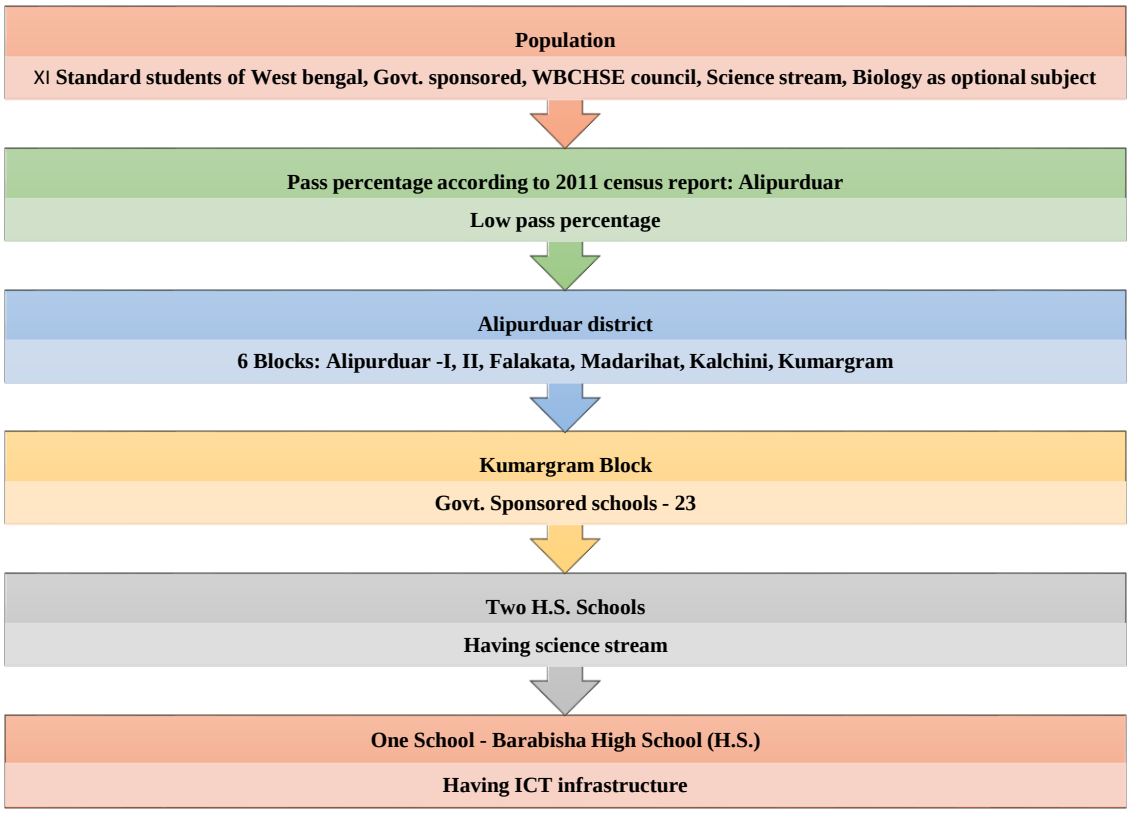


Figure 3.3: Sample selection procedure

According to above mentioned criteria, the school chosen for present study was Barabisha High School (H.S.) from where the due permission is taken from respected Headmaster of the school (Appendix – 1). As this school has intake capacity of 75 students in science stream (as per WBCHSE order) the sample size considered for this study was almost 70 in total (to avoid experimental mortalities). Out of these 35 were taken as experimental and 35 control groups. According to the result of pretest, two groups were constructed with almost equal weightage of marks by the SPSS software. Equation of groups were justified by Spearman's coefficient of co relation method (Conklin, 2017). By this process the samples were equated in both groups. Distributions of samples are as Figure 3.4.

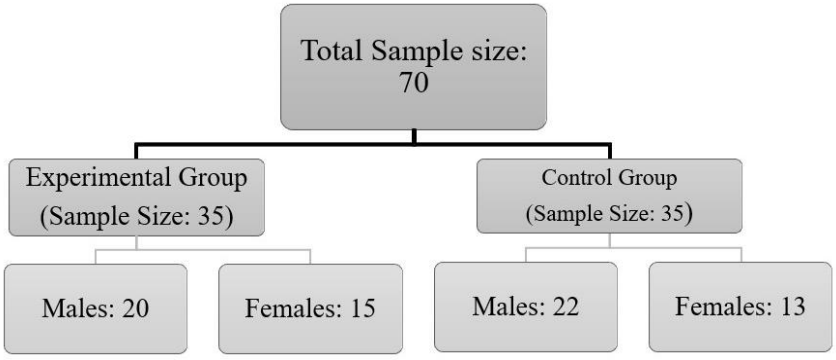


Figure 3.4: Sample distribution

According to some previous researchers the sample size and sampling method were chosen for present study. In this research, purposive sampling was used to ensure that the respondents are capable of understanding the use and application of blended learning in Biology subject to reduce anxiety in biology, gaining positive attitude in biology and achievement in biology. The sample population in this study were, therefore, selected purposely to include senior secondary students for better viability of knowledge and application of Blended learning and the whole sample of 70 students were taken as sample for present study.

Year	Researcher	Sample size	Study design
Buket Akkoyunlu	2006	64	Quasi experimental
Yun Jeong Park and Curtis J. Bonk	2007	4+4 = 8	Quasi experimental

Feza Orhan	2008	30	Quasi experimental
Özgen Korkmaz Ufuk Karakus	2009	28+29 = 57	Experimental Design
Rehana Masrur	2010	38+30=68	Quasi Experimental
Serap Samsa	2010	38	Quasi Experimental
Ms. Arwa Ahmed Abdo Qasem	2017	60	Quasi Experimental
Monal Kanubhai Desai	2018	49	Single group experimental
Shurygin	2020	89	Experimental
Hizaki and Alnatour	2020	100	Quasi Experimental
Thinh and Huyen	2020	56	Experimental

3.5. VARIABLES OF THE STUDY

In both experimental and quasi experimental research design the objective of research works moves around along with the activities of variables. The chief purpose of the research work is to find out the effect of following variables.

According to the Australian Bureau of Statistics (2022) “A variable is any characteristics, number, or quantity that can be measured or counted. A variable may also be called a data item. Age, sex, business income and expenses, country of birth, capital expenditure, class grades, eye color and vehicle type are examples of variables. It is called a variable because the value may vary between data units in a population and may change in value over time.”

Variables are some characteristics or features or conditions which can be manipulated, controlled or observed by the researchers. The variables can be defined and categorized in various ways, but here, in present study three kinds of variables were applied to conduct the experiments.

INDEPENDENT VARIABLE

In experimentation, the manipulated variable is called an independent Variable. The proposed study measures the effectiveness of Blended Learning Strategies and the Conventional Method. Therefore, the independent variables are Instructional Approaches.

DEPENDENT VARIABLE

- Achievement Test in Biology,
- Anxiety towards Biology,
- Attitude towards Biology.

CONTROL VARIABLE

The variable which remains constant throughout the experimental period so that a researcher can focus on his or her experiment, is called control variable. To ensure accuracy of the research outcomes and to avoid any marginal interference, researcher tried to control some of the variables; they were controlled by recognition of effective method of controlling as:

- **Subject oriented Variables:** Age of students and grade were controlled by purposive sampling.
- **Environmental Variables:** The classroom climate, noise, light etc. were controlled by providing similar conditions.
- **Sequence Relevant Variables:** Fatigue and co-operation were controlled by experimenter.

3.6. RESEARCH TOOLS FOR THE STUDY

- Blended Learning Strategies: Rotation, Face-to-face driver
- Lesson Plans – prepared by investigator.
- Achievement Test – Pre and Post Test questions prepared by investigator herself.
- Biology Attitude Scale – by Prokop, Tuncer and Chuda (2007) – it was adapted in Indian scenario and focus was given on three dimensions, i.e. Interest,

difficulty and importance – as per need of study. Due Permission already been taken from the author (Appendix – 8).

- Biology Anxiety Scale– was constructed by investigator. Reliability and validity were checked as per need of the study with proper sample size.
- All the tools were constructed and applied in English Language and medium of instruction, lesson plans and achievement test questions was prepared in their mother languages i.e. Bengali Language and administered with the same form along with a English version of that in questions (Nair, 2014; Fakhir, 2015).
- The concept for distribution of percentage used for different strategies of Blended Learning has been derived by following the research of Allen et. al, (2007) and Means, Bakia, and Murphy (2014). According to them, when the online resources are used over 30% to 79% that comes under blended learning category, above which i.e., 80% is digital learning and below 29% is conventional learning.

3.7. PILOT STUDY FOR SELECTION OF CHAPTERS FOR STUDY

Five chapters were chosen from Class XI syllabus provided by West Bengal council for Higher Secondary Education (Appendix 3), chapters were chosen according to the findings of pilot study. As per syllabus of WBCHSE, the child centered approach followed entirely to maintain the goal of NCF 2005. The curriculum helps to enhance our national identity and to provide the next generation the opportunity to reconsider by instilling in pupils a sense of solidarity, democracy, and togetherness (as per official report of upgraded curriculum of WBCHSE, 2013 – Appendix 3). Data were collected from NEET aspirants, H.S. passed and 1st year medical students, with a sample size 84. On the basis of findings, students expressed their hardness as stated below. The five chapters namely – Photosynthesis, Respiration, Cell division, Neural co-ordination and chemical co-ordination which are seemed to be much difficult in class Eleventh syllabus and they are difficult to understand as well. So, these chapters were chosen for present study. Table 3.1. showing average percentage of response in relation to hardness in pilot study.

Table 3.1. Average percentage of response in relation to hardness in Pilot Study

Chapter No.	Name of theChapter	Average percentage of response in relation to hardness
1	Science of life	3.782895
2	Taxonomy and Systematic	0.657895
3	Classification of Living Organisms	9.142174
4	Structural Organization in Plants	13.33946
5	Structural Organization in Animals	14.89875
6	Cell	3.759398
7	Chemical constituents of living cell	19.10458
8	Cell Division	**19.86398**
9	Movement of Water, Food, Nutrition and Gases	11.79725
10	Plant Nutrition and Minerals	7.347915
11	Respiration	**31.56186**
12	Photosynthesis	**34.78725**
13	Plant Growth and Development	10.00299
14	Digestion and Absorption	19.08749
15	Breathing and Respiration	4.652256
16	Body fluids and Circulations	13.97386
17	Excretory Products and their Elimination	11.56869
18	Locomotion and movement	17.59441
19	Neural control and co-ordination	**35.24222**
20	Chemical co-ordination and regulation	**26.55502**

Figure 3.5. represents graphical presentation of percentage of responses in response to hardness.

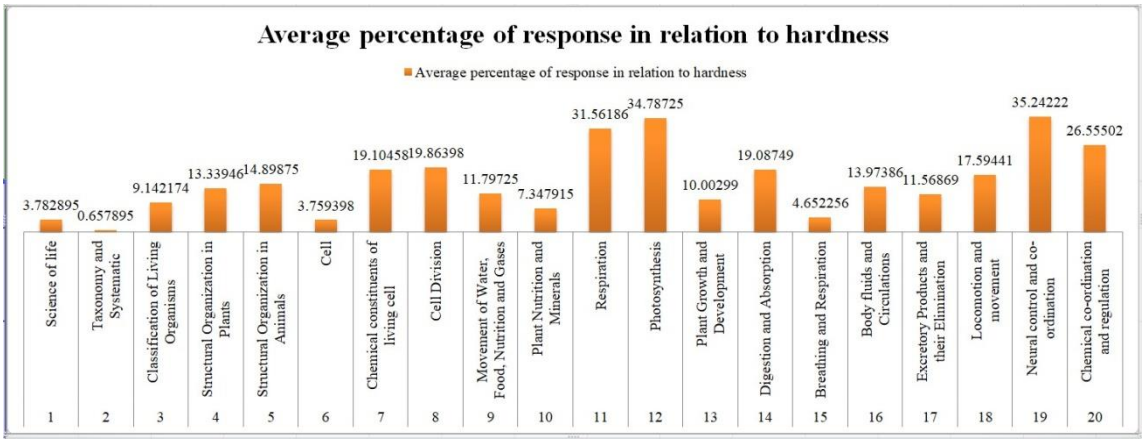


Figure 3.5. Percentage of Response in relation to hardness

3.8. CONSTRUCTION AND VALIDATION OF BIOLOGY ACHIEVEMENT TEST QUESTION

Achievement is a process of achieving something with efforts and skills. Achievement in Biology means achieving good scores in biology subject which is obtained by the administration of achievement test questions constructed according to the scientific pattern based on Bloom taxonomy. An achievement test is an evaluation of learning outcome or skill or knowledge which usually indicates the rate of success after learning a topic or lesson. Achievement test is a tool for teachers to evaluate their students in normal school situation. So, the achievement test is constructed for subject biology to access the and the same test is constructed for Class XI standard students.

Steps for constructing an Achievement Test

Following steps are to be followed to construct a standardize achievement test:

- Planning the test
- preparation or generation of test items
- send for expert advice
- administration of test
- pilot testing or first try out
- final try out

- preparation of final draft
- standardization of tool
- establishment of reliability and validity

(i) Planning the test

Planning for a test is the first and foremost step to construct an achievement test. To make a standarized achievement test it is very important to have a careful planning. It is very important to keep in mind that the design of the test must meet the need of the test, i.e., it must satisfy the questions like to whom, what, when and how to measure. Planning of the test includes objectives of the test, content of the test, nature of the test, scoring schemes, number of items, types of items, length of the test, weightage of objectives, weightage to content, weightage to questions, allotment of time and making scheme (Bhagat and Baliya, 2015).

(ii) Objectives of the test

Objective of this achievement test were defined in behavioural terms based on Knowledge, understanding and application domains, from live chapters obtained by pilot study of class 11th standard biology book according to the syllabus of "West Bengal Council for Higher Secondary Education".

(iii) Content of the test:

The Achievement test covered the contents from the five chapters of biology of Class XI standard, according to the syllabus of West Bengal Council of Higher Secondary Education. Five chapters are chosen according to a pilot study conducted earlier. These chapters are cell division, photosynthesis, respiration, nervous coordination and chemical coordination.

(iv) Blueprint of the test:

The blueprint is and universally accepted tool generally used to construct questions for examination in form of matrix or chart that reports the number and type of examination questions given throughout the topic and content area. It also represents the objective and relative weight of marks given in the test on each topic. Main purpose of blueprint

formation also includes Competencies as a dimensional cognitive process tested in knowledge, comprehension, application and skill domains of Bloom's taxonomy of educational objectives and selection of topic and relative weightage to each topic in content area.

i. **Weightage to the objectives**

Table 3.2. Weightage to the Objectives

Objective	**Percentage of Marks**	**Marks Allotted**
Knowledge	25	25
Comprehension	25	25
Application	25	25
Skill	25	25
Total	100	100

Table 3.3.Weightage to the content

Chapter	**No. of questions**	**Marks**	**Percentage**
Cell Division	20	20	20
Endocrine System	20	20	20
Respiration	20	20	20
Photosynthesis	20	20	20
Nervous System coordination	20	20	20
Total	100	100	100

(iii) Weightage to the form of Questions- In order to keep the objectivity objective type questions were selected for the test and it is represented in table given below-

Table 3.4. Types of questions

Item Type	**No. of Questions**	**Marks**	**Percentage**
Multiple Choice Type	100	100	100%
Total	100	100	100%

Table 3.5. Blueprint of the 1st draft of question

Objectives	Knowledge	Comprehension	Application	Skill	Total
Cell Division	5(5)	5(5)	5(5)	5(5)	20 (20)
Respiration	5(5)	5(5)	5(5)	5(5)	20 (20)
Photosynthesis	5(5)	5(5)	5(5)	5(5)	20 (20)
Nervous System coordination	5(5)	5(5)	5(5)	5(5)	20 (20)
Endocrine System	5(5)	5(5)	5(5)	5(5)	20 (20)
Total	25 (25)	25 (25)	25 (25)	25 (25)	100 (100)
	25	25	25	25	100%

(Note-Number outside the brackets indicates number of questions and the number within the brackets indicates scores assigned to each question)

Preparation of the Test Items and scoring key

- The preliminary draft of the test consisting of 100 items with100 marks has been prepared.
- All items are multiple choice questions.
- The test is prepared on the basis of 'Blue-Print' considering the Knowledge, comprehension, application and skill type items.
- In the present test all the selected items are objective type and each item carry equal marks.

Preparation of the first draft-

First Draft was constructed with 100 questions from above mentioned 5 chapters from WBCHSE syllabus having equal weight of 20 marks from each chapter. Then there were revised by following steps:

i) To check the content and face validity of the achievement test 8 teachers with more than 15 years of teaching experience and 8 Professors.

ii) 3 teachers of Biology Discipline (PGT) individually solved the questionnaire to compare the answer key and the validity of question.

iii) All comments made by experts are incorporated and final draft was prepared with 76 questions now administered in 120 student's population.

Scoring of Items:

For each correct answer, a score of 01 will be given and zero was given for wrong answers. The scoring key for the test is prepared.

Final try out: Final trial was administered to randomly selected population of class XIth standard from different Government and private schools under West Bengal council of higher secondary Education. Answer sheet were collected from students by investigator along with the scoring key and then item analysis was done.

- **Item Analysis**

Item analysis is a process evaluating examination's quality by which analysis of individual questions can be possible according to the student response. This is a process under psychometrics it is a statistical method used for inclusion of items in a psychological test or achievement test. It is helpful in framing proper questions and to reach the objective of an achievement test.

Characteristics of an item:

a) Difficulty value: this characteristic focuses on the level of difficulty of each question. When an item marked wrong by every student, it will be considered as difficult question as well as the question answered correctly by all students, will be considered as easy or least difficult question. difficulty value will be calculated by using the following formula:

$$DV = \frac{R_u + R_l}{T}$$

DV = Difficulty value

Ru= number of students who answers correctly from the higher group.

Rl= number of students who and surds correctly from the lower group

T = total number of students in both the groups =. (Nh+Nl) - Nr

Nh = number of examinations in higher group

Nl= number of examiners in lower group.

Nr = number of non-response examinees.

Discrimination index: "index of discrimination is that ability of an item on the basis of which the discrimination is made between superiors and inferiors" - Blood and Budd(1972) this refers to the power of the equipment test items which it can discriminate the high achievers and low achievers. A good item should discriminate between those who score high(top achievers 27%) in the test and who scores low in the test (bottom 27%). According to discrimination index three types of item can be found in a test. zero discrimination or not discrimination positive discrimination and negative discrimination.

The formula for discrimination index

$$DI = \frac{R_u - R_l}{T/_2}$$

Where

DI = discrimination index

Ru= number of students who answers correctly from the higher group.

Rl= number of students who and surds correctly from the lower group

T = total number of students in both the groups.

Table 3.6: Item Analysis of 1st Draft of Question

Item No.	No. of Correct Items		Difficulty Value	Discrimination Index	ACCEPTED /REJECTTED
	Upper Group	Lower Group			
1	24	4	0.4375	0.625	ACCEPTED
2	12	2	**0.21875**	**0.3125**	**REJECTED**
3	20	5	0.390625	0.46875	ACCEPTED
4	12	2	**0.21875**	**0.3125**	**REJECTED**
5	22	7	0.453125	0.46875	ACCEPTED
6	16	6	0.34375	0.3125	ACCEPTED
7	9	1	**0.15625**	**0.25**	**REJECTED**
8	16	2	0.28125	0.4375	ACCEPTED
9	21	8	0.453125	0.40625	ACCEPTED
10	8	1	**0.140625**	**0.21875**	**REJECTED**
11	23	17	**0.625**	**0.1875**	**REJECTED**
12	23	18	**0.640625**	**0.15625**	**REJECTED**
13	23	16	0.609375	0.21875	ACCEPTED
14	25	15	0.625	0.3125	ACCEPTED
15	24	20	**0.6875**	**0.125**	**REJECTED**

Item No.	No. of Correct Items		Difficulty Value	Discrimination Index	ACCEPTED /REJECTTED
	Upper Group	Lower Group			
16	26	14	0.625	0.375	ACCEPTED
17	26	21	**0.734375**	**0.15625**	**REJECTED**
18	24	13	0.578125	0.34375	ACCEPTED
19	22	12	0.53125	0.3125	ACCEPTED
20	20	13	0.515625	0.21875	ACCEPTED
21	23	13	0.5625	0.3125	ACCEPTED
22	26	13	0.609375	0.40625	ACCEPTED
23	21	15	**0.5625**	**0.1875**	**REJECTED**
24	28	16	0.6875	0.375	ACCEPTED
25	28	15	0.671875	0.40625	ACCEPTED
26	23	14	0.578125	0.28125	ACCEPTED
27	25	19	**0.6875**	**0.1875**	**REJECTED**
28	24	16	0.625	0.25	ACCEPTED
29	24	14	0.59375	0.3125	ACCEPTED
30	23	17	**0.625**	**0.1875**	**REJECTED**
31	25	17	0.65625	0.25	ACCEPTED
32	26	18	0.6875	0.25	ACCEPTED
33	27	14	0.640625	0.40625	ACCEPTED
34	25	10	0.546875	0.46875	ACCEPTED
35	23	18	**0.640625**	**0.15625**	**REJECTED**
36	21	12	0.515625	0.28125	ACCEPTED
37	29	14	0.671875	0.46875	ACCEPTED
38	27	15	0.65625	0.375	ACCEPTED
39	28	12	0.625	0.5	ACCEPTED
40	24	13	0.578125	0.34375	ACCEPTED
41	24	10	0.53125	0.4375	ACCEPTED
42	23	10	0.515625	0.40625	ACCEPTED
43	26	13	0.609375	0.40625	ACCEPTED
44	28	14	0.65625	0.4375	ACCEPTED
45	27	16	0.671875	0.34375	ACCEPTED
46	30	20	**0.78125**	**0.3125**	**REJECTED**
47	27	17	0.6875	0.3125	ACCEPTED

Item No.	No. of Correct Items		Difficulty Value	Discrimination Index	ACCEPTED /REJECTTED
	Upper Group	Lower Group			
48	25	12	0.578125	0.40625	ACCEPTED
49	28	14	0.65625	0.4375	ACCEPTED
50	30	13	0.671875	0.53125	ACCEPTED
51	27	14	0.640625	0.40625	ACCEPTED
52	26	12	0.59375	0.4375	ACCEPTED
53	26	11	0.578125	0.46875	ACCEPTED
54	25	13	0.59375	0.375	ACCEPTED
55	27	13	0.625	0.4375	ACCEPTED
56	26	16	0.65625	0.3125	ACCEPTED
57	28	18	0.71875	0.3125	ACCEPTED
58	26	15	0.640625	0.34375	ACCEPTED
59	25	12	0.578125	0.40625	ACCEPTED
60	26	15	0.640625	0.34375	ACCEPTED
61	26	8	0.53125	0.5625	ACCEPTED
62	19	14	**0.515625**	**0.15625**	**REJECTED**
63	25	15	0.625	0.3125	ACCEPTED
64	28	9	0.578125	0.59375	ACCEPTED
65	30	17	0.734375	0.40625	ACCEPTED
66	23	14	0.578125	0.28125	ACCEPTED
67	27	16	0.671875	0.34375	ACCEPTED
68	20	18	**0.59375**	**0.0625**	**REJECTED**
69	26	14	0.625	0.375	ACCEPTED
70	25	14	0.609375	0.34375	ACCEPTED
71	24	13	0.578125	0.34375	ACCEPTED
72	23	13	0.5625	0.3125	ACCEPTED
73	22	17	**0.609375**	**0.15625**	**REJECTED**
74	22	11	0.515625	0.34375	ACCEPTED
75	27	22	**0.765625**	**0.15625**	**REJECTED**
76	18	15	0.515625	0.09375	REJECTED

Criteria for acceptance and rejection of items:

According to table no. 3.6. difficulty value ranges from 0.25 to 0.75 were accepted and discrimination index value from 0.2 to 0.9 were also accepted for present test (Aggarwal, 2018). Total 59 items were finalized for final try out among 20 students. Final 50 items were selected for Final Biology achievement test questionnaire.

Standardization of the test:

The standardization process of an achievement test includes the measurement of reliability and validity of the same test.

Reliability:

Reliability means the level of consistency of the test scores. There are different techniques are available to check the reliability of a test. split half technique, test retest technique, alternate forms, scorer reliability etc.

Here the investigator used test-retest technique to check the reliability of the test. To carry out this method the final version of the test was administered to a pre-selected sample size of 20 and with the same sample size the test was administered again after 15 days of 1st test. Here again 9 items found confusing by students of the sample. So, 9 items were rejected again in this stage. Both scores were correlated by using product moment method of correlation and value of coefficient of correlation was calculated which is found 0.880 indicate the test is reliable.

Table 3.7. Test – retest reliability

		Test	**Retest**
Test	Pearson Correlation	1	.880
	Sig. (2-tailed)		.000
	N	120	120
Retest	Pearson Correlation	.880	1
	Sig. (2-tailed)	.000	
	N	120	120

Test-retest reliability was calculated with a sample of 120, within 15 days gap period between two tests. Pearson correlation found here is 0.880 which is satisfactory for the current test questionnaire.

Validity:

Test validity is the measure by which a test is accurately measure what it is supposed to measure "it is the degree to which evidence and theories about the interpretation of the test scores test by proposed use of test".

Face validity: More informal and subjective assessment method.

Content validity: Content validity is the logical process where connection between test items and objective and vertical domain are established. To check the content and face validity of the achievement test. Some biology teachers with more than fifteen years of teaching experience and ten Associate Professors. Three teachers of Biology Discipline (PGT) individually solved the questionnaire to compare the answer key and the validity of question (Manna and Mete,2021). List of Experts are given in Appendix 8.

Final draft:

After carrying out the entire process of construction and validation of that finally selected items are arranged to prepare the final version of achievement test and administered with 20 individuals (Manna and Mete, 2021) as final try out. Table 3.8. showing distribution of weightage of content and objectives in final achievement test question. Whereas table no. 3.9. serial nos. of retained items (objective wise) in final question.

Table 3.8. Distribution of Weightage of content and objectives in final Achievement Test

Contents	Knowledge	Comprehension	Application	Skill	Total	Percentage
Cell Division	03	02	02	03	10	20%
Respiration	02	04	02	02	10	20%
Photosynthesis	02	03	02	03	10	20%
Nervous System	03	02	03	01	09	18%
Endocrine System	02	03	03	03	11	22%
Total	12	14	12	12	50	100%
Objectives based Total percentage	24%	28%	24%	24%		100%

Table 3.9 (A). Serial no. of retained items (Objective wise) in Final questionnaire

Objective	Serial No. of Items retained	Total	Percentage
Knowledge	2, 3, 18, 21, 32, 56, 60, 65, 70, 71, 82, 96	12	24%
Comprehension	4, 12, 27, 30, 35, 36, 43, 47, 48, 63, 69, 80, 81, 98	14	28%
Application	5, 10, 24, 28, 49, 50, 67, 68, 76, 97, 99, 100	12	24%
Skill	6, 8, 15, 29, 34, 51, 52, 59, 79, 87, 88, 91	12	24%
	Total	50	100%

Conclusion

Biology achievement Test questionnaire was prepared with 50 items. It is now standardized and validated and ready for its administration. The test-retest co-efficient value found for present test is found 0.880 which is satisfactory. Most valuable thing for construction of an achievement test is four basic things: Validity, objectivity, reliability and norm. Test questionconstructed and validated also used for present study is attached in appendix 9.

3.9. CONSTRUCTION AND VALIDATION OF BIOLOGY ANXIETY SCALE

Sample

The sample of this study includes total 504 higher secondary (+2) school students for the year 2021-22 of five different Govt. Sponsored schools of Alipurduar district of West Bengal. namely: “Barabisha High School (H.S.), Kamakhyaguri Mission High School (H.S.), Daldali High School (H.S.), Volka High School (H.S.), Kumargramduar MS High School (H.S.)” of West Bengal, India. All students are age group ranging from 16 to 19. Among them 286(56.74%) were male and 218(43.25%) females.

Scale development process

One by one interview of students who reads in class 12 and some first year Biology Honours and Medical student to know which kind of difficulties they are facing/ faced during their senior secondary level with Biology Subject.

Intrinsic literature review was done due to know how many kinds of anxiety can be seen in students and how the scale items can be written or generated. Review of literature can help a researcher to form a idea about a phenomenon and helps in development of items pool (Artino et.al, 2014). Review of literature also helps in comparison and criticisms of existing scales (Waltz et. al, 2010) to form more certain items for a new scale.

Items pool were generated with eighty (80) items at first stage of scale constructed. Then it was passes with in-depth analysis and consultation was done. By following proper steps, 32 items were excluded as they cannot express the whole essence of anxiety in Biology as per theoretical foundation of the study among our target group.

Then the scale was sent to two language experts to check language errors if any. Biology anxiety scale 1stdraft was sent to experts for their expert comment ensuring its validity. After receiving their valuable comments six items were discarded and some words were reframed.

Now the 1st draft of scale is ready for administration and finalization. Total 504 students of class XIth and XIIth standard, i.e., senior secondary level of 5 different senior secondary schools under "West Bengal Council for Higher Secondary Education" (WBCHSE) and who opted biology as their elective subject but chosen as the sample for this study.

KMO value for the same is found 0.933 proving the adequacy of sample for the present study. Data collected after due permission of head of the institutions, after getting response the responses were coded in Microsoft excel as per need of study. Then they are analyzed with SPSS 26 software. Finally, a scale with 20 items was done as of 03 dimension was ready.

FINDINGS

Findings related to Content Validity:

Many subjective experts critically reviewed the scale items which include concepts and definitions of event and items selected for operationalize the study. Bolarinwa (2015), expressed that taking expert's review is more structured and helps a researcher to establish validity of the scale. Content validity is the logical process where connection between test items and objective and vertical domains are established. For the present

study, after the construction of scale items, at first it was sent to different language experts. As the scale is constructed in English language, it was sent to associate professors in English and experienced PG teachers with 15 years' experience. After their valuable suggestions, rectification was made in language, now the scale was sent to different experts including associate professors, assistant professor from Govt. University, experienced teachers with fifteen and thirty years of teaching experience of different subjects Education, Higher Education, Zoology, Psychology and Biology. As per their consent, the scale items were reduced from 48 to 42.

To measure content validity of the question/ tool it is essential to calculate content validity index, i.e., CVI. It can be concurred that for content validation, the minimum acceptable expert number is two, however most of recommendations propose a minimum of six experts. Considering the recommendations (5–8) and the author's experience, the number of experts for content validation should be at least 6 and does not exceed 10. For the same purpose the scale was sent to experts with 2 points rating scale for each items scoring 1 for accepted, 0 rejected. The number of experts and its implication on the acceptable cut-off score of CVI according to Yusof (2019) are as follows:

Table 3.9(B): Number of experts and its implication on the acceptable cut-off score of CVI according to Yusof (2019)

No. of Experts	Acceptable CVI value
2	≥0.8
3 – 5	1
6	≥0.83
6 – 8	≥0.83
9	≥0.78

To measure content validity following scores were calculated:

1. CVI: Content validity index
2. I-CVI: item-level content validity index (agreed item)/ (number of expert)

3. S-CVI/Ave: scale-level content validity index based on the average method (sum of I-CVI scores)/(number of item)

4. S-CVI/UA: scale-level content validity index based on the universal agreement method (sum of UA scores)/(number of item)

Table 3.9.(C): The relevance ratings on the item scale by 09 experts

Item No.	Experts									Experts in Agree-ment	I-CVI	UA
	1	2	3	4	5	6	7	8	9			
1	0	1	1	0	1	0	1	1	1	6	0.66	0
2	1	0	1	1	1	1	1	1	1	8	0.88	0
3	1	1	1	1	1	1	1	1	1	9	1	1
4	1	1	1	1	1	1	1	1	1	9	1	1
5	1	1	1	1	1	1	1	1	1	9	1	1
6	1	1	1	1	1	1	1	1	1	9	1	1
7	1	1	1	1	1	0	1	1	0	7	0.77	0
8	1	1	1	1	1	1	1	1	1	9	1	1
9	1	1	1	1	1	1	0	1	1	8	0.88	0
10	1	1	1	1	1	1	1	1	1	9	1	1
11	1	1	1	1	1	1	0	1	1	8	0.88	0
12	1	1	1	1	1	1	1	1	1	9	1	1
13	0	0	1	0	0	1	0	0	0	2	0.22	0
14	0	0	0	0	1	0	1	1	1	4	0.44	0
15	1	1	1	1	1	1	1	1	1	9	1	1
16	1	1	1	1	1	1	1	1	1	9	1	1
17	1	1	1	1	1	1	1	1	0	8	0.88	0
18	1	1	1	1	1	1	1	1	1	9	1	1
19	1	1	1	1	1	1	1	1	1	9	1	1
20	1	1	1	1	1	1	1	1	1	9	1	1
21	1	1	1	1	1	1	1	0	1	8	0.88	0
22	1	1	1	1	1	1	1	1	0	8	0.88	0
23	1	1	1	1	1	1	1	1	1	9	1	1
24	1	1	1	1	1	1	1	1	1	9	1	1
25	1	1	1	1	1	1	1	1	1	9	1	1
26	1	1	1	1	1	1	0	1	1	8	0.88	0
27	1	1	1	1	1	1	1	1	1	9	1	1

Item No.	Experts									Experts in Agree-ment	I-CVI	UA
	1	2	3	4	5	6	7	8	9			
28	1	1	1	1	1	1	1	1	1	9	1	1
29	1	1	1	1	1	1	1	0	1	8	0.88	0
30	1	1	1	1	1	1	1	1	1	9	1	1
31	1	1	1	1	1	1	1	1	1	9	1	1
32	1	1	1	1	1	1	1	1	1	9	1	1
33	1	1	0	1	0	0	0	0	0	3	0.33	0
34	1	1	1	1	1	1	1	1	1	9	1	1
35	1	1	1	1	1	1	1	1	1	9	1	1
36	1	1	1	1	1	1	1	1	1	9	1	1
37	1	1	1	1	1	0	1	1	0	7	0.77	0
38	1	1	1	1	1	1	1	1	1	9	1	1
39	1	1	1	1	1	1	1	1	1	9	1	1
40	1	1	1	1	1	1	1	1	1	9	1	1
41	1	1	1	1	1	1	1	1	1	9	1	1
42	1	1	1	1	1	1	1	1	1	9	1	1
43	1	1	1	1	1	1	1	1	1	9	1	1
44	1	1	1	1	1	1	1	1	1	9	1	1
45	0	1	0	1	1	0	0	1	1	5	0.55	0
46	0	0	1	0	0	1	0	1	1	4	0.44	0
47	1	1	1	1	1	1	1	1	1	9	1	1
48	1	1	1	1	1	1	1	1	1	9	1	1
Sum	43	44	45	44	45	42	41	44	42		43.33	32
Proportion relevance	0.89	0.91	0.93	0.91	0.93	0.87	0.85	0.91	0.87	S-CVI/Ave	0.90	
Average proportion of items judged as relevance across 9 experts									0.90	S-CVI/UA		0.66

According to table no. 3.9 (B) total 6 items were excluded. 42 items containing scale was distributed for try out.

Construct validity of the scale

Construct validity ensures the amount of validity of a test or research. To get construct validity Exploratory and Confirmatory factor analysis conducted here.

Exploratory Factor Analysis (EFA)

EFA was conducted with 252 sample sizes. Kaiser-Meyer-Olkin Measure of Sampling Adequacy value shows 0.933, when the KMO value (Table 3.10) exceeds 0.7 that means sample size is adequate (Büyüköztürk, 2004). Here KMO value is 0.933 which depicts the sample size is adequate for the present study. Bartlett's test was significant ($\chi 2$ = 1083.614, p=.000) indicates the validity of factor analysis.

Table 3.10: KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.933
Bartlett's Test of Sphericity	Approx. Chi-Square	1083.614
	df	251
	Sig.	0.000

As EFA was applied to the data, the factor load values of the scale, which was confined to three factors, were investigated. The difference in their factor loads for many items was found to be less than 0.10, hence these items were erased off the items. Finally, the exploratory factor analysis was done on the current 20 items in the same way. The measured structure of the three factor-structure was found to have a variation of 68%. The eigenvalue of the first factor was determined, and there were 5 items in it. There are 8 elements in the second factor, and the eigenvalue of the factor lies in-between 0.6 and 0.83. Finally, in the third factor, there are 7 items, and the eigenvalue of the factors were found in-between 0.51 and 0.68. Table 3.11. reveals the total variance found in factor analysis and table 3.12 showing rotated component matrix of CFA.

Table 3.11: Total Variance Explained in EFA

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% Of Variance	Cumulative %	Total	% Of Variance	Cumulative %
1	9.582	47.909	47.909	9.582	47.909	47.909
2	2.764	13.822	61.731	2.764	13.822	61.731
3	1.451	7.255	68.987	1.451	7.255	68.987

Table 3.12: Rotated Component Matrix

	Components of the study		
	1	2	3
CE02	0.836		
CE08	0.803		
CE05	0.794		
CE01	0.767		
CE06	0.764		
CE03	0.763		
CE04	0.761		
CE07	0.751		
LAB01		0.819	
LAB05		0.803	
LAB02		0.802	
LAB03		0.793	
LAB04		0.790	
LAB06		0.668	
LAB07		0.440	
BIO04			0.870
BIO01			0.834
BIO03			0.737
BIO02			0.666
BIO05			0.573

Confirmatory Factor Analysis (CFA)

Confirmatory factor analysis was conducted with separate 252 responses. First the CFA was conducted with 4 dimensions and no significant results found and chi square goodness of fit and factor loading value that is lambda value found not significant.

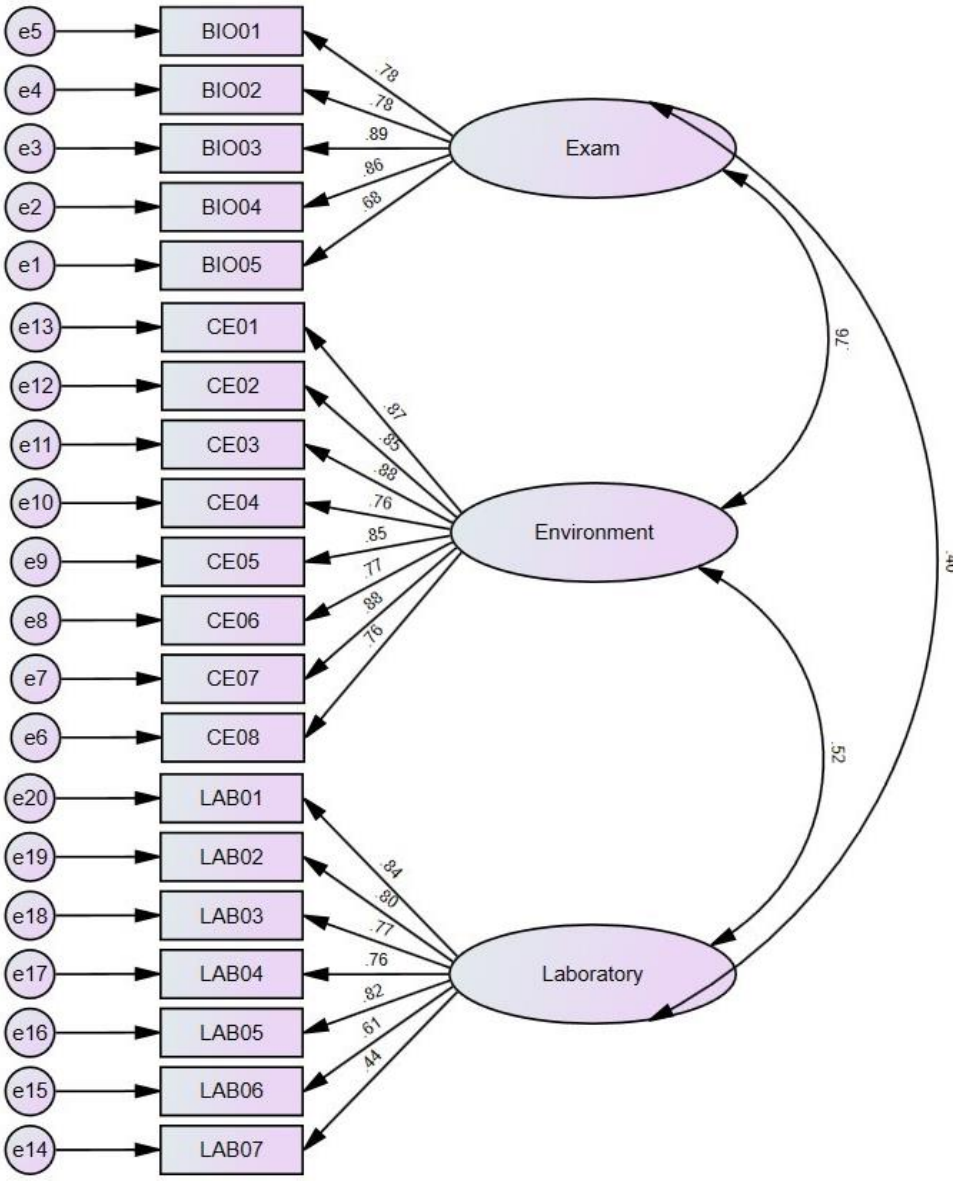


Figure 3.6.: Lambda value (Factor Load Value) of the scale

The structural validity of the 3-dimensional was determined using confirmatory factor analysis (CFA). P value found from Chi square 1083.614 is 0.00 which is found significant (Table 3.13). The t values of all 20 items were determined to be significant in the CFA findings. Figure 3.3 depicted the scale's factor load values (Lambda). "Corrected item-total correlations" range between 0.45and 0.73. Büyüköztürk (2007) explained that items with value of more 0.3 are considered as distinctive and good items, and should be kept for study. Here all 20 items show values more than 0.3, so all the items here are good fit for then scale.

Table 3.13: Different Consistency indices

Consistency Index	Acceptable Range	References	Value	Result
χ^2/sd	<5 Medium consistent <3 well consistent	Atici and Midilli, 2020	1083.614/ 251=4.31	Medium consistent
CFI	>0.90	Atici and Midilli, 2020	0.914	Acceptable
NFI	>0.90	Atici and Midilli, 2020	0.906	Acceptable
RFI	>0.85	Atici and Midilli, 2020	0.909	Acceptable
PCFI	>0.80	Atici and Midilli, 2020	0.903	Acceptable
PCLOSE	>0.05	Atici and Midilli, 2020	0.07	Acceptable
TLI	>0.90	Atici and Midilli, 2020	0.907	Acceptable
SRMR	≤0.8	Prudon, 2015	0.7	Acceptable
RMSEA	<0.08	Atici and Midilli, 2020	0.044	Acceptable

Reliability of the scale

To obtain reliability of the scale Cronbach alpha reliability co-efficient, Split helves reliability and Guttman split half co-efficient were calculated.

Reliability co-efficient (Cronbach's alpha)

Büyüköztürk (2007) explored that Cronbach's alpha reliability co-efficient reliability value of a test if exceeds 0.7 it is considered as reliable. Cronbach's alpha values of 3 dimensions and the whole test are given in the following table 3.14:

Table 3.14: Cronbach alpha value of individual dimensions and whole test

Name of Dimension	Cronbach's Alpha
Biology Test Anxiety	0.896
Biology Classroom and Environment Anxiety	0.946
Biology Laboratory Anxiety	0.875
Total Cronbach alpha	0.935

Cronbach Alpha value of whole test was computed as 0.935 which means this scale consists of a high internal consistency.

Difference of reliability between below 27% and the top 27% groups were investigated for each item by t-test. The results of t-test are as follows:

Table 3.15: t-test result for top 27% and below 27% group

Name of Dimension	t value	P value
Biology Test Anxiety	- 26.08	.000
Biology Classroom and Environment Anxiety	- 26.952	.000
Biology Laboratory Anxiety	- 27.633	.000
Total	- 26.88	.000

The value of the 3 dimensions were found significant at the level of $p<0.001$, which means that the scale has enough discrimination power to differentiate students with low score from students with high scores. Split half reliability was also tested. Where the reliability for 1st Part with 10 items was calculated 0.933 to and 2nd part with 10 items was 0.880 which are also satisfactory. Guttman split-half coefficient was calculated 0.799 and Spearman-Brown Coefficient 0.805 Both are acceptable.

Item Analysis

According to Büyüköztürk (2007), corrected item total correlation values more than 0.3 are acceptable for scale items. Here the 20 items scale's corrected item total correlation values are found from 0.392 to 0.806 which all are acceptable and distinctive.

Table 3.16: Mean value, SD value and Item total correlation values of Biology Anxiety Scale

	Mean	Std. Deviation	Corrected Item-Total Correlation
BIO01	3.30	1.349	0.572
BIO02	3.08	1.524	0.661
BIO03	3.21	1.651	0.730
BIO04	3.41	1.576	0.625
BIO05	3.07	1.491	0.638
CE01	3.59	1.492	0.776
CE02	3.49	1.248	0.754
CE03	3.46	1.468	0.799
CE04	3.49	1.367	0.691
CE05	3.78	1.346	0.745
CE06	3.29	1.383	0.705
CE07	3.73	1.430	0.806
CE08	3.17	1.404	0.686
LAB01	3.46	1.435	0.601
LAB02	3.77	1.263	0.549
LAB03	3.11	1.451	0.498
LAB04	3.95	1.236	0.536
LAB05	3.77	1.424	0.611
LAB06	3.22	1.604	0.445
LAB07	3.41	1.537	0.392

RESULTS

Reliability analysis, EFA and CFA were performed to get the result. The final biology anxiety scale was constructed with 20 items and three dimensions. Three dimensions of the scale are as follows: Biology test anxiety, Biology Classroom and Environment Anxiety and Biology Laboratory Anxiety. Final Biology Anxiety Scale comprises of 13 positive items showing positivity towards anxiety in Biology, whereas 7 items are marked as negative items which shows negativity towards Biology anxiety. A Five-point Likert scale was used, from Strongly Disagree to Strongly Agree were the measures of different levels of Biology Anxiety for present scale.

Dimensions of Biology Anxiety Scale:

After the literature review items which were previously used in relevant studies of anxiety measurement and which were eligible for structure and content of a biology course (i.e.

lab, exam, environment, Subjective) were selected. Some items were constructed with respect to the purpose of the scale and goes of Biology course, some items are generated according to the need of study and to fill up previous research gap found in literature review. Final Biology anxiety scale contains 3 dimensions:

Evaluation Anxiety in biology or Test Anxiety (Selkrik et al., 2011; Ko and Yi, 2011; Hembree, 1988;Cimen and Yilmaz, 2015; Udo et al., 2004; Kurbanoglu and Akim, 2010).

Biology Classroom Environment & Learning Anxiety (Cimen and Yilmaz, 2015; Udo et al., 2004; Usher et al., 2006; Permatasari and Tentama, 2020; Petridou and Williams, 2007; Ko and Yi, 2011; Aydin, 2013; Permatasari and Tentama, 2020; Prokop et al, 2007; Ko and Yi, 2011; Cimen and Yilmaz, 2015; England et. Al 2017)

Biology Laboratory Experiences Anxiety (Bowen, 1999; Berber, 2001; Selkrk et al, 2007)

DISCUSSIONS AND SUGGESTIONS

Test or evaluation anxiety is a very common Factor among all categories of students. Almost all ages and categories of students irrespective of Gender and socio-economic background show amount of anxiety before, during and after a test. So, to know more about biology anxiety, it is very important to measure the level of test or evaluation anxiety in biology. Many previous researchers categorized test anxiety into two subcategories namely state and trait test anxiety. State test anxiety is linked with worry and emotional condition. State test anxiety also being the mediator connecting performance evidence goals to performance attainment. War retention palpitation etc comes under the components of state test anxiety. Trait test anxiety is considered to be equivalent to the fear of failure and it is situation specific. Wren and Benson, (2012) constructed ‘Children’s Test Anxiety Scale’. 50 items initial scale was constructed, then it was administered to a sample size 230 among grade 3 to 6 students from which final 30 items scale with 3 dimensions constructed and established.

Shah (2019) worked on test anxiety scale; following him here the sub domains which were followed to constructed following Biology Anxiety Scale: Before exam, During exam, After exam.

Comfortable and friendly atmosphere in class as well as in society makes a child more enthusiastic thus helping them to feel free to ask a question. Positive Learning environment promotes happiness and better learning outcomes. So, environment is very sensitive factor in case of formation of anxiety. Positive reinforcement by environment triggers better learning outcomes on the other hand negative environmental cues causes' growth of anxiety. Following points were considered during the construction of scale items in Biology class and environment and learning anxiety category: Previous Experience, Motivation and Friend/ Teacher (Ko and Yi, 2011)

Biology is a branch of science which deals with living organisms. So practical knowledge is one of the most important things needed for Biology learning and to get practical knowledge and hand-to-hand experience in Biology learning, laboratory is the ideal place. In biology laboratory students deals with chemicals, specimens, different instruments, different models and charts etc. When they have to deal with such things it causes development of anxiety among them. Many previous studies have shown the same results. Laboratory anxiety in Biology domain is included here to measure the level of laboratory among students in biology. This domain consists of items considering following points according to Bowen (1999) pointed out 6 points for expressing acute laboratory anxiety in chemistry like working with chemicals, working procedure, use of laboratory equipment, data collection, group work among students and use of time during laboratory session. Laboratory learning always have major impact in teaching science. Students may have anxiety about their science laboratory sessions. Science students make grow anxiety in laboratory learning because development of skill to apply theoretical knowledge is required for practical education. So, it is very important to find out if anxiety related to laboratory is present or not in a science learning student. Different previous researches like Bowen (1999), Kurbanoglu and Akin (2012), Berber (2013) etc. developed different laboratory anxiety scales in Physics and Chemistry in different times. Bowen (1999) constructed a Chemistry Laboratory Anxiety Instruments with 30 items and 5 dimensions having six items in each dimension. Azizoglu and Uzuntiryaki (2006) adapted the same scale which now developed with 20 items and internal consistency for this scale found 0.86. Kurbanoglu and Akin (2012) constructed Physics Laboratory Anxiety Scale with 18 items and single factor. This scale found internal consistency of Cronbach Alpha with 0.94. On the other hand, Berber (2013) formed and standardized

Physics laboratory anxiety scale with 16 items and 4 sub dimensions. Cronbach Alpha of this scale found 0.87. The motto of construction of Biology anxiety scale is to measure the amount of anxiety in Biology in different dimensions like Test Anxiety in Biology, Biology Classroom and environment anxiety and Biology Laboratory Anxiety. Results found satisfactory among Senior secondary students and it is now ready to administer to estimate Biology Anxiety among students.

3.10. ADAPTATION OF BIOLOGY ATTITUDE QUESTIONNAIRE

The original scale was constructed by Dr.Pavol Prokop, Tuncer and Chuda (2007) to measure Students' attitudes toward science significantly alter their achievement in Biology. World is now suffering from covid-19 attack. No religion no prayer no blind faith showing any effective remedy for this but to handle this situation one who is fighting from the beginning is science is the only way out right now to find out the remediation covid-19 we are hoping that our scientists may find out the remedy for it very soon we are all realizing right now that a greater number of scientists and doctors are needed right now to meet the situation. But what is most important for future that to grow a pure scientific mind first. And as we all know charity begins at home in the education system school is the first place where the development of mind takes a particular shape concrete Idea building drawing of scientific minds all round development happens at this stage, so it is very important to grow scientific attitude in every child previous research has shown that those students have a growth of negativity towards science especially in biology because of many reasons. For the same reason Indian adaptation of Biology Attitude Questionnaire is done.

Previous studies shows that there is an utmost need of rectified teaching methods among the other factors to be responsible for lower state of student's achievement in science (Lampe et. Al, 1998).Ige and Aremu, 2005, found that conventional lecture method ultimately results in lack of interest in science classes especially in biology. Many previous workers recommended that renovation of methodology in teaching of biology should be done for the sake of growth in attitude towards biology (Odubunmi, 1983; Bajah, 1986; Yapici and Akbayin, 2012; Juweto, 2015). Some of the previous searches suggested that if the teaching method will change from expository to discovery teaching method the development of

positive attitude toward biology can be happened. It enhances the knowledge seeking process, make able to identify own problems and finding a solution for it thus growing more positive attitude towards science (Ajewole, 1991).

The century has been considered as the age of biology. Research opportunities are growing rapidly in the branch of biology as well as emphasis given to learning process of biology has improved quickly. Some chapters, some lessons which are relevant to regular life are found as complicated for understanding by the students (Staeck, 1995; Gill and Yesilyurt, 2010). Transportation of water, photosynthesis, respiration, genetics (Bahar, Jhonstone and Hansell, 1999), chromosomes cell cycle hormone neural system and mentally and genetics (Tekkaya, Ozkan and Sungur, 2001) are some facts in which students have difficulties in understanding during their learning. Some previous researchers found that inspiration towards biology is one of the most important factors that influence student's achievement in the field of Biology. For the improvement of achievement in biology it is very important to grow positive attitude towards biology first (Cimer,2012; Ekici ,2012). Wang et al, 2007 found that the factors affecting level of learning of concepts of biology among the senior level of students their perspective towards biology. They concluded that attitude towards values and motivation affects mostly in concepts building in biology. Students shown a high level of motivation and attitude towards biology positively retained among senior secondary level learning concept in biology.

Method:

The Biology Attitude Questionnaire (BAQ) (Prokop, Tuncer&Chuda, 2007) contains 24 items in its final form distributed into six dimensions as follows: interest, career, importance, teacher, difficulty, and equipment. A five-point Likert scale; ranging from "strongly disagree" to "strongly agree" with "neither disagree nor agree" as the pivotal point of the scale is used to get the result. The scale was first conducted as a cross-age study applied to students who are at grades 5 – 9. At the end of application to Slovakian students, Cronbach's alpha values were found from 0.69 to 0.36 for each 6 dimensions. Though results can be considered as relevant, two dimensions were found with low reliability, i.e., Equipment dimension with 0.36 and difficulty with 0.46. they were further

examined to avoid wrong calculation of the result. Cronbach's alpha for "interest (α =0.68), career (α = 0.62), importance (α = 0.69) and teacher (α = 0.62) showed satisfactory reliability".

For the present study data collection was done from five different higher secondary schools under West Bengal Board of Higher secondary Education. Data collected from 700 students, from those 640 senior secondary student's data recorded for present study as they were completed fully. Of them 219 was female and 421 male students given their opinion about their attitude towards Biology.

Analysis of result:

KMO value found 0.916 with sample size 640 which is proven adequate for present study, with chi square value 2444.256 and significant P value below 0.5.

Reliability analysis:

To measure the reliability of the present test by Cronbach Alpha was estimated 0.944, which is found significant for the study. Split half reliability found 0.885 and 0.938 for Part A and Part B, Spearman Brown coefficient 0.817 and Guttman split half coefficient 0.813. Item total correlation (Figure 1) was found for 24 items within 0.405 to 0.752 all of which are acceptable as the value of correlation coefficients ≥0.40 for the items listed (Bosc, Dubini and Polin, 1997).

Cronbach Alpha value for each dimension found are as follows: Interest towards Biology dimension is 0.952, with a mean value of 42.12 with variance of 174.408 and standard deviation value 13.206 for total 12 items, for Biology teacher dimension is 0.911, with a mean value of 13.62 with variance of 26.433 and standard deviation value 5.141 for total 04 items and finally Difficulty in Biology dimension the alpha value calculated is 0.897, with a mean value of 27.49 with variance of 75.339 and standard deviation value 8.680 for total 08 items.

Table 3.17: Item-Total Statistics

	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

EFA and CFA were conducted to get the final result. RMSEA in the range of 0.05 to 0.10 is treated as demaration of Good fit and values above 0.10 shows poor fit (MacCallum et al, 1996). Here the value comes 0.051which is acceptable. Figure 2 shows different indices found as a result of EFA and CFA. Scree plot (Figure 3.4) and variance table shows 66% of variance with 3 predictable dimensions obtained by principal component analysis (Table 3.19). Communalities values (Table 3.20) are also found good for 24 items ranging from 0.36 to 0.81, value higher than 0.3 are acceptable, so all values are

accepted. Rotated component matrix (Table 3.21) also shows 3 dimensions with varimax rotation in principle component analysis. CFA analysis path diagram (Figure 3.5) created with factor loading value (Table 3.22).

As original scale was constructed with six dimensions accordingly the confirmatory factor analysis was done and found the values are not significant for the present study. Same process again and again conducted with 5 and 4 dimensions which are also found not significant. So, the three-dimension structure of the scale is taken to form adapted Indian version of Biology Attitude Questionnaire. 3 factors are named according to the previous study: 1. Interest, 2. Teacher and 3. Difficulty.

Table 3.18: Consistency Indices of the test

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

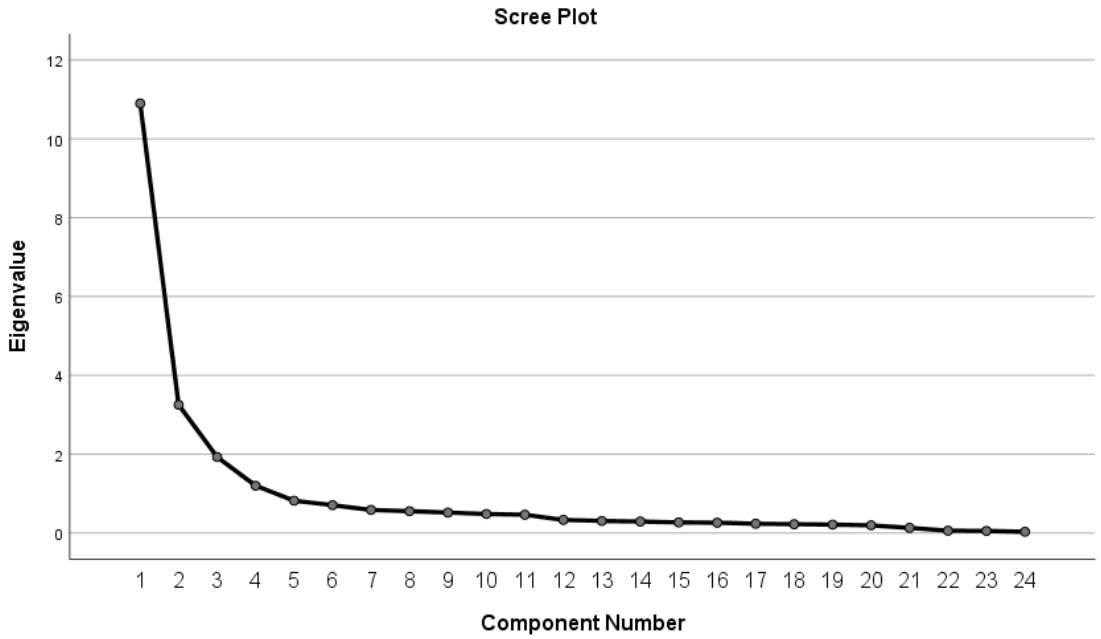


Figure 3.7: Scree plot showing 3 dimensions

Table 3.19: Total Variance table

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% Of Variance	Cumulative %
1	10.896	45.401	45.401	10.896	45.401	45.401	7.507	31.278	31.278
2	3.250	13.543	58.944	3.250	13.543	58.944	4.837	20.155	51.432
3	1.927	8.031	66.974	1.927	8.031	66.974	3.730	15.542	66.974
Extraction Method: Principal Component Analysis.									

Table 3.20: Communalities value

	Initial	Extraction
Q01	1.000	.664
Q02	1.000	.647
Q03	1.000	.566
Q04	1.000	.612
Q05	1.000	.693

	Initial	Extraction
Q06	1.000	.360
Q07	1.000	.665
Q08	1.000	.606
Q09	1.000	.733
Q10	1.000	.809
Q11	1.000	.778
Q12	1.000	.661
Q13	1.000	.725
Q14	1.000	.766
Q15	1.000	.693
Q16	1.000	.818
Q17	1.000	.494
Q18	1.000	.632
Q19	1.000	.603
Q20	1.000	.708
Q21	1.000	.709
Q22	1.000	.626
Q23	1.000	.757
Q24	1.000	.749

Table 3.21. Rotated component matrices

	Component		
	1	2	3
Q01		.764	
Q02		.770	
Q03		.723	
Q04		.744	
Q05		.777	
Q06		.578	
Q07		.798	
Q08		.759	
Q09	.813		
Q10			.830
Q11			.839
Q12	.755		
Q13	.779		
Q14	.851		
Q15	.802		
Q16			.828
Q17	.874		
Q18	.738		
Q19	.784		
Q20			.799
Q21	.789		
Q22	.749		
Q23	.822		
Q24	.826		

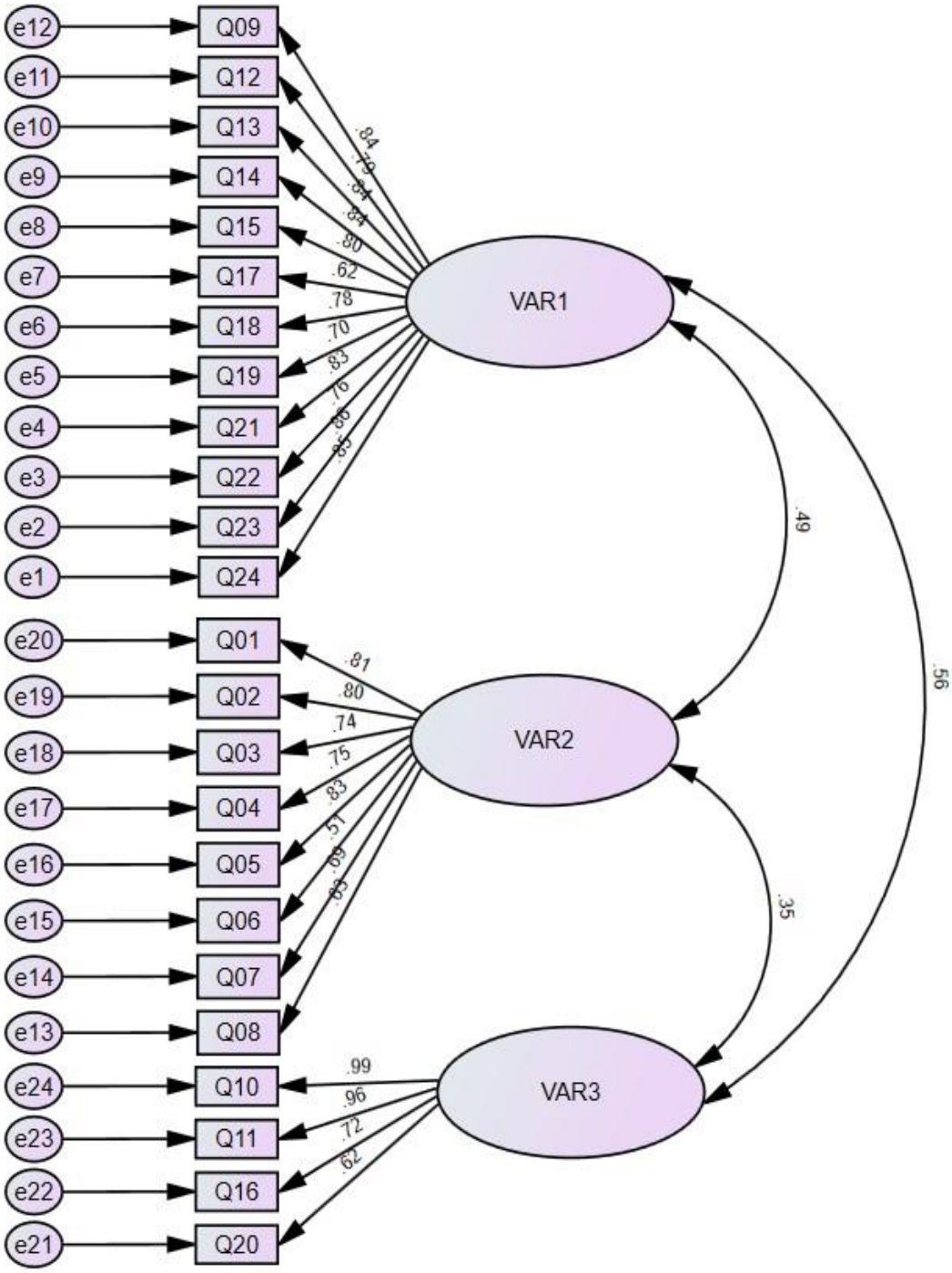


Figure 3.8: CFA path diagram

Table 3.22: Factor load value

FACTOR	ITEM NO.	Item total correlation	Factor load	Alpha co-efficient
FACTOR 1	Q09	0.899	0.847	0.797
	Q12	0.886	0.795	
	Q13	0.886	0.849	
	Q14	0.883	0.848	
	Q15	0.881	0.809	
	Q17	0.879	0.626	
	Q18	0.879	0.78	
	Q19	0.877	0.70	
	Q21	0.903	0.831	
	Q22	0.894	0.761	
	Q23	0.882	0.861	
	Q24	0.873	0.851	
FATOR 2	Q01	0.867	0.811	0.899
	Q02	0.864	0.80	
	Q03	0.951	0.743	
	Q04	0.948	0.752	
	Q05	0.845	0.838	
	Q06	0.911	0.511	
	Q07	0.906	0.691	
	Q08	0.902	0.833	
FACTOR 3	Q10	0.888	0.761	0.853
	Q11	0.866	0.735	
	Q16	0.824	0.632	
	Q20	0.812	0.611	

Interest

To discover specific characteristics influencing students' interest in biology, a two-way univariate analysis of variance (ANOVA) was performed. The findings indicated that Gender and interest in biology were both significant as shown in table 3.23 below. Surprisingly from our result we can find that Males showed a higher level of interest in When compared to females, biology lectures are more difficult. There had been a substantial link between gender and interest in the biology subject.

Table 3.23: Interest in biology by Gender

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	127.676[a]	9	14.186	7.980	.000
Intercept	4070.439	1	4070.439	2289.755	.000
Gender	.166	1	.166	.093	.760
Biology	78.794	4	19.699	11.081	.000
Gender*Biology	9.645	4	2.411	1.356	.248
Error	1119.935	630	1.778		
Total	8721.000	640			
Corrected Total	1247.611	639			

Table 3.24: Reliability of interest dimension

Cronbach's Alpha	N of Items
.952	12

Table 3.25: Item Statistics

	Mean	Std. Deviation	N
Q09	3.72	1.401	640
Q12	3.40	1.307	640
Q13	3.53	1.395	640
Q14	3.56	1.318	640
Q15	3.56	1.319	640
Q17	3.12	1.462	640
Q18	3.66	1.354	640
Q19	3.32	1.405	640
Q21	3.73	1.339	640
Q22	3.42	1.397	640
Q23	3.47	1.296	640
Q24	3.62	1.308	640

Table 3.26: Item total statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
Q09	38.38	144.890	.817	.947
Q12	38.70	147.900	.780	.948
Q13	38.57	144.865	.822	.946
Q14	38.53	146.450	.822	.947
Q15	38.54	147.970	.770	.948
Q17	38.98	150.637	.603	.954
Q18	38.44	147.787	.753	.949
Q19	38.78	149.030	.682	.951
Q21	38.37	146.415	.809	.947
Q22	38.68	147.169	.746	.949
Q23	38.63	146.587	.833	.946
Q24	38.48	146.550	.826	.946

Table 3.27: Mean and SD values

Mean	Variance	Std. Deviation	N of Items
42.10	174.408	13.206	12

Biology Teacher

A univariate ANOVA revealed that interest in Biology is the factor that influences Indian school and college level students' sentiments toward teachers shown in biology teacher table. This link, however, appears to be non-linear although pupil studying in different grates had a mix attitude. According to the replies to this dimension, students have favourable feelings about their instructors; the majority of them like their biology teacher, half of them believe that their teacher stimulates them, and only few students agree that their teacher's evaluation of them is not based on their grades. Although the findings of this dimension provide a general picture of Indian students' attitudes toward biology teacher, the results for each individual teacher are prone to change.

Table 3.28. Univariate ANOVA

Teacher * Biology	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	17.318[a]	24	.722	2.139	.001
Intercept	1269.042	1	1269.042	3762.523	.000
Teacher like	3.335	4	.834	2.472	.043
Biology	2.345	4	.586	1.738	.140
Teacher * Biology	10.602	16	.663	1.965	.013
Error	207.430	615	.337		
Total	2017.000	640			
Corrected Total	224.748	639			

Table 3.29. Reliability value of Biology teacher dimension

Cronbach's Alpha	N of Items
.911	4

Table 3.30. Mean and SD value of Biology teacher dimension

	Mean	Std. Deviation	N
Q10	3.39	1.357	640
Q11	3.41	1.348	640
Q16	3.38	1.535	640
Q20	3.44	1.537	640

Table 3.31. Item total correlation

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
Q10	10.23	15.695	.828	.876
Q11	10.21	15.980	.801	.884
Q16	10.24	14.411	.830	.873
Q20	10.18	15.155	.745	.905

Difficulty

The factor that determines Indian student's perceptions regarding the difficulty of biology is the delivery of teacher in the class. Biology was rated as one of the easiest topics by majority of the students. On the other hand, the dispersal of students who opted biology to be "easy" was not random. Students in all grades rated biology as an easy subject. Furthermore, significant number of students responded that they enjoy the way biology courses are delivered at their school.

Table 3.32. Univariate ANOVA for difficulty dimension

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	330.801[a]	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 3.33: Reliability value of difficulty dimension

Cronbach's Alpha	N of Items
.897	8

Table 3.34. Mean and SD value of difficulty dimension

	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 3.35: Item total correlation

	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

3.11. CONSTRUCTION AND VALIDATION OF LESSON PLANS

Lesson plans are the most important instrument for successful teaching. As the present study was conducted with experimental design with pre and posttest groups, so, for the purpose of teaching of both the groups total 60 lesson plans. (30 for control group: taught with convention method and 30 lesson plans for experimental group: taught with blended learning method). 5E lesson plans were used for control group to teach them with conventional method and SAMR model were followed to construct the lesson plans for experimental group. Lesson plans were constructed in Bengali and English both because the medium of instruction of students was Bengali and for the purpose of completion of thesis it was translated in English also. All lesson plans were constructed by the investigator and validated by experts given in Appendix portion of this thesis. Content validity was checked by the experts and accordingly all changes were incorporated into.

3.11.1. 5E Lesson plans:

5E instructional model was first developed by Bybee (1980) for bioscience curricula. It includes 5 different phases: engage, explore, explain, elaborate and evaluate. Eisenkart (2003) expanded it into 7 stages. Many researchers used 5E lessons plans to complete their studies as conventional method of teaching (Eisenkraft, 2003; Goldston et al., 2010; Namdar and Kucuk, 2018).

Engage:

Here the teacher introduces students with previous knowledge and finds out all possible misunderstandings, this stage does not involve any lecture, definition or any elaboration (Duran and Duran, 2004). The engage phase of the 5E learning cycle model is when the instructor piques students' interests, elicits their questions, and then assesses their understanding. Teacher assessed the pupils' prior understanding of the idea or concepts that were taught.

Explore:

This phase includes small size activities with students to know the content area of present class. Here generation of new ideas occurs (Bybee, 1997). It is an inquiry based method which helps a student for his better understanding (Duran and Duran, 2004). During the explore phase, the instructor invites pupils to actively work with other students on a learning assignment with little guidance from the teacher. The teacher serves as a facilitator, giving the pupils the chance to find their own solutions to the issues while giving instructions and answering their questions.

Explain:

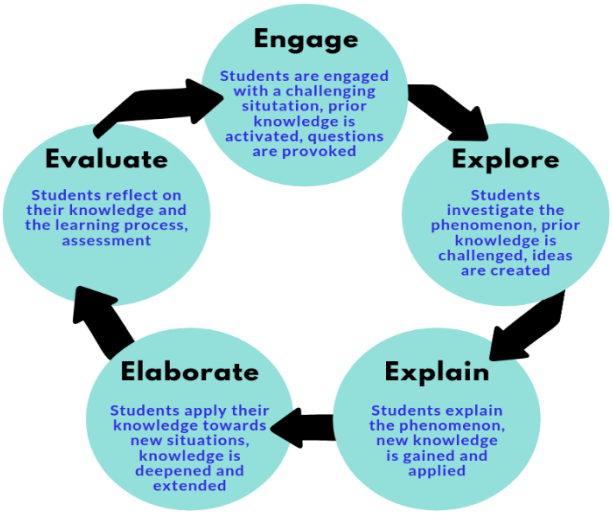
It is a teacher centric phase where the teacher drives his class with knowledge acquired in previous phase. Building of conception, ideas, definitions, notes etc. are provided by teacher in this phase (Bybee, 2009). During the explain phase, the instructor encourages students to explain ideas by asking them questions and encouraging them to provide examples to back up their claims. The instructor also presents formal definitions and explanations of ideas during this stage, based on what the pupils discovered during the explore activities.

Elaborate

This stage includes more involvement of students than previous stages. Here students try to incorporate their newly gained knowledge into new situation. Group activities can also take place here. Duran and Duran (2004) found that "Students may conduct additional investigations, develop products, share information and ideas, or apply their knowledge and skills to other disciplines" The teacher encourages pupils to use or expand their freshly built concepts into various or real-life scenarios when they are in the elaborate phase.

Evaluation:

In this last phase, students recapitulate what they have learn throughout the class. Here the teacher evaluates the level of understanding of student and infers that if the educational objectives are fulfilled or not. Traditional and nontraditional methods of evaluation. The teacher formatively monitors and evaluates students' learning throughout the class. Students may also evaluate their own learning. A summative evaluation is created during the evaluation step. Preservice teachers must create suitable criteria for rubrics as needed and offer an evaluation that addresses the lesson goals while planning a 5E inquiry lesson. Tongco and Fajardo (2019) used 5E lesson plans to complete their study to measure the level of achievement and attitude towards chemistry among 9th class high school students of Philippines.



*Source:https://knowledgequest.aasl.org/the-5-es-of-inquiry-based-learning/

Figure 3.9: Phases of 5E Lesson plan

3.11.2. Opinions of Experts on 5E Lesson Plans:

Different opinions of experts were incorporated, and lesson plans were modified accordingly. Opinions of experts are attached in appendix 19.

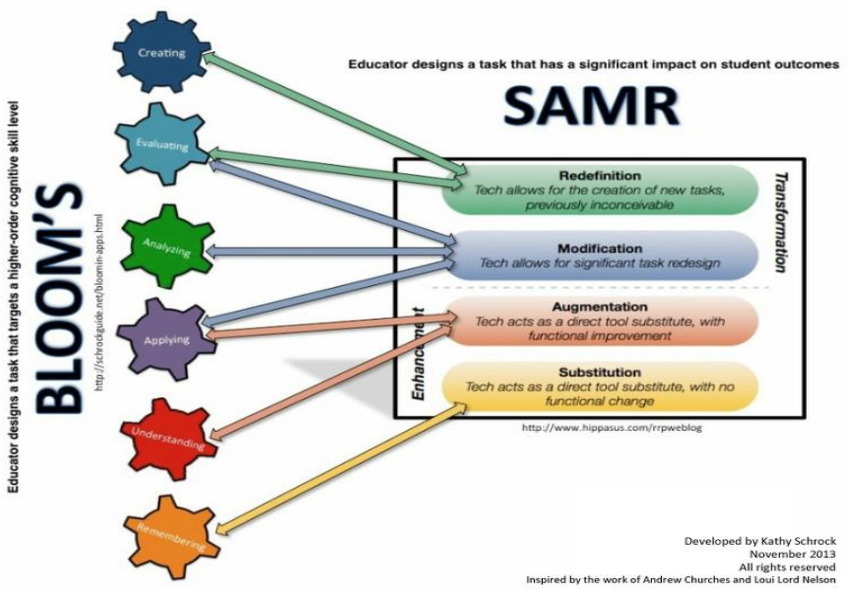
3.11.3. SAMR Lesson plans:

SAMR lesson planning method was discovered by Dr. Ruben Puentedura in the year 2010. This a new type of lesson plan specially made for technology integration in class. This method was developed to find out the effect or impact of technology in class. It can be said that SAMR model represents how learning experience changes with integration of technology in class. A teacher can integrate technology in his class for the betterment of his teaching, and by application of this framework the effectiveness of technology integration becomes easier. There are 4 stages of SAMR framework. they are Substitution, Augmentation, Modification and Redefinition. There are 5 phases in SAMR lesson plan:

- Overview: it includes goal setting and learning objectives making,
- Preparation: Text reading, learning process continues, listening, defining, understanding
- Drill and practice: Drill phase id teacher-led, here teacher speaks, writes, states etc. and practice includes maximum involvement of students
- Check: Demonstration of content by the teacher and development of skill by the students
- Follow-up: evaluation of the content taught, analysis of result which ultimately leads to reaching learning objectives attainment.

Ertmer and Ottenbreit-Leftwich (2010) revealed that, for the purpose of maintenance of flow of knowledge on case of technology integrated class, it is very much essential to incorporate it in a proper way. Aldosemani (2019) found that integration of technology in class can enhance skills that teachers intend to acquire to achieve learning objectives. It is very important to select proper tool for a technology enriched class. Wiljaya et al. (2021) found SAMR model was very much useful in teaching mathematics in Guangxi

Normal University students. Introduction of technology by this method was proven useful by this method. Rehman, Aurangzeb and Saeed (2022) performed their study in Pakistan to know the level of motivation, inspiration and knowledge retention among university level of students in respect to SAMR model for technology integration into the classroom and found positive result.



*Source:https://www.schrockguide.net/samr.html

Figure3.10: Phases of SAMR model fulfilling the levels of Bloom's Taxonomy

3.11.4. Opinions of Experts on SAMR Plans:

Different opinions of experts were incorporated, and lesson plans were modified accordingly. Opinions of experts are attached in appendix 19.

3.12. CONSTRUCTION AND VALIDATION OF E-CONTENTS

Investigator taken proper training before starting construction part of e-contents (Appendix 7). Renderforest, Animaker, Microsoft word, excel, power point, Audacity, Windows media creator, OBS studio etc. software was used to make the videos. 1st draft of e-contents (30 in no.) was created as per need of the study, and they were sent to experts for content validity. After receiving their comments, all comments were incorporated into

the videos i.e., all necessary changes were made. And they were used as intervention instrument during the entire treatment period.

3.12.1. Opinion of experts:

- More voice clarity needed. Good to see the video. Background music too high. Don't know Bengali language, so subtitles are necessary to see for me, which can distract a child also, suggested to put English language in screen along with Bengali that will help you to maintain bi-lingual nature of content.
- Doing e-content for Class XI students, using such kind of animation is childlike, seems to me. Avoid such kind of animation. Instead of that use voice over video, that will surely help them to do better.
- Good, improve the sound quality, pronunciation is good, clear, and vivid. Reduce Background music, sometimes it can distract young minds. Length of video is too large - Keep in mind too
- Try different types of video contents for each of your lecture.
- Videos sent by you interesting but avoid background music or decrease its volume so that your voice can be heard more clearly.
- Clarity of contents is ok.
- Show yourself in video if you wish.
- Your technique of teaching is good. I don't understand why you are using subtitles for your contents. As you are writing your things in Bengali, you can write that too in English and put them together there. As per my opinion it will be better to visualize also not to put sub titles there, because it covers your things mostly shadowing the original part of content.
- Voice good, way of teaching ok, sometimes monotonic to me. You have good voice, use voice modulation which will surely affect young mind positively. Reduce moving animations, it can distract pupil.

- Voice clarity and other things are good. Size of subtitle should be reduced because it's blocking the view of the original video. English language used there was found correct by me.
- Good video, just add some extra points there, reduce length of video. Don't make it assignment based because everyone is not able to perform assignment during seeing video. Give separate task to them as assignment. Ask project online based in class. That will go better for you.
- Good, Clear, Sound not clear, voice modulation needed, speedy video
- everything good but language. Again, do not mix common language with traditional one. Voice up and down needed for active learning. Keep that in mind and rock.
- Language okay, slow down your speed of talking, way of teaching is good attractive, and pronunciation correct.
- Your videos are great. Only felt some unnecessary sounds there. Try a calm place to record your video/voice. You can make it more Interesting by asking questions in between video.

3.13. STEPS OF EXPERIMENTATION

- Permission was taken from Head of the institution of respective school which is decided as experimental and control group for present study (Appendix -1).
- Adaptation of the tool Biology Attitude Questionnaire – By Prokop, Tuncer and Chuda (2007) after proper adaption in Indian context with a proper size of sample size. Due permission was taken from the author (Appendix -3).
- Construction and validation of Biology Anxiety Scale.
- Preparation of the lesson plans for Biological Sciences of Class XI, of both blended learning strategies (Appendix – 5) and conventional teaching methods (Appendix – 6) of content of 5 units each (selected as per pilot study and mentioned above).

- Construction and validation of pre/post-test Achievement questionnaire for blended learning strategies and conventional Biology teaching strategies.
- Achievement test question, Biology attitude scale and Biology anxiety scales tools were administrated to all 70 students and scored.
- According to the achievement test result, groups were first equated by using Spearman's coefficient of co relation method (Conklin, 2017) and with the help of SPSS software. Finally control and experimental groups were established each with 35 students.
- Treatment was given through 6 weeks periods. Control group was taught with conventional method and experimental group was taught with blended method.
- The achievement test questionnaire was administered again to control and experimental group both as post-test. Test of Biology Attitude questionnaire and Biology Anxiety Scales tools have been administrated to both experimental and control groups and scored.
- Suitable statistical techniques now applied, and analysis of the data calculated.

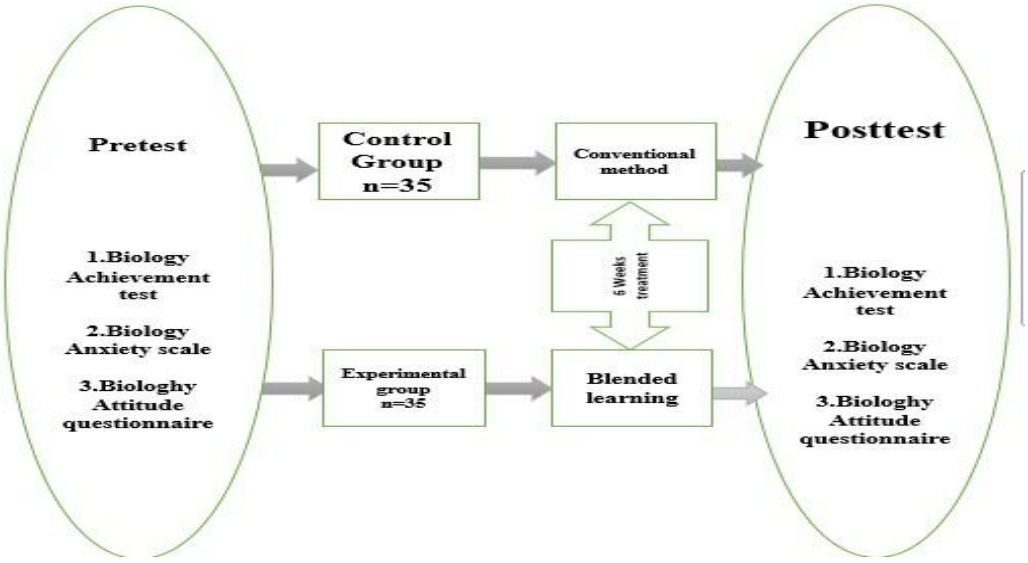


Figure 3.11: Overview of research

3.14. STATISTICAL TECHNIQUES USED

Statistical techniques used to analyze data are:

Descriptive: Mean, Median, Mode, Standard Deviation, Kurtosis, Skewness

Inferential: t-Test and ANOVA

3.15. CONCEPTUAL FRAMEWORK

Conceptual framework helps a researcher to establish relation between variables of the study, decreasing data into tabular of pictorial form, forms relation between research objectives, explains theoretical basis and conceptual understanding (Leshem and Trafford, 2007). Conventional chalk and talk classroom situation are not enough to meet the educational objectives of present-day classroom. So, to improve and accelerate the all-round development process by education it is very important to break the rigid classroom conditions like past century. Blended learning is an excellent opportunity to change classroom situation with a minimum technological touch and efficiency of teacher. Sloan Consortium (2011) defined blended learning as, "integrate online with traditional face-to-face class activities in a planned, pedagogically valuable manner."

Pupils attends their classes to acquire knowledge and for their all round development. touch of technology in class makes learning more joyful and understandable as it involves engagement of more than one senses at a time. But how it could be measured if the learning was successful or not. Achievement test is the easiest way to evaluate one student's learning outcome. Enhancement of academic achievement can be possible by the promotion of blended learning, it was proved by many researchers before (El-Deghaidy and Nouby, 2008; Picciano, 2012; Yapici and Akbayin, 2012; Porter et.al, 2014; Kumar, 2014; Aldalalah et.al 2014; Kassab et al, 2015; Nazarenko 2015; Gohil, 2018; Harahap et al. 2019; Ayob et al. 2020; Polhun et al. 2021). So, achievement test was chosen as a variable of present study.

Anxiety is a negative psychological situation which can grow in anyone. Students are easiest victim of academic anxiety. England et al. (2019) pointed out that anxiety is a kind of emotion which negatively affects the performance and the quality of students So, it is

very important to find out the way to reduce it. Previous studies of Cimen and Yilmaz and Stinkamp (2021) proves that blended learning is capable to reduce the level of academic anxiety among students.

Attitude towards a subject is another variable for this study. It is a positive aspect where the attachment and positivity is grown in respect to any subject. Attitude towards biology indicates the fondness of students for the subject biology in terms of intellectual, recreational values and moral values (Prokop et. al, 2007). It was seen that, even with a positive attitude towards a subject, students can show lesser result in academic achievement test. If negative attitude is shown among students, it can ultimately leads into growth of academic anxiety in and that can cause lesser performance in academic achievement.

This is the era of biology, the emphasis, research scopes and opportunities to work under biology is increasing day by day. (England et al., 2017). Biology is the way to explore the world of living beings. Less studies found in the field education in improving biology education by the application of blended learning. Also, lesser study found to corelate blended learning with academic achievement, anxiety and attitude towards biology together. So, for the present study those variables were chosen. So, the effectiveness of blended learning program is to be seen in this study in respect to achievement, anxiety and attitude towards biology.

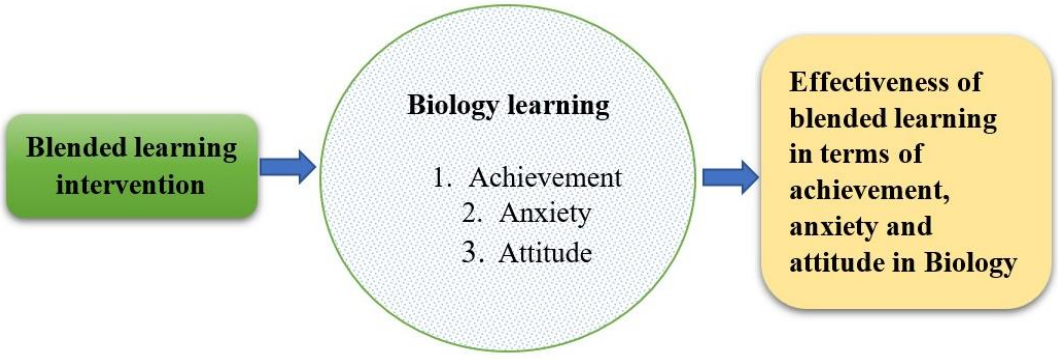


Figure 3.12. Conceptual framework of the study

3.16. DELIMITATIONS

The study has the following delimitations:

- **Area:** The study was confined to schools following WBCHSE syllabus of a particular area.
- **Grade and size of sample:** The study was delimited to only 70 senior secondary students especially of Class XI.
- **Subject:** Only teaching learning of Biology was considered for the study.
- **Medium of study:** Only Bengali medium students were considered here in this study, Achievement and treatment was delivered in Bengali.
- Among all Blended learning strategies only rotation and face to face driver are limited for present study.

CHAPTER – 4

ANALYSIS AND INTERPRETATION OF DATA

4.1. INTRODUCTION

Systematic research procedure includes two major phenomena namely – analysis and interpretation of collected data, there are complementary parts of each other. Aim of data analysis is to make raw data understandable or to get some result from collected data after completion of proper experimentation. Collected data becomes meaningful with the help of analysis of data so as to obtain same significant results. Analysis involves chopping down of existing complicated factors into easier parts and putting them into proper groups to make necessary arrangements for next phase that is interpretation. Interpretation "is essentially one of stating what their significance is" (Good, 1954).

Main objective of the present study was to find out the effect of blended learning strategies on achievement, anxiety, and attitude towards Biology among Senior Secondary students. Another objective of this study was aimed at constructing blended learning lesson plans and blended learning contents for Biology of experimental group. This study also involves construction and validation of Biology Anxiety scale, construction and validation of achievement test questionnaire and adaptation of Biology Attitude questionnaire – the tools used for this study. The techniques for the same were discussed in chapter 3.

The process of data analysis and interpretation involves quantitative techniques which deal with analysis of pretest and post test scores of dependent variables and relevant interpretations.

Descriptive statistics like mean and standard deviation were also used as a part of inferential statistics t test (independent sample t-test, paired sample t test) and ANOVA was used for quantitative Analysis of data. For all the purpose of quantitative statistical analysis statistical packages for social sciences (SPSS 26.0) and AMOS were used.

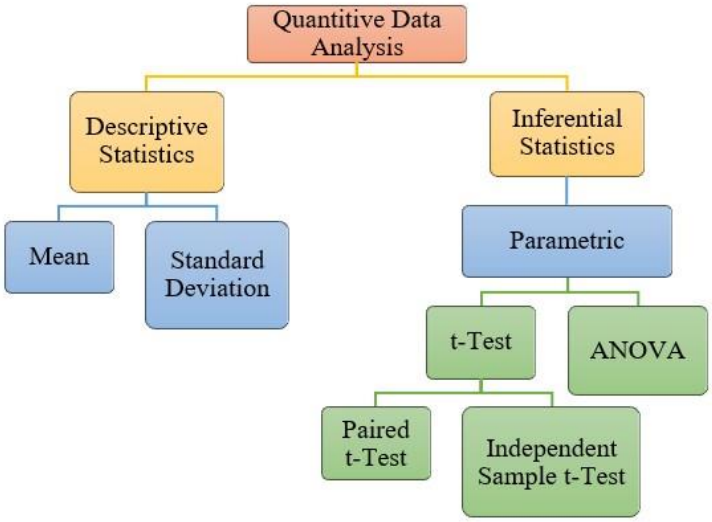


Figure 4.1: Flow Chart showing Data Analysis Process

4.2. DESCRIPTIVE STATISTICS FOR WHOLE EXPERIMENTATION

Achievement test questionnaire was supplied to the whole group of 72 students as pre-test. Top and bottom scores were excluded. Rest scores were calculated. Mean, median, mode, SD, Kurtosis and Skewness values of the whole sample are shown in Table 4.1.

Table 4.1. Descriptive Statistics for N=70

Descriptive Statistics	**Value**
N	70
Mean	30.97
Variance	29.072
Std. Deviation	5.392
Skewness	-.108
Kurtosis	-1.022

To distribute the whole group into two equated groups following steps were followed: Top and bottom most score excluded to avoid experimental moralities. Slack and

Draugalis (2019) stated that, by equating the groups of experiment i.e., control and experimental groups, the problem of experimental mortality can be reduced. Marginal scores exclusion can be another way out to prevent the same. Rest 70 scores were distributed into equated two groups i.e., control group and experimental group by SPSS 26.0 software. Test for normality for whole sample are shown in Table 4.2.

Table 4.2. Normality Test for N=70

Kolmogorov-Smirnov			Shapiro-Wilk Test		
Statistic	**Df**	**Sig.**	**Statistic**	**Df**	**Sig.**
.112	70	.200*	.932	70	.102

*p<0.05

Kolmogorov-Smirnov and Shapiro-Wilk both test shows were conducted to know if the distribution of data is normal or not. Here both p value shows 0.200 and 0.102 which exceeds significance level which is 0.05. Therefore, it can be concluded the sample is normally distributed.

4.3. ANALYSIS FOR ACHIEVEMENT

Achievement is one of dependent variable of this study. Here, achievement is also considered as the measurement criteria for distribution of control and experimental group determination. By achievement estimation we can measure the level of learning outcomes and success rate after experimentation. Here, to serve the same purpose, a standardized achievement test questionnaire was constructed and the procedure of the same is discussed in Chapter 3 of this study. Same test questionnaire was applied to control and experimental groups as pre and posttest questionnaire during the study to estimate the level of achievement after treatment with experimental method.

4.3.1. DESCRIPTIVE STATISTICS FOR ACHIEVEMENT

Descriptive analysis was conducted for all three variables i.e., achievement, anxiety and attitude towards Biology. Descriptive statistics of Biology achievements of both the group, i.e., control and experimental group was conducted for pretest and posttest. The

mean, standard deviation, Skewness and Kurtosis were calculated for achievements variable and shown in Table. 4.3

The values of Mean of pretest scores do not differ significantly and it shows the distribution is tends to be normal. The standard value of skewness falls between +1 to -1 and the same for Kurtosis from +2 to -2 (Marie, 2016). The table shows the values are coming under aforesaid value. So, again by these values we can assume that the sample maybe distributed normally. Achievement of students was measured by using achievement test scores. The test questionnaire constructed and validated, was used in study. That contained 50 multiple choice type of questions. Each correct answer provided two (02) marks and no negative marking was made. Accordingly the students score were divided and 0 – 33 considered as low achiever, 34 – 66 are average achievers and those who scored more than 67 was considered as high achievement.

Table 4.3. Mean scores of achievements in Biology with respect to control and experimental groups

Dependent Variable	Group	Test	N	Mean	SD	Skewness	Kurtosis
Achievement in Biology	Control	Pretest	35	30.57	6.5	-0.053	-1.310
		Posttest	35	61.25	5.63	-0.307	-1.336
	Experimental	Pretest	35	31.74	6.02	0.080	-1.105
		Posttest	35	67.94	6.44	0.105	-1.706

All the table values show that there is a tendency of normal distribution hence assumption of t-test also occurs.

4.3.2. NORMALITY TEST FOR ACHIEVEMENT

Normal distribution of data confirms conductance of parametric test for statistical analysis. To know the same Kolmogorov-Smirnov and Shapiro-Wilk test of normality were conducted. The current study includes 70 in total sample sizes each 35 for control and experimental group. This is considered as small sample size. In case of small samples, it is generally found that Shapiro-Wilk test is more appropriate to diagnose the normality

of data. Table for the test of normality and the values obtained from present study in achievement are shown in Table 4.4.

Table 4.4. Normality Test for achievement

Group	Test	Kolmogorov-Smirnov Lilliefors Significance Correction			Shapiro-Wilk			Distribution
		Statistic	Df	Sig.	Statistic	Df	Sig.	
Control group	**Pretest**	.112	35	.200*	.932	35	.302*	Normal
	Posttest	.108	35	.200*	.966	35	.352*	Normal
Experimental Group	**Pretest**	.127	35	.163*	.941	35	.260*	Normal
	Posttest	.125	35	.183*	.968	35	.403*	Normal

*p<0.05

The significance value of both Kolmogorov-Smirnov and Shapiro-Wilk Test of normality if exceed 0.05 (Mary, 2006) it indicates the sample follows normality. In table 4.4 we can see all the significance value are above 0.05. So, it can be concluded that that distribution of data is normal here. According to this assumption the parametric test namely t-test (Independent sample t-test and paired sample t test) were calculated for the further analysis of data.

4.3.3. INFERENTIAL STATISTICS

Inferential statistics is a very important part of hypothesis testing. It is found that in quasi-experimental study inferential statistics plays key role to compare the performance of two groups i.e., control and experimental group. For normally distributed samples parametric tests are generally conducted. t-test is used to find out difference between two different groups based on its mean score, and ANOVA is calculated to find out difference between more than two groups. On the other hand, for not normally distributed samples non-parametric test are conducted. Mann Whitney U test is used as a replacement of independent sample t-test, and Wilcoxon signed rank test is conducted replacing paired t-test for parametric test and Kruskal Wallis test is calculated in place of ANOVA.

4.3.3.1. INFERENTIAL STATISTICS FOR ACHIEVEMENT

To compare the mean scores of control group and experimental group for dependent variable achievement parametric test was used here. For the present study Paired sample t-test was used to find out the quantitative measurement taken from same group which maybe control group or experimental group separately. Independent sample test was used to find out the comparison between experimental and control group.

4.3.3.1.1. RESULT OF ACHIEVEMENT PAIRED SAMPLE 't' TEST FOR CONTROL GROUP

The paired sample t test includes all measures of descriptive statistics like mean, standard deviation, mean difference, data set number, p value and t value for both pretest and post test results for the control group. Here paired sample t test is conducted to find out the outcomes of achievement of students of control group taught by conventional method.

- **HYPOTHESIS 1**

For testing of hypothesis following null hypothesis was formulated to find the significant difference between pretest and post test score of control group treated with conventional method of teaching.

$H_{0(1)}$: There is no significant difference between pre and post test score in biology among class XI students of control group taught by conventional method.

The null hypothesis always depicts there is no significant difference between pretest and post test scores of control group. It is used to identify the significance between two means i.e., pretest and post test scores of the control group. Accordingly, the hypothesis is tested and the results are presented in table 4.5. Paired sample t-test is conducted for the variable achievement for control group and results are presented below.

Table 4.5. Paired Sample t-test result for control group of achievement in Biology

Group	N	Test	Mean	SD	Mean Difference	t-Value	df	P (2 tailed)
Control	35	Pre-test	30.57	6.5	30.68	39.908	34	0.000*
	35	Post-test	61.25	5.63				

*p<0.01

Paired sample t test for control group shows that there is a significant difference between means score of pretest and posttest of control group at 0.01 level. So, it can be concluded that the null hypothesis is rejected. **So, there exists significant difference between pre and post test score in biology among class XI students of control group taught by conventional method. The students of control group, after post test shown better result in comparison to the pretest score in achievement of biology**.

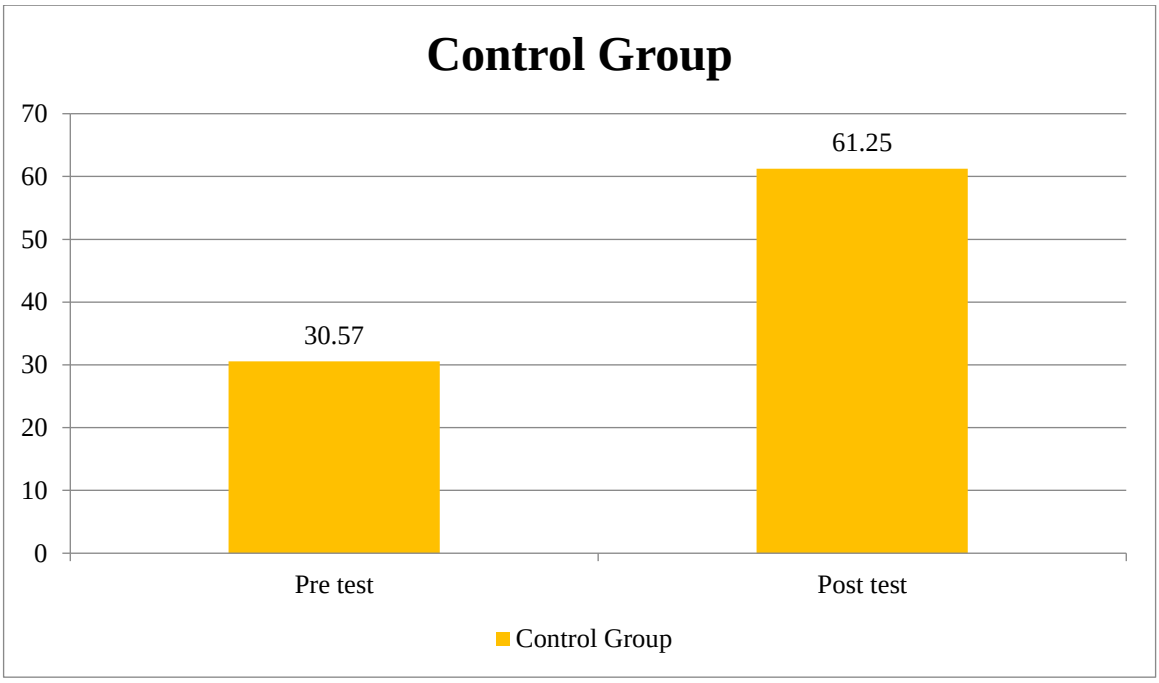


Figure. 4.2: Mean Score of pretest and posttest of Control Group

The figure 4.2 shows that average marks of pretest of posttest in control group students are 61.25 and standard deviation of 6.5, the mean value for pretest is 30.57(Fig.4.2.) and SD 5.63 and t value is 39.904, p value 0.00 (<0.05; standard value). This result indicates that in control group students show good amount of difference using conventional method in achievement of biology. It may be concluded that the students of control group, after posttest shown better result in comparison to the pretest score in achievement of biology.

DISCUSSION

For the present study in control group conventional method of teaching was applied. It is clearly shown that the conventional method of teaching used in classroom help them a lot in improving their achievement score. The result indicates that control group which was

exposed with conventional method expressed improvement in achievement scores as per t value=39.904 and p=0.05.

4.3.3.1.2. PAIRED SAMPLE 't' TEST OF ACHIEVEMENT FOR EXPERIMENTAL GROUP

Here paired sample t-test is conducted to find out the outcome of achievement of students of experimental group taught by blended method.

- **HYPOTHESIS 2**

For testing the significant effect of blended learning strategies in achievement scores on both posttest and pretest of experimental group, following hypothesis was formulated.

$H_{0(2)}$: There is no significant difference between pre and post test score in biology among class XI students of experimental group taught by blended learning method.

Paired sample t test is conducted for the variable achievement for experimental group and results are presented below in table 4.6

Table 4.6. Paired Sample t test result for Experimental group

Group	N	Test	Mean	SD	Mean Difference	t-Value	df	p(2 tailed)
Experimental	35	Pretest	31.74	6.04	36.74	45.553	34	0.000*
	35	Posttest	67.94	6.44				

<0.01*

Paired sample t test for experimental group shows that the value of p is 0.00 which means there is a significant difference between means score of pretest and posttest of experimental group at 0.01 level**. So, it can be concluded that the null hypothesis is rejected. There exists significant difference between the result of pretest and posttest of experimental group.**

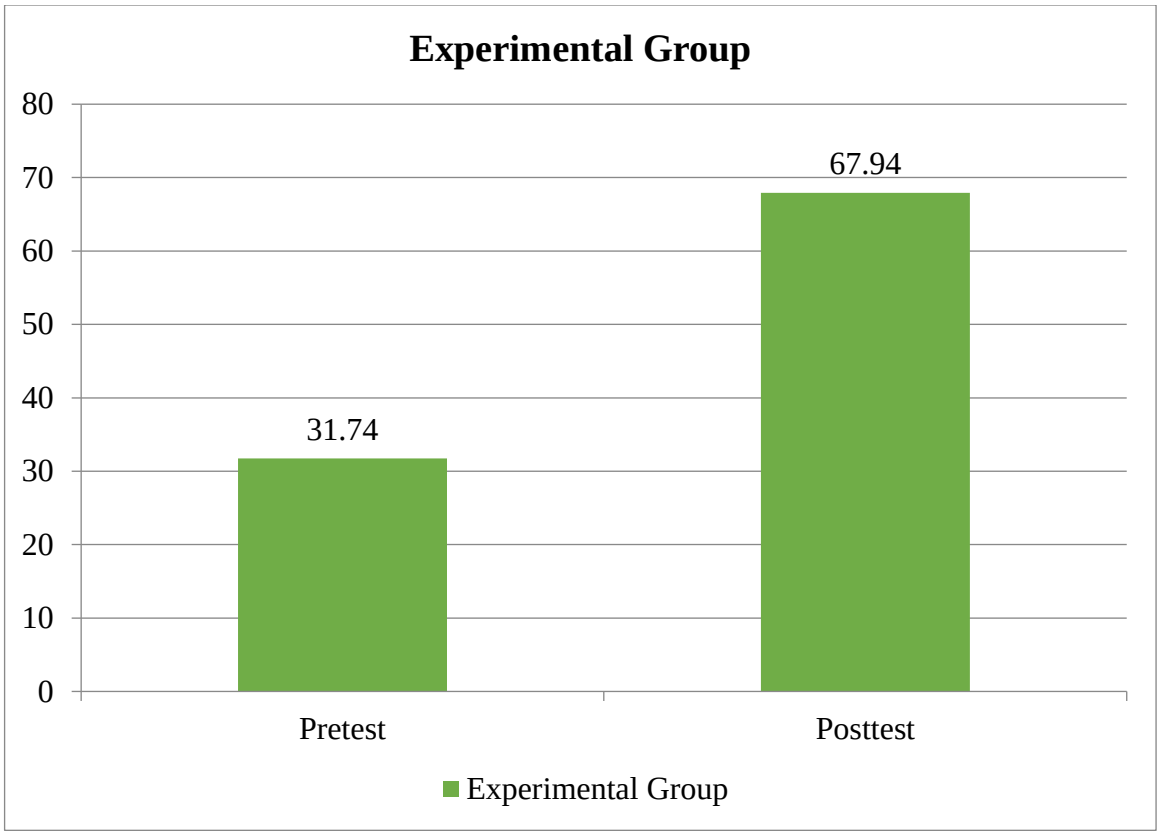


Figure. 4.3: Mean scores of pretest and posttest of experimental group in achievement in Biology.

The average marks of posttest in control group students is 67.94, for pretest the value is 31.74 (Fig.4.3) and t value is 45.553, p value 0.00 (<0.05; standard value). This result indicates that in experimental group students shows betterment in achievement scores using blended learning method in achievement of biology.

- **OVERALL DISCUSSION**

For the present study, the experimental group was treated with blended learning program which included conventional teaching environment with e content to create an interactive environment both for teacher and students. Audio visual content used in classroom to have enhanced their learning ability. The result of the present study indicates that the experimental groups which were exposed to blended learning program showed significant improvement in their achievements. Many previous researches were conducted before to know the effectiveness of blended learning strategies. The result of the study supports the conclusion found by Nair (2016), Lim and Morris (2009) and Graham (2003) that blended

blending method of teaching can improve pedagogical, promptness of revise, knowledge accumulation, social interaction etc. Yapici (2012), Hasan (2012) conducted a study with 9thgrade students in Biology in a High School and found blended learning is an effective technique than the conventional one. Chitra (2017) studied effectiveness of London learning in learning science among 9th standard students in Chennai, concluded that blended learning environment is more effective than the conventional one in case of teaching science. Integration of technology in learning process makes learning more interesting where both learner and teacher can express their individuality.

4.3.3.1.3. INDEPENDENT SAMPLE 't' TEST OF ACHIEVEMENT FOR CONTROL AND EXPERIMENTAL GROUP

Independent sample t-test is conducted to know the comparison between experimental group and control group. This test is applied when different treatment techniques are given to two different groups. Here, in present study control group was taught with conventional method of teaching and experimental group was treated with blended learning strategies. Therefore, the differences in means scores of both the groups are compared to find the effectiveness of blended learning program.

- **HYPOTHESIS 3**

For testing of hypothesis following null hypothesis and alternative hypothesis was formulated to find the significant difference between pretest and post test score of both control and experimental group treated with conventional method and blended method of teaching respectively.

$H_{0(3)}$: There is no significant difference between post test score in biology among class XI students of control and experimental group.

It is used to identify the significance between two means i.e., pretest and post test scores of the control and experimental group. Accordingly, the hypothesis is tested, and the results are presented in table 4.7. Independent sample t test is conducted for the variable achievement for control and experimental group and results are presented as follows:

Table 4.7. Independent sample t-test result for both control and experimental groups in achievement in biology

Test	Group	N	Mean	Standard Deviation	t	p
Pretest	Control	35	30.57	6.5	0.114	.909
	Experimental	35	31.74	6.02		
Posttest	Control	35	61.25	5.63	4.620	0.00*
	Experimental	35	67.94	6.44		

*p<0.05

The mean score of experimental and control group at 0.05 level in the pretest, where t = 0.114, p=0.909, which is greater than 0.05. So, Null hypothesis is accepted. Therefore, it is proved that the average marks of students of control group and experimental group in pretest do not have any significant difference.

For the present study there is significant difference found between the mean scores of experiment group and control group at 0.05 level in the post test, where t= 4.620, p= 0.00 which is found less than 0.05. So, the null hypothesis is rejected, and alternative hypothesis is accepted. Therefore, it can be concluded that the average marks of students a control and experimental group in posttest differs significantly. The average marks in the post test and pretest of experimental group were found 67.94 and 31.74. On the other hand, the average marks in the posttest and pretest of control group students are 61.25 and 30.57.

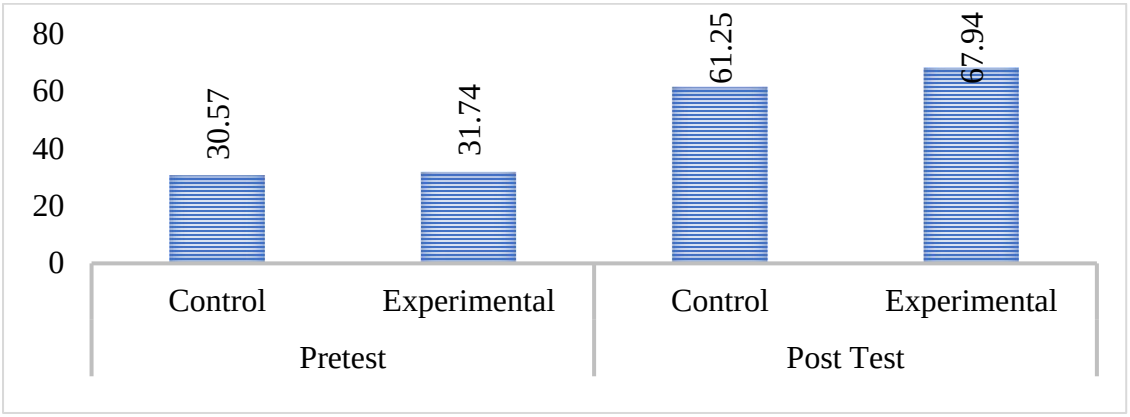


Figure 4.4: Mean scores of pre and posttest of both for control and experimental groups in achievement in biology

From this data and Figure 4.4., it can be concluded that blended learning method of teaching is much more effective than the conventional teaching strategy. It gives the opportunity to interact with e-contents as well as conventional contents side by side. So, for the present study blended learning strategies is proven effective than conventional method in Biology learning for improving achievement scores.

4.3.3.1.4. EFFECT SIZE ANALYSIS OF ACHIEVEMENT VARIABLE

Cohen's d is used to evaluate the effect between subjects for grouped data. Mainly it is applicable in case of experimental studies to measure the differential effects of experimental treatment over conditions on the dependent variable of need (Piasta and Justice, 2010). The value indicates how many standard deviations lie between two means. It also means the quantitative measure of the magnitude. Like t test, the effect size aims to determine a population parameter and not affected by sample size. According to Table no. 4.8. it can be said that if the effect size comes less than 0.2, the difference between two groups is a little. this also satisfies that if the values signify statistically, still it remain negligible because of its low effect size (Cohen.

Effect size is calculated in a study to get the proportion of Variance in the dependent variable that is explained by independent variable. For the present Effect size was calculated by using the formula: d= $\eta^2 = \frac{t^2}{df+t^2}$ Cohen (1988).

Cohen's d value depicts the effect size. Cohen's d value was calculated by using internet through a software developed by University of Colorado by Becker (1999) (Retrieved from: https://lbecker.uccs.edu/). It was measured according to the table 4.8.

Table 4.8 Table references to determine the Level of Size Effect (d), Cohen (1988)

Test	**Criterion for Effect Size**		
d	Small	Medium	Large
	0.01	0.06	0.14

So, it can be concluded that the large effect size is due to the implementation of blended learning to the experimental group. The effect size of the blended learning program was also calculated. Effect size of program on the experimental and control group was calculated in presented in table number 4.9.

Table 4.9. Effect Size of the program on the experimental and the control groups on achievement in Biology

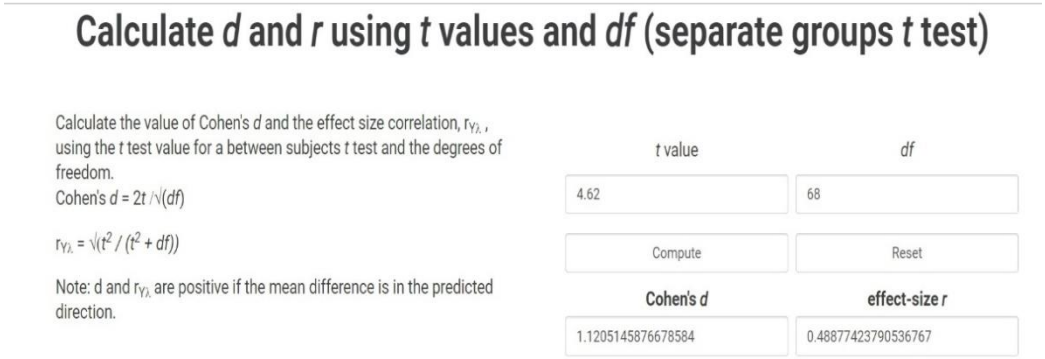
Test		Df	t	D	R	Effect Size
Paired Sample t test	**Control group**	34	39.908	1.045	0.829	Large
Paired Sample t test	**Experimental group**	34	45.553	1.798	0.945	Large
Independent sample t test	**Control and Experimental group**	68	4.620	1.12	0.488	Large

*****Sources: Screenshot taken from https://lbecker.uccs.edu/

Fig. 4.5.: Calculation of Cohen's d and r value with mean and SD values from paired t test for control group on achievement in biology

*****Sources: Screenshot taken from https://lbecker.uccs.edu/

Fig. 4.6: Calculation of Cohen's d and r value with mean and SD values from paired t test for experimental group on achievement in biology



*****Sources: Screenshot taken from https://lbecker.uccs.edu/

Fig.4.7: Calculation of Cohen's d and r value by t value from independent t test of control and experimental groups on achievement in biology

Table 4.7 shows that the Cohen's d value for control group is 1.045 and r value is 0.829. For the experimental group, Cohen's d value found 1.798 and r value found 0.945. In case of independent sample t test value of d is 1.12 and r is 0.488. result of independent test it can be said that the effect size of the program is large on students' achievement in biology. Also, it must be mentioned that all the effect size found here are showing large effects. But when it is compared, it can be easily seen that the experimental group treated with blended learning strategies have more positive value (d=1.798, r=0.945) in comparison to control group (d=1.045, r=0.829). This large effect may be resulted due to innovative activities and techniques which are integrated along with the conventional techniques of teaching in blended classroom designed for experimental group.

DISCUSSION

To compare the scores of pretest and posttest of experimental and control groups together independent sample t test was conducted. Experimental group was taught with blended learning which combines the conventional classroom along with e contents to create interactive learning environment for students and teachers both. The result depicts that there is no significant difference in main score of control and experimental group at 0.05 level in pre-test, where t =0.114 and p = 0.909, which exceeds 0.05. Result also shows that there exists significant difference between main score of control and experimental group at 0.05 level in the post test, where t =4.620, p=0.00, which indicates that

introduction of technology in classroom, have improved their learning ability thus enhancing their achievement score. **The result also indicate that experimental group exposed with blended learning program showed significant improvement in their achievement in comparison to the control group which was taught by conventional method.** Many previous research prove the effectiveness of blended learning technique. Rovai and Jordon (2004) formulated a comparative study of traditional, total online and blended classroom and measured efficiency to each technique. Experimentation was conducted with total 68 students. Of them, 26 students with traditional teaching method, 28 with blended platform and 25 with online mode of learning. Classroom community scale developed by Rovai, (2002) was used to measure the classroom connectivity and learning of pupil. This scale consisted of 20 self-reported items measurable with a 5-point Likert scale. Higher score indicates more classroom community sense among students. Result of study reveals blended learning is effective technique. To find out efficiency of Blended Learning strategies, some investigator followed a conceptual framework, called 3C concept includes 'content' of learning resources, two ways 'communication' between instructor and pupil and results in 'construction' of learner's positive outcome in teaching process (Kerres and DeWitt 2003). It plays a role as an anchor between conventional learning and e-learning (Rovai and Jordon, 2004). A study with blended learning co-operative approach with preservice teacher's training course and found successful positive result in achievement test (Deghaidy and Nouby, 2007).

4.4. ANALYSIS FOR ATTITUDE TOWARDS BIOLOGY

4.4.1. DESCRIPTIVE STATISTICS FOR ATTITUDE TOWARDS BIOLOGY

Descriptive analysis was conducted for all three variables i.e., achievement, anxiety, and attitude towards Biology. Descriptive statistics of Attitude towards Biology of both the group, i.e., control and experimental group was conducted for pretest and posttest. Scores were calculated by application of adapted Biology Attitude Questionnaire (Prokop et.al, 2007). The highest score was 120 and lowest score was 24 in the questionnaire. Attitude questionnaire scores from 24 – 56 depicts low score and low level of attitude towards biology, scores range from 57 – 87 found showing moderate level of attitude towards biology and scores above 88 shown high level of attitude towards biology. The mean,

standard deviation, Skewness and Kurtosis was calculated for achievements variable and shown in Table. 4.10

The values of Mean of pretest scores do not defer significantly and it shows the distribution is tends to be normal. The standard value of Skewness falls between +1 to -1 and the same for Kurtosis from +2 to -2 (Marie, 2016). The table 4.10 shows the values are coming under aforesaid value. So, again by these values we can assume that the sample may be distributed normally.

Table 4.10. Descriptive Statistics Values for attitude towardsbiology

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

All the table values of Table 4.10. show that there is a tendency of normal distribution hence assumption of t-test also occurs.

4.4.2 NORMALITY TEST FOR ATTITUDE TOWARDS BIOLOGY VARIABLE

Normal distribution of data confirms conductance of parametric test for statistical analysis. To know the same Kolmogorov-Smirnov and Shapiro-Wilk test of normality were conducted. The current study includes 35 sample sizes each for control and experimental group. This is considered as small sample size. In case of small samples, it is generally found that Shapiro-Wilk test is more appropriate to diagnose the normality of data. Table for the test of normality and the values obtained from present study in attitude towards biology are shown in Table 4.11.

Table 4.11. Normality Test for attitude towards biology

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

The significance value of both Kolmogorov-Smirnov and Shapiro-Wilk Test of normality if exceed 0.05, it indicates the sample follows normality. In table 4.11 we can see all the significance value are above 0.05. So, it can be concluded that that distribution of data is normal here. According to this assumption the parametric test namely t-test (Independent sample t-test and paired sample t test) was calculated for the further analysis of data.

4.4.3. INFERENTIAL STATISTICS

Inferential statistics is a very important part of hypothesis testing. It is found that in quasi-experimental study inferential statistics plays key role to compare the performance of two groups i.e. control and experimental group. For normally distributed samples parametric tests are generally conducted. T-test is used to find out difference between two different groups based on their mean score, and ANOVA is calculated to find out difference between more than two groups. On the other hand, for not normally distributed samples non parametric test are conducted.

4.4.3.1. INFERENTIAL STATISTICS FOR ATTITUDE TOWARDS BIOLOGY

To compare the mean score of Control group and Experimental group for dependent variable attitude towards biology parametric test were used here. For the present study Paired sample t-test is used to find out the quantitative measurement taken from same group which maybe control group or experimental group separately. Independent sample test was used to find out the comparison between experimental and control group.

4.4.3.1.1. PAIRED SAMPLE 't' TEST FOR ATTITUDE TOWARDS BIOLOGY FOR CONTROL GROUP

The paired sample t test includes all measures of descriptive statistics like mean, standard deviation, mean difference, data set number, p value and t value for both pretest and post test results for the control group. Here paired sample t test is conducted to find out the outcome of attitude towards biology of students of control group taught by conventional method.

- **HYPOTHESIS 5**

For the purpose of testing of hypothesis following null hypothesis and alternative hypothesis was formulated to find the significant difference between pretest and posttest score of control group treated with conventional method of teaching.

$H_{0(5)}$: There is no significant effect of control group conventional method on the mean score of attitude towards Biology among the students of XI standard.

The null hypothesis always depicts there is no significant difference between pretest and post test scores of control group. It is used to identify the significance between two means i.e. pretest and post test scores of the control group. Accordingly, the hypothesis is tested and the results are presented in table 4.12 Paired sample t test is conducted for the variable attitude towards biology for control group and results are presented below.

Table 4.12. Paired Sample t test result for control group of attitude towards 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				

*p<0.05

Paired sample t test for control group shows that there is a significant difference between means core of pretest and posttest of control group at 0.05 level. So, it can be concluded that the Null hypothesis is rejected. Significant difference found between pretest and posttest score in attitude towards biology of control group.

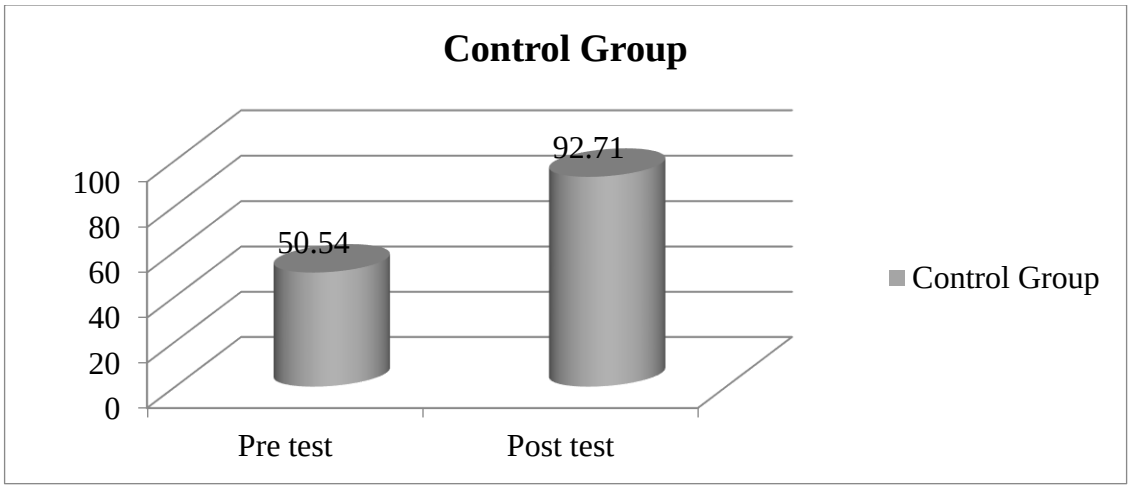


Figure.4.8. Mean scores of pretest and posttest of control group in attitude towards biology

The average marks of posttest in control group students is 92.71, the same is for pretest is 50.54(Fig.4.8.) and t value is 10.671, p value 0.00 (<0.05; standard value). This result indicates that in control group students show good amount of difference using conventional method in attitude towards biology.

DISCUSSION

For the present study in control group conventional method of teaching was applied. It is clearly shown that the conventional method of teaching used in classroom help them a lot in improving their attitude towards biology score. The result indicate that control group which was exposed with conventional method expressed improvement in attitude towards biology scores as per t value=10.671 and p= 0.00.

4.4.3.1.2. PAIRED SAMPLE 't' TEST FOR ATTITUDE TOWARDS BIOLOGY FOR EXPERIMENTAL GROUP

The paired sample t-test includes all measures of descriptive statistics like mean, standard deviation, mean difference, data set number, p value and t value for both pretest and post test results for the experimental group. Here paired sample t test is conducted to find out the outcome of attitude towards biology of students of experimental group taught by blended method.

- **HYPOTHESIS 6**

$H_{0(6)}$: There is no significant difference of pre and posttest scores of attitude towards Biology among the students of XI standard of experimental group.

The null hypothesis always depicts there is no significant difference between pretest test and post test scores of experimental group. It is used to identify the significance between two means i.e., pretest and post test scores of the experimental group. Accordingly, the hypothesis is tested and the results are presented in table 4.13. Paired sample t test is conducted for the variable attitude towards biology for experimental group and results are presented below.

Table 4.13. Paired Sample t test result for experimental group of attitude towards 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				

*p<0.05

Paired sample t test for experimental group shows that there is a significant difference between means core of pretest and posttest of control group at 0.05 level. **So, it can be concluded that the Null hypothesis is rejected, and significant difference found among pretest and posttest results of experimental group.**

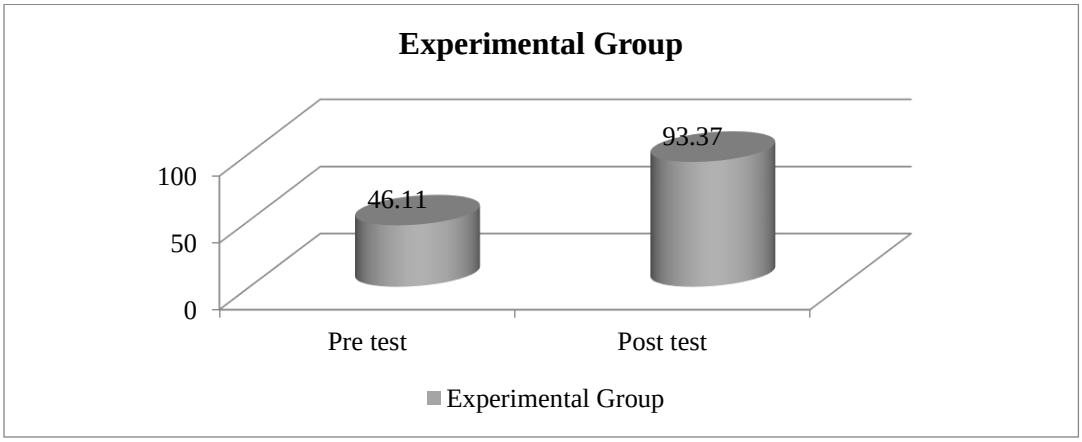


Figure 4.9. Mean scores of pretest and posttest of experimental group in attitude towards Biology.

The average marks of posttest in control group students is 93.37, the same is for pretest is 46.11(Fig. 4.9.) and t value (Table. 4.13) is 13.163, p value 0.00 (<0.05; standard value). This result indicates that in experimental group students show good amount of difference using blended learning method in attitude towards biology.

DISCUSSION

For the present study, the experimental group was treated with blended learning program which included conventional teaching environment with e content to create an interactive environment both for teacher and students. Audio visual he content used in classroom to have enhanced their learning ability. The result of the present study indicates that the experimental groups which were exposed to blended learning program showed significant improvement in their attitude towards biology curriculum. Previous researchers were conducted many studies to find out the effectiveness of blended learning towards increasing positive attitude in learning. The result of the study supports the conclusion found by Czaplewski (2014), Rosa (2017) found efficiency of blended learning was measured in an introductory mathematics course, Blended Learning proved effective in growing positive attitude towards mathematics. McCall (2017) was conducted to detect the effects of Individual Versus Cooperative Testing in a Flipped Classroom on the Academic Achievement, Motivation toward Science, and study time for 9^{th} Grade Biology Students. Blended learning proved effective in growing positive attitude towards Biology and growing motivation in science. Integration of technology in learning process makes learning more interesting where both learner and teacher can express their individuality.

4.4.3.1.3. INDEPENDENT SAMPLE 't' TEST FOR ATTITUDE TOWARDS BIOLOGY FOR CONTROL AND EXPERIMENTAL GROUP

Independent sample t test is conducted to know the comparison between experimental group and control group. This test is applied when different treatment techniques are given to two different groups. Here, in present study control group was taught with conventional method of teaching and experimental group was treated with blended learning strategies. Therefore, the differences in means scores of both the groups are compared to find the effectiveness of blended learning program.

- **HYPOTHESIS 7**

$H_{0(7)}$: There is no significant difference of pre and posttest scores of attitude towards Biology among the students of XI standard of control and experimental group.

It is used to identify the significance between two means i.e., pretest and post test scores of the control and experimental group. Accordingly, the hypothesis is tested, and the results are presented in table 4.14. Independent sample t test is conducted for the variable attitude towards biology for control and experimental group and results are presented below.

Table 4.14. Independent sample t test result for both control and experimental groups in attitude towards biology

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		

Found in the mean score of experimental and control group at 0.05 level in the pretest, where t =1.125, p=0.268, which is greater than 0.05. So, Null hypothesis is accepted. Therefore, it is proved that the average marks of students of control group and experimental group in pretest do not have any significant difference.

For the present study there is no significant difference found between the mean scores of experiment group and control group at 0.05 level in the post test, where t= 0.272 , p= 0.786 which is found greater than 0.05. **So, the null hypothesis is accepted. Therefore, it can be concluded that the average marks of attitude questionnaire of students a control and experimental group in posttest do not differ significantly, depicting no significant improvement towards attitude towards Biology with Blended method.**

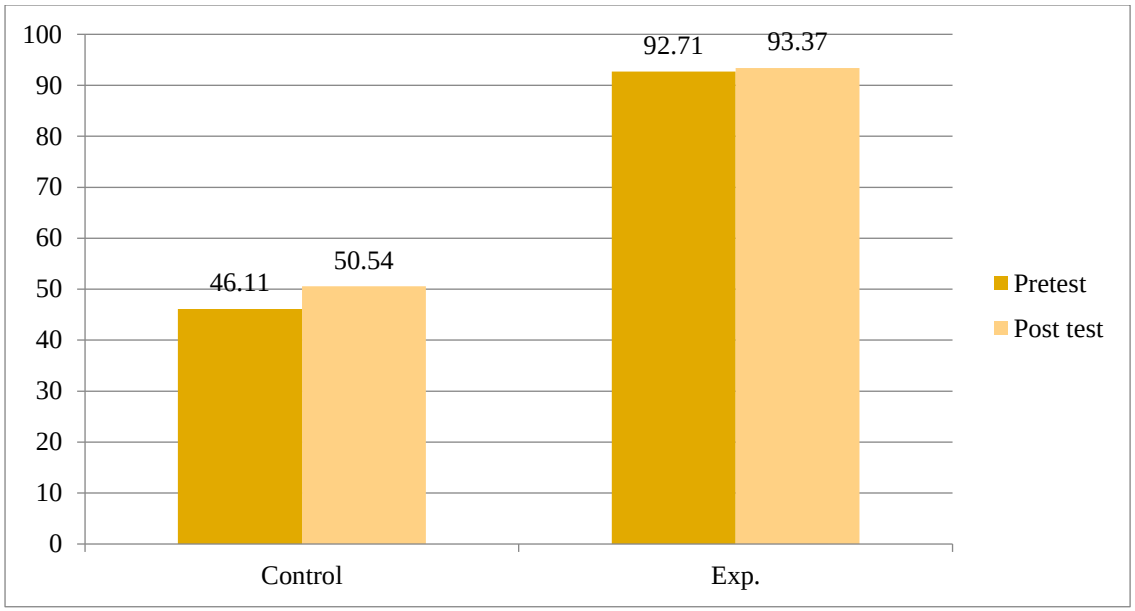


Figure4.10: Mean scores of pre and posttest of both control and experimental group in attitude towards biology

The average marks in the post test and pretest of experimental group students are 92.71 and 93.37. On the other hand the average marks in the post test and pretest of control group students are 50.54 and 46.11. From this data and Figure 4.8., we can infer that both the groups shows incredible good result I increasing positive attitude towards Biology. But the independent t test result and graphical result both shows the amount of increase in result is almost same for the both groups. So, it can be concluded that both the method increases the positive attitude towards Biology and it cannot be said that blended learning or conventional method specifically better in increasing positive attitude towards Biology. Showing much low score before treatment for both groups occurred possibly due to lack of knowledge, lack of readiness etc. But in detailed analysis reveals that experimental group taught with blended learning shown slight greater increase in score than control group.

4.4.3.1.4. EFFECT SIZE ANALYSIS OF ATTITUDE TOWARDS BIOLOGY VARIABLE

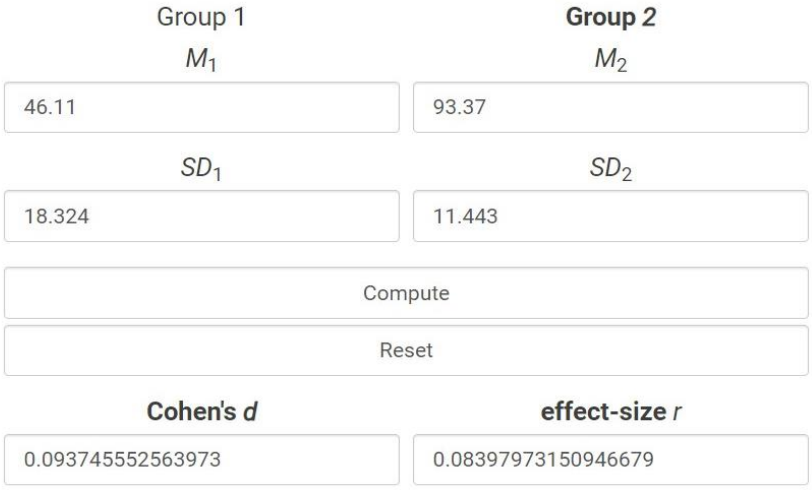
The effect size is calculated according to the table no. 4.15 for the attitude towards biology variable. T value of independent t test and mean and SD values of paired sample t test were used to get the effect size.

Table 4.15. Effect Size of the program on the experimental and the control groups attitude 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

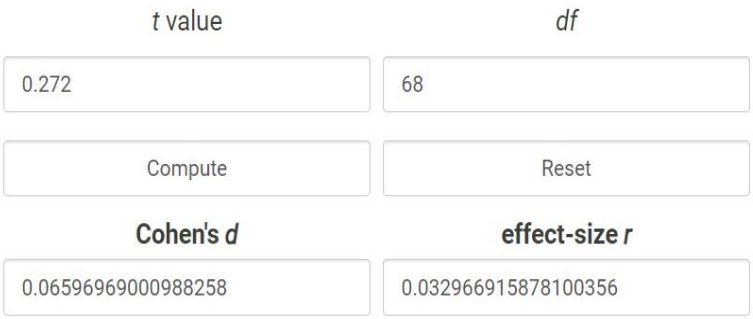
*****Sources: Screenshot taken from https://lbecker.uccs.edu/

Figure 4.11. Calculation of Cohen's d and r value with mean and SD values from paired t test for control group on attitude towards biology



*****Sources: Screenshot taken from https://lbecker.uccs.edu/

Fig. 4.12: Calculation of Cohen's d and r value with mean and SD values from paired t test for experimental group on attitude towards biology (Screenshot retrieved from https://lbecker.uccs.edu/)



*****Sources: Screenshot taken from https://lbecker.uccs.edu/

Fig.4.13: Calculation of Cohen's d and r value by t value from independent t test of control and experimental groups on attitude towards biology

Table 4.13. shown that of effect size of the program is small on students' attitude towards biology which is 0.03. Though Paired t test result shown medium effect size for both control (d=0.07, r = 0.08) and experimental groups (d= 0.09, r = 0.0839), it can be said slight positive increase may occurred in attitude towards biology among students, but overall positive impact is not shown at all in comparative test between the groups, which shown small effect size (0.03). Hence, the effect is not significant. This small effect may be caused due to not readiness before treatment period or due to lack of knowledge. From the present study, it can be inferred that with proper treatment with any proper teaching method, the attitude towards biology can be improved.

DISCUSSION

To compare the scores of pre-test and posters of experimental and control group together independent sample t test was conducted. Experimental group was taught with blended learning which combines the conventional classroom along with e contents to create interactive learning environment for students and teachers both. The result depicts that there is no significant difference in main score of control and experimental group at 0.05 level in pre-test, where t =1.125 and p = 0.268, which exceeds 0.05. Result also shows that there is no significant difference between main score of control and experimental group at 0.05 level in the post test, where t =0.272, p=0.786, which indicates that null hypothesis accepted and they do not differ from each other. Introduction of technology in classroom, have improved their learning ability also it is found that conventional

teaching can enhance their attitude towards biology score. The result also indicates that both experimental and control group exposed with blended learning program and conventional teaching techniques showed significant improvement in their academic attitude towards biology subject. Some previous researches had shown the almost same result. Akgunduz and Akinoglu (2016) investigated the impact of blended learning and social media supported learning over attitude of a students and self-directed learning skill in science education. The internal study was conducted with 74 students of 7^{th} standard in the year 2011-12 in Istanbul. In this pre-test posted control group Research design study the students of control group were taught with face to face technique along with 5E learning cycle model and experimental group was taught with blended learning model including face to face and internet-based learning. Science teaching attitude scale and self-directed learning skill scale were used as tools of study. Contracted with SPSS 17 software and with ANOVA, t-test and Kolmogorov-Smirnov test and results shown that both experimental and group grown more positive attitude towards science in comparison to control group but the effect size shows no significant difference among both the groups. The result of this study supports the results of present study. Akbarov, Gonen and Aydogan (2018) conducted another experimental study with 162 students of intermediate level of school which discusses about the introduction of infographics and establishing paperless classroom i.e., blended classroom, for the purpose of learning English. Researchers found slight positive result, which also does not support the effect size of the study. So, attitude towards English learning shown increase in positive results but not shown significant difference among students in each group like present study.

4.5. ANALYSIS FOR ANXIETY TOWARDS BIOLOGY

4.5.1. DESCRIPTIVE STATISTICS FOR ANXIETY TOWARDS BIOLOGY

Descriptive analysis was conducted for all three variables i.e., achievement, anxiety and Attitude towards Biology. Descriptive statistics of anxiety towards Biology of both the group, i.e., control and experimental group was conducted for pretest and posttest. Scores were calculated by application of newly constructed and validated Biology Anxiety Scale. The mean, standard deviation, Skewness and Kurtosis was calculated for anxiety variable and shown in table no. 4.16. Biology anxiety scale scores ranges from 20 – 100. Where

20 is the lowest score showing highest level of anxiety and 100 indicates least level of anxiety among students. Anxiety values from 20 – 46 indicates higher level of anxiety, scores from 47 – 72 indicates moderate level of anxiety, scores 73 indicates low level of anxiety.

The values of Mean and median of pretest scores do not defer significantly and it shows the distribution is tends to be normal. The standard value of Skewness falls between +1 to -1 and the same for Kurtosis from +2 to -2 (Marie, 2016). The table 4.16. shows the values are coming under aforesaid value. So, again by these values we can assume that the sample maybe distributed normally.

Table 4.16 Descriptive Statistics Values for anxiety towards Biology

	Group	**Test**	**N**	**Mean**	**SD**	**Skewness**	**Kurtosis**
Anxiety towards Biology	Control	Pretest	35	53.28	6.280	-0.542	-0.452
		Posttest	35	44.54	9.724	-.879	-0.778
	Experimental	Pretest	35	51.74	7.979	-.627	1.121
		Posttest	35	42.77	9.149	-.426	-0.552

All the table values show that there is a tendency of normal distribution hence assumption of t-test also occurs.

4.5.2. TEST FOR NORMALITY FOR ANXIETY TOWARDS BIOLOGY VARIABLE

Normal distribution of data confirms conductance of parametric test for statistical analysis. To know the same Kolmogorov-Smirnov and Shapiro-Wilk test of normality were conducted. The current study includes 35 sample sizes each for control and experimental group. This is considered as small sample size. In case of small samples it is generally found that Shapiro-Wilk test is more appropriate to diagnose the normality of data. Table for the test of normality and the values obtained from present study in Anxiety towards biology are shown in Table 4.17.

Table 4.17. Test for Normality for anxiety towards Biology

Dependent Variable	Group	Test	Kolmogorov-Smirnov			Shapiro-Wilk			Distribution
			Statistic	df	Sig.	Statistic	df	Sig.	
Anxiety	Control group	Pretest	.122	35	.200	.951	35	.125	Normal
		Posttest	.152	35	.200	.909	35	.121	Normal
	Experimental group	Pretest	.108	35	.200	.966	35	.352	Normal
		Posttest	.095	35	.200	.955	35	.156	Normal

The significance value of both Kolmogorov-Smirnov and Shapiro-Wilk Test of normality if exceed 0.05, it indicates the sample follows normality. In table 4.25 we can see all the significance value are above 0.05. So, it can be concluded that that distribution of data is normal here. According to this assumption the parametric test namely t-test (Independent sample t-test and paired sample t test) was calculated for the further analysis of data.

4.5.3. INFERENTIAL STATISTICS

Inferential statistics is a very important part of hypothesis testing. It is found that in quasi-experimental study inferential statistics plays key role to compare the performance of two groups i.e., control and experimental group. For normally distributed samples parametric tests are generally conducted. T-test is used to find out difference between two different groups based on their mean score, and ANOVA is calculated to find out difference between more than two groups. On the other hand, for not normally distributed samples non parametric test are conducted.

4.5.3.1. INFERENTIAL STATISTICS FOR ANXIETY TOWARDS BIOLOGY

To compare the mean score of Control group and Experimental group for dependent variable Anxiety towards biology parametric test were used here. For the present study Paired sample t-test is used to find out the quantitative measurement taken from same group which maybe control group or experimental group separately. Independent sample test was used to find out the comparison between experimental and control group.

4.5.3.1.1. PAIRED SAMPLE t TEST FOR ANXIETY TOWARDS BIOLOGY FOR CONTROL GROUP

The paired sample t test includes all measures of descriptive statistics like mean, standard deviation, mean difference, data set number, p value and t value for both pretest and post test results for the control group. Here paired sample t test is conducted to find out the outcome of Anxiety towards biology of students of control group taught by conventional method.

- **HYPOTHESIS 9**

For the purpose of testing of hypothesis following null hypothesis and alternative hypothesis was formulated to find the significant difference between pretest and post test score of control group treated with conventional method of teaching.

$H_{0(9)}$: There is no significant difference of pre and posttest scores of anxiety towards Biology among the students of XI standard of control group.

The null hypothesis always depicts there is no significant difference between pretest and post test scores of control group. It is used to identify the significance between two means i.e., pretest and post test scores of the control group. Accordingly, the hypothesis is tested, and the results are presented in table 4.18. Paired sample t test is conducted for the variable Anxiety towards biology for control group and results are presented below.

Table 4.18. Paired Sample t test result for control group in anxiety towards biology

Group	N	Test	Mean	SD	Mean Difference	t-Value	df	P (2 tailed)
Control	35	Pretest	53.28	6.280	8.74	4.958	34	.000
	35	Posttest	44.54	9.724				

Paired sample t-test for control group shows that there is a significant difference between means score of pretest and posttest of control group at 0.05 level. So, it can be concluded that the **Null hypothesis is rejected. Significant differences found in mean anxiety scores in biology. So, it can be concluded that conventional teaching method here proven effective in reducing anxiety towards biology.**

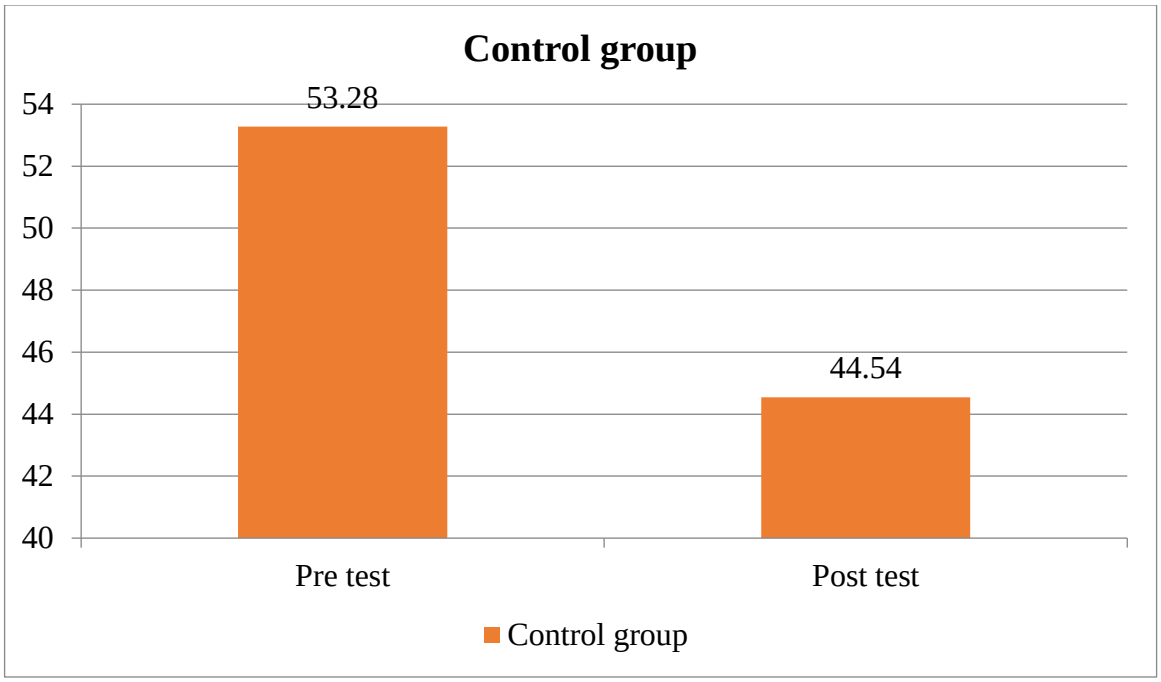


Figure 4.14. Mean Score of anxiety of pretest and posttest of control group

The average marks of posttest in control group students is 44.54, the same is for pretest is 53.28(Fig.4.14.) and t value is 4.958, p value 0.00 (<0.05; standard value). This result indicates that in control group students show good amount of difference using conventional method in Anxiety towards biology. The result shows reverse result showing lower score in posttest. This result is found due to the nature of variable. Anxiety is a negative psychological variable. So, lower average score means positive result towards negative variable anxiety.

DISCUSSION

For the present study in control group conventional method of teaching was applied. It is clearly shown that the conventional method of teaching used in classroom help them a lot in improving reducing Anxiety towards biology. The result indicates that control group which was exposed with conventional method expressed improvement reducing Anxiety towards biology scores as per t value=4.958 and p= 0.00.

4.5.3.1.2. PAIRED SAMPLE 't' TEST FOR ANXIETY TOWARDS BIOLOGY FOR EXPERIMENTAL GROUP

The paired sample t test includes all measures of descriptive statistics like mean, standard deviation, mean difference, data set number, p value and t value for both pretest and post test results for the experimental group. Here paired sample t test is conducted to find out the outcome of Anxiety towards biology of students of experimental group taught by blended method.

HYPOTHESIS 10

For the purpose of testing of hypothesis following null hypothesis and alternative hypothesis was formulated to find the significant difference between pretest and post test score of experimental group treated with blended method of teaching.

$H_{0(10)}$: There is no significant difference of pre and posttest scores of anxiety towards Biology among the students of XI standard of experimental group.

Accordingly, the hypothesis is tested, and the results are presented in table 4.19. Paired sample t test is conducted for the variable anxiety towards biology for experimental group and results are presented below.

Table 4.19. Paired Sample t test result for experimental group for anxiety towards biology

Group	N	Test	Mean	SD	Mean Difference	t- Value	Df	P (2 tailed)
Experimental	35	Pretest	51.74	7.979	8.971	6.854	34	.000*
	35	Posttest	42.77	9.149				

*p<0.05

Paired sample t-test for experimental group shows that there is a significant difference between means core of pretest and posttest of control group at 0.05 level. So, it can be concluded that **the Null hypothesis is rejected. Significant difference found between pretest and posttest scores in anxiety towards biology. So, blended learning method proven effective in reducing anxiety towards biology.**

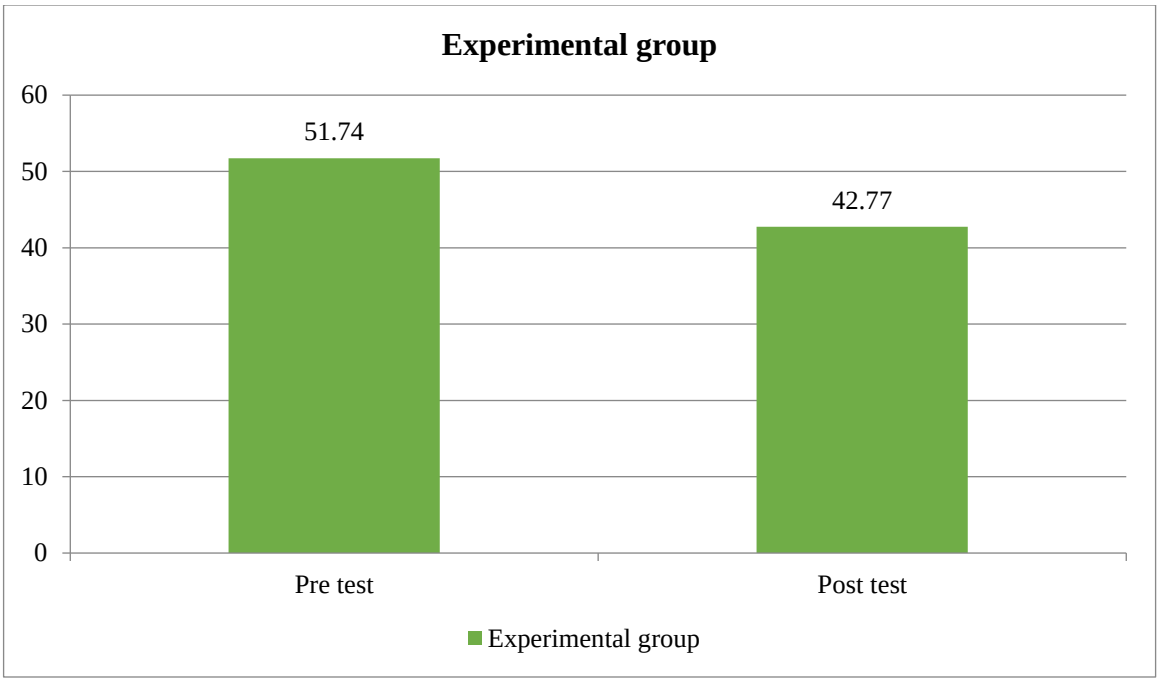


Figure 4.15. Mean score of anxiety of Paired Sample t test result for Experimental group

The average marks of posttest in control group students is 42.77, the same is for pretest is 51.74(Fig. 4.15.) and t value is 6.854, p value 0.00 (<0.05; standard value). This result indicates that in experimental group students show good amount of difference using blended learning method in reducing Anxiety towards biology. This result indicates that in control group students show good amount of difference using conventional method in Anxiety towards biology. The result shows reverse result showing lower score in posttest. This result is found due to the nature of variable. Anxiety is a negative psychological variable. So, lower average score means positive result towards negative variable anxiety.

DISCUSSION

For the present study, the experimental group was treated with blended learning program which included conventional teaching environment with e content to create an interactive environment both for teacher and students. Audio visual he content used in classroom to have enhanced their learning ability. The result of the present study indicates that the experimental groups which were exposed to blended learning program showed significant improvement in their Anxiety towards biology curriculum. Previous researchers were

conducted many studies to find out the effectiveness of blended learning towards increasing positive Anxiety in learning. The result of the study supports the conclusion found by Czaplewski (2014), Rosa (2017) found efficiency of blended learning was measured in an introductory mathematics course, Blended Learning proved effective in growing positive Anxiety towards mathematics. McCall (2017) was conducted to detect the effects of Individual Versus Cooperative Testing in a Flipped Classroom on the Achievement, Motivation toward Science, and study time for 9th Grade Biology Students. Blended learning proved effective in growing positive Anxiety towards Biology and growing motivation in science. Integration of technology in learning process makes learning more interesting where both learner and teacher can express their individuality.

4.5.3.1.3. INDEPENDENT SAMPLE 't' TEST FOR ANXIETY TOWARDS BIOLOGY FOR CONTROL AND EXPERIMENTAL GROUP

Independent sample t test is conducted to know the comparison between experimental group and control group. This test is applied when different treatment techniques are given to two different groups. Here, in present study control group was taught with conventional method of teaching and experimental group was treated with blended learning technique. Therefore, the differences in means scores of both the groups are compared to find the effectiveness of blended learning program.

- **HYPOTHESIS 11**

$H_{0(11)}$: There is no significant difference of pre and posttest scores of anxiety towards Biology among the students of XI standard of control and experimental group.

Accordingly, the hypothesis is tested, and the results are presented in table 4.20. Independent sample t test is conducted for the variable Anxiety towards biology for control and experimental group and results are presented below.

Table 4.20. Independent sample t test result for both control and experimental group in anxiety towards biology

Test	Group	N	Mean	Standard Deviation	t	P
Pretest	Control	35	53.28	6.280	0.899	0.372
	Experimental	35	51.74	7.979		
Posttest	Control	35	44.54	9.724	0.785	0.043*
	Experimental	35	42.77	9.149		

*p<0.05

Found in the mean score of experimental and control group at 0.05 level in the pretest, where t =0.899, p=0.372, which is greater than 0.05. So, Null hypothesis is accepted. Therefore, it is proved that the mean scores of students of control group and experimental group in pretest do not have any significant difference.

For the present study there is no significant difference found between the mean scores of experiment group and control group at 0.05 level in the posttest also, where t= 0.785 , p= 0.0435 which is found lesser than 0.05. So, **the null hypothesis is rejected, and alternative hypothesis is accepted. Therefore, it can be concluded that the average marks of students a control and experimental group in posttest differs significantly.** The result of present study was found similar with Aldalalah and Gasaymeh (2014) were seen that their study also proves that a visible difference found among anxiety in students taught with blended learning strategies.

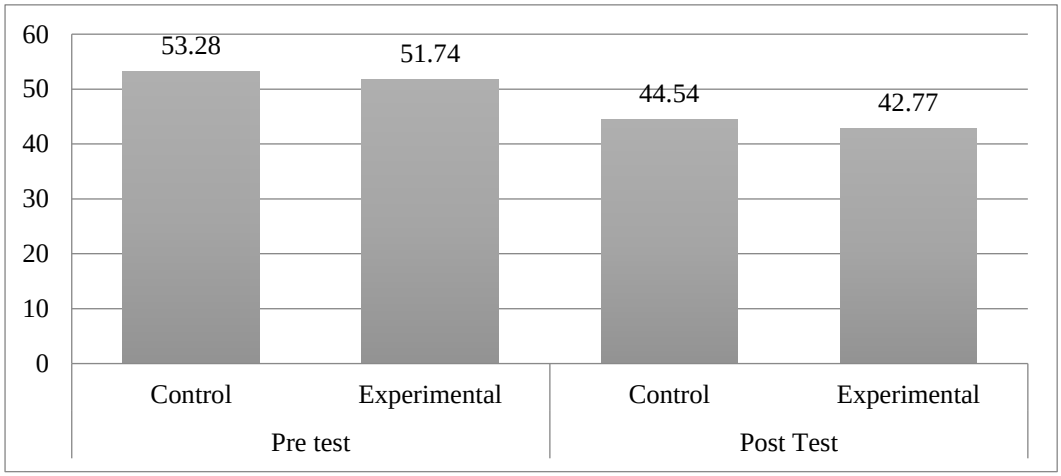


Figure 4.16. Mean score between pre and posttest of both control and experimental group in anxiety towards biology

The average marks in the post test and pretest of experimental group students are 53.28 and 51.74. On the other hand, the average marks in the posttest and pretest of control group students are 44.54 and 42.77. From this data and Figure 4.18, we can infer that both the groups show incredibly good resulting in decreasing anxiety score towards biology. But the independent t test result and graphical result both shows the amount of increase in result is higher in experimental group. So, it can be concluded that the blended method increases the negative scores anxiety towards biology, and it can be said that blended learning method specifically better in increasing lowering anxiety towards biology. Showing much low score after treatment for experimental groups occurred as anxiety is a negative psychological disorder. Anxiety especially academic anxiety is seen among in all students. It is also to be mentioned that various previous studies prove that low or moderate amount of academic anxiety is good for learning.

4.5.3.1.4. EFFECT SIZE ANALYSIS OF ANXIETY TOWARDS BIOLOGY

The effect size is calculated according to the table no. 4.8. for the anxiety towards biology variable. t value of independent t test and mean and SD values of paired sample t test were used to get the effect size.

Table 4.21. Effect Size of the program on the experimental and the control groups anxiety towards biology

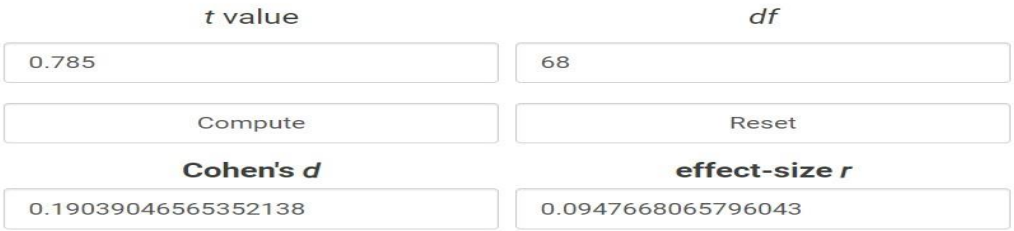
Test		df	T	D	R	Effect Size
Paired Sample t test	**Control group**	34	4.958	1.068	0.0471	Small
Paired Sample t test	**Experimental group**	34	6.854	1.044	0.463	Large
Independent sample t test	**Control and Experimental group**	68	0.785	0.190	0.094	Large

Paired t test result for control group shows small effect size (d=1.06, r=0.04) which indicates that conventional teaching method is not enough worthy to reduce academic anxiety among students. But paired t test for experimental group resulted in large effect size (d=1.04, r=0.46) which proves that blended learning has a positive effect on reducing academic anxiety among students, the result of effect size (d=0.19, r=0.094) of independent t test also proves the same. Hence, it is proved that blended learning intervention proven effective in reducing academic anxiety among senior secondary students in present study.

*****Sources: Screenshot taken from https://lbecker.uccs.edu/

Fig. 4.17: Calculation of Cohen's d and r value with mean and SD values from paired t test for control group on anxiety towards biology

Fig. 4.18: Calculation of Cohen's d and r value with mean and SD values from paired t test for experimental group on anxiety towards biology



*****Sources: Screenshot taken from https://lbecker.uccs.edu/

Fig.4.19: Calculation of Cohen's d and r value by t value from independent t test of control and experimental groups on anxiety towards biology

DISCUSSION

To compare the scores of pretest and posttest of experimental and control group together independent sample t test was conducted. Experimental group was taught with blended learning which combines the conventional classroom along with e contents to create interactive learning environment for students and teachers both. The result depicts that there is no significant difference in main score of control and experimental group at 0.05 level in pre-test, where t =0.899 and p = 0.372, which exceeds 0.05, so conventional method of teaching has not affected in reduction of anxiety. Result also shows that there exists significant difference between mean score of control and experimental group at 0.05 level in the post test, where t =0.785, p=0.043, which indicates that null hypothesis rejected, and they do differ from each other. Large effect size in independent t test also proves the positive result in reduction of academic anxiety. Introduction of technology in classroom, have improved their learning ability also it is found that conventional teaching cannot reduce their anxiety towards biology. The result also indicates experimental group exposed with blended learning program showed significant improvement in their academic anxiety towards biology subject. Result of present study was found similar with Aldalalah and Gasaymeh (2014) were seen that their study also proves that visible difference found among anxiety in students taught with blended learning strategies. The conducted their study to analyze the effect of Locus of control and anxiety levels on students of educational technology taught with blended learning competency and hazards. Sample size for this study was 107. Though, other variables shown positive results in relation to blended learning but anxiety had shown no significant difference. Bervell and Umar (2018) used a preprogrammed learning management system as a tool for teaching students with blended learning strategies. Control group was taught with conventional method of teaching. Data collected from 267 distance learning students. Other factors like influence of college, achievement and support shown positive significant difference among students. But it was found from same study that anxiety can slightly be reduced by the application of blended method of learning. Bai et al., (2020) compared blended learning method along with traditional teaching mode. Variables like motivation and academic efficacy shown positively increasing with application of blended learning strategies but their study also shown learning anxiety do not shown such positive results

with the application of blended learning method. Nida et al. (2020) investigated the effect of blended learning strategies in reducing Mathematics anxiety among 246 students of three different schools. Positive results found in mathematics thinking skill and mathematics anxiety. In this study, researchers concluded that significant improvement found in reducing Mathematics anxiety with blended learning program. Current study result shows that anxiety have reduced in both cases in conventional classroom and in blended classes also. It is also found that anxiety reduced in blended class is slight greater in comparison to conventional classroom settings. This result was supported by the study of Dove and Dove (2017) where they completed their study with trainee Teacher's anxiety and overall anxiety at the time of teaching in mathematics subject. Three different strategies of learning like teacher led classroom, flipped classroom settings with videos made by teacher and same settings with videos made by Khan Academy. Response was collected through survey and questionnaire and interview of students. Study result suggests that in three methods level of anxiety reduced among students. But the flip classroom settings with videos created by their teachers have more positive impact and score in comparison to other two groups in reducing anxiety and anxiety in teaching mathematics. The result also reveals that that settings with teacher created videos grows more positive attitude among them during class.

4.6. STUDY FOR INTERACTION EFFECT

As per need of the study, interaction effects with variables are calculated. Effect of instructional strategies and gender are assessed.

4.6.1. INTERACTION EFFECT FOR ACHIEVEMENT

To find out interaction effect for academic achievement variable, first of all gain scores were calculated. Then ANOVA was conducted to get the result.

GAIN SCORE FOR ACHIEVEMENT

Gain score can be obtained by calculating the difference between same kinds of tests. Here mean gain score were calculated from control group and experimental group each pre and post test scores.

DESCRIPTIVE STATISTIVS FOR GAIN SCORES OF EACH GROUP

The mean, standard deviation, Skewness and Kurtosis was calculated for gain scores of each group i.e., control and experimental group are shown in Table.4.22.

Table 4.22. Descriptive statistics for gain score of achievement test score

Group	N	Mean	SD	Skewness	Kurtosis	Conclusion
Control	35	30.69	4.549	0.455	1.169	Normal
Exp.	35	37.20	4.831	-0.615	1.056	Normal

The values of mean and median of pretest scores do not defer significantly and it shows the distribution is tends to be normal. The standard value of skewness falls between +1 to -1 and the same for Skewness from +2 to -2 (Marie, 2016). The table shows the values are coming under aforesaid value. So, again by these values we can assume that the sample maybe distributed normally.

All the table values show that there is a tendency of normal distribution hence assumption of t-test also occurs.

TEST OF NORMALITY FOR GAIN SCORE

Normal distribution of data confirms conductance of parametric test for statistical analysis. To know the same Kolmogorov-Smirnov and Shapiro-Wilk test of normality were conducted. The current study includes 35 sample sizes each for control and experimental group. This is considered as small sample size. In case of small samples, it is generally found that Shapiro-Wilk test is more appropriate to diagnose the normality of data. Table for the test of normality and the values obtained from present study in achievement are shown in Table 4.23.

Table 4.23. Tests of Normality for gain score in achievement

Group	Kolmogorov-Smirnov			Shapiro-Wilk		
	Statistic	Df	Sig.	Statistic	Df	Sig.
Control	.151	35	.072	.962	35	.264
Experimental	.145	35	.061	.947	35	.093

The significance value of both Kolmogorov-Smirnov and Shapiro-Wilk Test of normality if exceed 0.05, it indicates the sample follows normality. In table 4.4 we can see all the significance value are above 0.05. So, it can be concluded that that distribution of data is normal here.

HOMOGENEITY OF VARIANCE

The homogeneity of variance is generally tested by Levene's test by the help of SPSS software, described here in table no. 4.24. The variance within the cells must be homogeneous (Singh, 2018). Levene's Test with having a p-value below 0.05 indicates non-homogeneity of the assumptions (Singh, 2018).

Table 4.24. Levene's Test of Equality of Error Variances

		Levene Statistic	df1	df2	Sig.
Score	Based on Mean	1.457	3	66	.234
	Based on Median	1.385	3	66	.255
	Based on Median and with adjusted df	1.385	3	60.330	.256
	Based on trimmed mean	1.494	3	66	.224

For the present set of data, the result of the Levene's Test indicates that the assumption of homogeneity of variance has been complied with as the p-value is more than 0.05 ($p=0.557>0.05$). So, it is proved that the variances within the cells are homogeneous. Since all the assumptions for applying analysis of variance are satisfied, the given data was analyzed by applying the technique of ANOVA in SPSS to study the main effects and interaction effects of variables.

In experimental Research design and analysis of variance two types of effects can be calculated, i.e., Main and interaction effect. Main effect is the effect of an independent variable on a dependent variable average across the levels of any other dependent variables. Whereas the interaction effect refers to the role of a variable in an estimated model and its effect on dependent variable. Available that has an interaction effect have

a different effect on independence variable depending on the level of some third variable. Lavrakas (2008) defined interaction effect as "An interaction effect is the simultaneous effect of two or more independent variable on at least one dependent variable in which they are joint effect is significantly greater or lesser than the sum of the parts."

Two-way ANOVA (Analysis of Variance) is conducted as a parametric test which determines the effect of two different nominal variables on single continuous dependent variable. For the present study two independent variables are taken. It has two main effects and one interaction effects or combined effects of two variables on the dependent variable. Two-way classification and three F values were estimated. Two F-values for two main effects and one interaction effect's F value were calculated also.

Table 4.25. Tests of Main and Interaction Effect

Dependent Variable: Score						
Source	**Type III Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**	**Partial Eta Squared**
Corrected Model	764.02	3	254.67	11.39	.00*	.34
Intercept	76985.64	1	76985.64	3443.03	.00*	.98
Group [Control (3) and Exp.(4)]	759.67	1	759.67	33.97	.00*	.34
Gender [Male (1)and female(2)]	.024	1	.02	.001	.97	.00
Group * Gender	21.32	1	21.32	.95	.33	.01
Error	1475.75	66	22.36			
Total	82888.00	70				
Corrected Total	2239.77	69				

*$p<0.05$

- **HYPOTHESIS 4**

For the purpose of testing of the significant interaction effect between control and experimental group's achievement score on both pre-test and post test group treated with conventional method and blended method of teaching respectively along with gender, the following null hypothesis was formulated:

$H_{0(4)}$: There is no significant interaction effect of Blended Learning Strategies and conventional method with respect to gender on the mean score of achievement in Biology.

The null hypothesis always depicts there is no significant interaction effect between control and experimental group along with gender over achievement score. It is used to identify the significance between more than two means i.e., pretest and post test scores of the control and experimental group and gender. Accordingly, the hypothesis is tested, and the results are presented accordingly. Two-way ANOVA is conducted for the variable achievement for control and experimental group and results are presented as follows:

MAIN EFFECT IN INSTRUCTIONAL TREATMENTS FOR ACHIEVEMENT

Table 4.25. Reveals that the F value 33.975 with df 69 for the difference between control and experimental group had higher the table value at 0.05 level of significance. It stated that there was significant difference in mean gain scores of student achievement in Biology in respect two instructional treatments i.e., conventional strategies and blended learning modules. The result of significant difference among groups i.e., students taught through blended learning modules are highly effective or more positive result in achievement than students taught through traditional way.

MAIN EFFECT OF GENDER ON ACHIEVEMENT

Table 4.25. Reveals that the F value 0.974 with df 69 for the difference between categories was found to be insignificant at. 05 level of significance. There is no significant difference in mean gain score of student achievement in respect to gender i.e., male and females. Thus, it can be inferred that students are not affected in mean gain scores on student achievement in relation to gender.

INTERACTION EFFECT BETWEEN INSTRUCTIONAL TREATMENT AND GENDER

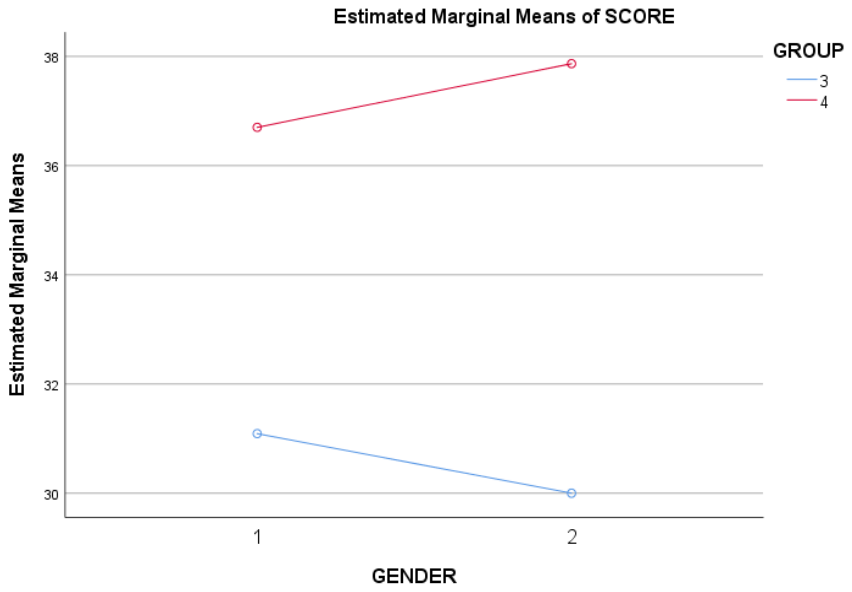


Figure 4.20. Interaction Effect among groups, gender and achievement scores of students in biology.
(Where gender 1 = male, 2=female; group3 = control, 4= experimental)

Table 4.25. reveals that the F value 0.332 with df 69 for the first order interaction effect between instructional treatments and gender was not found significant, because the F value is less than table value at. 05 level of significance. The result revealed that there was no significant interaction between instructional treatments and gender on student achievement. But figure 4.20. Showing that there is slightly interaction between students with gender and instructional treatments on student achievement.

Therefore, hypothesis H-4There is no significant interaction effect of Blended Learning Strategies and conventional method with respect to gender on the mean score of achievement in Biology is accepted.

4.6.2. INTERACTION EFFECT FOR ATTITUDE TOWARDS BIOLOGY

To find out interaction effect for attitude towards biology variable, first of all gain scores were calculated. Then ANOVA was conducted to get the result.

GAIN SCORE FOR ATTITUDE TOWARDS BOLOGY

Gain score can be obtained by calculating the difference between same kinds of tests. Here mean gain score were calculated from control group and experimental group each pre and post test scores.

DESCRIPTIVE STATISTIVS FOR GAIN SCORES OF EACH GROUP

The mean, median, mode, standard deviation, Skewness and Kurtosis were calculated for gain scores of each group i.e. control and experimental group are shown in Table.4.26.

Table 4.26. Descriptive Statistics for Gain score of attitude towards biology

Group	N	Mean	SD	Skewness	Kurtosis	Conclusion
Control	35	45.17	23.38	-0.502	-0.828	Normal
Experimental	35	47.26	21.24	-0.935	1.176	Normal

The values of Mean of pretest scores do not defer significantly and it shows the distribution tends to be normal. The standard value of skewness falls between +1 to -1 and the same for kurtosis from +2 to -2 (Marie, 2016). The table shows the values are coming under the aforesaid value. So, again by these values we can assume that the sample maybe distributed normally.

All the table values show that there is a tendency of normal distribution hence assumption of t-test also occurs.

TEST OF NORMALITY FOR GAIN SCORE

Normal distribution of data confirms conductance of parametric test for statistical analysis. To know the same Kolmogorov-Smirnov and Shapiro-Wilk test of normality were conducted. The current study includes 35 sample sizes each for control and experimental group. This is considered as small sample size. In case of small samples it is generally found that Shapiro-Wilk test is more appropriate to diagnose the normality of data (Mari, 2016). Table for the test of normality and the values obtained from present study in attitude questionnaire score are shown in Table 4.22.

Table 4.27. Tests of Normality for gain score in attitude questionnaire

Group	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	Df	Sig.	Statistic	Df	Sig.
Control	.198	35	.074	.923	35	.174
Experimental	.185	35	.321	.919	35	.063

The significance value of both Kolmogorov-Smirnov and Shapiro-Wilk Test of normality if exceed 0.05, it indicates the sample follows normality. In table 4.4 we can see all the significance value are above 0.05. So, it can be concluded that that distribution of data is normal here.

HOMOGENEITY OF VARIANCE

Table 4.28 Levene's Test of Equality of Error Variances in attitude towards biology

		Levene Statistics	df_1	df_2	Sig.
Attitude	Based on Mean	2.67	3	66	.06
	Based on Median	1.52	3	66	.21
	Based on Median and with adjusted df	1.52	3	59.56	.21
	Based on trimmed mean	2.56	3	66	.06

The homogeneity of variance is generally tested by Levene's test by the help of SPSS software, described here in table no. 4.28. The variance within the cells must be homogeneous (Singh, 2018). Levene's Test with having a p-value below 0.05 indicates non homogeneity of the assumptions (Singh, 2018).

For the present set of data the result of the Levene's Test indicates that the assumption of homogeneity of variance has been complied with as the p-value is more than 0.05 ($p=0.557>0.05$). So, it is proved that the variances within the cells are homogeneous.

Since all the assumptions for applying analysis of variance are satisfied, the given data was analysed by applying the technique of ANOVA in SPSS in order to study the main effects and interaction effects of variables.

In experimental Research design and analysis of variance two types of effects can be calculated i.e. Main and interaction effect. Main effect is the effect of an independent variable on a dependent variable average across the levels of any other dependent variables. Whereas, the interaction effect refers to the role of a variable in an estimated model and its effect on dependent variable. Available that has an interaction effect have a different effect on independence variable depending on the level of some third variable. Lavrakas (2008) defined interaction effect as "An interaction effect is the simultaneous effect of two or more independent variable on at least one dependent variable in which they are joint effect is significantly greater or lesser than the sum of the parts."

Two-way ANOVA (Analysis of Variance) is conducted as a parametric test which determines the effect of two different nominal variables on single continuous dependent variable. For the present study two independent variables are taken. It has two main effects and one interaction effects or combined effects of two variables on the dependent variable. Two way classification and three F values were estimated. Two F-values for two main effects and one interaction effect's F value were calculated also.

Table 4.29. Tests of main and interaction effect in attitude towards biology

Dependent Variable : Attitude						
Source	**Type III Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**	**Partial Eta Squared**
Corrected Model	820.408	3	273.469	.538	.658	.024
Intercept	131132.070	1	131132.070	257.904	.000	.796
INS_C_E	462.759	1	462.759	.910	.344	.014
Gender	362.242	1	362.242	.712	.402	.011
INS_C_E * Gender	3.601	1	3.601	.007	.933	.000
Error	33557.878	66	508.453			
Total	174334.000	70				
Corrected Total	34378.286	69				

- **HYPOTHESIS 8**

For the purpose of testing of hypothesis following null hypothesis and alternative hypothesis was formulated to find the significant interaction effect between control and experimental group's attitude towards Biology questionnaire score of both pre-test and post test group treated with conventional method and blended method of teaching respectively along with gender.

$H_{0(8)}$: There is no significant interaction effect of Blended Learning Strategies and conventional method with respect to gender on the mean score of attitude towards Biology.

It is used to identify the significance between more than two means i.e. pretest and post test scores of the control and experimental group and gender. Accordingly the hypothesis is tested and the results are presented accordingly. Two way ANOVA is conducted for the variable attitude score for control and experimental group and results are presented eventually.

MAIN EFFECT IN INSTRUCTIONAL TREATMENTS FOR ATTITUDE TOWARDS BIOLOGY

Table.4.29. Reveals that the F value 0.910 with df 69 for the difference between control and experimental group had higher the table value 0.344 at.05 level of significance. It stated that there was no significant difference in mean gain scores of student Attitude towards Biology in respect two instructional treatments i.e., conventional strategies and blended learning modules. The result of no significant difference among groups i.e., students taught through blended learning modules or conventional techniques in growing more positive attitude towards Biology.

MAIN EFFECT ON GENDER ON ATTITUDE TOWARDS BIOLOGY

Table.4.23. reveals that the F value 0.712 with df 69 for the difference between categories was found to be insignificant 0.402 at. 05 level of significance. There is no significant difference in mean gain score of student attitude towards Biology score in respect to gender i.e., male (1) and females (2). Thus, it can be inferred that students are not affected in mean gain scores on student attitude towards Biology scores in relation to gender.

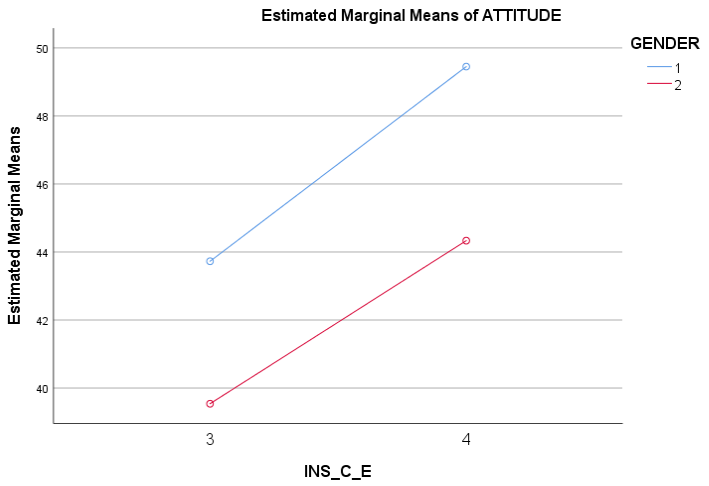


Figure 4.21. Interaction effect among groups, gender, and attitude of students towards biology.

[Where gender 1=male, 2=female; group control=3 and 4= experimental]

INTERACTION EFFECT BETWEEN INSTRUCTIONAL TREATMENT AND GENDER

Table 4.29. reveals that the F value 0.007 with df 69 for the first order interaction effect between instructional treatments and gender was not found significant, because the F value is less than table value 0.933 at. 05 level of significance. The result from figure 4.14. revealed that there was no significant interaction between instructional treatments and gender on student attitude towards Biology. Research work conducted by Greenfield (1997; Nasr and Soltani K.,2011) shown that attitude towards science has no significant effect on a particular gender i.e., males or females which supports the present study findings.

Therefore, hypothesis H-8 There is no significant interaction effect of Blended Learning Strategies and conventional method with respect to gender on the mean score of attitude towards Biology is accepted.

4.6.3. INTERACTION EFFECT FOR ANXIETY IN BIOLOGY

To find out the interaction effect for anxiety in biology variable, first of all gain scores were calculated. Then ANOVA was conducted to get the result.

GAIN SCORE FOR ANXIETY TOWARDS BIOLOGY

Gain score can be obtained by calculating the difference between same kinds of tests. Here mean gain score were calculated from control group and experimental group each pre and post test scores.

DESCRIPTIVE STATISTIVS FOR GAIN SCORES OF EACH GROUP

The mean, median, mode, standard deviation, Skewness and Kurtosis was calculated for gain scores of each group i.e., control and experimental group are shown in Table.4.32.

Table 4.30. Descriptive Statistics for Gain score for anxiety in biology

Group	N	Mean	SD	Skewness	Kurtosis	Conclusion
Control	35	8.74	10.433	0.898	0.534	Normal
Exp.	35	8.97	7.744	0.393	0.483	Normal

The values of mean of pre-test scores do not defer significantly and it shows the distribution is tends to be normal. The standard value of skewness falls between +1 to -1 and the same for kurtosis from +2 to -2 (Marie, 2016). The table shows the values are coming under aforesaid value. So, again by these values we can assume that the sample maybe distributed normally.

All the table values show that there is a tendency of normal distribution hence assumption of t-test also occurs.

TEST OF NORMALITY FOR GAIN SCORE

Normal distribution of data confirms conductance of parametric test for statistical analysis. To know the same Kolmogorov-Smirnov and Shapiro-Wilk test of normality were conducted. The current study includes 35 sample sizes each for control and experimental group. This is considered as small sample size. In case of small samples, it is generally found that Shapiro-Wilk test is more appropriate to diagnose the normality of data (Mari, 2016). Table for the test of normality and the values obtained from present study in biology anxiety scale score are shown in Table 4.31.

Table 4.31. Tests of Normality for gain score for anxiety towards biology

Group	Kolmogorov-Smirnov			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Control	.186	35	.084	.917	35	.067
Experimental	.161	35	.106	.955	35	.156

The significance value of both Kolmogorov-Smirnov and Shapiro-Wilk Test of normality if exceed 0.05, it indicates the sample follows normality. In table 4.31 we can see all the significance value are above 0.05. So, it can be concluded that that distribution of data is normal here.

HOMOGENEITY OF VARIANCE

Table 4.32. Levene's Test of Equality of Error Variances for anxiety towards biology

		Levene Statistics	df_1	df_2	Sig.
Gain Score_ Anxiety	Based on Mean	.764	3	66	.518
	Based on Median	.480	3	66	.698
	Based on Median and with adjusted df	.480	3	55.79	.698
	Based on trimmed mean	.659	3	66	.580

The homogeneity of variance is generally tested by Levene's test by the help of SPSS software, described here in table no. 4.32. The variance within the cells must be homogeneous (Singh,2018). Levene's Test with having a p-value below 0.05 indicates non homogeneity of the assumptions (Singh, 2018).

For the present set of data, the result of the Levene's Test indicates that the assumption of homogeneity of variance has been complied with as the p-value is more than 0.05 ($p=0.557>0.05$). So, it is proved that the variances within the cells are homogeneous.

Since all the assumptions for applying analysis of variance are satisfied, the given data was analyzed by applying the technique of ANOVA in SPSS in order to study the main effects and interaction effects of variables.

In experimental Research design and analysis of variance two types of effects can be calculated i.e. Main and interaction effect. Main effect is the effect of an independent variable on a dependent variable average across the levels of any other dependent variables. Whereas the interaction effect refers to the role of a variable in an estimated model and its effect on dependent variable. Available that has an interaction effect have a different effect on independence variable depending on the level of some third variable. Lavrakas (2008) defined interaction effect as "An interaction effect is the simultaneous effect of two or more independent variable on at least one dependent variable in which they are joint effect is significantly greater or lesser than the sum of the parts."

Two way ANOVA (Analysis of Variance) is conducted as a parametric test which determines the effect of two different nominal variables on single continuous dependent variable. For the present study two independent variables are taken. It has two main effects and one interaction effects or combined effect of two variables on the dependent variable. Two way classification and three F values were estimated. Two F-values for two main effects and one interaction effect's F value were calculated also.

Table 4.33. Test for main and interaction effect of anxiety towards biology

Dependent Variable: Gain score_Anxiety						
Source	**Type III Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**	**Partial Eta Squared**
Corrected Model	50.473	3	16.824	.195	.899	.009
Intercept	5453.441	1	5453.441	63.255	.000	.489
Group _Anxiety(control -3 , exp. – 4)	.363	1	.363	.004	.948	.000
Gender_Anxiety (male -1 , female -2)	49.299	1	49.299	.572	.452	.009
Group_Anxiety* Gender_Anxiety	.117	1	.117	.001	.971	.000
Error	5690.099	66	86.214			
Total	11232.000	70				
Corrected Total	5740.571	69				

- **HYPOTHESIS 12**

$H_{0(12)}$: There is no significant interaction effect of Blended Learning Strategies and conventional method with respect to gender on the mean score of anxiety towards Biology.

Two-way ANOVA is conducted for the variable attitude score for control and experimental group and results are presented eventually.

MAIN EFFECT IN INSTRUCTIONAL TREATMENTS AND GENDER

Table. 4.33. reveals that the F value 0.004 with df 69 for the difference between control and experimental group had higher the table value 0.948 at.05 level of significance. It stated that there was no significant difference in mean gain scores of student anxiety score in Biology in respect two instructional treatments i.e., conventional strategies and blended learning modules. The result of no significant difference among groups i.e., students taught through blended learning modules are highly effective or more positive result in reducing anxiety than students taught through conventional way.

MAIN EFFECT OF GENDER ON ANXIETY TOWARDS BIOLOGY

Table. 4.33. reveals that the F value 0.572 with df 69 for the difference between categories was found to be insignificant 0.452 at 0.05 level of significance. There is no significant difference in mean gain score of student anxiety score in respect to gender i.e., male and females. Thus, it can be inferred that students are not affected in mean gain scores on student anxiety scores in relation to gender.

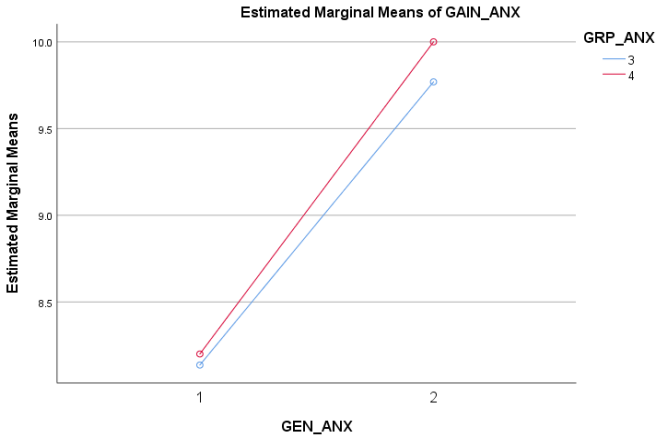


Figure 4.22. Interaction Effect among groups, gender and anxiety towards biology [Where gender 1=male, 2=female; group control=3 and 4= experimental]

INTERACTION EFFECT BETWEEN INSTRUCTIONAL TREATMENT AND GENDER

Table 4.33. reveals that the F value 0.001 with df 69 for the first order interaction effect between instructional treatments (Series 3) and gender (Series 4) was not found significant, because the F value is less than table value 0.971 at 0.05 level of significance. The result revealed from Figure 4.22. that there was no significant interaction between instructional treatments and gender on student achievement.

Therefore, hypothesis H-12 there is no significant interaction effect of Blended Learning Strategies and conventional method with respect to gender on the mean score of anxiety in Biology may be accepted.

4.7. EFFECTIVENESS OF EACH BLENDED LEARNING STRATEGY

For the present study, two different blended learning strategies were used to complete the study namely, Face to face driver and rotation techniques. As the sample remains same and taught with two different blended strategies, only achievement test was the way to get result about the effectiveness of two strategies individually (Chapzalwaski, 2014). 30 lessons were administered with blended method. 15 lessons were taught with the help of computers and station rotation method and 15 lessons were treated with k-yan machine and face to face driver technique. Achievement test question with 50 items were used to collect the data from students. Detailed analysis of questions revealed that 22 questions were comes under face-to-face method and 28 questions were constructed under the rotation technique.

After collecting achievement test data, pretest and posttest scores of each category were equated using percentage. Then gain scores were calculated for each group. To know which blended technique is more effective among face-to-face driver and rotation techniques, paired sample t test was conducted.

Table4.34: Paired t test for face-to-face driver and rotation techniques

Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference		t	df	Sig. (2-tailed)
			Lower	Upper			
3.886	6.842	1.156	6.236	1.535	3.360	34	0.002*

*p<0.05%

From table no. 4.34., Paired t test for face-to-face driver and rotation techniques reveals t value 3.360 in df 34 found significant in 0.05% level as the value found 0.002 which is less than 0.05. So, the value is significant and significant difference found between two blended learning strategies, i.e., face-to-face driver and rotation techniques.

Table 4.35: Mean and SD value for face-to-face driver and rotation techniques

	Mean	N	Std. Deviation	Std. Error Mean
Rotation	16.63	35	4.544	0.768
Face-to-face	20.51	35	3.737	0.632

Mean values for rotation and face-to-face driver techniques are 16.63 and 20.51 and standard deviation values found 4.544 and 3.737. from figure 4.23, it can infer that face-to-face driver technique is more effective in comparison to rotation method of blended learning.

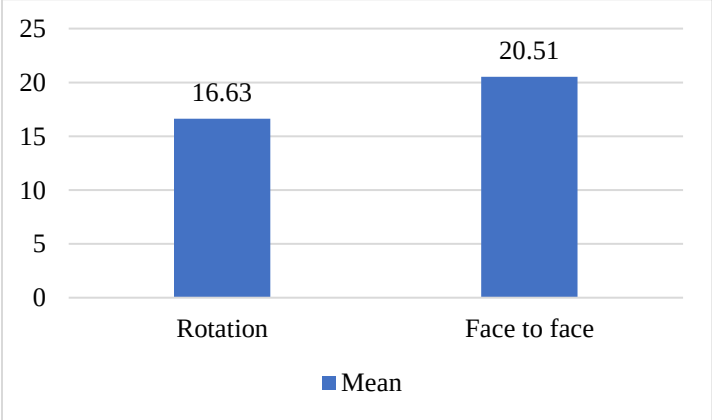


Fig 4.23. Mean scores of rotation and face to face techniques

Table 4.36. Effect Size of the different blended learning programs on the experimental groups on achievement in biology

Test	Df	T	D	R	Effect Size
Paired Sample t test	34	0.360	0.93	0.853	Large

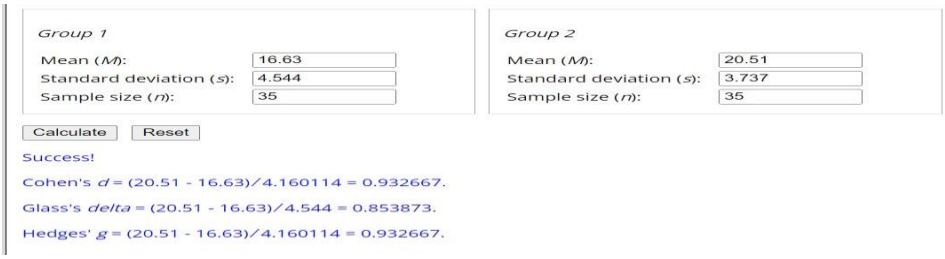


Figure 4.24. Effect size of paired sample t test

Table 4.36 and figure 4.24 shows that the Cohen's d value is 0.93 and r value is 0.853. From these data, it can be said that the effect size of the program is large on students' achievement in biology. The result of study was supported by Leeuwen et al. (2018), who used two different blended learning models to complete their study. The chief aim of the study was to find out the effectiveness of blended learning strategies and discover if any differences were found between using two different blended strategies. Two different blended strategies used for studies were flipped classroom and enriched virtual techniques. 150 students at university (114 females and 36 males) were chosen as sample for flipped classroom techniques and 470 students (216 females and 216 males). Results found that enriched virtual classroom set up has better impact in comparison to flipped classroom model of blended learning. It was also found from study that combined effect of both the strategies have better impact in comparison to individual model. Simonova and Kostolanyova (2016) also conducted their study with two different techniques but did not find significant result with any one method.

4.8. CONCLUSION

This Chapter is contributed the data Analyses part of present study and its interpretation also. Next Chapter contains summary of findings of the analyzed data and discussions of the found findings are presented.

CHAPTER – 5

SUMMARY AND CONCLUSIONS

Chapter 5 of a thesis helps to get an idea about the summary, implications, limitations of the present study, scopes for future studies and recommendations by the researcher. It gives vivid idea about the conclusion of research and all relevant outcomes of conducted research.

5.1. INTRODUCTION

With the emergence of Technology in education it became more machine dependent so that role of teachers becoming day by day lesser. “In the past 10 years, web accesses, the nature of the Web, and contexts for learning have been transformed, along with the emergence of desired technological competencies for learners, teachers, and administrators. Internet connectivity in schools, homes, neighborhoods, and communities has become increasingly pervasive. Since the mid-1990s, the percentage of public schools connected to the internet exploded from 35% to 100%. Public instructional classrooms with Internet access grew to 94%, up from 14% a decade earlier, and the ratio of students per Internet-connected instructional computer decreased from 12:1 to 3.8:1” (Wells and Lewis, 2006).

The term effectiveness refers to the results we get, the progress a student makes towards some specified goals of education. Learning effectiveness or learning ability can be defined as the comfort and pace by which students can receive the needed information, knowledge and skill (Khamparia and Pandey, 2018). Learning effectiveness refers to the degree to which online program graduates obtain educations that reflect the specific qualities of the institution, particularly when compared to learning received through the university’s more traditional face-to-face classroom-based instruction. The program or course is made to be at least as good as face-to-face classes provided by the same university. If there isn’t a face-to-face course that is similar, the normative benchmark of the institution is not fulfilled. Learning media (books, notes, software, CD-ROMs, and so forth), faculty who teach the class and are available outside of class, and students who interact with the faculty and with each other are typically the same learning resources in

online courses as they are in traditional face-to-face courses at the institution. (Janetmoore, 2004). Learning effectiveness can also be understood by distinctiveness of quality of education of online learning from a traditional classroom system. The motto of online learning is different from that of institution based or other delivery modes of teaching and it also remarkably differs from face-to-face, conventional teaching-learning system as it totally lacks the interaction part (Swan, 2003).

The researcher of present study is a teacher, so, she has personal experience to deal with children and being a teacher she is also facing different difficulties related to ever changing needs of pupils' and dynamic teaching learning process at school level. Anxiety towards Biology, Attitude towards Biology and achievement in Biology were 3 variables of this study as 3 A's. Improvement of these 3A's can improve overall learning outcome of a student, so they were chosen as the variables of study. Comparison was made within conventional chalk and talk classroom situation and blended learning model of teaching to know the efficiency of the blended learning technique. BL is a flexible learning method which includes online and offline materials mixed together to get more efficient learning outcome. Quasi experimental pre-test post-test design was adopted for the present study according to the need of the objectives of the study. Biology Anxiety Scale was constructed and validated for the study, Biology Attitude Questionnaire by Prokop et al., (2007) was adapted in Indian scenario and applied in present study to measure the attitude of the students and achievement test questionnaire was also constructed and validated to measure achievement in Biology. Conventional and Blended lessons plans were made and validated also to complete the process of research. And finally statistical analysis was conducted descriptive statistics (Mean, SD, Kurtosis, Skewness), Test for normality and parametric tests (t-test and ANOVA) was conducted for present study to get the result. Results were found as per the objectives and implementations of this study are discussed later here in this chapter.

BLENDED LEARNING

The central idea of Blended learning was first established in 1960s. But the term was coined by Bonk and Graham. Some synonyms of blended learning are –"Hybrid Learning", "Mixed–mode instruction", "web-enhanced instruction" etc. In late 60s,

University of Illinois developed Programmed Logic for Automatic Teaching Operations (PLATO) technique, which can be the example of first blended learning initiative in the world. The proper definition of blended learning was come to forth after release of "Handbook of Blended Learning" by Bonk and Graham in the year 2006. When in a classroom situation more than 80% of the contents are delivered with online resources that classroom can be said e-learning or online learning class and the percentage of online content when used below 29% it is considered as conventional offline class. When the amount of e resources is maintained from 30-79% that classroom comes under the category of blended learning (Allen, Seaman and Garrett, 2007). Ossiannilsson et al., (2015) found total 6 dimensions, namely: students, teachers, curriculum, educational technology, course pattern and classroom situations are the key factors to make a successful blended learning program. Bates (2016) found many challenges in implementation of blended learning program and he proposed several ways to solve the problems like: time management, adopt a proper methodology, support students, keep students motivated and most importantly increasing the scope of research in blended learning.

ACHIEVEMENT IN BIOLOGY

Ladson (1999) defined achievement as an increase in intellect and taking part in the knowledge production process. Achievement refers to knowledge acquired, and abilities gained during a student's academic career that are evaluated with the aid of teacher-made or standardized assessments and serves as a status of the student's learning (Arora,2016). Achievement in Biology means the gain of skill in subject Biology. Achievement in Biology means the gain of skill in subject Biology. Achievement test is the one of the easiest ways to measure the effectiveness of a variable implied as an intervention. Enhancement of achievement can be possible by the promotion of blended learning, it was proved by many researchers before (El-Deghaidy and Nouby, 2008; Picciano, 2012; Yapici and Akbayin, 2012; Porter et.al, 2014; Kumar, 2014; Aldalalah et.al 2014; Kassab et al, 2015; Nazarenko 2015; Gohil, 2018; Harahap et al. 2019; Ayob et al. 2020; Polhun et al. 2021).

ANXIETY TOWARDS BIOLOGY

Anxiety is a kind of psychological disorder mostly seen in all students. Poor academic score, irregularity, achievement, flow management of study, bullying, ragging, competition among students, pressure of guardians, result expectation, peer grouping maladjustment etc. are some causes of anxiety. England et al. (2019) pointed out that anxiety is a kind of emotion which negatively affects the performance and the quality of students. They found that anxiety can serve as a barrier in academic performance of students. Sharma and Sarkar (2020) conducted a study on the pick time of corona pandemic when blended mode was introduced in a large scale in many schools in India. Aim of the study is to know the impact of blended learning in reducing anxiety among students. Investigators used self-made questionnaire-based survey method with 56 school children. Students were taken from different schools with blended learning facilities. Results found that most of the students like to take lessons in science in blended mode whereas they are least interested in taking lessons in social science through blended platform. Almost 73% of the students likes blended learning platform to complete their studies and most of them believes that it can help them to reduce academic anxiety.

ATTITUDE TOWARDS BIOLOGY

Attitude is a positive psychological variable. Attitude towards Biology means growth of positive thought for the subject Biology. Human beings have a strong connection with science in their everyday life. Even the ordinary person uses science in their daily life simultaneously. So, it is very necessary to grow scientific attitude among children. Many previous workers recommended that renovation of methodology in teaching of biology should be done for the sake of growth in attitude towards biology (Odubunmi, 1983; Bajah, 1986; Yapici and Akbayin, 2012; Juweto, 2015). Wang et al. (2007) found that the factors affecting level of learning of concepts of biology among the senior level of students their perspective towards biology. They concluded that attitude towards values and motivation affects mostly in concepts building in biology. Students shown a high level of motivation and attitude towards biology positively retained among senior secondary level learning concept in biology.

The main purpose of this study is to discover the differences between conventional learning and blended classes with respect to Achievement, Anxiety towards Biology and Attitude towards Biology among Senior Secondary students in rural areas in West Bengal.

Biology is taken as experimental subject because the investigator is an experienced Biology teacher of a Govt. Sponsored School (12 years' Experience), due to mastery in Biology, the subject is chosen for present study. At present the need of an efficient doctor is in pick. Entrance exam related to Medical have most weightage of 50% in Biology. Higher Secondary or senior secondary is the preparative stage for such competitive exams. So, growth of confidence and positive attitude towards biology is very much needed in this stage. These are the chief causes to choose Biology and senior secondary Students in this study.

5.2. SIGNIFICANCE OF THE STUDY

Now a day, Blended learning is one of the most interesting and emerging innovative pedagogical techniques in India, so experimentation with blended learning is chosen for present study.

Rural areas are chosen strictly for current study to get its finest result as the resources and funding are very limited there. Because of high student teacher ratio in Govt. and sponsored schools in West Bengal, the teaching learning process cannot run as per requirement and quality, also teachers cannot get proper learning outcomes from students. Some of these schools have well developed computer lab and internet connection but still no use of those web resources into subjective teaching learning process. So, this study intended to pursue to know if the process of implementation of blended learning possible or not and also it is efficient or not in enhancement of teaching learning process without lots of investments and with the help of limited resources.

Students of Class XI and XII, they come under adolescent age group. Many previous studies prove that children of adolescent periods have shown a most amount of anxiety (Hishinuma et. al, 2000; Ozkan and Koseler, 2009; Henrie et. al, 2015) due to academic pressure, hormonal changes, other pressure etc. than other age group. So, it is decided to take adolescent age group as our study group.

Failure in achievement leads to less student satisfaction; increasing anxiety in them also embarks fear especially in Biology learning (Deb et. al, 2015). This project can justify if some of blended learning strategies are introduced in classrooms of a high student volume school is it helpful or not in growing interest in Biology. Who dream to become a doctor but because of traditional or conventional teaching methods they have anxiety towards certain topics where their clarity is required for further exposure, so to reduce anxiety and boosting pupils mind to get more satisfactory learning support in Biology teaching with the help of available human and e-resources.

The main purpose of this study is to discover the differences between conventional learning and blended classes with respect to Achievement, Anxiety towards Biology and Attitude towards Biology among Senior Secondary students in rural areas in West Bengal.

Biology is taken as experimental subject because the investigator is an experienced Biology teacher of a Govt. School(12 years' Experience), due to mastery in Biology, the subject is chosen for present study. At present the need of an efficient doctor is in pick. Entrance exam related to Medical have most weightage of 50% in Biology. Higher Secondary or senior secondary is the preparative stage for such competitive exams. So, growth of confidence and positive attitude towards biology is very much needed in this stage. These are the chief causes to choose Biology and senior secondary Students in this study.

5.3. STATEMENT OF THE PROBLEM

The problem under investigation is entitled as:

"EFFECTIVENESS OF BLENDED LEARNING IN BIOLOGY ON ACHIEVEMENT, ANXIETY AND ATTITUDE OF SENIOR SECONDARY STUDENTS OF WEST BENGAL"

5.4. RESEARCH OBJECTIVES

1. To prepare and validate the Blended Learning content for class XI students of Biology.
2. To prepare the achievement test for the content for Class XI students of Biology.

3. To prepare the lesson plans for blended learning and conventional learning approaches for the content in Biology.

4. To study the effect of Blended Learning strategies (BLS) on students of XI standard with respect to

a. Achievement in Biology.

b. Anxiety towards Biology.

c. Attitude towards Biology.

5. To study the interaction effect of Blended Learning strategies (BLS) and gender on students of XI standard with respect to

a. Achievement in Biology

b. Anxiety towards Biology

c. Attitude towards Biology.

5.5. HYPOTHESES

The hypotheses of this study are presented as follows:

1. There is no significant difference between pre and post test score in biology among class XI students of control group taught by conventional method.

2. There is no significant difference between pre and post test score in biology among class XI students of experimental group taught by blended learning method.

3. There is no significant difference between post test score in biology among class XI students of control and experimental group.

4. There is no significant interaction effect of Blended Learning Strategies and conventional method with respect to gender on the mean score of achievement in Biology.

5. There is no significant effect of control group conventional method on the mean score of attitude towards Biology among the students of XI standard.

6. There is no significant difference of pre and posttest scores of attitude towards Biology among the students of XI standard of experimental group.

7. There is no significant difference of pre and posttest scores of attitude towards Biology among the students of XI standard of control and experimental group.

8. There is no significant interaction effect of Blended Learning Strategies and conventional method with respect to gender on the mean score of attitude towards Biology.

9. There is no significant difference of pre and posttest scores of anxiety towards Biology among the students of XI standard of control group.

10. There is no significant difference of pre and posttest scores of anxiety towards Biology among the students of XI standard of experimental group.

11. There is no significant difference of pre and posttest scores of anxiety towards Biology among the students of XI standard of control and experimental group.

12. There is no significant interaction effect of Blended Learning Strategies and conventional method with respect to gender on the mean score of anxiety towards Biology.

5.6. DELIMITATIONS

The study has the following delimitations:

- Area: The study is confined to schools following WBCHSE syllabus of a particular area.
- Grade and size of sample: The study is delimited to only 70 senior secondary students especially of Class XI.
- Subject: Only teaching learning of Biology is considered for the study.
- Medium of study: Only Bengali medium students are considered here in this study, Achievement and treatment were delivered in Bengali.
- Among all Blended learning strategies only rotation and face to face driver are limited for present study.

5.7. OPERATIONAL DEFINITIONS

Effectiveness of blended learning, achievement, anxiety and attitude towards biology and senior secondary level are the key terms related to the present study.

Effectiveness of Blended learning

Effectiveness of Blended learning defines as a measure to study the impact of blended learning inventions, which is the combination of face to face and rotation techniques, on students learning.

Achievement in Biology:

Achievement in biology is measured on the basis of knowledge, comprehension, application and skills of scientific facts, ideas, laws, theories and principles related to the chosen topics from the curriculum of biology taught to eleventh grader of WBBSE.

Anxiety towards biology

In present study anxiety towards biology is measured with respect to test anxiety, classroom anxiety and laboratory anxiety.

Attitude towards Biology

In the present study the attitude towards biology is measured with respect to interest, difficulty and importance.

Senior Secondary School Students:

Senior secondary school students mean the students of XI standard.

5.8. SAMPLE AND SAMPLING TECHNIQUE

Choice of district for the present study has been done on the basis of result trend of this year's published data by West Bengal Council for Higher Secondary Education. Alipurduar district has been chosen because only 69.83% students qualified H.S. Examination this year from this district (though this district has computer literacy and infrastructure) whereas the overall pass percentage is 90.13%. Conditions of availability, presence of infrastructure are the priorities as per present research. As the present study requires a computer lab facility and well-developed electric supply and internet

connection, the school is chosen as per that basis. The accessible population consists of all male and female candidates of all Government sponsored schools of Alipurduar district. In this study, purposive sampling techniques were used to select schools to participate in this study based on the following criteria:

- School that has access to computers and the students are computer literate.
- Schools that have access to steady internet.

Based on above two criteria only 5 schools are found there; information collected from District Inspector of Schools (SE), Alipurduar that this district has 5 blocks, each having one ICT based school. Of them 2 are well equipped with many computers and steady internet connection, and 3 has issues with either internet connectivity or inadequate numbers of computers. Among them, by lottery, ONE school is chosen for present study namely Barabisha High School (H.S.) from where the due permission is taken from respected Headmaster of the school. As this school has intake capacity of 75 students in science stream (as per WBCHSE order) the sample size considered for this study are almost 70 in total (to avoid experimental mortalities). Out Of them 35 were considered as experimental and 35 students were considered as control group. According to the result of pretest, two groups were constructed with almost equal weightage of marks by the SPSS software. Equation of groups were justified by Spearman's coefficient of co relation method (Conklin, 2017).

5.9. RESEARCH TOOLS FOR THE STUDY

- Blended Learning Strategies: Rotation, Face-to-face driver
- Lesson Plans – prepared by investigator herself.
- Achievement Test – Pre and Post Test questions prepared by investigator herself.
- Biology Attitude Scale – by Prokop, Tuncer and Chuda (2007) – it was adapted in Indian scenario and focus was given on three dimensions, i.e. Interest, difficulty and importance – as per need of study. Due Permission already been taken from the author.

- Biology Anxiety Scale– was constructed by investigator. Reliability and validity were checked as per need of the study with proper sample size.
- All the tools were constructed and applied in English Language and medium of instruction, lesson plans and achievement test questions was prepared in their mother languages i.e. Bengali Language and administered with the same form along with a English version of that in questions (Nair, 2014; Fakhir, 2015).

5.10. DATA COLLECTION

Data were collected from chosen school before treatment period. According to the achievement test scores samples were distributed into two groups namely experimental and control group by SPSS 26 software. Then control group was treated with conventional method and experimental group were treated with blended method. After 6 weeks treatment period all tools were reapplied on both the groups. Data were collected and analyzed as per need of the study.

5.11. STATISTICAL TECHNIQUES USED

Statistical techniques were used to analyze data are:

- Descriptive: Mean, Median, Mode, Standard Deviation, Kurtosis, Skewness
- Inferential: t-Test and ANOVA

5.12. FINDINGS OF THE STUDY

Following are the findings of present study, which were derived from the results of data analysis on the hypotheses formulated for the study.

Objective 4: To study the effect of Blended Learning strategies (BLS) on students of XI standard with respect to a) Achievement in Biology, b) Anxiety towards Biology, c) attitude towards Biology.

$H_{(0)}$ 1. There is no significant difference between pre and post test score in biology among class XI students of control group taught by conventional method

Paired sample t test was conducted to get the result. The study findings explores that a statistically significant difference found between pretest and posttest score in biology among class XI students of control group. So, it can be concluded that conventional method is an effective way to enhance academic achievement score in biology.

$H_{(0)}$ 2. There is no significant difference between pre and post test score in biology among class XI students of experimental group taught by blended learning method.

Paired sample t test was conducted to get the result. The study findings finds that a statistically significant difference found between pretest and posttest score in biology among class XI students of experimental group. It can be concluded that blended strategy is effective to improve academic achievement scores among students.

$H_{(0)}$3. There is no significant difference between post test score in biology among class XI students of control and experimental group.

Independent sample t test was conducted to get the result. The study findings reveals that a statistically significant difference found between post test score in biology among class XI students of control and experimental group. So, it can be concluded that "blended learning strategies is effective for achievement in biology"

$H_{(0)}$5. There is no significant difference of pre and posttest scores of attitude towards Biology among the students of XI standard of control group.

Paired sample t test was conducted to get the result. The study findings explores that a statistically significant difference found between pretest and posttest attitude questionnaire score in biology among class XI students of control group. So, it can be concluded that conventional method is an effective way to trigger positive attitude towards biology.

$H_{(0)}$6. There is no significant difference of pre and posttest scores of attitude towards Biology among the students of XI standard of experimental group.

Paired sample t test was conducted to get the result. The study findings finds that a statistically significant difference found between pretest and posttest attitude questionnaire score in biology among class XI students of experimental group. It can be concluded that blended strategy is effective to improve attitude towards biology among students.

$H_{(0)}$7. There is no significant difference of pre and posttest scores of attitude towards Biology among the students of XI standard of control and experimental group.

Independent sample t test was conducted to get the result. The study findings reveals that no statistically significant difference found between posttest score in attitude questionnaire in biology among class XI students of control and experimental group. So, it can be concluded that "blended learning strategies are not effective for improving attitude towards biology"

$H_{(0)}$9. There is no significant difference of pre and posttest scores of anxiety towards Biology among the students of XI standard of control group.

Paired sample t test was conducted to get the result. The study findings explores that a statistically significant difference found between pretest and posttest score in

anxiety towards biology among class XI students of control group. So, it can be concluded that conventional method is an effective way to reduce academic anxiety towards biology.

$H_{(0)}$10. There is no significant difference of pre and posttest scores of anxiety towards Biology among the students of XI standard of experimental group.

Paired sample t test was conducted to get the result. The study findings finds that a statistically significant difference found between pretest and posttest score in biology among class XI students of experimental group. It can be concluded that blended strategy is effective to reduce anxiety towards biology among students.

$H_{(0)}$11. There is no significant difference of pre and posttest scores of anxiety towards Biology among the students of XI standard of control and experimental group

Independent sample t test was conducted to get the result. The study findings reveal that statistically significant difference found between post test score in anxiety towards biology among class XI students of control and experimental group. So, it can be concluded that **"blended learning strategies are proved effective for reducing anxiety towards biology"**

Objective 5: To study the interaction effect of Blended Learning strategies (BLS) and gender on students of XI standard with respect to a) Achievement in Biology, b) Anxiety towards Biology, c) attitude towards Biology

$H_{(0)}$4. There is no significant interaction effect of Blended Learning Strategies and conventional method with respect to gender on the mean score of achievement in Biology.

Study result was established by the application of two-way ANOVA. Study result reveals that there is no significant interaction effect of blended learning strategies and conventional method with respect to gender on the mean score of achievement in Biology.

H(0) -8. There is no significant interaction effect of Blended Learning Strategies and conventional method with respect to gender on the mean score of attitude towards Biology.

Study result was established by the application of two-way ANOVA. Study result reveals that there is no significant interaction effect of Blended Learning Strategies and conventional method with respect to gender on the mean score of attitude towards Biology.

H(0)-12. There is no significant interaction effect of Blended Learning Strategies and conventional method with respect to gender on the mean score of anxiety towards Biology.

Study result was established by the application of two-way ANOVA. Study result reveals that there is no significant interaction effect of Blended Learning Strategies and conventional method with respect to gender on the mean score of anxiety towards Biology**.**

5.13. CONCLUSIONS

The conclusions of the study are discussed here objective wise. They are as follows:

Objective 1: To prepare and validate the Blended Learning content for class XI students of Biology.

- Blended learning contents were created by the researcher with the supervision of her supervisor.
- First of all the researcher attended many courses, workshops, webinars, seminars etc. related to blended content creations. This included certificate courses by Govt. of India (Appendix 12-16) and many Coursera Courses related to content creation.
- After contents were created and sent to many experts for its content validity evaluation.

- After successful incorporation of all experts' comments, they were again sent to experts for authentications.
- Finally, they were created and applied during experimentation for the present study.

Objective 2: To prepare the achievement test for the content for Class XI students of Biology.

Achievement test questionnaire was made and validated by experts (Appendix – 8) and pilot tested with 20 students.

Then it was applied in present study.

Finally, the test questionnaire was used as both pre and post-test questionnaire and results were jotted down.

Objective 3: To prepare the lesson plans for blended learning and conventional learning approaches for the content in Biology.

- Lesson plans of control group (taught with conventional method) were constructed using 5E lesson planning method
- Lesson plans of experimental group (taught with blended method) were constructed using SAMR lesson planning method specialized for technology enriched classrooms.
- After formulating lesson plans primarily, they were sent to experts of different subjects like Education, Special Education and Biology and language (Appendix – 6).
- After receiving their valuable comments, total 60 lesson plans (30 conventional + 30 BLS) were constructed.
- They were properly executed in classroom situations for the completion of study.

Objective 4: To study the effect of Blended Learning strategies (BLS) on students of XI standard with respect to (a) Achievement in Biology. (b) Anxiety towards Biology. (c) Attitude towards Biology.

Effect of BLS on students of class XI with respect to Achievement in Biology

Based on analysis and interpretation of data, following results and conclusions were drawn for the present study:

The findings of the present study show that students of both experimental and control group show low achievement scores before treatment. The findings of the present study show that students of both experimental and control group show high achievement scores after treatment. For the present study there is significant difference found between the mean scores of experiment group and control group. So, the null hypothesis is rejected. Therefore, it can be concluded that experimental group students shown higher mean scores in achievement test comparison to control group.

Effect of BLS on students of class XI with respect to Attitude towards Biology

Based on analysis and interpretation of data, following results and conclusions were drawn for the present study:

The findings of the present study show that students of both experimental and control group show low attitude scores before treatment. It is also revealed that the present study shows students of both experimental and control group show highly positive attitude scores after treatment. For the present study there is no significant difference found between the mean scores of experiment group and control group. So, the null hypothesis is rejected. Therefore, it can be concluded that no significant effects found on attitude towards biology after blended learning intervention.

Effect of BLS on students of class XI with respect to Anxiety in Biology

Based on analysis and interpretation of data, following results and conclusions were drawn for the present study:

The findings of the present study show that students of both experimental and control group show high academic anxiety scores before treatment. The findings of the present study show that students of both experimental and control group show lower academic

anxiety scores after treatment. For the present study there is significant difference found between the mean scores of experiment group and control group. So, the null hypothesis is rejected. Therefore, it can be concluded that experimental group students shown lower mean scores in response of anxiety scale in comparison to control group. Hence, it can be said that blended learning proven an effective method of teaching in lowering academic anxiety in biology.

Objective 5: To study the interaction effect of Blended Learning strategies (BLS) and gender on students of XI standard with respect to (a) Achievement in Biology (b) Anxiety towards Biology (c) Attitude towards Biology

a) The interaction effect of Blended learning strategies (BLS) and gender on students of XI standard with respect to Achievement in Biology

Two-way ANOVA (Analysis of Variance) is conducted as a parametric test for the present study two independent variables are taken.

The test to find main effect of scores of academic achievement in respect to both groups reveals that significant difference among groups i.e., students taught through blended learning modules are found highly positive result in achievement as compared to their counterpart.

Test to reveal main effect of gender on academic achievement shows that there is no significant difference in mean gain score of student achievement in respect to gender i.e., male and females. Thus, it can be inferred that no significant difference found in achievement scores of students in respect to their gender.

The test for interaction effect revealed that there was no significant interaction effect found between instructional treatments (blended learning method and conventional method) and gender on achievement scores of students

b) Interaction effect of Blended learning strategies (BLS) and gender on students of XI standard with respect to Anxiety towards Biology

Test for main effect in instructional treatment and gender reveals that there was significant difference in mean gain scores of student anxiety score in Biology in respect

two instructional treatments i.e., conventional strategies and blended learning modules. So, it can be concluded that i.e., students taught through blended learning modules are highly effective or more positive result in reducing anxiety than students taught through conventional way.

Test for main effect in anxiety towards biology and gender reveals that no significant difference in mean gain score of student anxiety score in respect to gender i.e., male and females. Thus, it can be inferred that students are not affected in mean gain scores on student anxiety scores in relation to gender.

The test for interaction effect revealed that there was no significant interaction effect found between instructional treatments (blended learning method and conventional method) and gender on anxiety level of students.

c) To study the interaction effect of Blended Learning strategies (BLS) and gender on students of XI standard with respect to Attitude towards Biology

Test for main effect in instructional treatment and gender reveals that there was no significant difference found in mean gain scores of student attitude towards biology in respect two instructional treatments i.e., conventional strategies and blended learning modules. So, it can be concluded that i.e., students taught through blended learning modules are not found highly effective result in attitude towards biology than students taught through conventional way.

Test for main effect in attitude towards biology and gender reveals that no significant difference in mean gain score of student's attitude towards biology score in respect to gender i.e., male and females. Thus, it can be inferred that students are not affected in mean gain scores on student's attitude towards biology in relation to gender.

The test for interaction effect revealed that there was no significant interaction effect found between instructional treatments (blended learning method and conventional method) and gender on attitude towards biology of students.

5.14. EDUCATIONAL IMPLICATIONS

Educational implications are very important part of thesis. Based on the research finding, revealed that the blended learning model contributed more to students' achievement than traditional learning model did. Blended learning can be used as an alternative learning technique for teachers in order to improves students' learning achievement. To implement these techniques, teachers are required to develop their computer and internet literacy rate. School has the important rules to provide training or workshop for the teachers in applying this model. This research is still limited to information and communication subject, it is hoped that further research will be conducted for other courses and it is suggested to give a concern about how to blend professionally between face to face and online instruction. Followings can be the educational implications for present study:

1. By the application of blended learning strategies in the classrooms disclosed better results as compared to conventional teaching method. The students taught by blended learning strategies showed better achievement. And it has been observed that female scores better in achievement than their counterparts' parts. It shows that girl students take more interest in the blended learning classrooms which directly reflects their better achievement. The females are contributing 50% in the population of India. So, to make girls better in their academics there is need to implement blended learning strategies in the classroom which will further definitely help to improve their better attendance in the classrooms. As previous research findings revealed that there is a significant relationship between classroom and student's attendance.

- **Educational Implications for students**

Students' performance is better academically in blended learning classrooms. In blended learning classrooms students are found to be more active, interactive and regular which directly influences their academic scores so shows better academics. Enjoy and are regular in the class if the classroom Students achievement can be improved by blended learning strategies.

- **Educational Implications for Teachers**

If the achievement of students is improved by using the blended learning strategies in the class, it will definitely provide satisfaction to the teachers. And for the better learner's achievement, teachers must be computer literate to implement these techniques effectively in the classrooms.

- **Educational Implications for making educational policies**

This finding of the present study will definitely help to give proper space to blended learning in the classes. And per UGC guidelines, 40% of the credits should be covered through MOOCs. Similarly, there is need to take initiative in the filed of school education too.

2. It has been found that blended learning strategies helped students in reducing their academic anxiety towards biology. In order to assist pupils, manage their anxiety, this blended learning strategies may also be used while teaching other disciplines, such as physics, chemistry and mathematics.

- **Educational Implications for students**

Students of medical and non-medical streams found more academic anxiety. But, the present study result revealed that use of blended learning strategies lowered the anxiety scores among learners. During the pilot study it was observed that there are certain topics where students feel more anxiously as per the complexity of the topics but through the use of blended techniques, there anxiety level decreased as compared to students taught by conventional techniques. So, its good to implement blended learning strategies in the classes to reduce academic anxiety toward their any subject. Further on the bases of gender, girls found more anxious as compared to their counterparts. it has been observed that blended learning strategies improves academic anxiety among girls. So blended learning will definitely help the students to understand better and reduce anxiety level.

- **Educational Implications for Teachers**

It has been observed that blended learning strategies reduced biology anxiety among learners so science teacher must be aware to teach the learners through blended learning strategies for lowering their academic anxiety. If the students doubts and concept will be

cleared through using blended learning strategies in the classroom, they will be less anxious and will perform better. Girls found more anxious as compared to boys.

- **Educational Implications for making educational policies**

Such cutting-edge teaching techniques should be used by educators to choose students' interests and aid in the management of their academic concerns. The outcomes and conclusions of the current study have some significant educational ramifications for raising the calibre and standard of biology instruction, controlling academic anxiety, Initiatives must be done to integrate blended learning-based solutions into the curriculum because the idea of blended learning is new to the Indian educational system. The use of blended instructional based tactics should be included in the teacher training curriculum.

Though the result of study discovers that no statistical significance difference found among the learners with respect to their attitude towards biology while teaching with blended learning strategies, but the mean score of students found better in posttest of experimental group as compared to their counterpart although that is not significant. So, it can be said blended method is effective in promoting positive attitude towards biology among senior secondary students. So, promoting blended method in science can be fruitful in motivating students for not only in biology but also in other science subjects. The utilisation of planned classroom activities and problem-solving exercises that emphasise applying the curriculum to resolve issues or uncertainties through learning activities and tasks is more likely to take place during class time.

- **Educational Implications for students**

This signifies that blended learning strategies more positively towards learning. During blended learning classes more interaction with teach occurs in comparison to conventional classes which encourages them to learn more actively and doubt clearing becomes easier for them. Students can turn more attentive, regular in class and learning can turn more joyous to them.

- **Educational Implications for Teachers**

If the attitude towards a subject increase by blended learning strategies, it also provides teacher positive feedback which ultimately leads to motivation towards using technology in classroom. It can encourage teachers to become more active, interactive classrooms situation and gives positive learning outcomes which may lead to academic success.

- **Educational Implications for making educational policies**

The present study finding supports that positive attitude towards biology motivates students for their career in the medical field of study. Also, a positive attitude towards science can encourage students for their future in Engineering, medical, and other competitive exams.

3. No significant result with interaction effect among all variables indicates that blended learning method affected children irrespective of their gender. It means blended learning strategies are useful for both male and female students.

- **Educational implications for students**

By the application of blended learning, achievement scores can be increased among students irrespective of their gender. To get the greatest outcomes in terms of student accomplishment, the best elements of both online learning and face-to-face traditional teaching methods can be merged. So, in general aspect, it can be implemented. Also, it can be applied to any remedial measures also. Students of all gender can be benefited by this method.

- **Educational implications for teachers**

Teachers can include these instructions into the process of teaching and learning because it is proven useful for all students equally. As, no gender specific effect found, it can be easier for teachers also to taught with blended learning strategies.

- **Educational implications for making education polices**

Blended learning can be useful in better handling of classroom, by creating positive attitude, lowering anxiety towards subject and to improve better results. situations as

result found in no interaction with gender. To provide a uniform and unbiased classroom environment, it can be proved effective as well.

5.15. LIMITATION OF THE STUDY

The study has the following limitations:

1. The study was limited to students of northern part of West Bengal.
2. The study was focused on Class XI students of west Bengal Council for Higher Secondary Education.
3. The effectiveness of blended learning was measured as a wholesome method in this study, not specifically based on the used strategies: rotation and face to face driver, this is one of the most important limitations of this study.
4. A short treatment period of 6 weeks is another limitation for the present study.

5.16. RECOMMENDATIONS

- This study depicts that blended learning is helpful in improving academic score. So, it is important to initiate blended learning practice in regular classroom.
- It is also proved that blended learning helps in growing more positive attitude towards Biology. So, it is necessary to introduce in every part of school, college and university education. As blended learning includes audio visual aids it will be more acceptable for students of every stage and every level of education.
- By implying blended learning in normal classroom in regular basis can improve teaching learning surrounding as feedback system will be easier for teachers and students both.
- Professional development of teachers will be easier as the blended environment promotes upgraded e-resources which help teachers to increase their efficiency.
- Implication of blended learning in regular classes is very important as it promotes and encourages active learning.

5.17. SUGGESTIONS FOR FUTURE RESEARCH

- Present study can be extended up to the college and university level or it can be done with a primary and secondary level of students to determine the role of blended learning in different phases in the education system.
- Tools that are capable of measuring anxiety in different academic subjects are needed to measure the academic anxiety in different subjects and take remedial of it.
- Role of blended learning in improving self-esteem, goal orientation, learning management system, learning disorders, self-paced learning, etc. must be done to know the efficiency of the system.
- Same study with different models of blended learning (other than rotation and face-to-face driver) in the Indian context can be replicated to know their effectiveness also.
- Impact of blended learning can be measured in an extension of the study with multiple teaching-learning processes together.
- Qualitative study on the effect of blend can be done with different variables
- Similar study can be formulated by comparing the effects of blended classes in Government and non-Government schools.
- More tools can be constructed on attitude towards a subject having more dimensions to make it more and more accurate.

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APPENDICES

APPENDIX – 1 (Permission Letter from Headmaster of experimental School)

To

The Headmaster

Barabisha High School (H.S.)

Barobisha, Alipurduar

Sub: Prayer for conduction of research on students (Class XI Science with Biology without hampering their own learning

Respected Sir,

I. Piyali Sarkar, Assistant Teacher of Biological Sciences (HPG), currently is pursuing Ph.D in Part Time mode from Lovely Professional University, Phagwara, Punjab, under kind supervision of Dr. Sonia Sharma. As I am conducting experimental study, for the need of my study, I need your kind permission for performing the same with Class XI students. With whom I have to conduct validation of tools, pretest, post test and have to give them treatment also in some chapters of Biology. I am assuring that also I will not cause any disturbance in their classes or syllabus. I also promise that my study results will explore new ideas and opportunities in the field of teaching biology which will further improve the performance of learners. Further I am assuring you I will not violate any emergency protocol regarding present CoVID 19 situation.

Kindly allow me to perform the same actions for the smooth conduction of my research work. Please grant my prayer and oblige.

Thanking You

Yours faithfully,

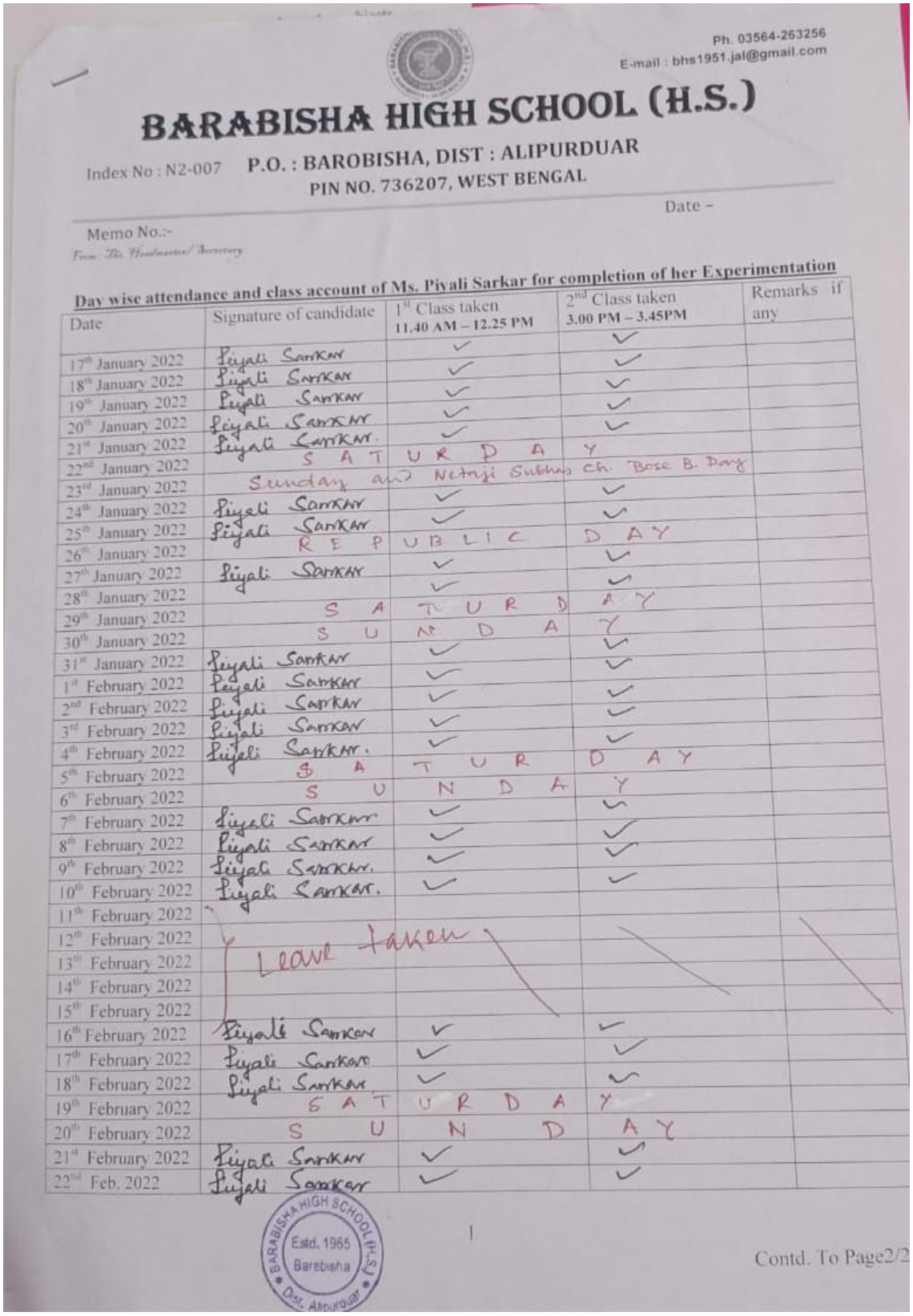
Piyali Sarkar.
Research Scholar,
Lovely Professional University
Phagwara, Punjab,
Registration No. 41866055

Received & accepted

28.8.2020.

Headmaster
Barabisha High School (H.S.)

APPENDIX – 2 (Schedule of Experimentation)



Ph. 03564-263256
E-mail : bhs1951.jal@gmail.com

BARABISHA HIGH SCHOOL (H.S.)

Index No : N2-007 P.O. : BAROBISHA, DIST : ALIPURDUAR
PIN NO. 736207, WEST BENGAL

Date –

Memo No.:-
From : The Headmaster/ Secretary

Day wise attendance and class account of Ms. Piyali Sarkar for completion of her Experimentation

Date	Signature of candidate	1st Class taken 11.40 AM – 12.25 PM	2nd Class taken 3.00 PM – 3.45PM	Remarks if any
17th January 2022	Piyali Sarkar	✓	✓	
18th January 2022	Piyali Sarkar	✓	✓	
19th January 2022	Piyali Sarkar	✓	✓	
20th January 2022	Piyali Sarkar	✓	✓	
21st January 2022	Piyali Sarkar.	✓	✓	
22nd January 2022	SATURDAY			
23rd January 2022	Sunday and Netaji Subhas ch. Bose B. Day			
24th January 2022	Piyali Sarkar	✓	✓	
25th January 2022	Piyali Sarkar	✓	✓	
26th January 2022	REPUBLIC DAY			
27th January 2022	Piyali Sarkar	✓	✓	
28th January 2022		✓	✓	
29th January 2022	SATURDAY			
30th January 2022	SUNDAY		✓	
31st January 2022	Piyali Sarkar	✓	✓	
1st February 2022	Piyali Sarkar	✓	✓	
2nd February 2022	Piyali Sarkar	✓	✓	
3rd February 2022	Piyali Sarkar	✓	✓	
4th February 2022	Piyali Sarkar.	✓	✓	
5th February 2022	SATURDAY			
6th February 2022	SUNDAY		✓	
7th February 2022	Piyali Sarkar	✓	✓	
8th February 2022	Piyali Sarkar	✓	✓	
9th February 2022	Piyali Sarkar.	✓	✓	
10th February 2022	Piyali Sarkar.	✓	✓	
11th February 2022				
12th February 2022	Leave taken			
13th February 2022				
14th February 2022				
15th February 2022				
16th February 2022	Piyali Sarkar	✓	✓	
17th February 2022	Piyali Sarkar	✓	✓	
18th February 2022	Piyali Sarkar	✓	✓	
19th February 2022	SATURDAY			
20th February 2022	SUNDAY			
21st February 2022	Piyali Sarkar	✓	✓	
22nd Feb. 2022	Piyali Sarkar	✓	✓	

BARABISHA HIGH SCHOOL (H.S.) Estd. 1965 Barabisha Dist. Alipurduar

Contd. To Page2/2

Ph. 03564-263256
E-mail : bhs1951.jal@gmail.com

BARABISHA HIGH SCHOOL (H.S.)

Index No : N2-007 P.O. : BAROBISHA, DIST : ALIPURDUAR
PIN NO. 736207, WEST BENGAL

Memo No.:-

From : The Headmaster/ Secretary

Date –

Day wise attendance and class account of Ms. Pivali Sarkar for completion of her work

Date	Signature of candidate	1st Class taken 11.40 AM – 12.25 PM	2nd Class taken 3.00 PM – 3.45PM	Remarks if any
23rd February 2022	Piyali Sarkar.	✓	✓	
24th February 2022	Piyali Sarkar.	✓	✓	
25th February 2022	Piyali Sarkar.	✓	✓	
26th February 2022	SATURDAY			
27th February 2022	SUNDAY			
28th February 2022	Piyali Sarkar	✓	✓	
1st March 2022				
2nd March 2022				
3rd March 2022	COUNCIL		EXAM	
4th March 2022				
5th March 2022				
6th March 2022	SUNDAY			
7th March 2022	Piyali Sarkar	✓	✓	
8th March 2022	Piyali Sarkar	✓	✓	
9th March 2022	Piyali Sarkar	✓	✓	
10th March 2022	Piyali Sarkar	✓	✓	
11th March 2022	Piyali Sarkar.	✓	✓	

BARABISHA HIGH SCHOOL (H.S.) Estd. 1965 Barabisha Dist. Alipurduar

Headmaster 12.3.22
Barabisha High School (H.S.)

APPENDIX – 3 (Syllabus of biology of XI Standard approved by WBCHSE)

SYLLABUS 2013

(UPGRADED VERSION)

XI - XII

WEST BENGAL COUNCIL OF HIGHER SECONDARY EDUCATION
Vidyasagar Bhavan, 9/2, Block - DJ, Sector-II, Salt Lake, Kolkata - 700091

Published by
Prof. Subrata Ghosh
Secretary
West Bengal Council of Higher Secondary Education
Vidyasagar Bhavan, 9/2, Block-DJ, Sector-II, Salt Lake
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Phone No. (033) 2407-7697
Mobile No : 9433010823
E-mail : ananta_gayen@rediffmail.com

PREFACE

Higher Secondary Syllabus acts as a gateway to higher education. After completion of this syllabus, doors open towards specialised education and professional training at higher levels. Thus this syllabus prepares a student for his/her future career and at the same time motivates him/her towards a supportive, congenial and harmonious social existence. If we consider the age group of the students pursuing Higher Secondary syllabus, we would understand the significant role this course plays in shaping their lives. Needless to say, West Bengal Council of Higher Secondary Education has taken utmost care to frame the syllabi, keeping in mind the backdrop of pluralist existence of our society.

While preparing the syllabi the Boards of studies of the Council in consultation with the members of Expert Committee, Department of School Education, Government of West Bengal have tried sincerely to put emphasis on some focal points. We tried to keep parity with the syllabi of other Boards/Councils, so that our students can cope with the Higher Education courses prevalent in modern world. We believe that the new syllabi would inculcate rational thinking, enhance analytical skill and infuse scientific approach in the minds of young students and would inspire them to acquire knowledge instead of cramming information. The syllabi would certainly help the students to become responsible citizens with firm democratic values and secular outlook.

Some unique features of the present syllabi (Session 2013-2014) :

i) Apart from the language and literature subjects all the Compulsory Elective Subjects have been divided into three sets. Moreover, restrictions in some cases have been imposed to keep parity with the present structure of higher education.

ii) While in subjects like Physics, Chemistry, Mathematics, Biological Science, Accountancy, Business Studies and Economics Common Core Syllabus has been introduced as per Central Government Guidelines (National Syllabus Framework 2005); in other subjects thorough changes have been incorporated in their structure. This paradigmatic shift has been necessitated by the fast changing socio-economic as well as education scenario of our country. Emphasis has been put more on acquiring basic knowledge about the subject than on mere memorizing some well-prepared notes without understanding them. Project - works have been brought in to develop the thinking ability, organising and proper presentation skills of our students so that they can independently handle these subjects in higher studies.

iii) In question-pattern too some basic changes have been made. Questions are divided into three types - Knowledge-based - Multiple Choice-Type Question; Information-based Short Answer-Type Questions; and Analytical-Descriptive Questions. Our respected teachers have to play a significant role in proper transaction of this Course - they have to work more as a facilitator than a mere teacher. They have to read the texts and work on them with the students to help them in understanding the topics and answering questions.

I do admit that these changes will initially appear to be a stumbling block to my adolescent learners; but at the same time I have strong faith in their acquisitive power and adjusting-capability. I do also firmly believe that all my colleagues will up-date themselves accordingly and discharge their duties to their utmost sincerity. My earnest appeal to them is to cooperate with the Council and the Department of School Education to achieve their vision and mission.

Here we present the restructured syllabi of forty-three subjects of the Higher Secondary Course taught under General stream. Separated syllabi of each and every subject to be studied in Class XI and Class XII respectively are arranged in this book in proper order.

I wish to express my heartiest gratitude to the respected members of the Expert Committee and the members of the Boards of Studies who had performed the extremely difficult and complex task of framing and restructuring the syllabi. For the benefit of the students they have rendered tireless effort. I wish to extend my sincerest thanks to my colleagues at the Council, whose active cooperation has played a vital part in the whole programme.

We hope that the revised and restructured syllabi will be of immense importance to our dear students.

February, 2013
Vidyasagar Bhavan
Salt Lake, Kolkata - 700 091

Dr. M.N Chatterjee
President
West Bengal Council of H.S. Education

BIOLOGICAL SCIENCE (BIOS)

CLASS – XI

Full Marks - 100

THEORY - 70 Marks

Unit-1	**DIVERSITY OF LIVING ORGANISMS**	**07 marks**
Unit-2	**STRUCTURAL ORGANIZATION OF PLANTS**	**12 marks**
Unit-3	**CELL: STRUCTURE & FUNCTION**	**15 marks**
Unit-4	**PLANT PHYSIOLOGY**	**18 marks**
Unit-5	**HUMAN PHYSIOLOGY**	**18 marks**

UNIT – I DIVERSITY OF LIVING ORGANISMS

1. Science of life

1.1 Science of Life – Introduction
1.2 Characteristics of life
1.3 Definition and concept of biodiversity

2. Taxonomy and Systematic

2.1 Taxonomy and Systematics – Definition
2.2 Taxonomic hierarchy-(Linnaeus) with Example 1
2.3 Bionomical nomenclature

3. Classification of Living Organisms

3.1 What is classification (Definition)
3.2 Need for classification
3.3 Five kingdoms of life and the basis of classification of five kingdoms.
3.4 Salient features and classification of Monera, Protoctista (Protista), Fungi and Lichens into major groups.
3.5 Virus and viriods – a brief General account.
3.6 Salient features and classification of plant into major group – Algae, Bryophytes Pteridophytes, Gymnosperms and Angiosperms (three to five salient and distinguishing features of each category and at least two examples of each category
3.7 Angiosperm – classification upto class, characteristic features (three to five) and examples.
3.8 Salient features and classification of Animals – major non chordata upto phyla And chordatas upto class level (three to five Salient features and at least two examples)
3.9 Tools for study of biodiversity – Museums, Zoos, Botanical Garden & Herberia.

Unit – II STRUCTURAL ORGANISATION IN PLANTS AND ANIMALS

4. Structural Organisation in Plants

4.1 Tissues (Definition)
4.2 Tissues in plants – Meristematic and Permanent (Structure and function)
4.3 Morphology of Root, Stem and leaf (including modifications, microscopic

Anatomy and functions)(To be dealt along with relevant practicals)

4.4 Inflorescenes (Major types – Racemose And Cymose)

4.5 Morphology of flower (including aestivation And placentation), fruit and seed (one Monocot-Maize and one Dicot-Gram)

5. Structural Organisation in Animals

5.1 Tissues in animals (structure, occurrence and function in brief).

5.2 Morphology, anatomy and functions of different systems (digestive, circulatory respiratory, nervous and reproductive) of an insect-cockroach.(brief account)

Unit-III CELL STRUCTURE AND FUNCTION

6. Cell

6.1 Cell theory and cell as the basic unit of life

6.2 Cell and its major parts - cell membranes and protoplasm (cytoplasm and nucleus)

6.3 Structure of a prokaryotic and eukaryotic cell (in brief).

6.4 Structure of plant cell and animal cell (in brief).

6.5 Cell envelop - cell membrane and cell wall (ultrastructure and function)

6.6 Cell organelles-Ultrastructure and function; Mitochondria, golgi bodies, endoplasmic reticulum, ribosomes, lysomes,vacuoles, plastids, micro bodies (peroxisomes, spherosomes and glyoxysomes).

6.7 Ultra structure and function of cytoskeleton, Cilia, flagella and centrioles.

6.8 Nucleus- nuclear membrane,nucleoplasm, Chromatin,nucleolus(ultrastructure and function)

7. Chemical constituents of living cell

7.1 Chemical constituents of living cell
7.2 Biomolecules-structure and function of protein, carbohydrate, lipid and nucleic acid.
7.3 Enzyme-types,properties and enzyme action (lock and key, induced fit model and allosterism)

8. Cell Division

8.1 Introduction
8.2 Definition and types
8.3 Cell cycle
8.4 Mitosis- Definition and significance (process not required)
8.5 Meiosis- Definition,types,process and Significance
8.6 Difference between mitosis and meiosis

Unit- IV PLANT PHYSIOLOGY

9. Movement of Water, Food, Nutrition And Gases

9.1 Introduction
Absorption of water,gases and nutrients.
9.2 Cell to cell transport- diffusion,facilitated diffusion,active transport
9.3 Plant-water relation- imbibitions,water potential,osmosis and plasmolysis.
9.4 Long distance transport-apoplast,symplast, root pressure transpiration pull, Uptake of mineral ions

9.5 Transpiration and guttation, opening and closing of stomata
9.6 Translocation- transport through xylem and phloem,
Mass flow hypothesis

10. Plant Nutrition And Minerals

10.1 Introduction
10.2 Essential minerals-macro and micro nutrients, their roles and deficiency symptoms (in tabular form)
10.3 Mineral toxicity
10.4 Elementary idea of the Hydroponics
10.5 Nitrogen metabolism-nitrogen cycle, biological nitrogen fixation.

11. Respiration

11.1 Introduction
11.2 Exchange of gases
11.3 Cellulare respiration-glycolysis, fermentation (anaerobic), T.C.A cycle and E.T.S (aerobic) Definition, process and significance
11.4 Energy relations-number of A.T.P molecules generated in respiration.
11.5 Amphibolic pathways
11.6 Respiratory quotient of nutrients

12. Photosynthesis

12.1 Introduction-Autotrophic nutrition: photo and chemo-autotrophic, nutritions.
12.2 Definition and the site of Photosynthesis.
12.3 Photosynthetic pigments (elementary idea-structure not required)

12.4 Photochemical and biosynthetic phases of photosynthesis.
12.5 Cyclic and non cyclic photophosphorylation.
12.6 Chemo osmotic hypothesis
12.7 Photo respiration
12.8 C_3 and C_4 pathways
12.9 Factors Controlling photosynthesis

13. Plant Growth And Development

13.1 Introduction
13.2 Phases of plant growth and plant growth rate
13.3 Condition of growth.....(light, temperature, water,hormone,nutrients only)
13.4 Differentiation, De-differentiation, and Re-differentiation-definition and example only.
13.5 Sequence of developmental process in a plant cell through chart.
13.6 Growth regulations-auxin, gibberellins cytokinin, ethylene, A.B.A
13.7 Seed germination
13.8 Seed dormancy
13.9 Vernalisation
13.10 Photoperiodism-definition, types of plants on the basis of the length of the photoperiod.

Unit- V HUMAN PHYSIOLOGY

14. Digestion and Absorption

14.1 Introduction
14.2 Structure (in brief) of human Alimentary canal including dental arrangement and digestive glands.

14.3 Role of the digestive enzymes and the G -1 Hormone in digestion.
14.4 Peristalsis
14.5 Digestion, absorption and assimilation of protein, carbohydrate and fat
14.6 [Caloric value of proteins, carbohydrates and fats.] Box item-not to be evaluated.
14.7 Egestion
14.8 Nutritional and digestive disorders- PEM (protein energy malnutrition,) indigestion, constipation vomiting, jaundice, diarrhoea.

15. Breathing and Respiration

15.1 Introduction
15.2 Respiratory organs in animals (through chart, recall only)
15.3 Respiratory system in human (outline)
15.4 Mechanism of breathing and its regulation in human.
15.5 Exchange of gases, transport of gases and regulation of respiration.
15.6 Repertory volumes
15.7 Disorders related to respiration Asthma, emphysema, occupational respiratory disorders- (e.g. Silicosis, Asbestosis)

16. Body Fluids And Circulation

16.1 Introduction
16.2 Composition of Blood (Tabular form)
16.3 Blood groups, ABO Blood groups
16.4 Coagulation of blood
16.5 Composition of lymph and its function
16.6 Human circulatory system-(outline idea)
16.7 Structure of Human heart and blood vessels.

16.8 Cardiac cycle
16.9 Cardiac output (stroke volume and minute volume, determination of cardiac output- Fick's Principle)
16.10 E.C.G (brief idea, no analysis required)
16.11 Double circulation
16.12 Regulation of cardiac activity (neutral and hormonal) including factors regulating Blood Pressure
16.13 Disorders of the circulatory system hypertension, corornary artery disese, angina pectoris, heart failure.

17. Excretory Products And their Elimination

17.1 Introduction
17.2 Modes of excretion- Ammonotelism Ureotelism, Uricotelism (Definition and Examples)
17.3 Human excretory system- structure and function (Histology of nephron)
17.4 Urine formation and Osmo- regulation
17.5 Regulation of Kidney function, Renin, angiotensin, Antidiuretic factor A.D.H and diabetes insipidus
17.6 Role of other organs in excretion- Liver, skin , lung and salivary gland.
17.7 Disorders- Uraemia, renal failure, Renal calculi, Nephritis.
17.8 Dialysis and artificial kidney

18. Locomotion and Movement

18.1 Introduction- What is locomotion and movement?
18.2 Types of movement ciliary Flagellar and muscular.

18.3 Skeletal muscle-contractile proteins and muscle contraction.
18.4 Skeletal system and its function. (To be dealt with relevant portion of practical syllabus)
18.5 Joints
18.6 Disorders of muscular and skeletal system- Myasthenia gravis, tetany, Muscular dystrophy, arthritis osteoporosis and gout.

19. Neural control and coordination

19.1 Introduction- what is neural control and co-ordination
19.2 Neurones and nerves (Revisionary)
19.3 Nervous system in human
19.4 Central Nervous System, Peripheral Nervous System (P.N.S), and visceral Nervous System. Brain and its major parts- cerebral cortex, thalamus, hypothalamus and lymbic system, mid brain, pons, medulla, cerebellum and Spinal cord (function only), Mode of distribution and function of P.N.S and autonomic nervous system.
19.5 Generation and Conduction of nerve impulse.
19.6 Reflex action and Reflex Arc
19.7 Sense Organs- sensory perception outline structure and function of eye and ear.

20. Chemical Coordination And Regulation

20.1 Introduction- endocrine glands and hormones.
20.2 Human endocrine system- Hypothalamus, Pituitary, Pineal,

Thyroid, Parathyroid, Adrenal,
Pancreas,Gonads
(location and function only)

20.3 Mechanism of hormone action
(elementary idea)

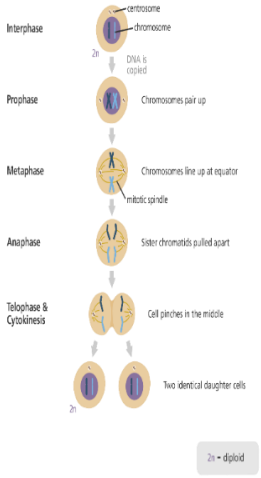
20.4 Role of hormones as messengers
and regulators.

20.5 Hypo and Hyper activity of
endocrine glands and related Disorders
(common disorders e.g., Dwarfism
Acromegaly Cretinism,Goiter,
Exopthalmic goiter, Diabetes,
Addisons disease.
(Important diseases related to physiology
of all Systems of human are to be
taught briefly.)

APPENDIX – 4 (Conventional 5E Lesson Plan – English Version)

<table>
<tr><td>Teacher</td><td colspan="2">Grade: XI</td><td>Date:</td></tr>
<tr><td colspan="3">Unit Title: 12. CELL DIVISION AND CELL CYCLE</td><td>Corresponding unit task:</td></tr>
<tr><td colspan="3">Materials/Resources</td><td>Essential Vocabulary</td></tr>
<tr><td colspan="2">Teacher: Chalk, Duster, Blackboard</td><td>Student:
Book, Copy, Pen, Pencil etc</td><td>Cell division, mitosis, spindle, interphase</td></tr>
<tr><td colspan="4">SPECIFIC OBJECTIVES: After the completion of the lesson, the learner will be able to-
• Define cell cycle (Knowledge)
• Choose the kind of cell division. (Knowledge)
• Explain different parts of cell cycle (Comprehension)
• Classify cell division (Comprehension)
• Draw and level each stage of mitotic division (Application)
• Can differentiate prophase and metaphase.(Application))</td></tr>
</table>

Content Highlight	Engagement	Exploration	Explanation	Elaboration	Evaluation
Module1- Introduction cell cycle interphase and mitotic phase	Teacher will show students a picture of an animal cell and ask to tell me what is this?	The teacher will ask students that what are the two chief phases of cell cycle students with answer interphase and mitotic phase the face between two divisional phases is called interphase and the gradual process by which Two daughter cells are produced from a single mother cell, is called mitosis	The teacher will ask students which phase is longest in a Cell cycle. Students will answer which is the longest phase. Now the teacher asks do you know where the mitosis division takes place? Students will answer mitosis occurs in somatic cells. Now the teacher will explain interphase and mitotic phase in detail	the teacher asks students what are the sub-phases of interphase? Students will answer G1, S and G2 the teacher now elaborates the mechanism of cell cycle along with its characteristics and significance.	now that teacher will ask a question in which phase of cell cycle chromosomal duplication occurs? a. G1 b. S c. G2 a. M

Content Highlight	Engagement	Exploration	Explanation	Elaboration	Evaluation
Module 2 Mitosis division different stages definition and function	the teacher will show a picture of mitotic division and ask students do you know what kind of cell division is occurring here?  	The teacher will ask Students why mitotic division is called equal division? students will answer that as in mitotic division two daughter cells are produced of equal function and equal properties with their mother cell, Differences are called equal division. Now the teacher will ask what are the two chief phases of Mitosis?	students will answer karyokinesis and cytokinesis at the two chief phases of the Mitotic division now the teacher will explain the karyokinesis process in brief .	Now the teacher will ask how two daughter cells are produced from one mother cell in Mitosis? Students will answer to the cytokinesis process two daughter cells are produced. the teacher will elaborately discuss about cytokinesis process.	tell true or false: cytokinesis of plant cells occurs by cleavage process.

Content Highlight	Engagement	Exploration	Explanation	Elaboration	Evaluation
Module 3 different stages of interphase	Teacher will ask students about life cycle and ask them can you relate life cycle along with cell cycle?	Teacher will ask what is the first phase of interphase? Students will answer G_1 is the first phase of interphase. Teacher now asks when the synthesis phase comes During cell cycle?	students will answer synthesis phase or S phase comes after the completion of G_1 phase during the cell cycle. The teacher will explain to them the characteristics of the G_1 and S phases. Along with that the teacher will further explain about Quiescent phase or G_o phase.	Now the teacher will ask students that how many stages are there in cell cycle after completion of s phase. Students will answer two phases. teacher now elaborately describe G_2 phase and the significance of cell cycle.	Now the teacher will ask a question: Name one animal cell which attains Go phase?

RECAPITULATION:

At the end of the lesson, teacher will say that today we have learnt about different mode of nutrition, definition of photosynthesis, photosynthetic pigments and place of photosynthesis.

- What is Cell cycle?
- What is Go Phase?
- Differentiate between G_1 and G_2 phase?
- What are the phases of cell cycle?
- Where meiosis occurs?

HOME WORK:

- Make a flow chart showing different phases of cell cycle.

APPENDIX – 5 (Conventional 5E Lesson Plan – Bengali Version)

Teacher	**Grade: XI**	**Date:**
Unit Title: 8		Corresponding unit task: সূচনা:কোষচক্র ইন্টারফেজ দশা সংজ্ঞা ও কাজ মাইটোসিস কোষ বিভাজন: সংজ্ঞা, প্রকারভেদ এবং কাজ
উপকরণ		**অপরিহার্য শব্দ ভান্ডার**
শিক্ষক: চক,ডাষ্টার,ব্ল্যাকবোর্ড	শিক্ষার্থী: বই,খাতা,পেন,পেন্সিলইত্যাদি	ক্রোমাটিড, বেমতন্তু, নিউক্লিওজালক

বিশেষলক্ষ্য:

এই ক্লাস শেষ হওয়ার পর শিক্ষার্থী যা করতে সক্ষম হবে তা হল -

1. কোষচক্রের সংজ্ঞা বলতে পারবে (জ্ঞানমূলক)
2. কোষচক্রের ভাগগুলি ব্যাখ্যা করতে সক্ষম হবে (বোধমূলক)
3. মাইটোসিস বিভাজনের প্রত্যেকটি দশার চিত্র অঙ্কন করতে সক্ষম হবে (প্রয়োগমূলক)
4. মেটাফেজ দশার পার্থক্য করতে সক্ষম হবে (ব্যাখ্যামূলক)

বিষয়সার	**Engagement** **ব্যস্তকরা**	**Exploration** আবিষ্কার**করা**	**Explanation** **ব্যাখ্যাকরা**	**Elaboration** **বিস্তারিতকরা**	**Evaluation** **মূল্যায়ন করা**
কোষচক্র, ইন্টার	শিক্ষিকাএকটিপ্রাণীকোষেরছবিদেখিয়েজিজ্ঞেসকরবেনএটাদেখে	শিক্ষিকাশিক্ষার্থীদেরজিজ্ঞাসাকরবেনকোষচক্রেরপ্রধানদুটিদশাকিকি?	শিক্ষক-শিক্ষার্থীদেরপ্রশ্নকরবেনকোষচক্রেরকোনদশায়স্থায়িত্ববে	শিক্ষকশিক্ষিকাএবারশিক্ষার্থীদেরউদ্দেশ্যেপ্রশ্নকরবেনএমাইটোসিসবিভাজনকি	

ফেজওমাইটোটিকদশা	তোমাদেরকি মনেহচ্ছে?	শিক্ষার্থীরাউত্তরকর বেইন্টারফেজওমাই টোটিকদশা। দুটিবিভাজনদশারম ধ্যবর্তীযেদশাতেকো ষবিভাজিতনাহয়েবি ভাজনেরপ্রস্তুতিনেয় তাকেইন্টারফেজদ শাবলে। যেপ্রক্রিয়ারমাধ্যমে দেহমাতৃকোষবিভা জিতহয়েসমআকৃতি সমগুনসম্পন্নদুটিঅ পত্যকোষউৎপন্নক রেতাকেবলাহয়মাই টোসিসবিভাজন।	শি? এবংমাইটো সিসবিভাজ নকোথায় দেখাযায়? শিক্ষার্থীরাউ ত্তরকরবেই ন্টারফেজদ শাস্থায়িত্বস র্বাধিক। এবংসবদে হকোষেমাই টোসিসবি ভাজনদেখা যায়। শিক্ষকএবা রইন্টারফে জএবংমাই টোটিকফে জসম্পর্কে বিস্তারিতব র্ণনাদেবেন।	ব্যাক্টেরিয়ারক্ষে ত্রেদেখাযায়? শিক্ষার্থীরাতাতে সম্মতিজানালে শিক্ষকশিক্ষিকা এবারকোষবিভা জনসম্পর্কেবি স্তারিতবর্ণনাদে বেন।	কোষ চক্রে রকো নদ শায় স্থায়ি ত্ববে শি?

বিষয় সার	**Engagement ব্যস্তকরা**	**Exploration** আবিষ্কার**করা**	**Explanation ব্যাখ্যাকরা**	**Elaboration বিস্তারিতকরা**	**Evaluation মূল্যায়নকরা**
Module 2 মাইটোসিসকোষবিভা	শিক্ষিকাশিক্ষার্থীদেরএকটি মাইটোসিসবিভাজনেরছবি দেখিয়েপ্রশ্নকরবেনকোনপ্র	শিক্ষিকাশিক্ষার্থীদেরপ্রশ্নকরবেনমাইটোসিসকোষবিভাজনকেসমবিভাজনকেনবলাহয়তোমরাজানোকিশিক্ষার্থীরাউত্তরকরবেমাতৃকোষঅসমআকৃতিরসমগ্রসম্পন্ন	শিক্ষার্থীরাউত্তরকরবে ক্যারিওকাইনেসিসওসাই	এখন শিক্ষিকাছাত্রদেরপ্রশ্নকরবেনদুটিঅপ	সত্যঅথবামিথ্যা বল :

জনেরবিভিন্নদশা সংজ্ঞাওকাজ	কৃতিরকোষবিভাজনএখানে হচ্ছে?	দুটিঅপত্যকোষউৎপন্নহয় হওয়ায়গুণসম্পন্নএকেশহর বলাহয় এখনশিক্ষিকাজিজ্ঞাসাকর বেনমাইটোসিসবিভাজনের দুটিমুখ্যদশাকিকি	টোকাইনেসিস এখনক্যারিওকাইনেসিসসাইটোকাইনেসিসসম্পর্কেবিশদধারণা শিক্ষার্থীদেরদেবেন	ত্যকোষকিভাবেসৃষ্টিহয়। শিক্ষার্থীরাউত্তরকরবে সাইটোকাইনেসিসএরমাধ্যমে শিক্ষিকাসাইটোকাইনেসিসএরবিস্তৃতবর্ণনাদেবেন	উদ্ভিদকোষেসাইটোকাইনেসিসক্লিভেজপদ্ধতিতেসম্পন্নহয়

বিষয়সার	**Engagement** **ব্যস্তকরা**	**Exploration** আবিষ্কার **করা**	**Explanation** **ব্যাখ্যাকরা**	**Elaboration** **বিস্তারিতকরা**	**Evaluation** **মূল্যায়নকরা**
মডিউল3 ইন্টারফেজ	শিক্ষিকাশিক্ষার্থীদেরজীবনচক্রসম্পর্কেজিজ্ঞাসাকরবেনএবংজিজ্ঞাসাকরবেনযেজীবনচক্রকেকিভাবেকোষচক্রেরসঙ্গেতুলনাকরাযায়?	শিক্ষিকাশিক্ষার্থীদেরজিজ্ঞাসাকরবেনইন্টারফেসেরপ্রথম দশাকোনটি?	শিক্ষার্থীরাউত্তরকরবেসংশ্লেষদশাঅর্থাৎs দশাদশারপরেসংঘটিতহয় শিক্ষিকাএবারG_1ও S দশারব্যাখ্যাকরবেন তাদেরবৈশিষ্ট্যওতাৎপর্যসহ, তারসাথেসাথেসুপ্তদশাঅর্থাৎকাকেবলেতাব্যাখ্যাকর	এবারশিক্ষিকারশিক্ষার্থীদেরপ্রশ্নকরবেনএসবাসারপরেরকোষচক্রেরকয়টিদশা সংঘটিতহয়? শিক্ষার্থীরাউত্তরকরবে দুটিদশা	এখন শিক্ষিকাএকটিপ্রশ্নকরবেন সুপ্তদশাযায়এমনএকটি

এর বিভিন্নদশা		শিক্ষার্থী রাউত্তরক রবেন কোষচক্রেরপ্রথমদশা_____l এখনশিক্ষিকাপ্রশ্ন করবেনদশাকখন সংঘটিত হয়?	বেনএবং তাকোন কোনকোষেদেখাযায় তাওজানাবেন	শিক্ষিকাএবারg2 দশারবিস্তারিতবিবরণ দেবেনএবংকোষচক্রেরতাৎপর্যব্যাখ্যাকরবেন	প্রাণীকোষেরউদাহরণদাও

পুনরাবৃত্তি:

পাঠেরশেষে, শিক্ষকবলবেনযেআজআমরাপুষ্টিরবিভিন্নপদ্ধতি, সালোকসংশ্লেষণেরসংজ্ঞা,
সালোকসংশ্লেষকপিগমেন্টএবংসালোকসংশ্লেষণেরস্থানসম্পর্কেশিখেছি।

1. কোষচক্রকি?
2. G_0পর্যায়কি?
3. G_1এবংG_2পর্বেরমধ্যেপার্থক্যকর?
4. কোষচক্রেরপর্যায়গুলোকিকি?
5. কোথায়মিয়োসিসহয়?

বাড়িরকাজ:

 কোষচক্রের বিভিন্ন পর্যায় দেখায় একটি ফ্লো চার্ট তৈরি করুন।

APPENDIX – 6 (Experimental SAMR Lesson Plan – English Version)

Subject: Biology Date: Grade: XI

Unit: 12 Topic: Photosynthesis

<table>
<tr>
<td>Lesson Overview</td>
<td>Corresponding unit task:
12.1 Introduction- Autotrophic nutrition: photo and chemo-autotrophic, nutrition
12.2 Definition and the site of Photosynthesis.
12.3 Photosynthetic pigments (elementary idea-structure not required)</td>
<td>
SPECIFIC OBJECTIVES: After the completion of the lesson, the learner will be able to-
• Define the term Photosynthesis (knowledge)
• Enlist the certain pigments responsible for photosynthesis (knowledge)
• Explain the plant nutrition (comprehension)
• Draw the structure of chloroplast (Application)
• Draw the equation of photosynthesis (Application)
• Differentiate between autotroph and heterotroph. (analysis)
• Able to compare the functions of chloroplast and phycobilin. (Analyse)

Materials
Teacher: Chalk, Duster, Blackboard, computer, e-contents
Student: Book, Copy, Pen, Pencil etc.

As a result of this lesson/unit students will…
Understand concept of Photosynthesis
Know about the place of occurrence of photosynthesis
Can draw a chart showing different photosynthetic pigments

What will I differentiate? Content Process Product
</td>
</tr>
</table>

<table>
<tr><td></td><td></td><td>How will I differentiate? Readiness Interest Learning Profile Combination</td></tr>
<tr><td>Engage / Introduce</td><td></td><td>https://docs.google.com/document/d/1MRELGAg4NvqiLhE6kYJGgaPmCTYF0yrepkE5PtGSNto/edit</td></tr>
<tr><td></td><td>Teacher shows a picture and ask students a question</td><td>
<table>
<tr><td>Time Required: 10 minutes</td></tr>
<tr><td>Instructional Grouping: Whole group</td></tr>
<tr><td>Essential Question(s) to Ignite Deeper Thinking:
https://forms.gle/Qy41DEJqEqwPN9zG7</td></tr>
<tr><td>Daily Learning Target(s): I can understand the concept of food production.</td></tr>
</table>
</td></tr>
<tr><td>Explore / Explain/ Investigate / Create /</td><td>How will they learn it?</td><td>Activities and Tasks / Learning Experiences to Engage Students
<table>
<tr><td>Time required</td><td>Phase</td><td>Resources</td></tr>
<tr><td>10 min</td><td>Small Group Differentiated Instruction (Teacher led)

Instructional phase</td><td>Blackboard, chalk, duster</td></tr>
<tr><td>10 min</td><td>Collaborative / Individual Work (Project / Assignment)

Draw a table showing different photosynthetic pigments.</td><td>Copy, pen, pencil etc</td></tr>
<tr><td>10 min</td><td>Independent Technology Work (Digital Content)</td><td>Resources Needed</td></tr>
</table>
</td></tr>
</table>

			https://youtu.be/j7GOieO12rU	Computer, K-Yan
		Grouping: To conduct this class the whole class will be divided randomly into three groups containing 12, 12 and 11 students in each group		
	How will you know they have learned it?	Formative Post Assessment: 10min All students will attend a quiz: https://forms.gle/5MxS6zNUmyY5zWA6A		
Evaluate	What will we do if they did not learn it? What will we do if they already know it?	Whole Group Closing: 5min Next day we will discuss about the process and prerequisites of photosynthesis. Make a list of each 5 plants who cannot perform photosynthesis and animals who can perform photosynthesis by the help of internet.		

APPENDIX – 7 (Experimental SAMR Lesson Plan – Bengali Version)

Subject: Biology Date:

Grade: XI

Unit: 12 Topic: Photosynthesis

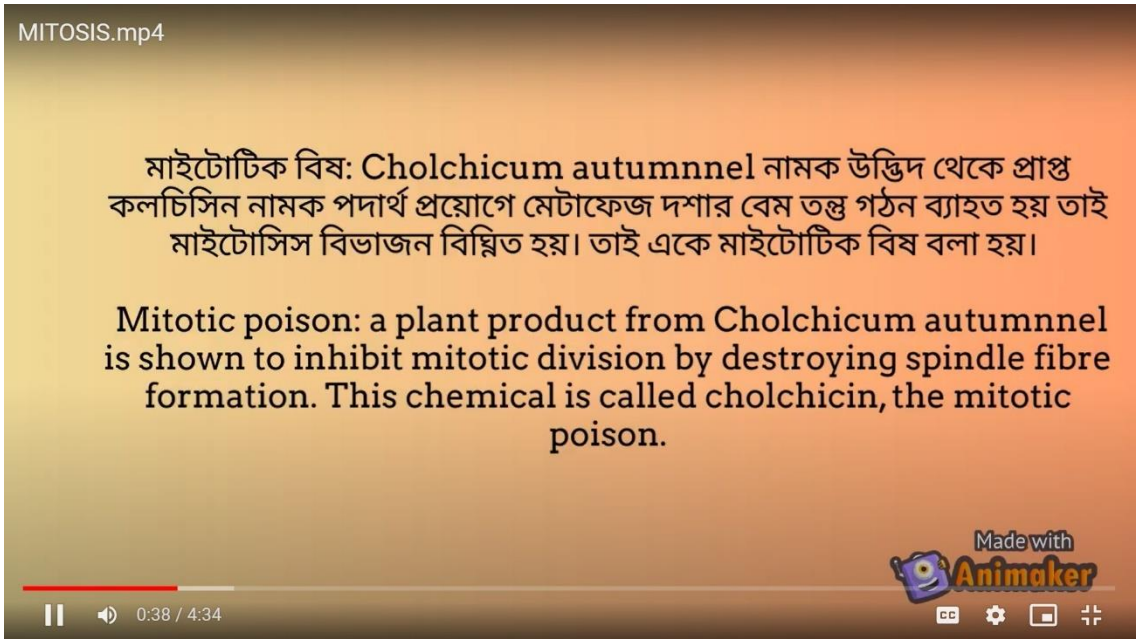
Lesson Overview	Corresponding unit task: 12.1 সূচনা:অটোট্রফিকপুষ্টি;ফটোওকেমো অটোট্রফিক পুষ্টি 12.2 সালোকসংশ্লেষএরসংজ্ঞাওস্থান 12.3 সালোকসংশ্লেষেররঞ্জক (সাধারণধারণা - গঠনপ্রয়োজননেই)	**বিশেষলক্ষ্য:** এইক্লাসশেষহওয়ারপরশিক্ষার্থীযাকরতেসক্ষমহবেতাহল - • সালোকসংশ্লেষএরসংজ্ঞাবলতেপারবে। (জ্ঞানমূলক) • সালোকসংশ্লেষেপ্রয়োজনীয়রঞ্জকগুলিরতালিকাপ্রস্তুত করতেপারবে (জ্ঞানমূলক) • উদ্ভিদসহজেপুষ্টিপ্রক্রিয়াকেব্যাখ্যাকরতেসক্ষমহবে (বোধমূলক) • উদ্ভিদদেহেসালোকসংশ্লেষেরপ্রয়োজনীয়স্থানচিহ্নিতক রতেপারবে (বোধমূলক) • ক্লোরোপ্লাস্টএরচিত্রঅঙ্কনকরতেসক্ষমহবে (প্রয়োগমূলক) • সালোকসংশ্লেষেরসমীকরণআঁকতেসক্ষমহবে (প্রয়োগমূলক) • অটোট্রফিকওহেটারোট্রফিকপুষ্টিরপার্থক্যকরতেসক্ষম হবে (ব্যাখ্যামূলক) • ক্লোরোপ্লাস্টআরফাইকবিলিনএরকাজেরতুলনামূলক আলোচনাকরতেসক্ষমহবে। (ব্যাখ্যামূলক) **Materials** শিক্ষক: চক,ডাষ্টার,ব্ল্যাকবোর্ড, কম্পিউটার, ই-কন্টেন্ট, k-yan শিক্ষার্থী: বই,খাতা,পেন,পেন্সিলইত্যাদি আজকেরপাঠশেষেবিদ্যার্থীদের… সালোকসংশ্লেষপ্রক্রিয়াসম্পর্কেধারনাগঠনহবে।

<table>
<tr><td></td><td></td><td>
<table>
<tr><td>সালোকসংশ্লেষেরস্থানসম্পর্কেজানতেপারবে</td></tr>
<tr><td>সালোকসংশ্লেষেররঞ্জকএরএকটিতালিকাপ্রস্তুতকরতেসক্ষমহবে</td></tr>
</table>
</td></tr>
<tr><td>Engagement ব্যস্তকরা</td><td>শিক্ষকশিক্ষিকাএকটিছবিদেখাবেনএবংকিছুপ্রশ্নকরবেন</td><td>https://docs.google.com/document/d/1MRELGAg4NvqiLhE6kYJGgaPmCTYF0yrepkE5PtGSNto/edit</td></tr>
<tr><td>Exploration আবিষ্কারকরা</td><td>বর্তমানপাঠেরসাথেসংযুক্তকরতেগভীরচিন্তারউপযোগীকিছুপ্রশ্নকরাহবে।</td><td>
<table>
<tr><td>সময়:10 মিনিট</td></tr>
<tr><td>নির্দেশনামূলকশিক্ষার্থী: সম্পূর্নক্লাস</td></tr>
<tr><td>গভীরচিন্তারউপযোগীপ্রয়োজনীয়প্রশ্ন: https://forms.gle/Qy41DEJqEqwPN9zG7</td></tr>
<tr><td>দৈনিকশিক্ষারলক্ষ্য: খাদ্যউৎপাদনেরধারণাবুঝতেপারবে।</td></tr>
</table>
</td></tr>
<tr><td>Explanation ব্যাখ্যাকরা</td><td>তারাএটাকিভাবেশিখবে?</td><td>ক্রিয়াকলাপএবংকাজ /
শিক্ষার্থীদেরজড়িতকরারজন্যশেখারঅভিজ্ঞতা
<table>
<tr><td>প্রয়োজনীয়সময়</td><td>পর্যায়</td><td>প্রয়োজনীয়সামগ্রী</td></tr>
<tr><td>10 মিনিট</td><td>সম্পূর্ণক্লাসেরতিনভাগেরএকাংশনিয়েগঠিতছোটবিভাগ
(শিক্ষকেরদ্বারাপরিচালিত)</td><td>ব্ল্যাকবোর্ড,ডাস্টার,চক</td></tr>
</table>
</td></tr>
</table>

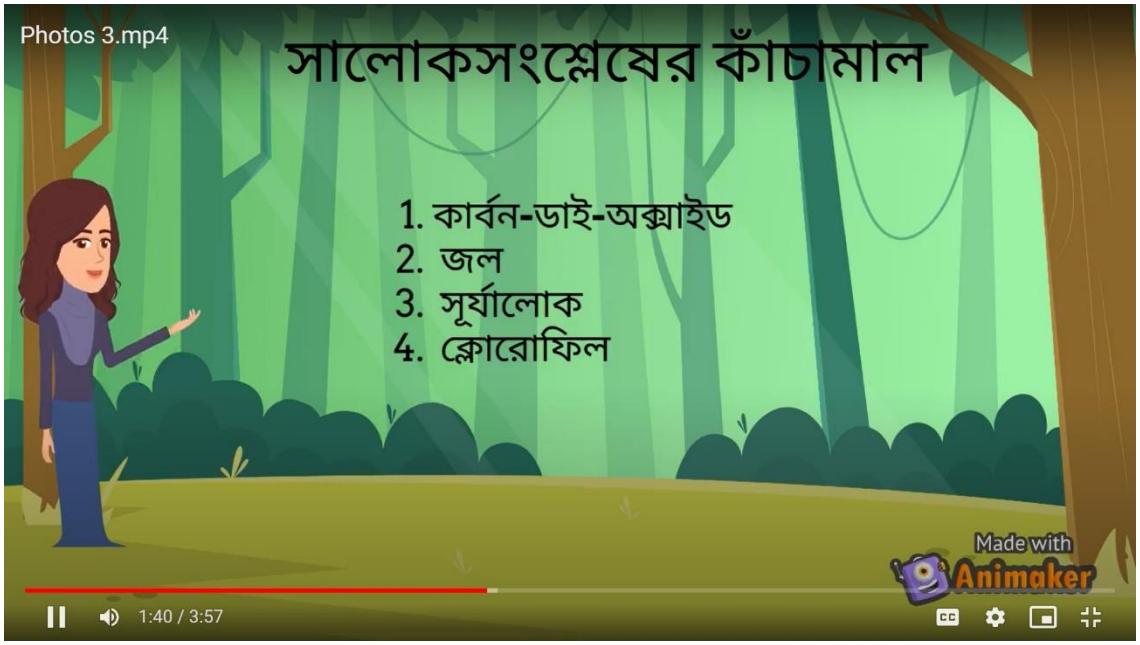
Elaboration বিস্তারিত করা			নির্দেশমূলকপর্যায়	
		10 মিনিট	সম্পূর্ণক্লাসেরতিনভাগেরএকাংশনিয়েগঠিতছোটবিভাগ(প্রজেক্ট/ অ্যাসাইনমেন্ট/ সম্মিলিতকাজ/ এককাজ) বিভিন্নসালোকসংশ্লেষকারীরঞ্জকপদার্থেরএকটিরেখাচিত্রঅঙ্কনকরো।	Copy, pen, pencil etc
		10 মিনিট	সম্পূর্ণক্লাসেরতিনভাগেরএকাংশনিয়েগঠিতছোটবিভাগ(অনলাইনবিষয়বস্তুদ্বারা পরিচালিত) https://youtu.be/j7GOieO12rU	Computer, K-Yan
		শ্রেণীবিভাগপ্রক্রিয়া: এইক্লাসপরিচালনারজন্যপুরোক্লাসকেএলোমেলোভাবেতিনটিগ্রুপেভাগকরাহবেযারপ্রতিটিগ্রুপে12, 12 এবং11 জনশিক্ষার্থীথাকবে।		
Evaluation মূল্যায়ন করা	ক্লাসেরবিষয়বস্তুসম্পর্কেশিক্ষার্থীরাপরিষ্কারহয়েছেতাকিভাবেজানাযাবে?	গঠনমূলকপাঠপরবর্তীমূল্যায়ন: 10 মিনিট সকলশিক্ষার্থীপাঠশেষেএকটিঅনলাইনকুইজএঅংশগ্রহণকরবে https://forms.gle/5MxS6zNUmyY5zWA6A		
Hom	যদিশিখনসফলহয়তাহলেকিকরণীয়?	নির্দেশনামূলকশিক্ষার্থী: সম্পূর্নক্লাস: 5 মিনিট		

e w or k গৃ হ কা জ	যদিশিখননাস ফলহয়তাহ লেকিকরণীয় ?	পূর্বোক্তকুইজেরফলাফলআশারুপহলেজানাযাবেশিখণসফলহ য়েছে। সেক্ষেত্রেশিক্ষার্থীদেরজানানোহবেপরবর্তীদিনসালোকসংশ্লেষের পদ্ধতিএবংপূর্বশর্তসম্পর্কেআলোচনাকরাহবে। আশানুরূপফলাফলনাহলেশিক্ষার্থীদেরবর্তমানপাঠেরভিডিওলিং কএবংঅন্যান্যবস্তুসরবরাহকরাহবেএবংজানানোহবেতাদেরজন্য আয়োজিতবিশেষনির্দেশনামূলকক্লাসেতারাএগুলিআলোচনারমা ধ্যমেবাশিক্ষকএরসহায়তায়সমাধানকরতেসক্ষমহবে। গৃহকাজ: পাঁচটিপ্রাণীরনামএরতালিকাপ্রস্তুতকরতেনির্দেশদেয়াহবেযারাসা লোকসংশ্লেষেরসক্ষমএবংপাঁচটিউদ্ভিদেরনামেরতালিকাপ্রস্তুতক রতেদেয়াহবেযারাউদ্ভিদহওয়াসত্বেওসালোকসংশ্লেষেঅক্ষম।প্র য়োজনেতারাইন্টারনেটেরসাহায্যনিতেপারবে।সেক্ষেত্রেতারাকো নকোনওয়েবসাইটব্যবহারকরেছেতারতথ্যসূত্রদিতেহবে।

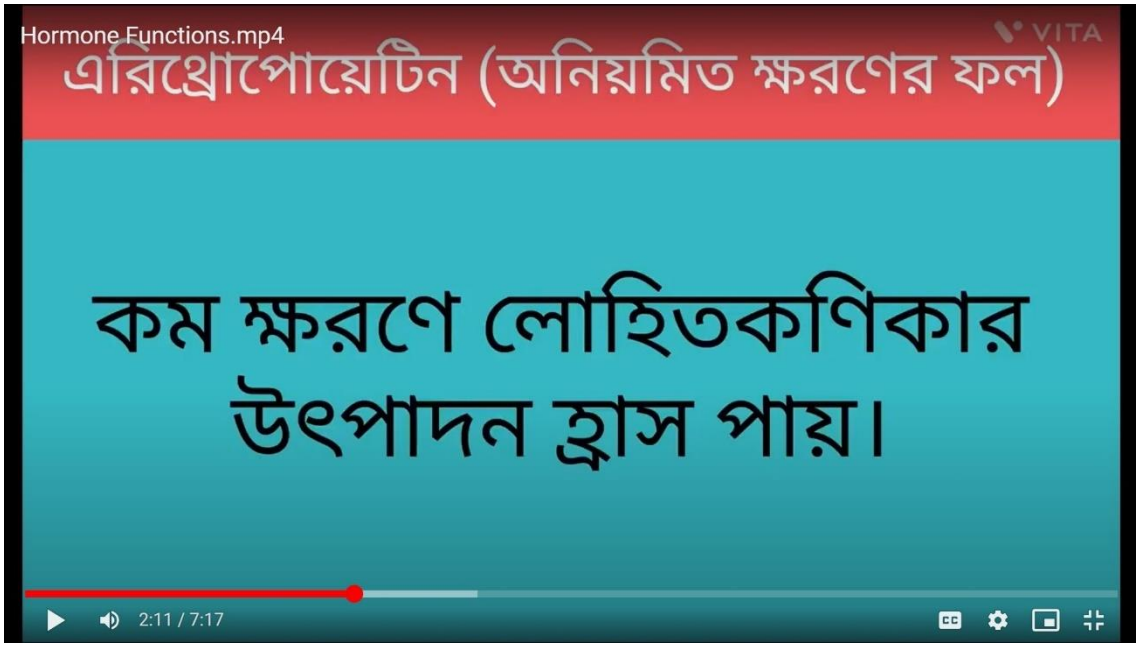
APPENDIX – 8 (Some pictures showing different e-contents)



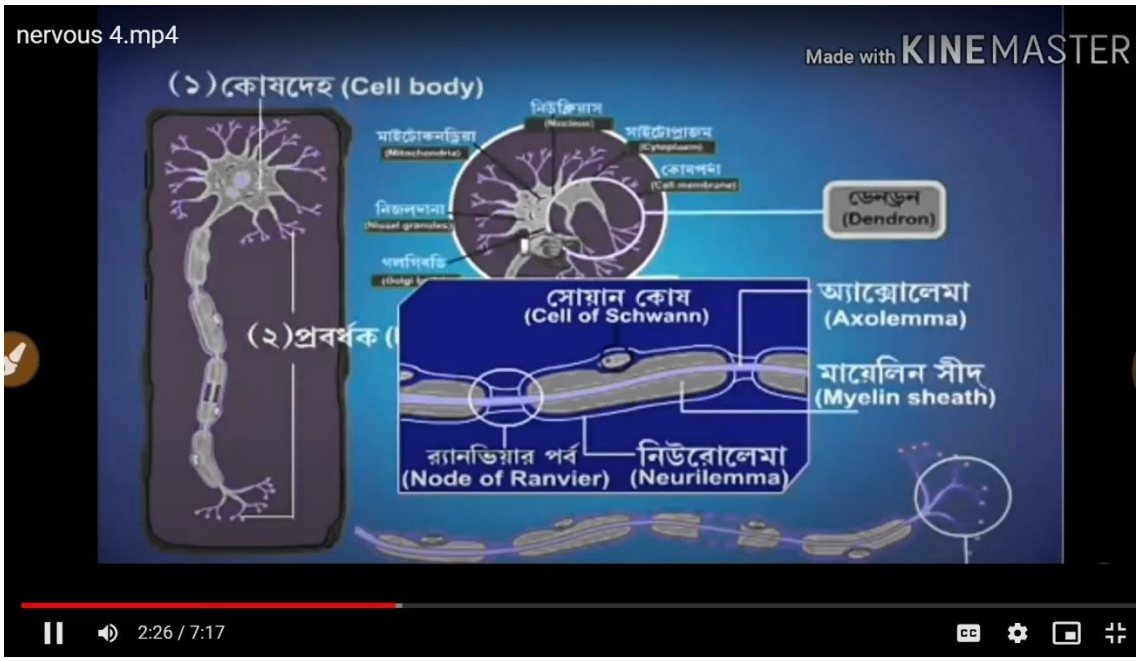
Cell Division



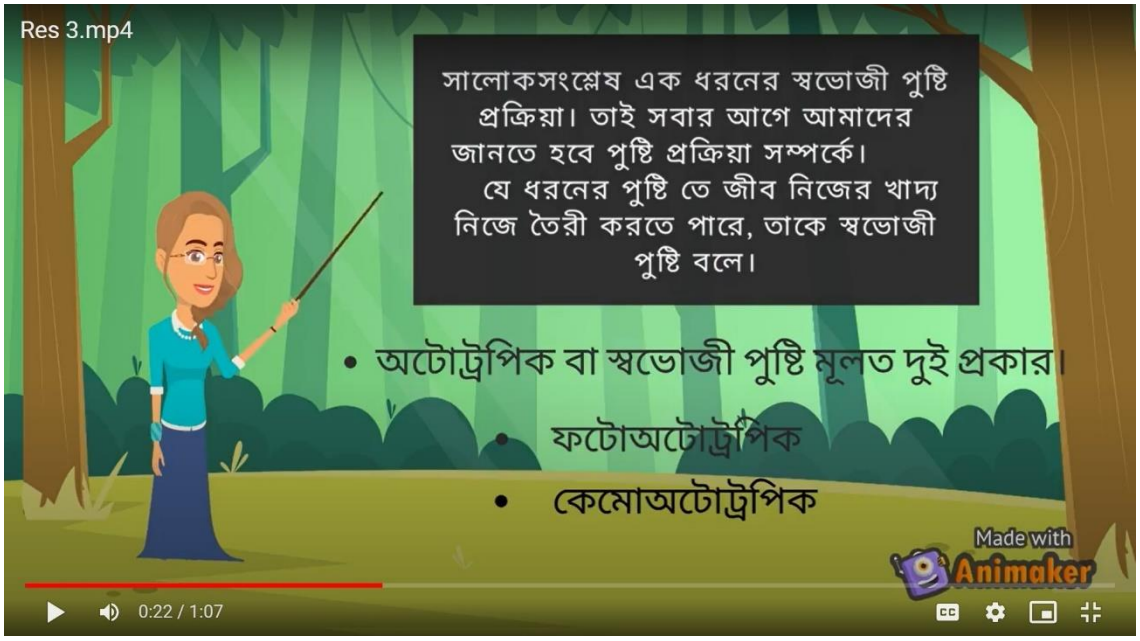
Photosynthesis



Hormone



Nervous System



Respiration

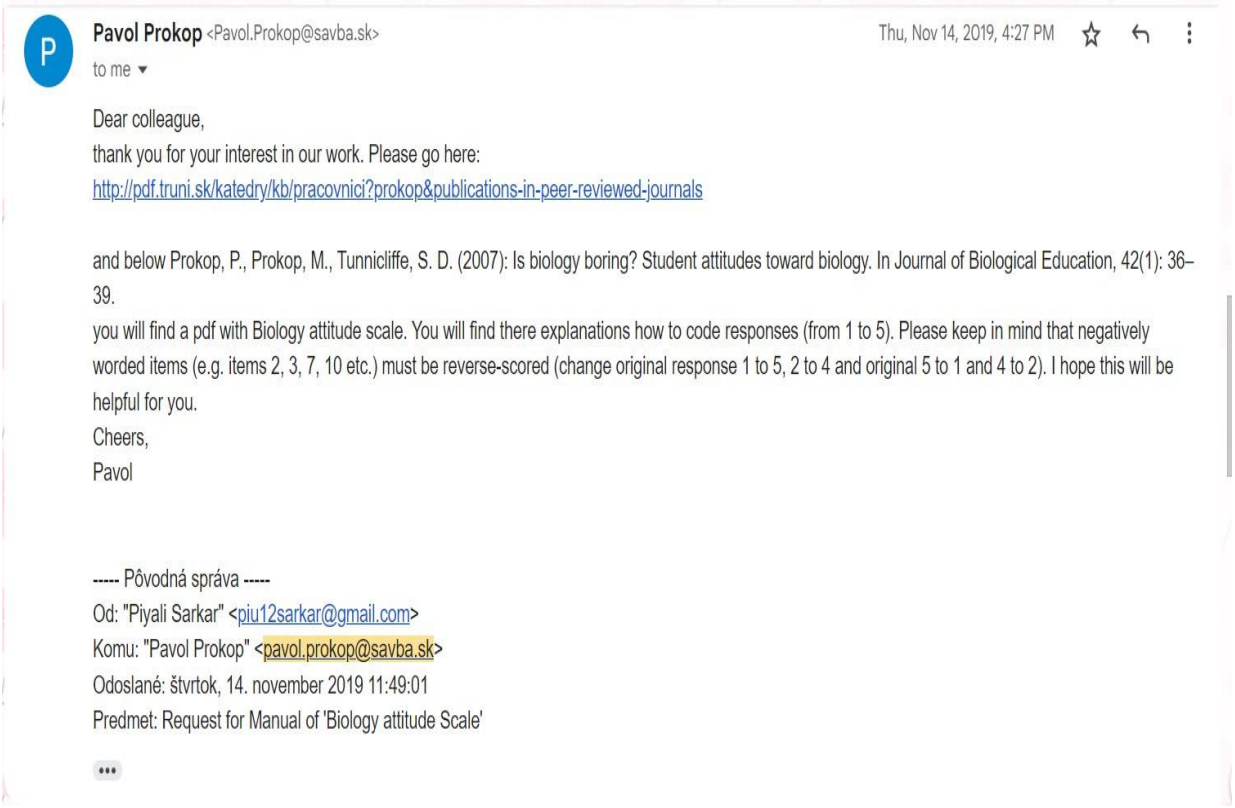
Drive link for e-contents: https://drive.google.com/drive/folders/1wGKxoaT-zGPfgS0-jxswkXWh1DCAUsOY?usp=drive_link

APPENDIX – 9 (List of Experts for present study)

		Name of Expert	Experience	Designation
English Language Expert	1	DR. Aparna Sharma	23 years	Associate professor S.V.S.D.P.G College, Bhatoli
Education	2	DR. N.K. Choudhury	26 years	Principal SD college, Hoshiyarpur
Education	3	PROF. DR. Jayanta Mete	25 years	Professor University of Kalyani
Education	4	DR. Sasmita Kar	20 years	Assistant Professor Rama Devi Govt. Women's University
Education	5	DR. Pavol Prokop	25 Years	Associate Professor Comenius University
Education	6	DR. G.P. Chowdri	26 Years	Associate Professor GRCCCM Govt. College
Education	7	PROF. DR. Jasraj Kaur	30 Years	HOD, Professor, Punjab University
Education	8	DR. Manohar Rao	22 Years	Associate Professor Kakatiya University
Education	9	DR. Amulya Kumar Acharya	10 Years	Associate Professor Fakir Mohan University
Psychology	10	DR. V. Ramachandram	20 Years	Associate Professor Kakatiya University

Education	11	DR. Paramita Sarkar	07 Years	Assistant Professor Govt. College, Kasba
Zoology	12	DR. Anupam Ghosh	09 Years	Assistant Professor Chatna College
English Language Expert	13	Rishiraj Choudhuri	18 Years	Assistant Teacher Govt. School Teacher
Bengali Language Expert	14	Sneharika Basumata	15 Years	Assistant Teacher Govt. School Teacher
Bengali Language Expert	15	Sakti Prasad Ghosh	24 Years	Assistant Teacher Govt. School Teacher
Bengali Language Expert	16	DR. Jyotirmay Roy	32 years	Assistant Teacher Govt. School Teacher
Education	17	Gopa Paul	26 years	Assistant Teacher Govt. School Teacher
Zoology	18	Nirmalendu Dhar Chowdhury	36 Years	Teacher in Charge Govt. School Teacher
Botany	19	Jadab Debnath	15 Years	Assistant Teacher Govt. School Teacher
Zoology	20	Raghunath Saha	30 Years	Retired Assistant Teacher Govt. School Teacher

APPENDIX – 10 (Biology Attitude Questionnaire – Permission from Author)



Pavol Prokop <Pavol.Prokop@savba.sk> Thu, Nov 14, 2019, 4:27 PM

to me

Dear colleague,
thank you for your interest in our work. Please go here:
http://pdf.truni.sk/katedry/kb/pracovnici?prokop&publications-in-peer-reviewed-journals

and below Prokop, P., Prokop, M., Tunnicliffe, S. D. (2007): Is biology boring? Student attitudes toward biology. In Journal of Biological Education, 42(1): 36–39.
you will find a pdf with Biology attitude scale. You will find there explanations how to code responses (from 1 to 5). Please keep in mind that negatively worded items (e.g. items 2, 3, 7, 10 etc.) must be reverse-scored (change original response 1 to 5, 2 to 4 and original 5 to 1 and 4 to 2). I hope this will be helpful for you.
Cheers,
Pavol

----- Pôvodná správa -----
Od: "Piyali Sarkar" <piu12sarkar@gmail.com>
Komu: "Pavol Prokop" <pavol.prokop@savba.sk>
Odoslané: štvrtok, 14. november 2019 11:49:01
Predmet: Request for Manual of 'Biology attitude Scale'

APPENDIX – 11(Biology Attitude Questionnaire - Adapted)

ITEM NO.	STATEMENTS	DOMAIN
9	Our biology teacher makes us do active work	INTEREST
12	I would like to have biology lessons more often	
13	Biology knowledge is essential for understanding other courses and phenomenon	
14	Nobody needs biology knowledge	
15	I hate biology lessons	
17	My future career is independent from biology knowledge	
18	The work with living organisms in biology lessons is very interesting	
19	I have often difficulties to understand what we have learn in biology	
21	The progress of biology improves the quality of our lives	
22	I would like to be a biologist	
23	When I prepare for biology lesson, I bring to mind equipment that we have used in biology	
24	I like the way how biology is teaching in our school	
10	Our biology teacher makes us do active work	TEACHER
11	Our biology teacher disregard aspiration of students with bad rating	
16	My biology teacher is my personal model, I would like to work like he	
20	I like my biology teacher	
1	I like Biology more than other subjects.	DIFFICULTY
2	Biology helps development of my conceptual skills	
3	I like watching natural history films; I would like therefore make a career in this in this field	
4	Biology is one of the easiest courses for me	
5	Our biology teacher makes drawings or uses pictures in each practical works	
6	Nature and Biology is strange for me	
7	Biology is not important in comparison with other courses	
8	Biology knowledge is necessary for my future career	

APPENDIX – 12 (Online Tool construction Course Completion Certificate)

University of Colorado
Boulder | Colorado Springs | Denver | Anschutz Medical Campus

COURSE CERTIFICATE

04/16/2020

Piyali Sarkar

has successfully completed

Blended Language Learning: Design and Practice for Teachers

an online non-credit course authorized by University of Colorado Boulder and offered through Coursera

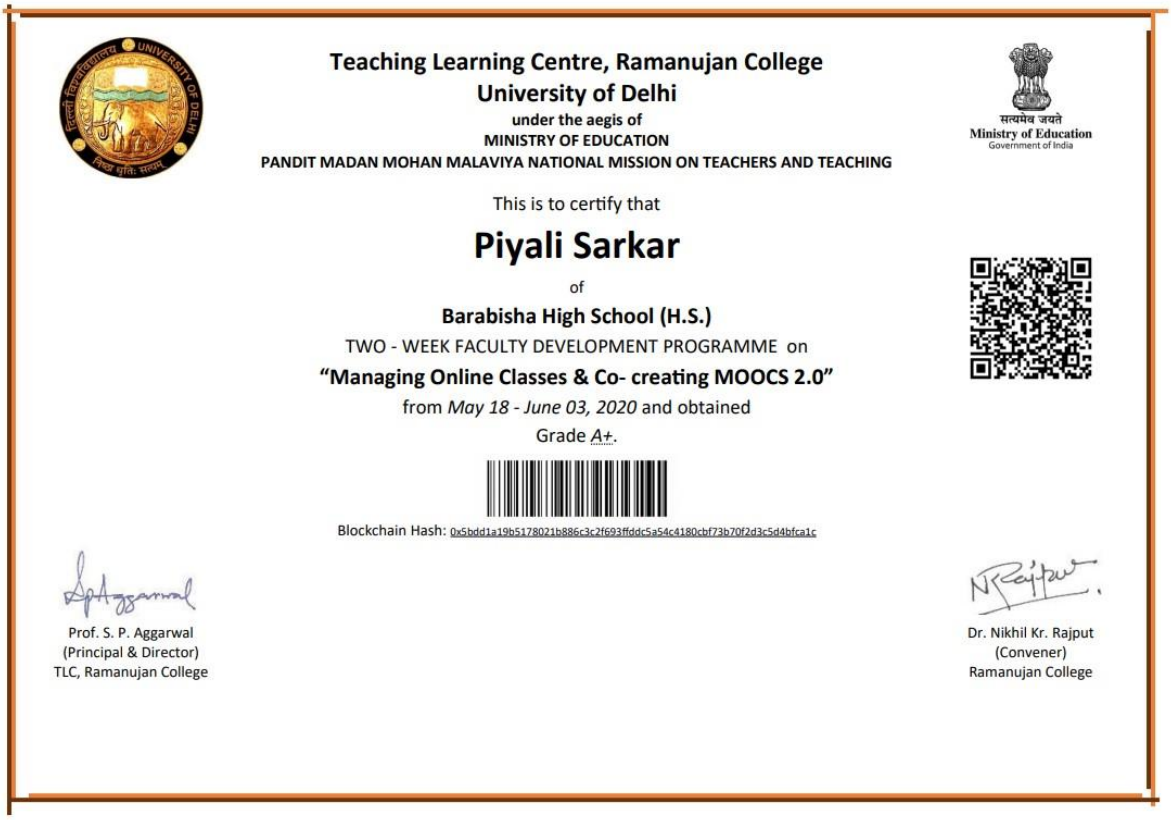
EDUCATION FOR EVERYONE · coursera · COURSE CERTIFICATE

Edwige Simon

Edwige Simon
Faculty Director of the Language Teaching with Technology Graduate Certificate
University of Colorado Boulder

Verify at coursera.org/verify/XAR58AAM8QFT
Coursera has confirmed the identity of this individual and their participation in the course.

APPENDIX – 13 (Online Tool construction Course Completion Certificate)



Teaching Learning Centre, Ramanujan College
University of Delhi
under the aegis of
MINISTRY OF EDUCATION
PANDIT MADAN MOHAN MALAVIYA NATIONAL MISSION ON TEACHERS AND TEACHING

सत्यमेव जयते
Ministry of Education
Government of India

This is to certify that

Piyali Sarkar

of

Barabisha High School (H.S.)

TWO - WEEK FACULTY DEVELOPMENT PROGRAMME on

"Managing Online Classes & Co- creating MOOCS 2.0"

from *May 18 - June 03, 2020* and obtained

Grade *A+*.

Blockchain Hash: 0x5bdd1a19b5178021b886c3c2f693ffddc5a54c4180cbf73b70f2d3c5d4bfca1c

Prof. S. P. Aggarwal
(Principal & Director)
TLC, Ramanujan College

Dr. Nikhil Kr. Rajput
(Convener)
Ramanujan College

APPENDIX – 14 (Online Tool construction Course Completion Certificate)

MANONMANIAM SUNDARANAR UNIVERSITY, Tirunelveli, Tamil Nadu

Cert No: CSMEMSU 12079

CERTIFICATE OF PARTICIPATION

Project under MHRD GOVERNMENT OF INDIA

सत्यमेव जयते

Presented to

Ms PIYALI SARKAR

RESEARCH SCHOLAR
DEPARTMENT OF EDUCATION
LOVELY PROFESSIONAL UNIVERSITY, PHAGWARA
JALANDHAR, PUNJAB

for participating in the Webinar on "Online Tools for Teachers and Administrators" through online on June 27, 2020 at 10.00 am - 01.00 pm.

CENTRE FOR SPECIAL AND MOVEMENT EDUCATION

SCHOOL OF EDUCATION

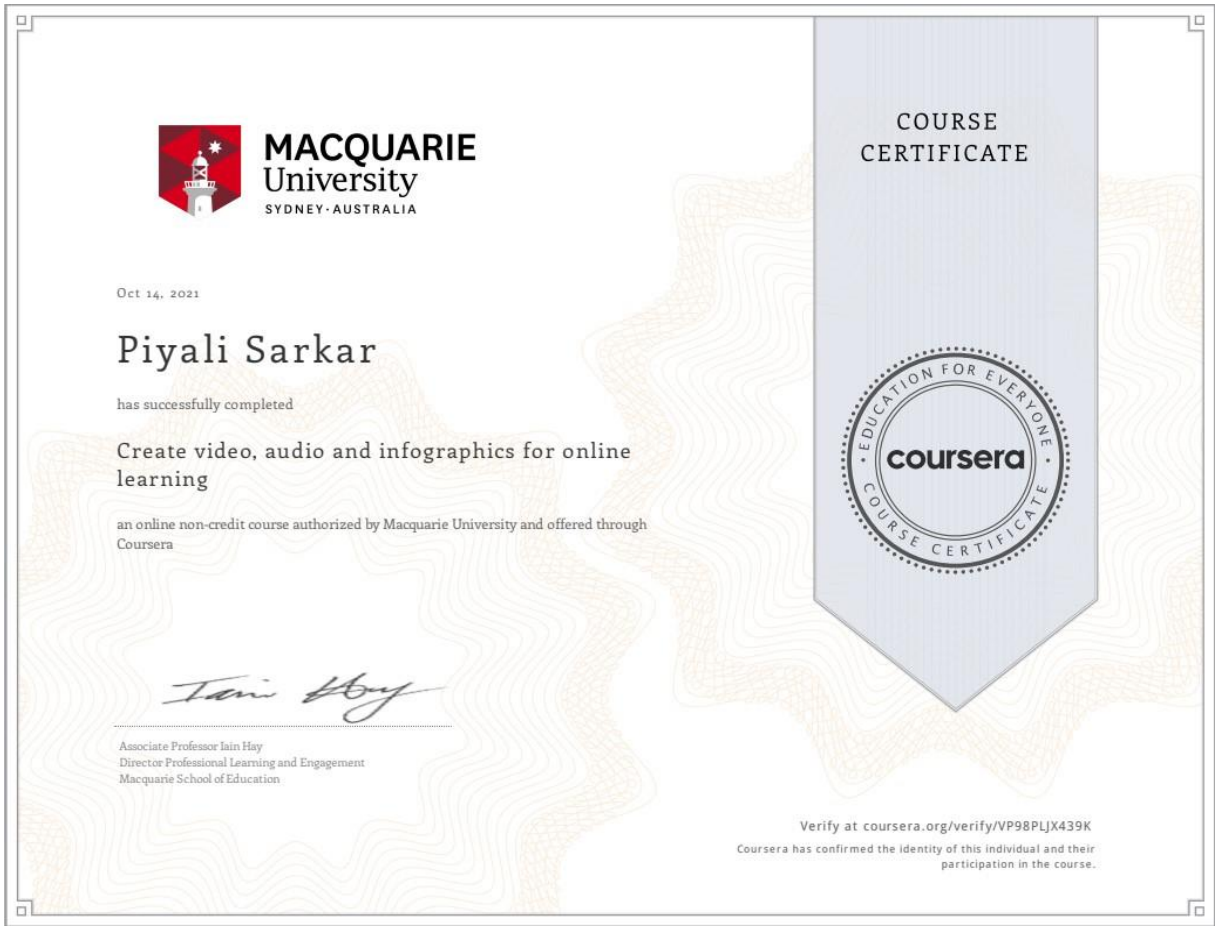
PANDIT MADAN MOHAN MALAVIYA NATIONAL MISSION ON TEACHERS AND TEACHING

Dr. S. Sethu
Organising Secretary

ONLINE WEBINAR e-certificate ONLINE WEBINAR

Dr. S. Santhosh Baboo
Registrar

APPENDIX – 15 (Online Tool construction Course Completion Certificate)



MACQUARIE University
SYDNEY·AUSTRALIA

COURSE CERTIFICATE

Oct 14, 2021

Piyali Sarkar

has successfully completed

Create video, audio and infographics for online learning

an online non-credit course authorized by Macquarie University and offered through Coursera

Associate Professor Iain Hay
Director Professional Learning and Engagement
Macquarie School of Education

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Verify at coursera.org/verify/VP98PLJX439K

Coursera has confirmed the identity of this individual and their participation in the course.

APPENDIX – 16 (Online Tool construction Course Completion Certificate)

Indian Council of
Social Science Research

Ten days Online Workshop

on

Research Methodology Course for Research Scholars and Students

Organized by

Uttarakhand Open University collaboration with M.B.G.P.G.College, Haldwani

Approved by ICSSR, New Delhi

(A under MHRD, Govt of India, New Delhi)

Certificate of Participation

This is to certify that Mr./Ms./Dr. PIYALI SARKAR from Lovely Professional University has participated in Ten days online workshop on Research Methodology Course from 22 April to 1 May 2021, organized by **Uttarakhand Open University** and **M.B.G.P.G. College**, Haldwani, Uttarakhand.

Dr. Rashmi Pant
(Course Director)

Dr. Siddharth Kumar Pokhriyal
(Co-course Director)

APPENDIX – 17 (Experiment Completion certificate from Experimental School)

BARABISHA HIGH SCHOOL (H.S.)

Ph. 03564-263256
E-mail : bhs1951.jal@gmail.com

Index No : N2-007 P.O. : BAROBISHA, DIST : ALIPURDUAR
PIN NO. 736207, WEST BENGAL

Memo No.:-

Date - 12/03/2022

TO WHOM IT MAY CONCERN

This is to certify that **Ms. Piyali Sarkar**, a Part Time Research Scholar from Department of Education, Lovely Professional University, was taken prior permission for experimentation with class 11th Science students of my school for the completion of her PhD thesis titled as **"Effectiveness of Blended Learning on Achievement, Anxiety and Attitude of Senior Secondary School students of West Bengal"**.

She has completed her entire experimentation from Barabisha High School (H.S.) from **17.01.2022** to **11.03.2022**. I would like to congratulate her for completion of experimentation on time, perfection and perseverance despite having many challenges that came during the process. I appreciate her sincere effort.

Wish you all the best for rest of your research career.

BARABISHA HIGH SCHOOL (H.S.) Estd. 1965 Barabisha Dist. Alipurduar

Headmaster 12.3.22
Barabisha High School (H.S.)

APPENDIX – 18 (Opinions of Experts on 5E Lesson Plans)

- Ok with your 5E lesson plans.
- Language is ok for me. In the cell division part, found grammatical mistakes in explanatory part of module 2. In the Nervous system part, I found mistakes in sentence construction in module 1.
- Both lesson plan and unit break up is good also well maintained. Sometimes you are adding whole text in lesson plan so not do this. Do only how much needed. Reduce online task. Every time you cannot maintain online responses. Will be a burden to keep record.
- maintain Bloom taxonomy, attach less picture, too many objectives for single lesson plan, lengthy lesson plan not easy to cover within class.
- You have used mixing of common language and traditional language like চলছে, চলিতেছে; বপনকরাহয়, রোপিতকরাহইতেছে।Avoid such kind of mixing. Do not add whole text in your lesson plan. Chance Language ambiguity increases thereby.
- Language of 5E and SAMR lesson plans are good in Bengali. Add some punctuation marks where needed.
- Well constructed lesson plans, more specification needed topic wise. All things should be shown in your class planning. Be more authentic about biochemical processes
- Lesson plans are ok as per Biology subject teacher experience. Your module division choice is good and it is very good to apply without giving burden to students.
- Lengthy, Unit break up good, Maintain correct sequence of Bloom's taxonomy during objective writing.

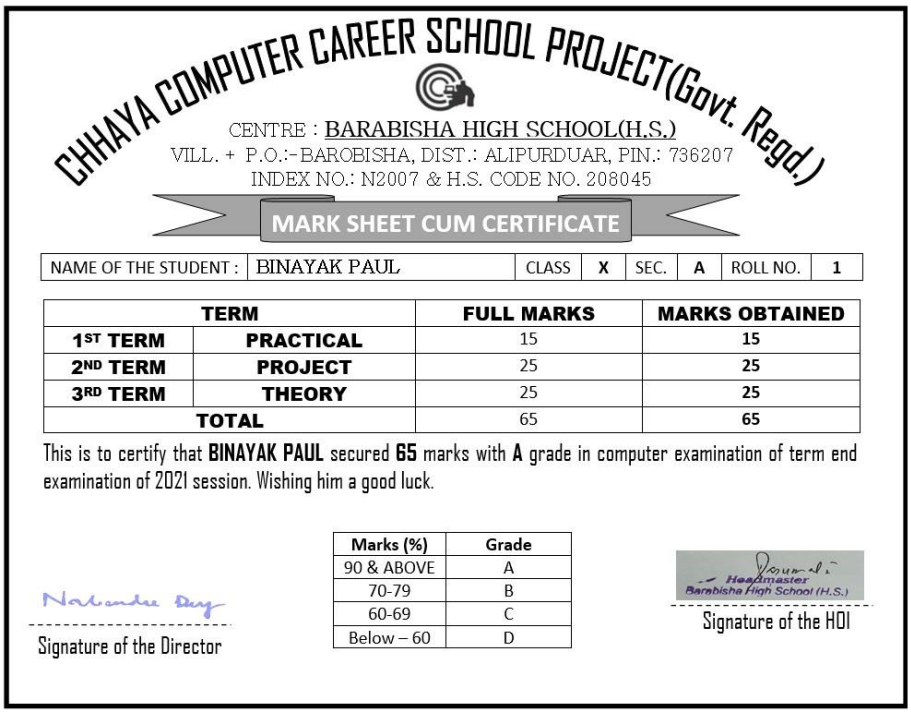
- Put some use of Blackboard also, above all it’s our heritage tool of teaching. Use of chart, diagrams and other are good.
- Just maintain Bloom’s taxonomy sequence during writing your objectives. Other things are ok with your lesson plans.
- well developed
- Too lengthy, objectives written in good ways. Language ok here. Try a more simple language instead of the Bookish language. Your pictorial description is good to imply.
- Too detailed, may be shortened, you can make it more compact. Otherwise, good.
- Write only needed objectives. Always too many objectives are not needed for your lesson plan. Keep the lesson plan precise and clear to yourself. In conventional classes it is generally found to use blackboard and chalk that’s why we call traditional settings as chalk and talk technique. So, include blackboard and chalks use in your lesson plan to make it more conventional.

APPENDIX – 19 (Opinions of Experts on SAMR Plans)

- Easy to apply and creative. Add timings for your own good. As per my opinion blended learning based on percentage of technological contents. So, mentioning timing and maintain timing is most important for your study and lesson plan.
- Language use is ok. The contents are ok. Others are found correct to me.
- Both lesson plan and unit break up is good also well maintained. Sometimes you are adding whole text in lesson plan so not do this. Do only how much needed. Reduce online task. Every time you cannot maintain online responses. Will be a burden to keep record.
- maintain Bloom taxonomy, attach less picture, too many objectives for single lesson plan, lengthy lesson plan not easy to cover within class.
- You have used mixing of common language and traditional language like চলছে, চলিতেছে; বপনকরাহয়, রোপিতকরাহইতেছে।Avoid such kind of mixing. Do not add whole text in your lesson plan. Chance Language ambiguity increases thereby.
- Language okay, slow down your speed of talking, way of teaching is good attractive, and pronunciation correct.
- Well constructed lesson plans, more specification needed topic wise. All things should be shown in your class planning. Be more authentic about biochemical processes
- Lesson plans are ok as per Biology subject teacher experience. Your module division choice is good, and it is very good to apply without giving burden to students.
- SAMR – good choice for Blended lesson
- Rotation – which type mention it.
- Face to face – what is K-yan? Mention how you will use it.

- Try offline assessment, you have mentioned all Google forms and other things as assessment tool, which needs continuous internet supply, if you use offline things, that can reduce the pressure/risk of blended to e-learning transformation.
- Good one for blended mode, mention timings for each station for station rotation model. In face-to-face method use of OHP is also very good option along with k-yan. Here also mention time. Other things ok
- Well developed.
- Too lengthy, objectives written in good ways. Language ok here. Try a simpler language instead of the Bookish language. Your pictorial description is good to imply.
- Excellent lesson plan, Segmental, Station wise well distributed. Some minor spelling mistakes can be rectified. Should use different machineries for teaching children, like film.
- Blended lesson plan is okay to imply SAMR technique is well employed in blended learning lesson plan. Need little language proficiency in Bengali language blended lesson plan.

APPENDIX – 20 (Last year report Cards of some students)



CHHAYA COMPUTER CAREER SCHOOL PROJECT(Govt. Regd.)

CENTRE : BARABISHA HIGH SCHOOL(H.S.)
VILL. + P.O.:-BAROBISHA, DIST.: ALIPURDUAR, PIN.: 736207
INDEX NO.: N2007 & H.S. CODE NO. 208045

MARK SHEET CUM CERTIFICATE

NAME OF THE STUDENT :	BINAYAK PAUL	CLASS	X	SEC.	A	ROLL NO.	1

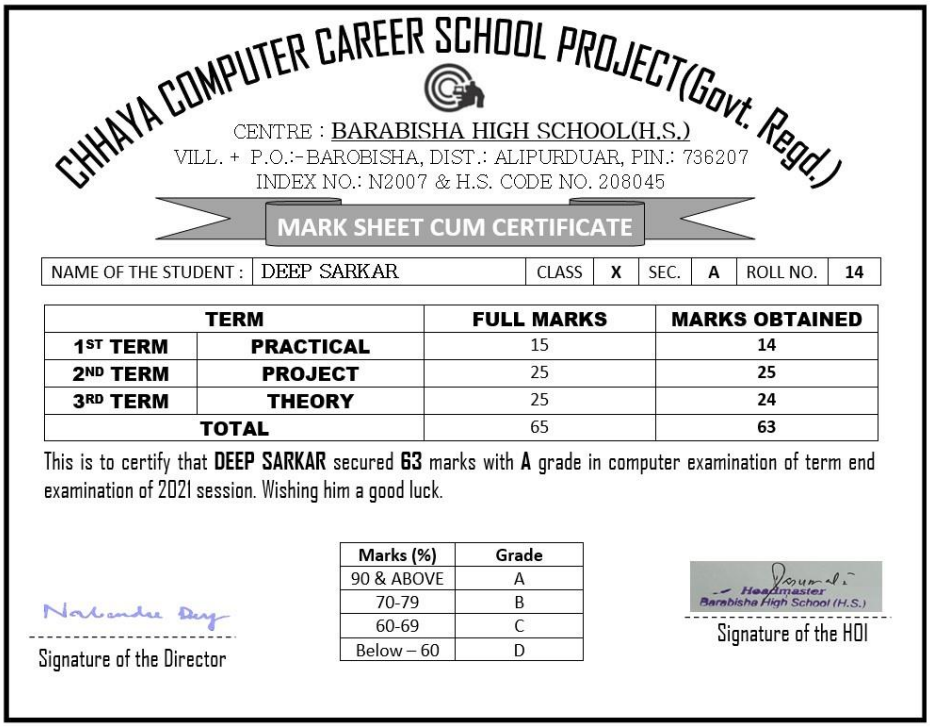
TERM		FULL MARKS	MARKS OBTAINED
1ST TERM	PRACTICAL	15	15
2ND TERM	PROJECT	25	25
3RD TERM	THEORY	25	25
TOTAL		65	65

This is to certify that **BINAYAK PAUL** secured **65** marks with **A** grade in computer examination of term end examination of 2021 session. Wishing him a good luck.

Marks (%)	Grade
90 & ABOVE	A
70-79	B
60-69	C
Below – 60	D

Nalendu Dey
Signature of the Director

Headmaster
Barabisha High School (H.S.)
Signature of the HOI



CHHAYA COMPUTER CAREER SCHOOL PROJECT(Govt. Regd.)

CENTRE : BARABISHA HIGH SCHOOL(H.S.)
VILL. + P.O.:-BAROBISHA, DIST.: ALIPURDUAR, PIN.: 736207
INDEX NO.: N2007 & H.S. CODE NO. 208045

MARK SHEET CUM CERTIFICATE

NAME OF THE STUDENT :	DEEP SARKAR	CLASS	X	SEC.	A	ROLL NO.	14

TERM		FULL MARKS	MARKS OBTAINED
1ST TERM	PRACTICAL	15	14
2ND TERM	PROJECT	25	25
3RD TERM	THEORY	25	24
TOTAL		65	63

This is to certify that **DEEP SARKAR** secured **63** marks with **A** grade in computer examination of term end examination of 2021 session. Wishing him a good luck.

Marks (%)	Grade
90 & ABOVE	A
70-79	B
60-69	C
Below – 60	D

Nalendu Dey
Signature of the Director

Headmaster
Barabisha High School (H.S.)
Signature of the HOI