“A STUDY OF EFFECTIVENESS OF BLENDED LEARNING ON THE ACADEMIC ACHIEVEMENT OF GRADE VIII STUDENTS IN SCIENCE.”

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DECLARATION

I, Mr. Udesh Ramakant Natekar hereby declare that this thesis represents work that I have carried out and that it has not been submitted, either in part or full, to any other University or Institution for the award of any research degree.

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CERTIFICATE

I hereby certify that the work was carried out under my supervision and may be placed for evaluation.

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Research Scholar

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CHAPTER I

INTRODUCTION

1.1 INTRODUCTION

It is said, ‘Education makes a man perfect’, in the sense that one becomes a knowledgeable, skilful, responsible, and considerate individual who confidently leads a good life. Education has become a basic need, as well as food, shelter, and clothing, and plays a significant role in every individual’s life. A person becomes successful in life if one understands the practical applicability of education. Education brings about an individual's all-round development, further boosting one’s personality. It includes a variety of formal and informal experiences, inside and outside conventional educational settings. Education is an enduring process of constant learning and individual development. Education allows individuals to accomplish one's potential, track interests and ambitions, and contribute to society as knowledgeable and engaged citizens. Education is frequently seen as a way to social and fiscal mobility, which offers individuals prospects to develop their socioeconomic position and excellence in life.

1.1.1 STATUS OF SECONDARY EDUCATION IN INDIA

Education in India is mainly classified into Primary, Secondary, and Higher education. Secondary education in India includes grades VIII, IX, and X.

(The researcher is aware that the new academic structure of NEP-2020 is 5+3+3+4, where grade VIII falls in middle school and grade IX is considered the secondary stage. This structure is to be followed by the whole country.)

Secondary education is the backbone of the educational system of any country, and India is no exception for it. Secondary Education is the bridge between primary education and higher education. The role of secondary Education is to prepare students for higher education, improve their practical skills and practical efficiency, and enable them to contribute to the

social and economic development of the country. Higher education needs a higher level of thinking, which should be developed in the earlier stages.

Efforts at different levels are necessary to solve the rising challenges affecting the completion of secondary education. The Government of India has come up with many initiatives like Rashtriya Madhyamik Shiksha Abhiyan (2009), the Girls Hostel Scheme (2009), the National Scheme of Incentives to Girls for Secondary Education (2008), Inclusive Education for Disabled at Secondary Stage (2009), Scheme of Vocational Education(2018), National Merit-cum-Means Scholarship Scheme (2008), Scheme for construction and running of Girls' Hostel for students of secondary and higher secondary schools (2001), Scholarship schemes for Minority students, National Scholarships, the results are yet far from expectations. Despite the continuous rise in the establishment of secondary schools across the country, which has increased physical access to schools, the quality of education provided in these schools remains a critical issue.

1.1.2 EDUCATIONAL SCENARIO IN GOA

As per Census data released by the Directorate of Census Operations, Goa, 2011, "Goa takes pleasure in pride in the country as one of the most literate states of India with 87.40 percent literacy".

Since liberation from Portuguese rule in 1961, Goa has registered impressive progress in education. The Government of Goa believes education is the base for individuals' progress and a cause of the progress of personality for accountable citizenship.

Though the State of Goa has recorded 87.40 percent literacy, as per the report submitted by Bharatiya Jain Sanghatana (2009) to the Directorate of Education, Government of Goa, "A towering 77% of schools in Goa use stereotyped methods of teaching leaving minimal scope for interactive, experiential teaching. These schools also lack creativity in their teaching

methods" (Bharatiya Jain Sanghatana Educational Quality Improvement Program). As per the secondary Education index (2012) for Goa, Learning in Goa is by rote memorisation and not by understanding. According to the Union Education Ministry's Performance grading index, (2019-2020), Goa has poor learning outcomes, quality, and governance processes as compared to neighbouring states. So still, the pressing necessity is to improve the quality of education, which calls for research on this aspect.

1.1.3 TEACHING LEARNING AS A FACTOR FOR QUALITY EDUCATION

One critical factor affecting the quality of education is the teaching-learning process. The teaching methods used by the teachers, if they do not catch the attention of the students if they do not create interest in them, the students tend to deviate from their studies, more so in the present situation when they can find much interesting (?) subjects at the tips of their fingers. This further creates indiscipline among the students, the most significant problem haunting our schools today.

"Teaching is a complex activity designed to maximize learning" Gagne (1963). The process of enhancement of teaching-learning has fascinated researchers for quite some time, and the search for more effective teaching strategies, methods, and techniques continues and will continue with the introduction of communication technologies being investigated. There is conformity that teaching is all about creating a classroom environment to assist or shape the learner's development. These environments are to a large extent a manifestation of a teacher's aptitude in the profession. The role and responsibility of the teacher Vis–a–Vis the learners have undergone numerous changes connected with the reorganization process of education. Classroom operation is moving on the range from teacher-centered to learner-centered, which has given the teacher a changed task that of the facilitator for learning.

The child-centered approach to education has more expectations from the teacher. The teacher must master several roles to become more professional and express effectively. The

teacher has to use many research-based teaching strategies, which are tried and tested. To accomplish all-round development, a teacher needs to design appropriate instructional approaches that help the students grow emotionally, socially, and intellectually. A big gap exists between theoretical knowledge and actual teaching in the classroom or in schools.

According to the report of the Secondary Education Commission (1952-53): "Even the best curriculum and the most perfect syllabus remain dead unless quickened to life by the right methods of teaching and the right kind of teacher". Appropriate instructional strategies are vital for realizing the learning objectives. This led researchers to investigate various methods and techniques for the progress of cognitive, affective, and psychomotor domains. There is no sole best way or teaching strategy that can be engaged in all situations since the number of teaching goals is large and varied. The best technique is the one that will be most effective or reaching a particular goal in a certain given situation. Blended Learning Strategies are one such effective instructional strategy for achieving educational objectives.

1.1.4 SECONDARY SCHOOL EDUCATION AND TECHNOLOGY

Although the internet is very useful for students in their studies, students these days tend to indulge in destructive activities such as misuse of social media, chatting for hours, creating reels, etc. thereby deceiving the whole purpose of using the internet for learning. So, it is high time to integrate traditional methods of teaching with technology with proper planning and come up with new innovative teaching strategies that will motivate students to learn effectively. One such strategy which is being largely supported and promoted today is 'Blended Learning.'

As per the Annual Status of Education Report 2020 (Rural), "Although the proportion of children from households with assets like TV and motorized vehicles change only slightly over the preceding years of the report, the proportion owning a Smartphone increased to a

great deal from 36.5% to 61.8%. Most often parents purchase smartphones. But even among children who did not have a Smartphone at home, about 1 in every 10 was able to access a Smartphone elsewhere, for example from a neighbour."

However, according to the Annual Survey of Education (2021), "20.2% of teachers used online recorded videos as learning material in the class for grades VI-VIII, whereas 82.1% of the teachers used WhatsApp as additional material for grades VI to VIII."

According to the National Achievement Survey (2021), "78% of the students termed learning at home as burdensome with a lot of assignments. So also, 38% of the students faced difficulties in learning at home. It is because of lack of planning and no proper organisation in the dissemination of the learning information."

Blended Learning is one such strategy that can be planned properly and well-organized to address the above-mentioned issues

Therefore, the researcher integrated technology into teaching Science for greater academic achievement of learners. To be more precise, the researcher studied the effectiveness of the Blended Learning Strategy in teaching science subjects at the early secondary level in the State of Goa for students' Academic achievement.

1.1.5 BACKGROUND OF THE STUDY

Technology integration in education has significantly converted teaching and learning processes, steering the rise of various innovative teaching methods. One such method is Blended Learning, which combines conventional face-to-face classroom teaching with online learning activities. This approach influences the strengths of both face-to-face and online education, intending to improve students' learning experiences and outcomes.

Blended Learning has been accepted across diverse educational levels and subjects due to its ability to provide a more flexible, personalised, and engaging learning environment. It allows students to access a wide range of resources, work together with peers, and receive immediate feedback, thus encouraging a more active and self-directed learning process. Moreover, Blended Learning can accommodate various learning styles and paces, which is remarkably useful in diverse classrooms.

Regardless of the increasing implementation of Blended Learning, there is a need for realistic research to assess its effectiveness, particularly in specific subjects and educational contexts. In the realm of science education, where conceptual understanding and hands-on experimentation are vital, the impact of Blended Learning on students' academic achievement remains a subject of investigation.

Blended Learning has shown promise in enhancing student engagement, motivation, and academic performance across various subjects and educational levels. However, its effectiveness can vary based on the specific combination of online and offline instructional methods used. In the context of science education for eighth-grade students, it is crucial to explore how different Blended Learning Strategies can impact their academic achievement.

This study spotlights the effectiveness of the Blended Learning Strategies that incorporate the use of MOODLE, an online learning management platform, with various offline teaching methods in teaching science to eighth-grade students. MOODLE, known for its flexibility and user-friendly interface, facilitates a range of online learning activities, including quizzes, forums, and multimedia resources. When combined with traditional offline methods, MOODLE can create an active and interactive learning environment.

The offline teaching methods chosen for this study are the discussion method, learning by doing method, survey integrated with the discussion method and case study method. Each of these methods brings unique benefits to the learning process

Discussion Method aids dynamic participation and critical thinking by permitting students to share ideas, debate concepts, and collaboratively solve problems. This method promotes a deeper understanding of scientific principles through peer interaction and teacher guidance. Learning by Doing Method stresses hands-on activities and experiments, allowing students to directly encounter scientific phenomena. This experiential learning approach helps solidify theoretical knowledge by linking it to practical applications. Survey Integrated with the Discussion Method blends data collection through surveys with successive discussions, permitting students to discover scientific concepts through real-world data and collaborative analysis. This method enhances analytical skills and promotes the practical application of theoretical knowledge. Case Study Method employs real-life scenarios to explain scientific concepts, urging students to apply their knowledge to solve complex problems. This method develops critical thinking and problem-solving skills by presenting students with practical challenges.

The conventional methods of teaching science frequently involve direct instruction, textbook reading, and laboratory experiments. While these methods are effective to some extent, they may not fully address the varied needs of all students. Blended Learning offers an opportunity to enhance the science curriculum by incorporating multimedia resources, virtual labs, interactive simulations, and online assessments, enhancing students' engagement and understanding.

The choice of eighth grade is meaningful as it signifies a critical stage in students' academic journey, where foundational scientific concepts are introduced and developed. Science

education at this level is necessary for nurturing students' curiosity, critical thinking, and problem-solving skills, which are important for their future academic and career pursuits.

This study aims to evaluate the effectiveness of the described Blended Learning Strategies on the academic achievement of eighth-grade students in science. By assessing the impact of MOODLE in combination with various offline instructional methods, this research seeks to provide insights into the probable benefits and challenges of implementing such a Blended Learning Strategy in early secondary school science education. The findings will aid the expanding body of knowledge on Blended Learning and suggest practical implications for educators, curriculum developers, and policymakers seeking to expand science education through innovative teaching strategies.

1.2 BLENDED LEARNING

Blended Learning is an instructive program that integrates teaching materials in an online digital platform with conventional classroom methods. It involves the physical existence of both teacher and learner. While students still attend schools, face-to-face classroom teachings are integrated with computer-mediated activities concerning content and delivery to offer learners added flexibility to modify their learning experiences. It is a combination of conventional and modern-day technology-driven learning where technology has a leading role to play.

Collis & Moonen (2001) define Blended Learning as “a fusion of conventional face-to-face and online learning which is an extension to conventional classroom learning, where the instruction occurs both in the classroom and online.”

Singh & Reed (2001) state that “Blended Learning is a learning program using more than one delivery mode to optimise the learning outcome and cost of program delivery”.

Valiathan (2002) defined Blended Learning as “a learning that mixes a variety of event-based activities, together with face-to-face classrooms, live e-learning, and self-paced learning.”

Procter (2003) defines Blended Learning as “the effectual grouping of dissimilar modes of delivery, models of teaching, and styles of learning.”

Garrison & Kanuka 2004 state that “Blended Learning is a student-centred approach to create learning, where there is a thoughtful combination of classroom face-to-face learning experiences with online learning experiences.”

Graham (2005) defines Blended Learning as “a learning combination between face-to-face and self-paced online learning.”

According to Deepak Halan (2005) in the article “Blended Learning”, Blended learning is a merging of self-paced and collaborative learning, offline and online learning, and structured and unstructured learning.

Dziuban, Hartman, & Moskal (2005) defined Blended Learning as “a universal technique of teaching that mixes efficacy and prospects to socialise the classroom collectively with the potential of dynamic learning in an online medium.”

Garrison & Vaughan (2008) state that “Blended Learning is the unprocessed incorporation of attentively chosen and matching face-to-face and online approaches and technologies.”

Maciuc 2009 states that “Blended Learning signifies a teaching-learning method that mixes and refers several features and studies precise approaches.

Köse (2010) defines Blended Learning as “an instructive approach that mixes diverse models of face-to-face and distance education by making use of all types of technologies that belong to educational studies.”

Chew et al. (2010) state that, “Blended Learning expresses a range of instruction which combines both face-to-face and online methods.”

According to Safranj (2013), Blended Learning refers to the integration of diverse learning environments.

Yigit et al (2014) define Blended Learning as “the rational combination of e-learning and conventional learning to deal with our instructive goals.”

Boelens, et.al (2015) defines Blended Learning as “a situation that occurs in an instructional context that is characterized by a cautions combination of online and classroom-based involvements to provide and initiate learning”

According to Martha Cleveland-Innes with Dan Wilton (2018) “Blended Learning is not simply adding technology elements to the existing course but is a plan or a teaching-learning approach, an instructional methodology to integrate the best of both the face to face and online learning presents using synchronous and asynchronous learning tools, thus providing a most favourable option for the planning of efficient learning processes.

Several findings on Blended Learning illustrate an enhancement in learners’ capability to learn collaboratively, think innovatively, study without help, and alter their personal learning experiences to meet individual desires.

Since the late 1990s, Blended Learning has developed very rapidly with several permutations and combinations, but it took time for this to take place.”

1.2.1 THEORY OF BLENDED LEARNING

Blended Learning is an educational method that combines conventional face-to-face Teaching with online learning activities, influencing the might of both methods to construct a more open and effective learning environment. The theoretical background of Blended Learning pulls from various educational theories and frameworks. Here are a few main theoretical outlooks that highlight Blended Learning.

Theories

Constructivism: -Constructivism is a learning theory that highlights the dynamic creation of knowledge by learners through their interactions with the environment. (John Dewey, Vygotsky, Jean Piaget) In a Blended Learning environment, students are involved in both online and face-to-face activities that motivate them to create meaning and interpretation through discovery, cooperation, and reflection.

Cognitive Load Theory: Cognitive Load Theory by John Sweller (1980) suggests that students have limited cognitive resources present for treating new information, and the instructional model should intend to manage cognitive load effectively. Blended Learning can help enhance cognitive load by presenting opportunities for students to get involved with subject matter online at their own pace, releasing up face-to-face class time for more interactive and application-based activities.

Connectivism: Connectivism is a learning theory by George Siemens (2005) that underlines the significance of links and networks in learning.). In a blended learning environment, online means and resources support students in be in contact with a wide range of information and attach with peers and experts outside the limits of the conventional classroom, smoothing knowledge creation and community learning.

Experiential learning theory: Experiential learning theory, developed by David Kolb (1970), indicates that learning is a means of thought on experience. Blended Learning can integrate experiential learning theories by presenting opportunities for students to employ in hands-on activities, simulations, and true-world applications both online and in face-to-face situations.

Theoretical Frameworks

The Complex Adaptive Blended Learning system

The main Blended Learning theoretical framework presented by Wang, Han, and Yang (2015) is the **Complex Adaptive Blended Learning System** which proposes a noteworthy outline of all the key Blended Learning theoretical frameworks available. This theoretical framework applies to Blended Learning in any section of education, irrespective of whether one is a teacher in schools, colleges, or universities.

The six elements in the system, namely the learner- who is at the center, teacher, technology, content, learning support, and the institution, have their sub-system and have an influence on each other.

Learners: -Takes the role of active learner rather than inactive learner.

Teachers: -The teacher takes a novel role in a Blended Learning environment and will collaborate with learners as both connect with and get accustomed to each other and also the other four elements in the system. And therefore, these teachers are acknowledged as facilitators, guides, advice-givers, and mediators.

Contents: Contents refers to the interactive, dynamic, media-rich subject matter available online which creates prospects for teachers and students to add it before during, and even after the course, which is utilized to keep learners in the course of mastering that subject. The choice and the usage of content depend upon the learning support and the institution.

The learning support and the institution impact the choice and use of content. The prospect for profound learning of subject matter is available via this complex engagement of many learning modes influenced by various elements.

Technology: Technology for learning necessitates novel ways of going through and working with content and novel tasks for the students and teacher. Still, much more investigation is needed to spot the applications, issues, and outcomes of technology for learning, though much research is on hand on technology for learning in various settings with diverse learner groups, resulting in a huge range of outcomes. In this theoretical framework, the technology has to be observed as an element of the system of Blended Learning, one that contains all elements working concerning each other.

Learner Support: Learner support can engage familiar support in the area of understanding subject matter and assignments as well as technology troubleshooting, material access, and learning to communicate efficiently online. For Wang et al. (2015), learner support means educational support highlighting help learners develop effective learning methods, such as time management and collaborative skills, and technological support, which proposes to help students to expand their knowledge of the technological tools and the fluency with which they use the tools to complete specific learning tasks".

Institution: -Blended Learning necessitates technological infrastructure and digital porter, just as classroom-based learning needs buildings, school desks, illumination, and other frills of brick-and-mortar institutions. Institutional support is vital if not sufficient provision for booming Blended Learning.

The Community of Inquiry

Another significant outline of Blended Learning theoretical frameworks that is on hand is The Community of Inquiry Theoretical Framework in Blended Learning by Garrison,

Anderson, and Archer (2000). Garrison, Anderson, and Archer published a theoretical framework, developed to structure the process of learning in an online or blended environment. It is built on the work of John Dewey and constructive views of experiential learning The Community of Inquiry (CoI), is a model of inquiry-based teaching and inquiry-based learning. The CoI framework postulates that successful online learning experiences are facilitated through the occurrence of three related presences.

Rodgers and Raider-Roth (2006) define presence as both the individual's and the group's state of alert attentiveness, accessibility, and contentedness to the social, cognitive, emotional, and physical workings in the context of learning environments.

Social Presence: Social presence refers to the aptitude of learners to recognize others as genuine people and to build up a sense of community and connectedness. In blended learning, social presence can be promoted through online discussions, group projects, peer feedback, and face-to-face interactions, which help to build up understanding, interpersonal relationships, faith, and a helpful learning environment (Garrison, Anderson & Archer, 1999).

Cognitive Presence: This refers to the aptitude of learners to build meaning through continued communication, expression, and significant conversation. In a Blended Learning circumstance, cognitive presence engages learners in meaningful learning activities, discussions, and collaborative problem-solving both online and face-to-face (Garrison, Anderson & Archer 1999).

Teaching Presence: This presence covers the design, facilitation, and way of the learning experience by the teacher. In Blended Learning environments, teaching presence engages in setting up and managing learning activities, offering guidance and feedback, moderating

online discussions, and incorporating online and face-to-face interactions to encourage deep learning and involvement. (Garrison, Anderson & Archer, 1999).

Afar from content attainment Inquiry-based learning is seen as a key opportunity for developing capability in higher order thinking skills (Garrison, 2016) and this call for more dynamic learning drew insight from foundation thinkers in education like Dewey (1938) and Vygotsky (1997), who saw the utilization of individual's experience and the building of one's knowledge formation as a way to commitment and educational product. Inquiry-based learning is more imperative now than ever before, as both a process for learning and a subject for learning to learn. Inquiry-based teaching then requires a focus on providing significant engagement prospects to a certain extent rather than direct instruction about content.

Inquiry-based teaching also requires making the learning process overt. Resting on the early work of Schwab (1966), this teaching exercise offers structure to shift learners through lively inquiry processes. For Schwab, the active inquiry process begins by using questions, problems, and material to attract learners to make out relationships between theories or variables. As learners move ahead, questions or problems are offered and the learners find out the path to answers themselves. As a third and concluding phase, a topic is offered, and learners themselves recognize questions, problems, methods, and answers while the teacher offers supervision and makes possible learning.

The CoI framework presents an active model that redesigned the educational experience based on thinking and learning collaboratively, for an institutional approach to shift away from an inactive lecture (Garrison, 2018). The Community of Inquiry (CoI) framework has been one of the on the whole mainly used and investigated learning frameworks.

Punya Mishra and Koehler (2006) first introduced the TPACK framework. The framework focuses on Technological knowledge, Pedagogical knowledge, and Content Knowledge.

As per the Concept Note on Blended Learning UGC (2020) “Blended Learning is not a sheer mixture of online and face-to-face approach, but it refers to a well-planned mixture of meaningful activities in both the modes. The blend stresses the deliberation of numerous factors, largely aiming at learning outcomes and the learner-centered teaching-learning environment.

According to Dr. Margarate Driscroll: Blended Learning: Let's Get Beyond the Hype (2002), “Blended Learning is to combine or mix modes of Web-based technology (e.g., live virtual classroom, self-paced instruction, collaborative learning, streaming video, audio, and text) to achieve an educational goal. It combines pedagogical approaches (e.g., Constructivism, Behaviourism, Cognitivism) to create the best learning outcome with or without instructional technology. Or combine any instructional technology (e.g., videotape, CD-ROM, Web-based training, film) with face-to-face instructor-led training and mix or combine instructional technology with real work tasks to produce a pleasant result of learning and working”.

According to Allen and Seaman (2010), “Blended Learning is a course that blends online and face-to-face delivery. A substantial proportion of the content is delivered online, typically uses online discussions, and typically has reduced number of face-to-face meetings.”
The simplest definition of Blended Learning which is sometimes called hybrid or mixed-mode learning is the use of conventional class teaching techniques collectively with the usage of online learning for the unchanged students perusing the unchanged content in the unchanged course.

To put it in another way, according to Martha Cleveland-Innes with Dan Wilton (2018), “Blended Learning is a term applied to the practice of providing instruction and learning experiences through some combination of both face-to-face and technology-mediated learning.”

One significant perception of Blended Learning is that it is not simply adding up a few technological components to the prevailing course but pretty fairly is an integrated sketch utilizing the finest of what equally face-to-face and online learning have to offer.

The integration of technology with teaching plays a major role in transforming the educational system from a teacher-centered into a rich student-centered interactive environment.

1.2.2 MODELS OF BLENDED LEARNING

According to Michael B. Horn and Heather Staker (2017), "The widely held Blended-Learning programs bear a resemblance to one of four models: Rotation, Flex, A La Carte, and Enriched Virtual. The four sub-models included in the Rotation model are Station Rotation, Lab Rotation, Flipped Classroom, and Individual Rotation.

1. Rotation model — a course or subject matter in which students revolve on a fix program or at the teacher's discretion between learning modalities, at least one of which is online learning. Activities like small-group or entire-class teaching, projects in a group, individual teaching, and pencil-and-paper assignments are included as other modalities. The students learn mainly on the traditional campus, apart from any homework assignments.

a. Station Rotation — a course or subject matter in which students experience the Rotation model inside a controlled classroom or group of classrooms. Since the students rotate through all of the stations and not only those on their routine schedule, the station Rotation model differs from the Individual Rotation model.

b. Lab Rotation — course or subject matters in which students revolve to a computer lab for the online learning station.

c. Flipped Classroom — a course or subject matter in which students participate in online learning outside the school instead of typical home assignments and then attend the traditional school for face-to-face, teacher-guided practice. The chief delivery of content and instruction is online, which distinguishes a Flipped Classroom from students who are simply doing homework practice online at night-time.

d. Individual Rotation — a course or subject matter in which every student has an individualized playlist and does not essentially revolve around each accessible station or modality. An algorithm or teacher(s) sets individual student schedules.

2. Flex model — a course or subject matter in which the power of character of students learning is online learning, even if it directs students to offline assignments at times. Students go on an independently adapted, able to likely change schedule among learning modalities. Except for any home assignments even though the teacher is on-site, the students learn mostly on the traditional campus. The teacher of record or other adults offers face-to-face support on a flexible and adaptive as-needed basis through activities such as small-group instruction, group projects, and individual tutoring.

3. A La Carte model — a course that a student takes online to get all the experiences that the student will get at a traditional school or learning center. Students may take the A La Carte course either on the traditional campus or off-site where the teacher in the A La Carte course is the online teacher. It is not a whole-school experience so it differs from full-time online learning.

4. Enriched Virtual model — a course or subject matter in which students have essential face-to-face learning classes with a teacher and then are free to complete remaining assignments isolated from the face-to-face teacher. Online learning is the power of character

of student learning when the students are situated far away. The same people generally serve up as both the online and face-to-face teacher."

Benefits of Flipped Classroom Model for Teachers and Students.

The most noteworthy benefits connected with the flipped classroom teaching model, are teachers use less time introducing new topics, students develop independent learning skills, teachers can produce more engaging lessons, students who are not present do not drop at the back, teachers can re-use the content they produce, students are capable to construct a deeper understanding, teachers can present a more customized approach and students find classroom time more exciting. Considering all these benefits of the Flipped Classroom Model, the researcher decided to employ the Flipped Classroom model for the present study.

1.2.3 METHODS OF TEACHING FOR BLENDED LEARNING STRATEGIES

There is not any precise method of effective learning but including varied activities such as group discussions, online quizzes, games, and even role-playing impel user participation for all learning kinds. According to Parlindungan Pardede (2012), Blended learning is a blend of the best of face-to-face and ICT applications.

In the Blended Learning Programme learning takes place largely in the form of group activities. By which students are encouraged to learn in a meaningful learning environment. All the learning activities are efficiently incorporated with conventional face-to-face sessions and technology-enhanced online learning platforms.

The different learning methods employed in this study are: -

DISCUSSION METHOD

The discussion method is a pedagogical practice frequently utilized in educational scenarios. It involves making easy discussions between students to discover and get a deeper understanding of a topic. Discussion method takes a variety of forms, such as small group

discussions, whole-class discussions, or online discussions. It promotes energetic involvement from students, permitting them to communicate their thoughts, contribute ideas, be involved in critical thinking, promote teamwork amongst students to exchange viewpoints, discuss ideas, and develop communication skills. Group Discussion motivates a student to speak and interact with self-confidence and build connections. It also raises the ability to comprehend and learn further on the given topic with more ease and simplicity.

Investigating the effectiveness of Blended Learning by blending MOODLE (LMS) in online mode with discussion method in offline mode for eighth-grade students' academic achievement in science is significant for improving learning outcomes, promoting collaborative learning, enhancing the learning environment, escalating engagement and participation, encouraging critical thinking skills and communication skills, integrating technology and social interaction, promoting teacher's professional development, and making learners ready for twenty-first-century skills.

LEARNING BY DOING METHOD

Learning by doing is a pedagogical practice that is frequently referred to as experiential learning, which highlights the significance of hands-on experience and the energetic involvement of the students in the learning process. This practice proposes that learners attain knowledge and expertise more efficiently when they energetically take part in activities, experiments, or real-world experiences rather than exclusively relying on inactive teaching or theoretical knowledge. Learning by doing promotes critical thinking, problem-solving, and the application of knowledge in realistic situations, creating a broadly accepted and cherished pedagogical approach across diverse educational scenarios.

Blending MOODLE in online mode with learning by doing in offline mode incorporates technology into hands-on learning experiences, presenting students a way into online

resources, multimedia content, and interactive simulations. Measuring the effectiveness of this incorporation can emphasize the collaboration between technology-enhanced learning and experiential education. Educators can learn how to control technology to promote experiential learning opportunities to support students' achievement in science. Investigating the effectiveness of Blended Learning by blending MOODLE with learning by doing can also develop students' problem-solving abilities and scientific inquiry skills preparing students for future STEM careers.

A SURVEY INTEGRATED WITH DISCUSSION METHOD

By integrating surveys with the discussion method, teachers can improve students' commitment, encourage critical thinking, problem-solving, and data analysis, and collect precious insights into students' perceptions and understanding of the topic. This pedagogical practice promotes lively participation, reflection, and collaborative sense-making, encouraging a deeper, significant learning experience for students.

Determining the effectiveness of this Blended Learning approach can enlighten its role in encouraging inquiry-based learning and preparing students for success in the real world.

CASE STUDY METHOD

Case study is a pedagogical practice that refers to chipping in a case study and asking students to talk about their views in pairs or groups, and then share with the class as a presentation that is visually presented. In case study students are presented with a genuine case that the students have to analyze and discuss, applying knowledge and critical thinking skills to recognize the difficulty of the circumstances and suggest a way out or policy. Case studies are an efficient way to encourage active learning, problem-solving skills, and the application of theoretical knowledge to practical circumstances.

The case study method encourages students to analyze real-world situations, apply theoretical knowledge, and develop critical thinking skills. By investigating the impact of the case study method within a Blended Learning framework, researchers can investigate its effectiveness in encouraging better understanding and higher-order thinking skills among students.

1.2.4 BLENDED LEARNING ENVIRONMENT

Blended Learning environments are also normally discussed as hybrid courses or classes. Any combination of face-to-face mode of learning and online mode of learning is classified as blended learning. As per (Concept Note on Blended Learning, UGC (2020), "Online mode of learning refers to quite a lot synchronous and asynchronous learning activities such as accessing e resources, mainly in the form of Or consisting of formats such as text, graphics, animations, simulations, gaming, interactive multimedia, etc., accessing links, e Resources, digital libraries suggested by the teacher as well as explored independently or in groups, learning MOOCs/ SMOCs, etc uploaded by the teacher on Learning Management System, attending teacher's online virtual sessions, performing activities independently or in groups by means of any ICT tool or Learning platform, participating in the workshops/webinars, completing assignments and uploading on the Learning Management System, attempting tests or quizzes, engaging into virtual labs, simulations, museums, webinars, e-conferences, online short term training programmes, online internships/ projects, any activity directly linked to the course curriculum for which in fact learner's presence is not required in the classroom but needs to utilize digital tools and internet connectivity.

Face-to-face (F2F) mode refers to several activities to be implemented by coming together in the classroom such as remaining present for teachers during short periods of class for

beginning or briefing topics, understanding difficult concepts, determining doubts based on self-learning or group learning, participating in group activities in the classroom with fellow students mainly for analyzing and applying information sought through e-Resources, working collectively and co-creating new knowledge, make use of books and journals. Magazine, bulletin, etc. from the library, participating in field visits, sports, face-to-face physical training, apprenticeship, internship, appearing for periodical evaluations, school-based summative tests, or any teaching activity in which students and teachers physically meet on the campus or out of the campus but in the same geological environments to achieve learning outcomes."

1.2.5 TEACHER'S ROLE IN BLENDED LEARNING CLASSROOM

Teachers play a critical role in establishing Blended Learning pedagogy in the classrooms. The role of the teacher is that of a facilitator. Teachers should make sure that the teaching-learning process is learner-centered. The teacher should encourage students to work together and generate prospects for students to work in partnership around tasks. Teachers should support students to take responsibility for their learning. According to Blended Mode of Teaching and Learning: Concept Note, UGC (2020) "Blended Learning shifts the teacher's role from knowledge provider to coach and guide. This shift does not mean that teachers play an inactive or less important role in students' education. Fairly differing—With blended Learning, teachers can have an even more profound influence and effect on students' learning. Traditionally, teaching in the classroom has mostly been teacher-directed, but with Blended Learning, it now becomes more student-driven. Much of this new learning vibrant is due to the better role technology plays in instruction. Blended Learning provides the right balance between online instruction, which offers interactive, tech-based learning, individualized pacing, and privacy that keep students constantly occupied and stimulated,

and teacher-led instruction, which personalizes the learning experience and adds the human elements of encouragement, concern, and caring supervision that only teachers can give.

This new learning dynamic benefits students and teachers alike. Giving students consent and freedom to become active learners who gain knowledge directly lets them assume some command over their learning and helps them build up self-reliance. As more students are working independently, time opens for teachers to provide face-to-face support and individualized instruction more frequently for more students, effectively improving differentiation. Blended Learning provides teachers with a fuller, more precise picture of how each student is doing. Blended Learning acquiesces more recurrent and more individualized teacher interaction with individual students, teachers have the opportunity to intensify and make stronger student/teacher relationships. The belief that comes with close associations can give teachers insights into students' struggles and needs -insights which allow teachers to console and train students through challenges that often serve as a hindrance to learning."

Learner-centred teachers see each student as unique, competent to learn, and have an outlook that spotlights the learner. Students are encouraged to learn and accomplish when teachers create an optimistic classroom environment, acclimatize instruction according to individual differences, and assist students' learning and thought processes. Students are enthused when they are given chances to be dynamically occupied in their learning.

To be precise, Blended Learning mixes the finest features of online learning with the finest features of face-to-face teaching, helping teachers to enhance a great deal to meet students' desires without adding to an already substantial workload effortlessly.

1.2.6 BENEFITS OF BLENDED LEARNING

According to Martha Cleveland-Innes with Dan Wilton, Athabasca University, Canada Commonwealth of Learning (2018), "enlarged learning skills, higher access to information,

enhanced fulfilment and learning outcomes, and opportunities both to learn with others and to teach others are some of the advantages of Blended Learning for students. A key benefit of Blended Learning includes:

1. Opportunity for collaboration at a distance: Virtually students can work together in an intellectual venture as a learning custom.

2. Increased flexibility: With the probable support of in-person commitment the students can learn anytime and anywhere.

3. Increased interaction: Blended learning presents a stage to smooth the progress of better interactivity between students, as well as between students and teachers.

4. Enhanced learning: Supplementary kinds of learning activities advance engagement and can help students attain higher and more significant levels of learning.

5. Learning to be virtual citizens: Blended Learning courses facilitate learners to master the skills for using a range of technologies."

Boddy, et al. (2013), in the Report of the E-Learning Working Group, point out the following benefits of blended learning:

"Students put on an optimistic experience and mindset towards technology-arbitrated teaching and learning.

- It supports diverse styles of learning.
- It promotes enhanced learning outcomes and boosts interaction value among learners, between students and instructors, as well as with exterior professionals and communities, and the range of learning assets.
- It produces suppleness and offers more time to express in online discussions.
- It provides a more active and interactive learning environment which marks a superior level of engagement.

- It highlights the significance of the instructional plan for the most favourable learning outcomes.
- It presents an opportunity for a basic reform of teaching and learning approaches to grasp improved efficiency, practicality, and effectiveness;
- It offers superior ways to deal with several desires of learners and learning styles, as well as a well-built instructive basis for engaged and continued learning".

1.2.7 FEATURES OF BLENDED LEARNING STRATEGIES

The important features of Blended Learning Strategies include improved student commitment to learning, superior teacher and student interaction, accountability for learning, time management and flexibility, enhanced student learning outcomes, superior institutional reputation, extra flexible teaching and learning environment, more agreeable for self and continuous learning, enhanced opportunities for experiential learning.

1.2.8 ASSESSING BLENDED LEARNING

Employing Blended Learning effectively does not guarantee its success. For that, it is very indispensable to identify whether students have benefited from the teaching or not. And if the students have benefited then to what extent and how are they benefited. All these questions fall under the vital and complex task of assessment. Assessment plays a key role in educational liability. Being able to assess the effect of students' learning is very imperative and perhaps more so for such instructive practices as Blended Learning where accountability of learning is developed to the group and where the teacher acts as facilitator of learning. Novel Teacher to Blended Learning over and over again find it complicated to assess students in Blended Learning situations because here it is not only the achievement that has to be assessed which could be simply done by paper and pencil test.

Assessing students in Blended Learning means assessing them on six elements of the complex adaptive Blended Learning system framework and the three presences of the community of inquiry theoretical framework in Blended Learning. The six elements of the Complex Adaptive Blended Learning System framework are the learner, the teacher, the technology, the content, the learning support, and the institution. The three presences of the Community of Inquiry Theoretical Framework in Blended Learning are cognitive, teaching, *and* social. These elements and presences are not those that can be measured by the academic achievement of students. Also, students who score high on paper-pencil tests don't need to always be successful in Blended Learning.

Brown et al. (2007). "Identified quite a lot of significant student perceptions about the efficiency of assessment techniques in the blended environment. They found that neophyte learners believe that traditional measures, such as multiple-choice tests, better reflect their learning status than more interpretive measures. More experienced learners, however, report confidence in assessment activities that involve collaborative work and interactive feedback. These findings give credence to developing theories that incorporate the nexus of information literacy, technology literacy, and critical thinking into a broader concept of information fluency—a foundation for assessment in Blended Learning".

So there needs to be different types of assessment for the same. Some approaches that can be used for assessing students in Blended Learning include Discussion forums, quizzes, chats, worksheets, group assignments, and group presentations.

Worksheets with higher-order questions and space for students to respond are used by the researcher in the present study. A worksheet is a leaf of paper, usually with questions and places for the answers to be written, or may include tasks. In a classroom setting, a worksheet generally refers to a loose piece of paper that children use to answer questions or complete

a task. A worksheet in this primary, paper form is normally all the time coupled with a school setting as they are normally used to assess students' knowledge and is one of the most widespread materials used by teachers in assignments and assessments. Often these worksheets will contain some form of exercise and instructions or a set of questions with areas for students to respond and answer by recording a written response. They generally only need a child to have a pen or pencil to complete, making them ideal for in-class activities, homework tasks, and assessments. Worksheets to be mostly used as a dazzling assessment tool to assess learning outcomes and supervise a student's learning.

1.3 BLENDED LEARNING AND SCIENCE EDUCATION

As per the National Curricular Framework (2005), “Science is an active, growing body of knowledge, which covers ever-new spheres of experience. Important skills like Flexibility, innovation, and creativity have to be kept in mind in determining science education. Good science education is true to the child, true to life, and true to science. The important parts of the curriculum at the secondary stage should be logical experimentation as an instrument to determine and authenticate hypothetical principles, and working on locally considerable assignments relating to science and technology. Science education in India must go through a paradigm shift by off-putting rote learning, supporting and reinforcing, inquiry skills, and with active teacher participation, the restructuring suggested above could have an impact on all stages of science teaching in our schools”.

According to Berkeley (2013), “Science aims to explain and understand, Science works with testable ideas, Science relies on evidence, Science is embedded in the scientific community, Science is both a body of knowledge and a process.” But as per the Kothari commission report (1960) “If science is inadequately taught and poorly learned it’s very little fairly troubling the mind with lifeless info and it might deteriorate even into new superstitions”.

As per M. Monicka, and Dr.J.Jayachithra (2018), “the primary objective of science education is to improve teaching and learning practices. The area of science education has developed into various aggregation of areas of concern as witnessed within the pages of analysis in science education. It highlights the necessity for amendment within teacher’s viewpoint of teaching and spreading of instruction. The progression of science must be successfully sent to the scholars with not many time gaps. So, science teaching capability becomes an imperative issue for the swift improvement of science and the stimulation of interest among students to discover the crucial and latest development in science.”

In recent years, there has been increasing interest in revitalizing science education to expand both the number of individuals pursuing science careers and the global population of scientifically literate citizens. While the traditional textbook-and-lecture method benefits some, it is not the most effective way to inspire learning for many students. Therefore, it is essential to evaluate the effectiveness of alternative teaching methods that replace textbooks with technology-enhanced learning tools.

Blended learning permits teachers to personalize teaching to meet the varied desires of students. Teachers can use online evaluation and adaptive learning platforms to modify content and assignments to students' learning levels and preferences, providing targeted support and enhancement opportunities.

Science teaching becomes all the more demanding when incorporating hi-tech tools and practices into the line of learning. In this situation, Blended Learning has its worth in rousing the superiority of learning science by thrashing the broad potentialities of providing additional bendy ways of learning through online mode and the comfort of the ‘social presence’ in the classroom.

Blended Learning presents matchless opportunities to improve science education by integrating traditional classroom instruction with online learning activities.

1.3.1 VIRTUAL LABORATORIES AND SIMULATIONS

The purpose of utilizing virtual laboratories and simulations in the context of Blended Learning in science education is to improve teaching and learning outcomes. Blended Learning allows students to access virtual laboratories and simulations, allowing students to carry out scientific experiments and investigate scientific concepts in a secure, easy, cheap, and controlled online environment. These simulations can offer hands-on experience and strengthen theoretical knowledge regardless of their physical location. Virtual laboratories reduce the danger related to carrying out experiments concerning unsafe materials or unsafe procedures. Virtual laboratories and simulations reduce the need for buying costly chemicals, tools, and repairs, making science education more reasonable and sustainable for educational institutions. Allows students involved in experiments at their own pace. Offers students extremely interactive learning experiences, which promotes involvement, inquisitiveness, and a deeper perception of scientific principles. Interactive animations, simulations, and models help students envisage intricate procedures and structures. Students develop critical thinking, inquiry skills, and scientific reasoning abilities.

1.3.2 FLIPPED CLASSROOM MODEL

The flipped classroom model is mainly useful for science education. The Flipped classroom model of Blended Learning in science education is to make the best use of the teaching and learning experience by maximizing the advantages of technology to improve offline and online activities. Students can go through lecture materials, readings, and lesson videos online before coming to class. Class time is then used for hands-on experiments, group discussions, and problem-solving activities, allowing for deeper exploration of scientific concepts. The energetic commitments of the students endorse deeper learning, significant

thinking, and problem-solving skills, leading to improved understanding and retention of knowledge. Students can select the format and speed of their learning, giving them the power to take possession of their education. Teachers can utilize a range of digital devices, such as video lectures, online discussions, and interactive simulations, to produce an appealing and active learning experience that goes further than the traditional classroom. Teachers have ample opportunities for one-to-one interaction with students, offering personalized support, feedback, and supervision. The flipped classroom model of Blended Learning in science education intends to construct an interactive and student-centred learning environment that makes the most of student learning outcomes and trains students for achievement in science and afar.

1.3.3 INTERACTIVE MULTIMEDIA RESOURCES

Blended learning provides access to a wide range of interactive multimedia resources such as videos, animations, and interactive diagrams. By incorporating these multimedia resources, teachers can produce active and attractive learning experiences that highlight interest and keenness for science. These resources can help illustrate complex scientific phenomena, engage students in active learning experiences, and also encourage deeper comprehension and retention of scientific concepts by involving various senses and cognitive processes. Interactive learning permits the use of a variety of resources to meet the varied requirements and learning styles of students. Interactive learning activities, through online quizzes and interactive simulations, provide immediate feedback to students, guide students' learning, and help monitor students' progress.

Brent R. Stockwell, Melissa S Stockwell, Michael Cennamo, and Elise Jiang (2015) in their study Blended Learning Improves Science Education, suggest that a Blended Learning approach, which incorporates video assignments before each class to arouse interest in

the topic and provides foundational knowledge combined with lectures having in-class problem solving, was a more effective strategy for science education than traditional methods.

1.3.4 COLLABORATIVE LEARNING ACTIVITIES

Blended learning facilitates collaborative projects where students can investigate scientific questions, analyze data, and present findings. Dziuban, Hartman, and Moskal (2004) noted that "Blended Learning should be seen as an educational approach that blends the efficacy and socialization prospects of the classroom with the technically enhanced active learning potential of the online environment." This view is supported by iNACOL, the International Association for K-12 Online learning which defines Blended Learning as "combining online delivery of educational content with the best features of classroom interaction and live instruction to personalize learning, allow thoughtful reflection, and differentiated instruction from student-to-student across a diverse group of learners." Torrisi-Steele& Drew (2013) stated that "within the Blended Learning classroom, students gather in face-to-face teaching, and then have chance to cooperate, converse with the open conversation, to experience crucial debate through a world-wide open platform which in turn make possible larger expression on the part of learners. Therefore, it has a broad scope for the development of self-sufficiency, self-efficacy, and individual managerial skills."

By working together with peers on projects, discussions, and problem-solving tasks, students are more involved and devoted in their learning, develop interpersonal skills such as empathy, respect, and teamwork, as well as build significant relationships with classmates. Students learn to convey thoughts clearly and efficiently by taking on discussions, debates, and group projects learn to work effectively by collaborating on projects, sharing responsibilities, and resolving conflicts, and develop essential collaboration skills that are valuable in both academic and professional settings.

1.4 BLENDED LEARNING STRATEGIES AND ACADEMIC ACHIEVEMENT

Blended Learning Strategies have the potential to improve academic achievement by providing engaging, personalized, and flexible learning experiences that meet the varied needs of students. Blended Learning Strategies have been shown to positively impact academic achievement across various subjects, including science. The research results of the research conducted by Yapici, I. Umit; Akbayan, and Hasan (2012) discovered that "the Blended Learning model contributed more to the students' biology achievement than traditional teaching methods did and that the students' attitudes towards the Internet developed statistically significant." Results of the study by Mohammad (2013) revealed that "Blended Learning is a more effective strategy than a conventional strategy for the academic achievement in physics of 8^{th} standard students." The study by Turki Fahed Almasaeid (2014) "showed a high level of performance on achievement test as a whole after applying Blended Learning strategy." The findings of the study by Nair Tara (2016) showed that "Blended Learning provides a significant increase in the effectiveness of learning" It was concluded in the study by Fakhir, Z. (2015) that "Blended Learning was an effective strategy for teaching English to grade 6 students." The result of the study by Deivam Muniyandi (2015) shows that "Blended Learning is more effective than the conventional method of teaching."

1.5 STUDENTS' PERCEPTION OF BLENDED LEARNING

Students' perceptions of Blended Learning are many-sided and powered by a range of factors including content gained, engagement, flexibility, technology benefits, personalization, collaboration, the effectiveness of instruction, and overall satisfaction. Knowing and dealing with students' perceptions can help teachers design and employ Blended Learning Strategies that maximize students' learning experiences and outcomes. The perception of Blended Learning can differ among various stakeholders, including students, teachers, parents,

administrators, and policymakers. Several students analyze Blended Learning optimistically, welcoming the flexibility, interactivity, and range of teaching methods it presents. Students enjoy the prospect of learning at their own pace, accessing resources online, and involve in collaborative activities. However, some students may have worries about technology consistency, digital disruptions, or trouble managing time efficiently in a Blended Learning environment.

Alekya Ch (2018) found a positive perception of the Blended Learning approach among English language teachers in secondary schools in the north coastal districts of Andhra Pradesh. Similarly, Maria Josephine (2016) discovered that students in the experimental group had a more favourable view of the Blended Learning Program compared to the control group. Nita Devi (2022) demonstrated that secondary school teachers and students in Jammu District held optimistic views about Blended Learning. Smita Tanwar (2022) reported that students developed a more positive perception of the Blended Learning method when taught using Blended Learning strategies. Chen and Jones (2007) compared Blended Learning with traditional classroom settings and found that both groups held positive overall perceptions of the course, instructor, and learning outcomes. In a case study at the University of Bisha, Ja'ashan (2015) revealed that students had positive perceptions of Blended Learning across the three domains assessed in the questionnaire regarding English courses. Graham and Robison (2007) explored faculty experiences in designing and teaching Blended Learning courses at Brigham Young University, finding that the major benefits included more effective use of classroom time, increased flexibility in managing time constraints for both students and professors and a greater ability to meet individual student needs, as reflected in faculty perceptions through interviews.

Al-Ani and Wajeha Thabit (2013) found that using MOODLE in Blended Learning had a moderate level of effectiveness in students' motivation, achievements, collaboration, and

communication. Their results also showed no significant difference in student perceptions based on gender or college type. Similarly, Farmer (2009), in a study on the effectiveness of using a wiki as an online collaborative learning tool within a face-to-face course in higher education, found no significant difference in perceptions between students using the wiki and those in non-wiki groups

1.6 STUDENTS' ATTITUDE TOWARDS BLENDED LEARNING

Students' attitudes toward blended learning are shaped by students' experiences, perceptions of benefits, comfort with technology, levels of engagement and motivation, interactions with instructors concerning online learning, classroom learning, online interaction, technology, learning flexibility, and online environment. Understanding and dealing with students' attitudes can help teachers design and implement Blended Learning Strategies that maximize students' engagement, motivation, and learning outcomes. Attitudes towards Blended Learning can differ extensively depending on aspects such as individual likings, experiences, and cultural contexts. Several students welcome the flexibility that Blended Learning presents, permitting them to access educational materials and take part in learning activities at their speed and handiness. A few students may have a neutral attitude towards Blended Learning, neither robustly supporting nor contrasting it. However, a few students may refuse to accept Blended Learning due to a liking for traditional classroom teaching.

Alekya Ch (2018) found a positive effect on attitudes toward Blended Learning among English language teachers in secondary schools in the north coastal districts of Andhra Pradesh. Similarly, Fakhir (2015) demonstrated that Blended Learning had a positive impact on the attitudes of sixth-grade students toward learning English. Ja'ashan (2015) confirmed that students at the University of Bisha held positive attitudes toward Blended Learning across the three domains assessed in the study on English courses. Najeh Rajeh Alsalhi et al. (2019) also observed more favourable attitudes toward Blended Learning among ninth-

grade students. According to Zhu, Au, & Yates (2013), students with generally positive attitudes and high levels of motivation toward learning tend to have more favourable attitudes toward online learning in blended courses."

However, Alice Abraham Chacko (2019) investigated the communication skills of secondary students regarding their attitude toward Blended Learning and academic achievement, finding that students held a neutral attitude toward Blended Learning. Similarly, Pattabiraman R (2023) examined the attitudes of higher secondary students toward Blended Learning concerning their interests and the learning environment, and the study revealed that these students also exhibited neutral attitudes toward Blended Learning

1.7 RATIONALE OF THE STUDY

Blended Learning has been confirmed to be valuable in all subject areas and science is no exception. "The Collaborative nature of scientific and technology work should be energetically toughened by periodic group activities in the classroom." (Rutherford and Ahlgren,1990). However, "Teachers employ technology in the classroom to prove that the teachers know to make use of the technology ably and therefore sometimes the focus on the content is lost. Yet this method builds up lively participation to improve learners' motivation but loses the presence of teachers and social interaction. Therefore, a new method of teaching is essential to blend both conventional teaching and online teaching. This new attempt is called a Blended Learning program where teachers incorporate online learning and conventional learning. This effective mixing of technology into conventional classroom aids in developing and designing a Blended Learning Programme which has an advantage over a single method of teaching." (Maria Josphine ,2016). "The National Education Policy has provided a rare glimpse into what can be attained through the transformation of education." (Concept Note, Blended Learning, UGC, 2020). The NEP (2020) clearly states

that “it is time to take on a policy that is undoubtedly student-centric, or what can be safely put down as Education. The time has indeed come to recognize the fact that the student is the main stakeholder and that efforts must be taken to make the system respond to their dreams and aspirations. In this line of thought, the new policy offers the adequacy of several approaches to learning together with face-to-face learning, online learning, and distance or virtual mode. It also encourages vocational courses, multi-disciplinary courses, and multi-modal strategies thereby highlighting Blended teaching-learning”.

The vision of National Education Policy 2020 is to have India-centric education systems that directly transform the nation sustainably into a fair and energetic knowledge society by providing high-quality education to all.

According to Lionarakis and Parademetriou (2003) and Oliver and Herrington (2003) “To give significant understanding for learners, several vital elements have to be dealt with, such as technology, the organization of the course, the teacher, technological support, coursework, students’ commitment, and learning flexibility”.

“Blended Learning offers better time flexibility, enhances methodology, improves learning outcomes, produces better chances for interaction, enhances commitment in learning, generates opportunities for constant enhancement, enlarges way into teaching events and lessens effective costs”. (Stacey & Gebric, 2008; Wideman, Owston, & Sinitskaya, (2007))

“Blended Learning follows and increases engagement, improves communication, encourages personalization, lessens the cost for teachers, maximizes the chances for learning through communicating with self, and with the peers and with the teacher. Thus, the approaches for learning in the online environment establish a learning corridor that promotes students to search and determine their way through the content, thus by getting peer support,

effortless way in and flexibility, superior retention, improved satisfaction, and efficiency." Roslyn Gleadow (2015).

A noteworthy amount of work, both theoretical and practical, has been carried out on Blended Learning abroad. There have been several studies conducted abroad on the effectiveness of Blended Learning in Science and all have found a positive influence on science learning. Anxious investigators and educators, predominantly overseas, have improved one theoretical perspective of Blended Learning, projected instructional practices to encourage it, designed courses and instructional materials that highlight it, and developed assessment techniques to assess it. It is known that the accomplishment of any innovation depends upon the context in which it is implemented. The introduction and transfer of successful innovation from one country to another, one society to another, and one institution to another depends upon multiplicity and diversity of contextual factors. To implement Blended Learning instruction in schools, a thorough understanding of the existing context is a must.

However, there have been relatively few studies on Blended Learning in India, and it has yet to become a widely adopted instructional strategy in science education. This could be due to a lack of awareness among teachers about Blended Learning and how to effectively implement it in the classroom. As a result, students' engagement is often limited to seeking clarification on teaching points. Research in this area could assist educators in transitioning from traditional teaching methods to integrating Blended Learning more frequently and seamlessly.

The relationship between Blended Learning and academic achievement in subjects other than science was studied by several researchers. Akkoyunlu, B., & Soylu, M. Y. (2006), Melton, et al. (2009), Hong and Miao (2009) Lim and Morris (2009), Al-Saai, et. al (2011)

Wei-Fan Chen (2012) Alseweed (2013) Al-Ani, Wajeha Thabit (2013) Obiedat, R., et.al. (2014). Cross et. al. (2014) Zhigang Li, et. al. (2014) Feras Mohammed Al-Madani (2015) Fakhir, Z., & Ibrahim, M. (2018), Lin, Y. W.et. al. (2015), Salah Eldin Kassab, Ahmad I Al-Shafei, Abdel Halim Salem, Sameer Otoom, (2015) Ya-Wen Lin, Chih-Lung Tseng, Po-Jui Chiang (2016) Nick Z. Zacharias (2016) Ceylan, V. K., & Kesici, A. E. (2017), Isti'anah Arina (2017) Cabı, E. (2018) Turpin, Christopher Michael (2018) Wahyu Setyaningrum (2019) Cihad Şentürk (2020). Sari, R. N., & Amalia, A. V. (2021). However, only a few studies were conducted in India. Deivam Muniyandi (2015), LATHA R (2020), Sharma, Anju (2021), Vanitha, S T (2021), Harnam Singh (2022), Dhiman, Sonu Bala (2022), Smita Tanwar (2022) None of the study is conducted in the State of Goa. Therefore, much more researches need to be conducted in this area at a secondary level in the country and in the State of Goa in particular.

The relationship between Blended Learning and academic achievement in science was studied by several researchers., Yapici et. al. (2012), Kazu, et. al. (2014), Almasaeid, T. F. (2014), Stockwell BR, et. al. (2015) Cracraft, L. (2015) Harahap, et. al. (2019), Alsalhi, et. al. (2019). However, a few studies have been conducted in the Indian Context, A. SIVASA KAR (2011), Mohammad (2013), Nair Tara (2016), Maria Josephine (2016), Chitra P S (2017), Selvakumar, S (2019), Vahora, Samir. A. (2020), Neetika (2021), Monicka, M (2021), Mishra, Namrata (2021), Naseerali M K (2022), S Sripriya (2022), Harpreet Kaur (2022). Some are in Secondary education; some are in Higher Secondary Education and some in Teacher Education. The two studies by Stockwell, et.al., (2015,) and Cracraft, L. (2015) contradict the findings of all other studies when finding the effectiveness of Blended learning in academic achievement in science. So also, none of the study is conducted in the State of Goa. Therefore, findings necessitate much more research in the area of science education at the secondary level in the country and in the State of Goa in particular.

Perception of the students towards Blended Learning was studied by the following researchers. Chen and Jones (2007), Ja'ashan, M. M. N. H. (2015), Graham, C. R., & Robison, R. (2007), Delialioglu and Yilderum (2007) Chen and Jones (2007) Sun, Z. Et.al. (2017), Farmer, R. G. (2009). However, a few studies were conducted in India, by Alekya Ch (2018), Maria Josephine (2016), Nita Devi (2022), and Smita Tanwar (2022). A study by Farmer, R. G. (2009) and by Al-Ani, Wajeha Thabit (2013) contradicts the findings of other studies. This contradiction necessitates more research in the area. So also, none of the study is conducted in the State of Goa. Hence much more researches need to be done in this area at the secondary level in the country and in the State of Goa in particular.

The attitude of students towards Blended Learning was studied by the following researchers. Alseweed (2013), Fakhir, Z., & Ibrahim, M. (2018), Serap Samsa (2010) Zhu, Au & Yates (2013) Ja'ashan, M. M. N. H. (2015) Najeh Rajeh Alsalhi et.al. (2019) Akgunduz, Devrim; Akinoglu, Orhan (2016). However, only a few studies were conducted in the Indian Context, to mention a few ALICE ABRAHAM CHACKO (2019), Pattabiraman R (2023), Pradeep Kumar (2010), Alekya Ch (2018). Studies by ALICE ABRAHAM CHACKO (2019) and Pattabiraman R (2023) show a neutral attitude of students towards Blended Learning, which contradicts the findings of other studies in the area. None of the study is conducted in the State of Goa. These findings demand much more research in this area at the secondary level in the country and in the State of Goa in particular.

Many studies have been done in the area of the effectiveness of Blended Learning Strategies on learning styles, Eddie Gulc (2006), Professional Development, Hana Berger et.al. (2009) staff engagement in blended learning, Kathleen Gray and Jacinta Tobin (2010), on the teaching practice course, Mustafa Caner (2010), international Blended Learning cooperation project, Medical Training Courses, Melek Yaman Dittmar Graf (2010), Blended Learning with Moodle, etc. are the studies conducted on other aspects of Blended Learning. However,

Dhanya Krishnan (2011) on higher-order thinking and learning science, Sen, Deepshikha (2016) Paradigm of LIS Education, Scaria, Sumy M. (2016) on Techno pedagogical skills, Gupta, Rajni (2020) on critical thinking and social skills, Kamaraj N (2021) on microteaching skills were conducted in Indian Context. None of the study is conducted in the State of Goa. The findings call for much more research in this area at the secondary level in the country and in the State of Goa in particular.

It has also become crucial that students be trained effectively and efficiently to help them face the challenges and demands of work setting and daily living ahead. Even for students practicing higher education the worth of secondary education plays a very significant role. So, teachers need to amend their way of teaching from a conventional method to a more student-centered method. This will help both brilliant as well as weak students uniformly. Using Blended Learning will help all students to master the concepts of science effortlessly. The findings of the study will also help the curriculum framers, policymakers, and all those who are concerned with educational strategies to include Blended Learning as a new strategy in the curriculum.

There is a desperate need that the effect of Blended Learning which involves the combination of technology in the teaching-learning process to be validated by thorough studies. Moreover, these studies should be used to craft instruction for students to make the best out of this concept of Blended Learning.

Strategies like integrated learning and Blended Learning, with larger implementation of technology, will influence the prospect of education in schools. The way of learning and the way curriculums are dealt with may change. Aspects that were once considered fundamental to education may be revised.

Technology without teachers' involvement improves students' active participation and their motivation. However, students lose the presence of teachers and social interaction. So, it is required to develop and design Blended Learning Strategies that combine multiple delivery media with a variety of activities and resources over a single method of teaching.

The present study is conducted on VIII-grade students in Goa. It is in grade VIII that the most of vital concepts of science get introduced. If the students develop a strong knowledge base of subjects in the early secondary stage, they can build on it at a higher level.

The academic practices followed in the state educational system are teacher-oriented and non-participatory. They support only rote learning. Science teaching in the state is examination-oriented and not learner-centered. Encouragement is given to rote memorization and not to learners' inquisitiveness and curiosity in investigations. Scientific attitude is also not developed.

So as an education society dedicated to the achievement of the students, teachers must work out on these areas and come up with probable answers to help them.

Also, in the present study, MOODLE is used as a Learning Management System (LMS). From the review of related Literature, it can be seen that MOODLE as a Learning Management System is successfully used in teaching science.

To achieve maximum learning outcomes, there is a need for innovations in the teaching-learning process, and research reviews reveal that there is a lack of studies on blended Learning Strategies at the Secondary education level in the State of Goa. So, it is intended to design, develop, and implement a Blended Learning program and find its effectiveness on students' achievement at the early secondary education level.

So also, the strategies developed by the researcher based on Blended Learning can be used in orienting the teacher trainees in the Education Colleges.

It is hoped that the study findings will help open new frontiers in teaching-learning practices. Keeping all the above things in mind the present study was taken up by the researcher.

1.8 STATEMENT OF THE PROBLEM

"A STUDY OF EFFECTIVENESS OF BLENDED LEARNING ON THE ACADEMIC ACHIEVEMENT OF GRADE VIII STUDENTS IN SCIENCE"

1.9 OBJECTIVES OF THE STUDY

1. To design and develop Blended Learning Strategies by identifying suitable technology and pedagogical practices for teaching selected concepts in science from the prescribed course of study at grade VIII.

2. To study the effectiveness of Blended Learning Strategies on the academic achievement of grade VIII students in science

3. To compare the effectiveness of Blended Learning Strategies and Conventional methods of the teaching-learning process on academic achievement of grade VIII students in science.

4. To study the perception of the grade VIII students of the Blended Learning Strategy concerning content provided, technology benefit, and satisfaction.

5. To find the attitude of the grade VIII students towards the Blended Learning Strategy concerning online learning, classroom learning, online interaction, technology, learning flexibility, and online environment

1.10 HYPOTHESIS OF THE STUDY

THE NULL HYPOTHESES

i) There is no significant difference in pre-test and post-test scores of grade VIII students in science taught using Blended Learning Strategies.

ii) There is no significant difference in pre-test scores of grade VIII students in science taught using Blended Learning Strategies and conventional methods of teaching.

iii) There is no significant difference in post-test scores of grade VIII students in science taught using Blended Learning Strategies and conventional methods of teaching.

iv) There is no significant difference in pre-test and post-test scores of grade VIII students in science-taught conventional methods of teaching.

v) There is no significant difference in perception of Blended Learning Strategies concerning content among the grade VIII students.

vi) There is no significant difference in perception about Blended Learning Strategies concerning technology benefits among grade VIII students.

vii) There is no significant difference in perception about Blended Learning Strategies concerning satisfaction among the grade VIII students.

viii) There is no significant difference in attitude towards Blended Learning strategies concerning online learning among grade VIII students.

ix) There is no significant difference in attitude towards Blended Learning Strategies concerning classroom learning among the grade VIII students.

x) There is no significant difference in attitude towards Blended Learning Strategies concerning online interaction among the grade VIII students.

xi) There is no significant difference in attitude towards Blended Learning Strategies concerning technology among the grade VIII students.

xii) There is no significant difference in attitude towards Blended Learning Strategies concerning learning flexibility among the grade VIII students.

xiii) There is no significant difference in attitude towards Blended Learning Strategies concerning the online environment among the grade VIII students.

1.11 OPERATIONAL DEFINITIONS OF THE TERMS

1. **Effectiveness of Blended Learning Strategies**: In the present study effectiveness of Blended Learning Strategies is considered the degree to which Blended Learning Strategies will produce the desired result or success of grade VIII students of Secondary Schools in science subjects.

2. **Academic Achievement**: Total score obtained in science subject by grade VIII students of secondary schools while learning through Blended Learning Strategies.

1.12 UNIVERSE, POPULATION AND SAMPLE

UNIVERSE: The total population of students studying in grade VIII in North and South Goa district is the universe.

POPULATION: The students studying in Grade VIII in Pernem Taluka in north Goa District form the population for this study. The entire Goa is divided into two districts- North and South. Each district has six Talukas. Pernem Taluka lies in the North Goa District of the State of Goa, and all the schools have the same facilities for the students, and all the students in these schools belong to the same socio-economic group. The researcher is the Officiating Principal in one of the colleges of education in Pernem, the accessibility to the school was easier and the study could be conducted with the responsibilities of the college

SAMPLE: All 76 students of VIII grade of one of the schools in Pernem Taluka were selected as the sample for the study. The sampling technique used was simple random sampling.

1.13 VARIABLES OF THE STUDY

Independent Variable

Blended Learning Strategies developed by the researcher for science subjects are the independent variable are the independent variable of the study**.**

Dependent Variable

Here the Academic Achievement of grade VIII students in science subjects, Students' perception of Blended Learning, and the attitude of students towards Blended Learning are dependent variables.

Extraneous Variable

The control variables considered for the study are previous achievements in science concepts which are prerequisites for mastering the new topic, physical environment and environmental barriers, length of instruction, etc.

Intervening Variables

In the present study boredom, fatigue, excitement, and mood of the students in the situation are intervening variables.

1.14 SIGNIFICANCE OF THE STUDY

The study on the effectiveness of Blended Learning, which combines the use of MOODLE in the online mode with various offline teaching methods, such as the discussion method, learning by doing method, survey integrated with discussion method, and case study method, on the academic achievement of eighth-grade students in science holds noteworthy importance for several stakeholders in the educational area.

This study intends to determine whether Blended Learning can better students' understanding application and analysis of scientific concepts. By identifying effective

Blended Learning Strategies, educators can improve the quality of science education, leading to better academic performance and a deeper understanding of the students of the subject matter.

Blended Learning can make science education more pleasant and encouraging by blending interactive online learning management platforms like MOODLE with employing offline methods. Enhanced engagement and motivation can lead to better academic outcomes and a more positive attitude towards science.

Incorporating MOODLE with offline methods such as discussions, hands-on activities, surveys, and case studies encourages active learning. This approach engages students more fully in the learning process, fostering critical thinking, problem-solving, and analytical skills essential for scientific inquiry.

Blended Learning presents a flexible approach that can cater to the varied learning styles and paces of students. Understanding its impact on eighth-grade science education will help in developing more comprehensive and flexible teaching methods that can support all learners, including those who may struggle with conventional teaching methods.

As technology becomes progressively integral to several fields, students who are competent in employing digital tools for learning will be better equipped for future academic and career opportunities. Blended Learning advances digital mastery and critical thinking skills, which are essential for success in the 21st century.

Understandings from this study can assist in the professional development of teachers by providing them with evidence-based practices for incorporating technology into their teaching. This can lead to more effective and engaging science instruction, eventually benefiting students.

The findings of this research can update curriculum developers about the benefits and weaknesses of Blended Learning in science education. This can lead to the design of curricula that successfully integrate digital tools and resources, confirming that they complement conventional teaching methods.

Policymakers can apply the results of this study to make updated decisions about the implementation of Blended Learning strategies in schools. Confirmation of enhanced academic achievement through Blended Learning can support investing in technological infrastructure and teacher training.

Overall, this study is important as it seeks to offer valuable insights into the effectiveness of a Blended Learning Strategy that incorporates MOODLE with several offline teaching methods in improving the academic achievement of eighth-grade students in science. The outcomes of this research will have practical implications for advancing science education and stimulating the effective incorporation of technology in classrooms, eventually benefiting students, teachers, and the larger educational community.

1.15 SCOPE AND DELIMITATIONS OF THE STUDY

SCOPE

1. The Study can be conducted for students of grades above grade VIII.
2. The Study can be broadened for all other talukas in North Goa as well as South Goa district.
3. The Study can be undertaken in other school subjects than science.
4. The study can be conducted using other models of Blended Learning.

DELIMITATIONS

1. The study is delimited to the grade VIII students of Pernem Taluka of North Goa district in the Goa State only.

2. The study is delimited to science subjects only.
3. The study is also delimited to grade students only.
4. The study is delimited to the Flipped Classroom model of Blended Learning.

1.16 METHODOLOGY OF THE STUDY

Methodology occupies a very significant position in any research. The accomplishment of any research is mostly determined by the selection of suitable research methods, tools, and techniques applied during data collection. There are various methodologies adopted for research, such as Historical research, Descriptive Research, Qualitative and Quantitative research, and Experimental research.

The present study aims to design and develop Blended Learning Strategies to study the effectiveness of Blended Learning Strategies on the academic achievement of grade VIII students in science by identifying suitable technology and pedagogical practices.

In the present study, the researcher has decided to teach students through two different methods as a treatment and wanted to observe the effect of both methods in terms of achievement of the students. For this, the researcher has proposed the tentative answer to a hypothesis. Because of the effectiveness of two different teaching methods to be decided, the experimental method seems more suitable. So, the researcher decided to use the experimental method with a Pre-test, Post-test Equivalent Group Design.

1.17 TOOLS FOR DATA COLLECTION

A self-made achievement test was used to test the achievement of the students after the implementation of Blended Learning Strategies designed and developed by the researcher.

Perception scale by Robert G. Farmer, (2009) was adapted to test the perception of Blended Learning Strategies among grade VIII students.

An attitude scale by Roland Birbal et al. (2018) was modified and used to check the attitude of the respondent students towards Blended Learning Strategies.

The Achievement test, modified perception, and attitude scales were all validated by the experts in the respective fields.

1.18 STATISTICAL TECHNIQUES

The correlated t-test, independent t-test, ANCOVA, and Chi-Square Test for goodness of fit were used to analyse the collected data.

1.19 CHAPTER SCHEME

The present study is related to the design and development of Blended Learning strategies by incorporating the Learning Management System MOODLE and the classroom input of the teacher. An attempt is also made to study the effectiveness of Blended Learning strategies on the academic achievement of grade VIII students and their perceptions and attitudes toward Blended Learning.

The report of this study is organized into five chapters. The first chapter titled An Introduction deals with all the essential aspects to be included such as the theory of Blended Learning, Blended Learning and science education, benefits of Blended Learning, features of Blended Learning programs, models of Blended Learning, levels of Blended Learning, methods of teaching for a Blended Learning program, Blended Learning environment, teachers role in Blended Learning classroom, assessing Blended Learning, Blended Learning program and academic achievement, perception of Blended Learning and attitude towards Blended Learning, the statement of the problem, objectives of the study, rationale of the study, the hypothesis of the study, defining operational terms, scope and delimitations of the study, universe, population and a sample of the study, variables of the study,

significance of the study, methodology of the study, tools used for data collection and technique used for data analysis.

The second chapter is titled as the review of related literature which gives thorough descriptions about the research studies conducted in the areas associated with the present study. Studies Related to Blended Learning and Academic Achievement in science, Studies Related to Blended Learning and Academic Achievement in other subjects, Studies related to the Perception of students of Blended Learning, Studies Related to the attitude of students towards Blended Learning, and Studies related to other aspects of Blended Learning are discussed in this chapter.

The third chapter, titled Methodology, presents the methods used to conduct the study. It includes the design of the study, variables of the study, population, sampling, tools used for data collection, administration of the tools, scoring, and statistical techniques used for the analysis of the data.

The fourth chapter presents the analysis of data and interpretation of findings. The data is analysed using different statistical tests and results were interpreted based on hypothesis. The descriptions of the statistical tests and the reasons for using those tests are also described in this chapter.

In the last chapter, the entire study is summarized describing the objectives, methodology, and findings very briefly. This chapter also includes interpretation and discussion of the findings, educational implications of the study, and suggestions for future research.

CHAPTER II

REVIEW OF RELATED LITERATURE

2.1 INTRODUCTION

This chapter includes a review of the literature related to the present study. It is one of the early steps in the groundwork of research work and reassessing research done previously in the same area. It is essential for each researcher to notably analyze their problem with problems previously done by others. It offers knowledge of the previous studies carried out, the most up-to-date advances in the field of accessible research, and the missing gaps and gives scope for forthcoming research. The effect of reviewing the literature helps the researcher to identify the methodology and methods adopted for data collection, analysis, and interpretation of results and to arrive at objectives and hypotheses. Therefore, the study of related literature presents the researcher with a comprehensive idea of research. In this chapter, the researcher describes the studies related to the effectiveness of Blended Learning Strategies.

2.1.1 Brief analysis of referred journals and the databases.

In line with the study's objectives, the researcher has composed a review related to Blended Learning from referred journals and databases like Shodhganga, Google Scholar, NDLI, and Research Gate. The studies have been taken from 2006 to 2023. It facilitated the researcher to avoid the needless repetition of preceding research. It also offered essential insight into the problem and recommended an important base for the hypothesis. Altogether 39 studies conducted in India and 40 studies conducted outside India were referred by the researcher.

The Research studies spread over a wide range of subject areas like Science, Geography, English, Computer Science, Mathematics, Educational Psychology, Educational Technology, Teaching of Physical Science, LIS Education, civics, Environmental Education, English Grammar, Medical Education, General Health Course, Indonesia Language Education, World History course, didactics of biology and nursing finding effectiveness on academic achievement. Most of the studies have shown the effectiveness

of Blended Learning on academic achievement except a few which do not show any effect of Blended Learning on academic achievement.

The analysis also revealed the existence of studies on psychological outcomes, which include aspects like communication skills, effectiveness in written expressions, communicative skills in English, higher-order thought processes, cognitive absorption, and behavioural intention. critical thinking and social skills, creative thinking, microteaching skills, scientific attitude, teaching practice course, Techno pedagogical skills, reducing academic anxiety, on Goal –orientation, Task Value and Satisfaction, science attitude and self-directed learning skills, students' motivation, students' collaborations and communication, professional development of physics teachers, learning styles and instructional factors influencing learning outcomes.

The analysis also showed that there are several studies on Higher Education, Primary Education, Secondary Education, Higher Secondary Education, Teacher Education, and Health Education.

Based on the objectives and hypotheses of the study, the researcher categorized the collected reviews under eight headings. They are:

- Studies related to Blended Learning conducted in India.
- Studies related to Blended Learning conducted outside of India.
- Studies related to Blended Learning and academic achievement in science conducted in India.
- Studies related to Blended Learning and academic achievement in science conducted outside of India.
- Studies related to the Perception of Blended Learning conducted in India.
- Studies related to the Perception of Blended Learning conducted outside of India.

- Studies related to Attitudes towards Blended Learning conducted in India.
- Studies related to Attitudes towards Blended Learning conducted outside of India.

2.2 STUDIES RELATED TO BLENDED LEARNING CONDUCTED IN INDIA

1. Alice Abraham Chacko (2019) explored the communication skills of secondary students about their attitude towards Blended Learning and academic achievement. An objective of the study was to study the level of academic achievement of the students. A quantitative paradigm was selected for the study by the researcher. The sample of the study was 894 school students studying in higher secondary schools situated in the Union Territory of Puducherry, India. Data was collected by using the normative survey method. The data was gathered through the Academic Achievement Test. Data Analysis was done by using a test of significance ('t'- test), and correlation coefficient ('r'- test). The study revealed that the student shows an average level of academic achievement.

2. Blihi Ahmed Othman (2019) examined the effectiveness of the Blended Learning approach on the achievement of written expressions in English grammar and students' interest in English among undergraduate education students. The study was experimental, utilizing a pre-test and post-test control group design. The sample consisted of 80 first-year male and female students from Abs College of Education, selected through random sampling. The students were divided into two groups, namely an experimental group and a control group. The study employed several tools, including a Written Expressions Test, a Test of Achievement in English Grammar, and a Scale of Interest in English. Data analysis was conducted using mean, standard deviation, and t-test. The results indicated that the Blended Learning approach significantly improved students' written expressions and English grammar achievement while also increasing their interest in learning English.

3. Deivam, M (2018) investigated the effectiveness of Blended Learning in enhancing the B.Ed. Trainee's achievement in educational psychology. The major objectives of the study were to produce Blended Learning modules using Blendspace for teaching Educational Psychology among B.Ed. Trainees, to establish the Effectiveness of Blended Learning in Teaching Educational Psychology among B.Ed. Trainees, to analyse the effective blended learning models in Teaching Educational Psychology among B.Ed. Trainees and to find out the B.Ed. Trainee's attitude towards Blended Learning. The study was Experimental. The pre-test and post-test equivalent group design was employed in the research. The sample for the study was comprised of 100 B. Ed trainees in two different colleges of education from Dindigul district, Tamil Nadu. A purposive sampling technique was used in the research. An experimental research design with two groups was used in the study. The two groups in the study were the control group and the experimental group. Blended Learning was implemented in face-to-face in offline mode and online learning. The researcher used Station Rotation, Lab Rotation, and the Flipped Classroom Model of Blended Learning. Tools used in the research were the Achievement Test in Educational Psychology, Attitude Scale, Case Analysis, and Computer Knowledge Test. Data was analyzed using Mean, SD, Skewness, Kurtosis and Percentage analysis, "t" test, Effect size and ANOVA, and correlation. The finding of the study reveals that blended learning is more effective. The Case studies confirm that Blended Learning is effective, interesting, and offers better satisfaction to the learners.

4. Dhanya, J S (2017) conducted a study titled 'Development of a Blended Learning Program in Communicative English for B.Ed. Students,' employing a One-Group Pre-test, Post-test Experimental Design. The Blended Learning Program, called Easy English, combined web-based interactive self-learning, live online interactions with tutors and peers, and face-to-face classroom sessions. The study involved 45 B.Ed. students specializing in Sciences, Mathematics, and Social Sciences from training colleges in the Trivandrum district, selected

using a simple random sampling technique. Various tools were used, including an Interview Schedule to assess English language and communication skills, a Conversational Skills Rating Scale, and the Communication Skills Attitude Scale for Teacher Educators. Additional instruments included adapted versions of the Assessment Guide for Multimedia Learning Material and the iNACOL National Standards for Quality Online Courses, as well as the Communication Skills Assessment Online Test (CSAOT) and semi-structured interviews to gather feedback. Statistical analyses were conducted using One-Way Repeated Measures ANOVA, ANCOVA, One-Way ANOVA, the Bonferroni Post Hoc Test, and the Scheffe Post Hoc Test. The findings demonstrated that the Blended Learning program effectively enhanced communicative English skills for B.Ed. students.

5. Dhanya Krishnan (2011) investigated the consequence of Blended Learning on higher-order thought processes and science learning among secondary school students and found a positive effect of Blended Learning on critical thinking, problem-solving, and science process skills. The study was quasi-experimental. Pre-test and post-test non-equivalent group designs were used in the study. The study also endeavoured to study the learning style of the students in a Blended Learning environment. For data analysis, (ANCOVA) was employed.

6. Dhiman, Sonu Bala (2022) assessed the effect of blended e-learning on cognitive absorption behavioural intention, and academic achievement of senior secondary school students. One of the objectives of the study was to study the effect of blended E-learning on academic achievement of students. Instructional System for Blended E-learning - Development of Class Website on Google Sites was used as a tool by the researcher. The study employed the experimental method of research with a pre-test-post-test control group design. 60 students of class XI Commerce stream from two private co-educational CBSE affiliated schools of Nangal City, from Ropar district in Punjab, formed the sample of the

study. The students in the sample were equally divided into experimental and control groups. The Experimental group was taught using Blended E-learning and the Control Group was taught using traditional teaching. Tools used by the researcher were the Cognitive Absorption Scale, Behavioural Intention Scale, Academic Achievement Test in Commerce, and Feedback Form. The data analysis in the study was done by employing a t-test, 2x2 ANOVA, and 2x2 MANOVA. Therefore, the findings of the study revealed that blended e-learning resulted in improved cognitive absorption, behavioural intention, and academic achievement of students in comparison to traditional teaching.

7. Gupta, Rajni. (2020) showed that the Blended Learning Strategy proved effective and advantageous in promoting the critical thinking and social skills of students with ADHD. The major objective of the present research was to study the effect of the Blended Learning Strategy on the critical thinking and social skills of students with Attention Deficit Hyperactivity Disorder (ADHD). The study was experimental with a pre-test-post-test control group-experimental design. A random sampling technique was used in the study. 80 regular school-going VIII and IX grade students with Attention Deficit Hyperactivity Disorder of Amritsar City formed the sample of the study. The students were divided randomly into two groups, namely the experimental group, which was taught using Blended Learning, and the control group, which was taught using the conventional method of teaching. The study lasted for 50 working days. The collection of the data was done by using the Critical thinking scale and social skills rating scale. Analysis of the data was done by using the statistical technique of independent samples t-test. The results of the study revealed that the students with ADHD taught through the Blended Learning Strategy displayed better performance in critical thinking and social skills as compared to the students taught using the traditional method of teaching.

8. Harnam Singh (2022) supported his study by concluding that, Blended Learning is a superior method for imparting Geography education and creative thinking than a conventional method of teaching among 9th class students about exposure to technology and intelligence. Blended Learning has an optimistic effect to foster the creative thinking of the Learner. The blended Learning method of teaching had a positive impact on the Academic Achievement of students in Geography having a high level of intelligence. The important objective of the study was to study the effect on achievement in geography of the groups taught through blended learning and routine method teaching. Blended Learning Strategies included Face-to-Face Learning, self-paced learning, and online collaborative Learning strategies. In the online collaborative method, the students were taught with the help of Screen-o-Caste, Presentation Tube, U-Tube, PowerPoint Teaching, Google Class Room, WhatsApp Group, Skype, FaceTime, etc. The study was experimental. Pre-Test, Post –Test and Control group 2x2x2 factorial design was used in the study. 600 students from the 9th class studying in C.B.S.E. affiliated senior secondary schools of Jalandhar District of Punjab formed the sample of the study. A sample of 600 students was divided into two groups. Experimental group and control group. Tools used by the researcher were the Passi Test of Creativity (PTC), Ravens Standard Progressive Matrices, Achievement Test in Geography, and Exposure to Technology Test. Data was analyzed using mean, S.D., Skewness, Kurtosis, F-Ratio, T-Test, and Three Ways Analysis of Variances and Graphical techniques.

9. Kamaraj, N (2021) explored the effectiveness of project-based Blended Learning in developing microteaching skills among B.Ed. student teachers. The study employed an equivalent group experimental design, with a sample of 186 student teachers from three different colleges. These students were equally divided into an experimental group and a control group. The research utilized various tools, including diagnostic tests, achievement tests, retention tests, and case studies. Data analysis was conducted using Mean, Quartiles,

and Percentage Analysis, as well as 't' and F tests. The study's findings indicated that the experimental group, which learned through the project-based Blended Learning method, outperformed the control group in educational achievement. The experimental group also showed a higher gain percentage and significantly better retention scores compared to the control group.

10. Kaur, Manpreet. (2023) assessed the consequence of the Blended Learning Strategy on learning outcomes and scientific attitudes among secondary school students. The study reflected on the effect of a Blended Learning strategy on scientific attitude and learning outcomes among secondary school students in the subject of science and mathematics. An experimental research method was used in the study. The design of the study was a pre-test and post-test non-equivalent graph design. A sample of 200 students was randomly selected from class IX students of four secondary schools. 50 students were selected from each school. 25 students from each school were included in the Experimental group and 25 students from each school were included in the control group. The tools used by the researcher include the Scientific Attitude Scale by Dr. S.C. Gakhar and Dr Amandeep Kaur (2014), the Learning Outcomes Scale in Science, and the Learning Outcomes Scale in Mathematics and Blended Learning Oriented instructional material. T-test and 2-way ANOVA were utilized to analyze the data. From the findings, it can be resolved that Blended Learning contributes more towards achieving the educational goals.

11. Malathi, S. (2020) concluded that in Blended Learning implementation, the higher educational sector is still at the awareness level when describing a Model Framework on Blended Learning in Educational Technology. The research demonstrated apparent evidence of the usage belonging toa wide-ranging blended method for Teaching-Learning to improve the capability in Higher Education using the CTL Model. It has originated to be more valuable in terms of understandable explanation of concept-based content uploading, better

fit for scheduled studies along with time and pace leading towards the improvement and proficiency in the Higher Educational Sector. Data that was used for any type of explanation is referred to as large data. It also exposes the diverse outline of study in the CTL model.

12. Mustafa Caner (2010) aimed to study the introduction of Blended Learning and a model for a pre-service English Language teaching practice course at Anadolu University. It was supposed that providing a Blended Learning environment for teaching practice courses would improve the practice and contribute to the professional growth of pre-service teachers. Thus, the paper aims to provide a Blended Learning model for teaching practice courses at teacher training institutions and gives impetus for the researchers or instructors who would like to employ Blended Learning in their personal instruction setting. Finally, through illustrating a Blended Learning environment for teaching practice courses, it was hoped that this study might contribute to the growing body of knowledge of blended delivery and Blended Learning in higher education

13. Latha R (2020) attempted to investigate the effectiveness of Flipped Learning and Blended Learning on Achievement in Computer Science among XI Standard Students. The main objective of the study was to find out the significant difference between the experimental group (flipped learning) and control group (traditional learning) XI standard students in their post-test scores in computer science. The Blended Learning Strategies used in the study were the Video Lesson Package for Flipped learning and the Video Lesson Package for Blended Learning. The study was experimental with pre-test and post-test equivalent group experimental design. A sample of 120 students was selected from four different schools for the study. The students in the sample were divided into two groups namely the experimental group and the control group. The tool used in the study was the Criterion Test. Descriptive Analysis and Differential Analysis are used as statistical techniques. The results of the study indicated that the flipped learning approach and Blended

Learning approach have had a positive impact on the XI standard students' achievement in computer science.

14. Pandey, Archana (2023) studied the effectiveness of the Blended Learning approach in Geometry at VII grade in terms of students' achievement interest in Geometry and attitude towards Blended Learning. The main objective of the study was to compare the mean gain scores of the experimental and control groups concerning achievement in geometry for class VII. Blended Learning Strategies were developed by the researcher by using the Supplemental Model developed by Twigg (2003) and the Program Flow Model developed by Bersin and Associates (2004). Blending was between face-to-face instruction (computer-based instruction, lecturing, demonstration, discussion, and experimentation) and online learning. Quasi-experimental method was used in the study. 84 students of grade VII from two secondary schools formed the sample of the study. A cluster sampling technique was used in the study. Tools used by the researcher were achievement tests in Geometry, interest inventory in geometry, and attitude towards Blended Learning scale. The Blended Learning Approach was found to be effective in improving the achievement in the geometry of the students belonging to both genders. The use of application software like Geo-Gebra, Google Classroom, and meeting apps in teaching has improved the achievement of students exposed to the Blended Learning approach. The effectiveness of Blended Learning is seen in terms of interest in Geometry and in terms of attitude towards the Blended Learning approach of the students.

15. Pradeep Kumar (2010) found that the Blended Learning Strategy is better than the traditional teaching strategy for immediate learning and retention. The main objective of the study is to find the effect of Blended Learning on 9th-class students towards English. An experimental method was used in the research. A total sample of 120 students was selected for the study by random sampling technique. The blended Learning strategy in this study

included computer-assisted Instruction with CD ROM followed by classroom discussion and traditional classroom. This study dealt with the different learning strategies that can be used by teachers to minimize forgetting and the acquisition of knowledge effectively.

16. Scaria, Sumy. M. (2016) developed a Blended Learning program aimed at enhancing techno-pedagogical skills and achievement among secondary-level student teachers. The study's objectives were to create a Blended Learning Package (BLP) by integrating the Optimal Learning Model (OLM) with a Learning Management System (LMS) to improve student teachers' techno-pedagogical skills and achievement. The effectiveness of this package was compared with that of the OLM, LMS, and Activity Oriented Method (AOM) in enhancing these skills. The researcher employed a Survey Cum Experimental Method, using both the Normative Survey Method and a 'pre-test post-test non-equivalent groups design.' The study's sample included 410 student teachers, with data from 321 B.Ed. students at Mahatma Gandhi University selected for analysis. The Blended Learning Package on Modern Educational Practices was developed by combining OLM and LMS. Tools used in the research included the Techno-Pedagogy Awareness Scale, an Observation Schedule for assessing OLM's nurturing effects, an Evaluation Proforma for validating the BLP, lesson transcripts based on AOM, the Techno-Pedagogical Skill Test, and an Achievement Test in Techno-Pedagogy. Data analysis involved Descriptive Statistics, Percentage Analysis, Chi-Square test, ANOVA, ANCOVA, One-Way Repeated Measures ANOVA with Sidak Correction, and Post-hoc comparisons using LSD and Bonferroni methods. The study's findings showed that the Blended Learning Package was more effective than the LMS, OLM, and AOM in developing and sustaining techno-pedagogical skills and achievement in techno-pedagogy among secondary-level student teachers.

17. Sen, Deepshikha (2016) analysed knowledge of Blended Learning as a theory of LIS Education in certain Universities in North East India. The study provides valuable information on LIS Teachers, students, and research scholars' knowledge, use, views, and expectations regarding Blended Learning and its use in LIS education. The survey method was used in the research. A questionnaire as a main tool was utilized for the collection of data. The total sample size of the study was 353. Data was analyzed using quantitative data analysis software, namely MS Office Excel and MS Office Word. The study emphasized the need to present more training opportunities for LIS Teachers and students to exhibit how Blended Learning and its tools can be useful in their work in academic LIS departments of North East India. From the study, it was apparent that the use of Blended Learning tools by LIS Teachers and students in LIS departments in universities of North East India was slow and getting momentum slowly.

18. Sharma, Anju (2021) revealed that the Blended Learning Strategies proved effective in improving academic achievement in English of secondary school students as well as helpful in reducing academic anxiety about self-efficacy. The objectives of the study were to develop blended learning-based instructions on selected topics of English class and to investigate the significant difference in achievement in English of the groups taught through Blended learning strategy and Traditional teaching. Flipped-classroom Model of Blended Learning was used in the study in which blended instruction was imparted by combining traditional classroom teaching with asynchronous online learning activities. MOODLE was used in preparing the online learning material. An experimental Method of research was employed in the study with a randomized group pre-test and post-test design. 128 students of class IX from two private schools affiliated with CBSE formed the sample of the study. The tools used in the research were Mixed Type Group Test of Intelligence (MGMT) by Mehrotra (2008), Instructional Material based on MOODLE for Blended Learning, an

Achievement Test in English, an Academic Anxiety Scale for Children by Singh and Sengupta (2013) and Self-Efficacy Scale by Mathur and Bhatnagar (2012).

19. Singh, Namrata (2021) carried out a study to find the effect of Blended Learning on Goal –orientation, Task Value, and Satisfaction of Students. The research was experimental in nature. The design of the research was a 2x2 factorial pre and post-test design. The sample of the study was formed by 400 undergraduate students consisting of 200 formal modes (100 male and 100 female) and 200 blended learning modes (100 male and 100 female). The sampling techniques used in the research were purposive sampling and random sampling. The sample was divided into two groups. Tools used in the research were the Goal-orientation Scale, Task Value Scale, and Student Satisfaction Scale. The analysis of the data was done using MS Excel and SPSS for descriptive as well as inferential statistics. The findings of the study revealed that there was a significant effect of blended learning on task value and satisfaction of the students, whereas there was no effect observed on the overall goal orientation of students.

20. Smita Tanwar (2022) attempted to study the effectiveness of Blended Learning in comparison to Traditional Teaching. The objective of the research was to study the effectiveness of Blended Learning and to study the student's perception of blended Learning. The researcher used online resources, videos, PPTs, and discussions under the guidance of a teacher as Blended Learning Strategies. The researcher employed the Experimental research method for the study with Pre-test and Post-test design. 80 students from two different schools formed the sample of the study. The sample was divided into an experimental group, which was taught using the Blended learning method, and a Control group, which was taught using the traditional method. The data collection tools used by the researcher were achievement tests for class VIII civics, the Perception Scale on Blended Learning for Teachers, and the Perception Scale on Blended Learning for Students. The data

analysis of the collected data was done by using Mean, Standard Deviation, and t-test. The findings of the research revealed that the students of the Blended learning group performed better as compared to the students of the Traditional teaching group. The findings also revealed that the students developed a more positive perception of the Blended Learning method when taught using Blended Learning Strategies.

21. Vanitha, S T (2021) conducted a study to examine the effectiveness of the Blended Learning Strategy on achievement in Environmental Education among B.Ed. trainees. The key objectives were to develop a Blended Learning Strategy for teaching Environmental Education to B.Ed. trainees and to compare its effectiveness with traditional learning and e-learning strategies. Modules were uploaded to the Google Classroom platform, allowing students to learn independently at their own pace. Students then attended class the following day to clarify any doubts and engaged in peer interaction through blogs, podcasts, PPT voiceovers, and other social media tools. The study employed a quasi-experimental method with a pre-test and post-test design. The sample consisted of 99 B.Ed. trainees, selected using simple random sampling and divided into three equal groups. The Blended Learning group was taught using the Blended Learning Strategy, the Traditional Learning group followed a conventional teaching method, and the E-learning group utilized an e-learning strategy. Tools used included modules on Environmental Education developed by the investigator, achievement tests, the Attitude Towards E-learning Scale, the Internet Surfing Behaviour Scale, and the Online Community Formation Habit Scale. Data analysis was conducted using significance tests, including the 't' test and 'F' test. The findings revealed that the Blended Learning Strategy was more effective in improving achievement in Environmental Education compared to both traditional and e-learning strategies. Additionally, the study showed that domestic responsibilities significantly influenced achievement in Environmental Education.

22. Wahyu Setyaningrum (2019) in the study Blended Learning: Does it help students in understanding mathematical concepts, investigated the effectiveness of learning mathematics delivered through blended learning. The study was experimental research. Learning Management System, MOODLE was used in Blended Learning Environment 127 VIII grade students of secondary school formed the sample of the study. Written tests and interviews were used to gather the data. This study compared the effectiveness of Blended Learning using MOODLE and traditional one on students' conceptual understanding and shows that students who learn in the Blended Learning approach have better conceptual understanding than the students who learn in conventional methods of teaching.

2.3 STUDIES RELATED TO BLENDED LEARNING CONDUCTED OUTSIDE OF INDIA

1. Akgunduz, D., & Akinoglu, O. (2016) found an increase in science attitude and self-directed learning skills, a positive impact on the attitude of social media-supported learning groups and self-directed learning skills while investigating the effectiveness of Blended Learning in science education. An experimental research method was used in the study. The sample of the study comprised Seventy-four7th-grade primary students in a primary school in Kadikoy, Istanbul in the 2011-2012 Academic Year. The design of the study was a pre-test-post-test control group design. One of the experimental groups was taught using face-to-face and internet-based learning as Blended Learning. The other experimental group was taught using network-supported face-to-face learning and the 5E learning cycle model, whereas the control group was taught by using the traditional face-to-face approach with the 5E learning cycle. Science Teaching Attitude Scale and the Self-directed Learning Skills Scale Data were used for data collection. By using One-Way ANOVA, t-Tests, and Kolmogorov Smirnov-Z Test of SPSS Statistic Program Quantitative data was analyzed.

2. Akkoyunlu, B., & Soylu, M. Y. (2006) conducted a study to analyze students' perspectives on the Blended Learning environment. The objective was to explore how students' views on this learning method were related to their achievement levels and frequency of participation. The sample consisted of 64 students from the Department of Computer Education and Instructional Technologies. Data were collected using a questionnaire, and a web-based environment was created for the research. The findings revealed that both face-to-face teaching and participation in online forums significantly contributed to students' learning experiences. Students reported enjoying their involvement in the Blended Learning environment. Additionally, students' achievement levels and frequency of participation in the forums influenced their opinions about the Blended Learning experience. Face-to-face interaction received the highest rating, underscoring the importance of interaction and communication in the success of online learning.

3. Al-Ani, Wajeha Thabit (2013) investigated to find university students' utilization of learning management system software (MOODLE) in learning in the way that activated their achievements. A sample for the study was 283 students from all the colleges at Sultan Qaboos University. The sample of the study was randomly selected. The data was collected using a questionnaire of 45 items is developed. The results revealed that using MOODLE in Blended Learning has an average level of effectiveness related to students' motivation, students' achievements, and students' collaborations and communication. The results revealed that there is no insignificant difference among student perceptions related to gender and college type. The results also indicated that the uppermost obstructions students face related to frequent disturbance in computer devices

4. Al-Saai, et. al. (2011) explored the impact of Blended e-learning on students' achievement and attitudes toward utilizing e-learning at the university level. Handouts before the class,

discussing the content through the virtual classroom, and meeting face–to–face with the teacher were blended into the study. A sample consisted of 43 female students who were randomly assigned to get one of two instructional interventions, namely a blended e-learning approach and a traditional face-to-face teaching approach. The findings of the study revealed that even though the attitude scale showed a significant difference in gain scores in favour of Blended e-learning, there was no significant difference between the two teaching methods in gain scores of the achievement test.

5. Alseweed (2013) investigated students' achievement and attitude toward using conventional learning, Blended Learning, and virtual class learning in the teaching and learning process at the university level. The results of the study indicate that there are significant differences among the instructional approaches and in achievement test scores in favor of Blended Learning. It also reveals that there is a significant difference in students' attitudes in favour of Blended Learning.

6. Berger et al. (2008), when studied the professional development of physics teachers in an evidence-based Blended Learning program that highlighted 'knowledge integration' innovative activities, saw the solidity of learning between face-to-face and online environments. The program had nine face-to-face meetings as well as continuous online exchanges between them through a website. The teachers implemented the activities, collected and analyzed data about their practice and their students' learning, and reflected on the evidence with their peers. This study shows that the appropriate use of an online environment in a Blended program leads to a continuous course of learning and transforms a 9 once–a–month meetings workshop into a 9-month workshop.

7. Boitshwarelo, B. (2009) explored Blended Learning for science teachers' professional development in Africa. The study reported deficiencies in policy, schools, and training

providers. The three major recommendations were, that schools should deal with the utility of ICT resources by both teachers and students and should support on-going teacher learning in the school. Institutionalized ICT access and use and participatory and localized learning should be supported by the government. Blended Learning with good modelled ICT practices should be provided by the training providers. There should be acceptance of ongoing, situated, participatory, and collaborative approaches to the change in the culture of teaching and learning.

8. Cabı, E. (2018) conducted a study to examine the impact of the Flipped Classroom Model on students' academic achievement using a mixed-methods approach. The study aimed to assess how the Flipped Classroom (FC) Model influenced academic performance. The sample consisted of 59 pre-service teachers from English Language Teaching and Turkish Language Teaching programs, selected through simple random sampling. The participants were divided into an experimental group and a control group. The experimental group received instruction via the Flipped Classroom Model within a blended learning environment, while the control group followed traditional teaching methods. Course materials for the experimental group were delivered through an online learning platform, with in-class activities including individual assessments and group presentations. The intervention lasted four weeks, and a pre-test and post-test were administered to both groups. Data were analyzed using a two-way ANOVA for Mixed Measures to compare the test scores of both groups. The results indicated that there was no statistically significant difference in academic achievement between the two groups

9. Ceylan, V. K., & Kesici, A. E. (2017), in their study on the effects of Blended Learning on academic achievement, investigated the effects of Blended Learning on middle school students' academic achievement level and product evaluation scores in computer science.

Blending was between enriched web technologies (such as video conferences, Learning Management Systems, Discussion blogs, etc.), and the present teaching methods in the classroom environment. The experimental method was used in the study. The sample comprised a total of 53 students enrolled in the 6th grade classrooms during the year 2014/2015. The students were divided into an experimental group and a control group wherein the experimental group was taught using Blended Learning Strategies. The intervention lasted for seven weeks. For quantitative data collection sources like academic achievement tests and product evaluation scales were used. Evaluation of students' projects that the students developed during the process of the study and through academic achievement tests the data was collected. Independent t-test, frequency, and ANOVA tests were used for data analysis. It is concluded from the study that the blended Learning environment had created a significant difference in students' academic achievement.

10. Cross, et. al. (2014) conducted an investigative study on online learning against Blended Learning. The study aimed to find answers to two questions: (i) How does viewing a video on a personal computer match up to viewing it as a group in a classroom, and (ii) how does viewing a video tutorial match up to attending a live tutorial? An experimental method was used in the study. Treatment was given to two groups, one control group (online learning) and another experimental group (Blended Learning Group). In the control group, students viewed the video on a personal computer and also viewed a follow-up tutorial (a quiz review) on the computer. The Blended Learning group (Experimental Group) students viewed the video as a group in a classroom and received the follow-up tutorial from a live lecturer. The research results do not reveal significant differences between the online and Blended conditions.

11. Fakhir, Z., & Ibrahim, M. (2018) conducted a study to know how effective Blended Learning is when implemented in a class of grade 6 students being taught English. The major objective was to identify the effect of blended learning on the achievement of students and to analyze attitudes towards implementing Blended Learning in the sixth-grade students enrolled in private primary schools of Amman/Jordan. PowerPoint slides, flashcards, computers, data shows, and resources were adopted as Blended Learning material in online mode whereas face-to-face meetings with the instructor were included as offline activities. The study was quasi-experimental in nature. The sample of the study was comprised of 50 female students selected from two schools selected purposively. Data for the study was collected using the Achievement test and attitude scale. The result revealed that Blended Learning was an effective strategy for teaching English to grade 6 students and has a positive effect on the attitudes of the sixth-grade students towards Blended Learning.

12. Gulc, E. (2006) published a paper on using Blended Learning to accommodate different learning styles. In this study, the researcher took on new educational technologies to increase the condition for participating and stimulating the learners' experience and prepare them to recognize this new learning experience for their lifetime learning. The researcher took a variety of teaching styles, which are more liable to present learners with a more flourishing educational experience. The result recommends that blending both e-learning and online learning benefited the learners to the utmost scope.

13. Isti'anah Arina (2017) used a Learning Management System (LMS), MOODLE, for applying Blended Learning and concluded that Blended Learning was effective in helping students learn English grammar while investigating the effect of blended Learning on Students' achievement in grammar class. The researcher adopted the program overflow model offered by Bersin (2004) for this research. 34 second-semester students of the English

Letters Department, at Sanat Dharma University were the participants. To understand students' responses to the use of Blended Learning pre-questionnaires and post-questionnaires were involved in the research.

14. Kathleen Gray and Jacinta Tobin (2010) studied students' and teachers' commitment in Blended Learning by bringing in an online community into a medical education environment, which resulted in producing high student ratings of the quality of learning and teaching and equivalent academic results to those from face to face only teaching learning This study planned an online community to harmonize a series of on-site workshops and watched its utilization over a semester. Quantitative and qualitative data recording 43 final-year medical students and 13 clinical educators' experiences with this blended approach to learning and teaching were analyzed using access, adoption, and quality criteria as measures of impact.

15. Karamizadeh, et. Al (23012) investigated the effectiveness of the Blended Learning approach for medical training courses. Class sittings on “congenital adrenal hyperplasia and ambiguous genitalia” were conducted for 130 students at various clinical levels. All the students gradually selected in the sample filled out a questionnaire and were given an educational CD. After a week question and answer session was held in which problem-solving method was used. After two to four weeks, students were given a post-test questionnaire. A noteworthy relationship was found between pre-test and post-test scores and it was found that the post-test scores were extensively more than the pre-test ones.

16. Lim and Morris (2009) investigated the learner and instructional factors that influence learning outcomes in a Blended Learning environment. The primary goal of the study was to assess how students' learning is affected by their demographic characteristics, learning styles, instructional design, motivation, and engagement. The study involved 60 students,

consisting of 21 males and 39 females. Data analysis revealed that factors such as age, prior experience with distance learning, delivery format preference, and average study time were key learner-related elements that influenced learning outcomes among college students. Regression analysis further confirmed that both learner and instructional factors significantly impact learning outcomes in a Blended Learning setting.

17. Lin, Y. W.et. al. (2015) researched the effect of Blended Learning on the achievement level of 7th-grade students in mathematics courses and the students' attitudes toward mathematics. Blended learning included videos and face-to-face classroom activities. The sample of the study consisted of 54 seventh-grade students mostly below the intermediate level in learning achievement from a junior high school in Kaohsiung, Taiwan. The study was quasi-experimental in nature with an untreated control group design with pre-and post-tests. The blended Learning method with MOODLE was used as the teaching method in the study for the experimental group. Achievement tests and the Mathematics Attitude Scale were used as tools in the study. The intervention program was carried out for eight months. The results of the study indicated that Blended Learning showed a considerable effect on academic achievement for seventh-grade students.

18. Melton, et al. (2009) studied achievement and satisfaction in Blended Learning versus traditional general health course designs. This study aimed to assess students' achievement and fulfillment with blended learning course deliverance as compared to a conventional face-to-face class design in a general health course. The research was quasi-experimental with a pre-test and post-test control group design. Surveys were distributed to three blended and one traditional section participants which were randomly selected classes during the 2007 semester. The findings of the study revealed that no significant difference was found in pre/post-test scores.

19. Noermanzah, N., & Suryadi, S. (2020) in their study recuperating students' aptitude to analyze discourse through the MOODLE-based Blended Learning method in the Master Program of Indonesia Language Education, University of Bengkulu, showed increased vigour, enthusiasm, autonomy, and student learning outcomes, especially in analyzing discourse after the appliance of the MOODLE -based blended learning method. A classroom action research method with the model of Kemmis, McTaggart, & Nixon was used in the study. Tests, observation, interviews, and documentation are the data collection techniques used.

20. Obiedat, R. et al. (2014) researched to investigate the effect of Blended Learning on the Academic Achievement of Students at the University of Jordan. The study aimed to assess the efficiency of blended learning on the academic achievement of students at the University of Jordan. A survey method was employed in the study. A sample of 427 students was selected using a conventional sampling technique from King Abdulla II School for Information Technology at Jordan University. For statistical analysis, SPSS software was used. The study reports a considerable and optimistic effect of Blended Learning on the academic achievement of the students at the University of Jordan.

21. Rachmadtullah, R., et.al. (2020) in the study described the use of Blended Learning with MOODLE to find effectiveness in elementary school teacher education students during the COVID-19 pandemic. The researcher used a quasi-experimental method with a pre-test and post-test control group design for the study. The findings of the study revealed that the use of the MOODLE blended-learning learning model in elementary school teacher education students during the COVID-19 pandemic period was effective and promoted the use of MOODLE Blended Learning as a network-based learning solution or online.

22. Sari, R. N., & Amalia, A. V. (2021) studied the effectiveness of Blended Learning using MOODLE on students' Independence and Learning Outcomes. The purpose of the study was to find the effectiveness of the Blended Learning model using MOODLE on the independence of human respiratory system learning material and student learning outcomes. The study was quasi-experimental with a non-equivalent control group design The sampling technique used was purposive sampling. For the analysis of the gathered data t-test was used. From the findings of the study, it can be concluded that Blended Learning using MOODLE is valuable for student independence and learning outcomes.

23. Turpin, Christopher Michael (2018) studied Blended Learning and its effect on students' Achievement: An Action Research Study. The purpose of the research was to find the impact of the employment of Blended Learning in understanding its possible advantages to students' achievement.10th-grade students who joined the Honors World History course were the sample of the study. Half of the information in one unit was imparted using direct instruction methods and the remaining half of the information was imparted using Blended Learning. Qualitative research conducted through pre- and post-perception surveys as well as researcher's notations in the journal showed growth in achievement and a positive perception of the learning method for students. Quantitative research conducted on student assessment data through the formative and summative assessments showed that overall student achievement increased.

24. Yaman, M., & Graf, D. (2010) assessed an international Blended Learning cooperation project focused on biology teacher education. The study involved the development, implementation, and evaluation of a cross-national Blended Learning workshop on biology didactics. The course covered three core themes that explored various perspectives on science education. The participants were biology teacher trainees from the University of Technology Dortmund and Hacettepe University in Ankara, all of whom were enrolled in a

'Teaching Biology' course during the winter term of 2008/09. Although some aspects received cautious feedback, the overall positive results supported the continuation of efforts to develop similar global educational initiatives.

25. Zhigang Li, et. Al. (2014) explored students' academic performance before and after the implementation of Blended Learning in an undergraduate nursing program. Faculty members were interviewed for insight into students' complaints and their corresponding solutions who taught those courses before and after the adoption. From the findings of the study, it was concluded that there was no significant difference in academic achievement before and after the Blended Learning courses were adopted. Interviews from the faculty members also suggested that there was some initial resistance from the students to taking the online content outside of class. The students were motivated to complete the online part at home before coming to the class employing pop quizzes provided at the beginning of each face-to-face class.

2.4 STUDIES RELATED TO BLENDED LEARNING AND ACADEMIC ACHIEVEMENT IN SCIENCE CONDUCTED IN INDIA

1. A. SIVASA KAR (2011) blended MS Word documents, PDF documents, PowerPoint presentations, audio clippings, video clippings, and online test components with face-to-face classroom study improvement Validation and Effectiveness of Blended Learning Modules in Science Instruction in B Ed Level. The main objectives of the study were to identify the level of achievements through blended learning modules in science subjects and to evaluate the effectiveness of blended learning modules in science subjects. The study was experimental in nature with a Pre-test and Post-test equivalent group experimental design. The sample comprised 80 student teachers selected purposively for the study. 40 student teachers were included in the control group whereas 40 student teachers were in the experimental group. Data was gathered through the Achievement test in science education,

the Quest scale, and the ICT readiness scale. Analysis of the collected data was done by using mean, standard deviation, ‘t’ test, and Pearson product-moment method. The results of the study highlight the effectiveness of the blended learning strategy with a large effect size in the achievement of science education, e-quest score, and ICT readiness score of student teachers.

2. Chitra, P S (2017) integrated face-to-face instruction, lab activities, demonstrations, classroom teaching, games, self-learning materials (SLM), teaching-learning materials (TLM), debates, and online clips to examine the effectiveness of Blended Learning in teaching science to ninth-grade students. A parallel group experimental method was used, with a sample of 240 students randomly selected from four higher secondary schools, with 60 students from each school. The students were divided into two groups: an experimental group and a control group. The study employed various tools, including a problem inventory for teachers, an achievement test (pre-test and post-test), a retention test, and case studies. Statistical techniques such as the 't' test, F test, and post-hoc analysis were used. The results showed that Blended Learning was more effective in teaching science than conventional methods across all four schools.

3. Dhanya Krishnan (2011) studied the effect of the Blended Learning Strategy on higher-order thinking and science learning among secondary school students. One of the key objectives was to assess the effect of this strategy on students' science achievement. The study adopted a Blended Learning design proposed by Huang and Zhou (2005), where PowerPoint presentations and interactive educational CDs were used in the online mode, while discussions, lecture demonstrations, traditional lectures, and projects were employed in the offline mode. This quasi-experimental study utilized a pre-test and post-test non-equivalent group design. The experimental group consisted of 38 students from one school,

while the control group comprised 36 students from another school. ANCOVA was used for data analysis. The findings revealed that the Blended Learning Strategy had a positive effect on students' critical thinking, problem-solving abilities, science process skills, and overall achievement in science.

4. In the study conducted by Harpreet Kaur (2022) titled Effect of Collaborative Blended Learning Model on Achievement in Physics and Attitude Towards Physics of Students with Different Levels of Intelligence, used a Collaborative blended learning instructional package in Physics based on Collaborative blended learning model by Ligorio and Sansone (2015). Various texts, animations, videos, and links to different websites (online) and Collaborative activities in the form of group discussions, group assignments, group projects, and group demonstrations (Offline) were used in the study. The primary objectives of the study were to develop and validate an Instructional package in Physics for senior secondary school students and to study the effect of instructional strategy on achievement in Physics. The study employed quasi quasi-experimental design. 180 students from Government schools of District SAS Nagar selected through random-cluster sampling formed the sample of the study which was divided equally into a control group and an experimental group. The data collection tools used in the study include instructional Material based on the traditional method, an Achievement Test for 10+1 Physics, an Attitude towards Physics Scale (By Kaur & Zhao, 2017), Standard Progressive Matrices, and a website for the execution of the experiment. Analysis of the data was done using t-test, ANOVA, Factorial design 2x3 ANOVA, and Factorial design 2x3 ANOVA The findings showed that the Collaborative Blended Learning model fosters improved achievement and a more encouraging attitude towards Physics over conventional teaching. The high intelligence group demonstrated improved achievement than the low and average intelligence group whereas low intelligence

displayed a more positive attitude towards Physics than average and high intelligence groups when all were taught by the Collaborative Blended Learning model.

5. Maria Josephine (2016) conducted a study to find the efficiency of a Blended Learning Program on academic achievement among Student Teachers of Puducherry in Physical Science. The objectives of the study were to identify suitable technology and pedagogical practices for teaching physical science to design a Blended Learning Programme, to design and develop a Blended Learning Programme for teaching physical science among student teachers of the experimental group, and to study the effectiveness of Blended Learning Programme of teaching on achievement in teaching of physical science. All the activities like video conferencing technique, PowerPoint presentation, video presentation, action planning, and reflection method were uploaded on the learning Platform EDMODO in Online Mode and brainstorming method, team teaching method, discussion, small group discussion, debate, Lecture Method were used in offline mode. The intact group of 29 student teachers from one College of education was considered the experimental group which was taught using a Blended learning program, whereas the Conventional method of teaching was used to teach to the intact group of 24 student teachers from another College of education which was considered as the control group. A purposive sampling technique was employed in the research. Data was analyzed quantitatively and qualitatively using mixed-method research. The Intervention program lasted for eight weeks. Data was collected by the researcher by using teacher-made achievement tests in the teaching of physical science. Data Analysis was done by using both descriptive and inferential techniques. Descriptive statistics such as mean and standard deviation were used whereas inferential statistics technique includes t-test, Wilcoxon Sign Rank test, and Mann Whitney U test. For the quantitative analysis of data, Statistical Package for Social Sciences (SPSS

19.0) was used. The findings of the study revealed that the Blended Learning program was effective in improving the achievement of the students in the teaching of physical science.

6. The study by Manpreet Kaur (2023) reflected on the effect of Blended Learning Strategies on scientific attitudes and learning outcomes among secondary school students in the subject of science and mathematics. An experimental research method was used in the study with pre-test and post-test non-equivalent graph design. A sample of 200 students was randomly selected from class IX students of four secondary schools. 50 students were selected from each school. 25 students from each school were included in the Experimental group and 25 students from each school were included in the control group. In Blended Learning Oriented instructional material, PowerPoint presentations through websites, YouTube videos in the online mode were blended with Lecture cum Demonstration method, Demonstration cum discussion method, and Peer tutoring method in the offline mode. The data collection tools used by the researcher include the Scientific Attitude Scale by Dr. S.C. Gakhar and Dr. Amandeep Kaur (2014), the Learning Outcomes Scale in Science, and the Learning Outcomes Scale in Mathematics. 't' test and 2-way ANOVA used to analyze the data. From the findings, it was concluded that Blended Learning contributes more towards achieving educational goals.

7. Mishra, Namrata (2021) compared the effectiveness of Blended Learning supported by ICT and cooperative learning strategies on the academic achievement of secondary school learners. The study aimed to examine the differences in science achievement among students taught using Blended Learning supported by ICT, cooperative learning strategies, and traditional methods. The research employed an experimental design with a pre-test-post-test control group setup. The sample consisted of 180 students from two branches of Central Academy schools, selected through simple random sampling. The students were divided into

three groups: Experimental Group 1 (taught using Blended Learning Strategies), Experimental Group 2 (taught using cooperative learning strategies), and a control group (taught using traditional methods). Each group comprised 30 male and 30 female students. The tools used included a video for the ICT-supported Blended Learning strategy, lesson plans for cooperative learning without ICT, and a self-developed achievement test for learners. Data were analyzed using t-tests and ANOVA. The results indicated that both Blended Learning and cooperative learning strategies were more effective than traditional teaching methods in improving student achievement.

8. Mohammad (2013) studied the effectiveness of blended learning in the achievement of physics of 8th-standard students. The experimental method of research was used by the researcher as the research method. PowerPoint presentations were used for delivering the content as Blended Learning. The sample for the research was selected by simple random sampling method. The sample was from a small district of Hyderabad. The findings of this study revealed that Blended Learning is a more effective strategy than the conventional strategy for the academic achievement in physics of 8th-standard students.

9. Monicka, M. (2021) investigated the effectiveness of e-learning and Blended Learning of science at the high school level. Learning materials were provided through live and recorded videos, recorded lectures, animations, student forums, and e-content in online mode and Field visits, lecture cum demonstration in offline mode. The method employed in the study was experimental. The researcher used pre-test and post-test equivalent group design for the study. The sample for this study included 100 High School Students studying the Ninth Standard of the Tamil Nadu State Board Curriculum in Karaikudi, Tamil Nadu, India selected through the Purposive Sampling technique. The experimental group was taught using blended learning and e-learning methods for teaching, while the control group

was taught using conventional teaching methods for teaching. Data was collected by the researcher using the Achievement test in science as a tool. The data was analyzed by the researcher by using mean, median, mode, Percentage analysis, S.D, Skewness and kurtosis, t-test, Correlation analysis, ANOVA, and one-way ANOVA with Post Hoc Test. The finding of the study revealed that ninth-grade students who received Blended Learning courses performed better than students who received e-learning and traditional teaching methods.

10. Nair, Tara (2016) examined the effect of Blended Learning Strategies on achievement and social and environmental attitudes of students at secondary level in Biology. The objectives of the study were to design a Blended Learning Strategy for learning Biology at the secondary level, to find the Achievement in Biology of secondary school students using the Blended Learning strategy developed, and to find the effect of Blended Learning on achievement in Biology of secondary school students. Blending was between Instructor-led classrooms, Discussion, Field visits, case studies, Laboratory work, Roleplay, Surveys, Interviews and Project work, Campaigns, open forums, debate in offline mode, and Web/Computer Based Learning in online mode. To find the effect of Blended Learning, the Experimental cum survey method was used by the researcher. To identify the environmental and social attitudes, a survey method was used. A sample of 450 students for the survey method and a sample of 84 students for the experimental method of secondary schools of the district of Maharashtra were used by the researcher. A stratified random sampling technique was used by the researcher for the selection of the sample. The findings of the study revealed that Blended Learning presents a significant boost in the effectiveness of learning.

11. Naseerali, M. K. (2022) carried out a study to find the efficiency of the Blended Learning approach among secondary school students in the achievement of educational objectives. The study mainly aimed at analyzing the effectiveness of the Blended Learning Approach

in the achievement of educational objectives in Physics at the secondary level in comparison with that of the Scaffolding instructional approach. Station Rotation model using Classroom activities in offline mode and online E-learning activities synchronous and asynchronous like Animation Video, Recorded Video, and simulations were blended in the study. The study was quasi-experimental in nature with a pre-test post-test non-equivalent group design. A sample of 428 students was selected by using a Purposive sampling technique from five CBSE schools in the Malappuram district of Kerala state. The sample was divided into two groups, the Experimental group and the control group. Each group consists of 214 students. An achievement test in Physics and a Blended Learning Portal developed by the investigator were the tools used in the study. Data management software such as IBM Statistical Package for the Social Sciences (SPSS) and Google Sheets were used to perform the statistical analysis of the data. Based on the findings, it was concluded that the blended Learning Approach is an effective method for facilitating learning in Physics at the secondary level of education.

12. Neetika (2021) analyzed the effect of Blended Learning on adolescents' academic performance motivation and course satisfaction in science. The study was carried out to investigate the effect of blended learning on adolescents' academic performance, motivation, and course satisfaction in science. The researcher used the Blended Learning Program: 7-E's Learning Cycle model in the research. Blending was through the 7 Es of Blended Learning in the form of online videos, PowerPoint presentations, and classroom activities. The study was experimental in nature with a pre-test post-test control group design employed. 80 adolescents selected by using a Random sampling technique from a private senior secondary school formed the sample of the study which was divided into experimental and control groups. The experimental and control group consisted of 40 students each. The tools for data collection used by the researcher were the Academic Performance Test,

Academic Motivation Scale, and Course Satisfaction Scale. The data was analyzed by using Descriptive statistical techniques like measures of central tendencies mean, median, standard deviation, Skewness, and Kurtosis. Inferential statistical techniques Levene's test for equality of variances and 2X2 ANOVA were used. The results of the study revealed that the students taught through the blended learning method displayed superior performance in science as compared to the students taught through the conventional method. The findings showed that the Blended Learning Strategies proved effective and valuable in promoting the Academic Performance, Motivation, and Course satisfaction of 9th-grade adolescents in science.

13. S, Sripriya. (2022) investigated the effectiveness of the Blended Learning method in learning the chemistry periodic table among tenth-standard students. This research investigated the efficacy of adopting a Blended Learning technique in learning chemistry (Periodic Table) among tenth-grade students. The website for BLM was designed and developed with the help of application software, allowing the displaying of a variety of information related to Chemistry (Periodic Table) in one place including short learning modules, animated topics, mind maps, tests, quizzes, etc. and constructivist methods in a blended manner. The quasi-experimental method was used in the research. 184 tenth-grade students selected by using a Random sampling technique formed the sample of the study. The investigator adopted a Parallel Group Design with a Control group and an Experimental group. The experimental group was taught using the Blended Learning Method (BLM) and the control group was taught using the conventional instructional method. Data was gathered by using a Criterion-referenced test (CRT) on chemistry (Periodic Table), Science interest scale, Attitude towards Science scale, and Personal data sheet. ASSURE model was adopted for developing a Blended Learning Program. Tests of significance like t-test and F-test were employed to analyze the data in the study. The findings of the study revealed that the

performance of students taught using Blended Learning was higher than those taught using the traditional approach.

14. Selvakumar, S (2019) attempted to study the effectiveness of Blended Learning Strategies in learning physics at a higher secondary level. The main objectives of the study were to develop Blended Learning Strategies in physics at a higher secondary level and to study the effectiveness of Blended Learning Strategies in learning physics at a higher secondary level. Blended learning was in the form of a combination of the conventional and the synchronous online learning method in the face-to-face mode, where students have to attend lectures in the classroom and also learn through the synchronous and asynchronous approach. The model used in the research was the face-to-face model. Experimental method with Randomized Groups – Pre-test, Post-test Design was employed in the study. By simple random sampling technique, the subjects were allotted to experimental and control groups. 30 students from one school formed the experimental group and 30 students from other schools formed the control group. The Experimental group was taught using Blended Learning Strategies while the control group was taught using the Conventional lecture method. Data gathering tools used in the study were the Achievement test and Interview schedule. Analysis of the data was done by using Mean, Standard Deviation, and Percentage analysis, 't' tests, Gap closure, and Effect size Percentage Analysis. Based on the findings, the researcher concluded that Blended Learning Strategies improved the achievement level of learners in physics at the Higher Secondary level.

15. Vahora, Samir. A. (2020) investigated the effectiveness of the Blended Learning program on achievement in chemistry in class IX. The important objective of the study was to compare the effectiveness of the blended learning program and traditional teaching on the achievement of chemistry in class IX. The Educational Technology and Management Academy (ETMA) design template was used by the researcher in the development of the

Blended Learning Programme (BLP). Self-learning, Collaborative learning, experimentation, Group work, Buzzing Demonstration, Illustration, Brainstorming, Questioning, group discussion, Lecture, and E-content were used in a blended manner. The study was experimental in nature. A randomized Experimental group-control group Post-test Design was used in the research.100 IX grade students formed the sample of the study. The sampling technique was simple and random. The students in the sample were divided into two equal groups. One group was called as Experimental group and the other as control group. The students of the experimental group were taught by blended learning program and the students of the control group were taught by traditional teaching. Achievement test was used for selected topics of chemistry for class-IX students. The 't' test was used for data analysis. The results concluded that the students of the experimental group used higher-order thinking skills and hence proved that the effectiveness of Blended Learning program was more effective than the traditional teaching.

2.5 STUDIES RELATED TO BLENDED LEARNING AND ACADEMIC ACHIEVEMENT IN SCIENCE CONDUCTED OUTSIDE OF INDIA

1. Almasaeid, T. F. (2014) investigated the effect of using a Blended Learning Strategy on achievement and attitudes in teaching science among 9th-grade students. The purpose of the study was to recognize the impact of teaching science using Blended Learning Strategies on achievement and attitudes. Forty-five 9th-grade students from one of the schools in the Dubai Educational zone in the first semester of the year 2013/2014 were the sample. Images, sounds, video clips, sound effects, and text together were used as Blended Learning Strategies for the designed class. Achievement test was administered before and after applying the educational program. To measure student's attitudes tests and a questionnaire was prepared. Data Analysis was done by using analysis of covariance (ANCOVA) along

with analysis of variance (ANOVA). The study showed a positive impact on achievement skills and attitudes of 9th-grade students in science.

2. Alsalhi, et. al. (2019) examined the effects of Blended learning on ninth-grade students' achievement in science and their attitudes towards using it in the intermediate stage, in the United Arab Emirates. The computerized educational program, an online learning platform through which activities were implemented online, PowerPoint presentations, illustrations, animations, and other relevant video clips were uploaded in online mode, and lectures, explanations, and experiments were conducted in a Blended manner. A quasi-experimental design case was used to conduct the study. 112 students were the participants in the study. 112 students were divided into two groups one experimental group and the other a control group. To confirm the study's validity and reliability an achievement test and questionnaire were designed. The data was analyzed using SPSS. The findings of the study revealed that there were statistically significant differences between the experimental and the control groups, in favour of the experimental group. The experimental group's attitude was also more positive towards using Blended Learning.

3. Cracraft, L. (2015) carried out a study to find the impact of technology used in 5^{th} Grade Elementary school students through the Blended Learning model. The study intended to see if student achievement improved with the addition of blended learning into everyday classroom teaching. A Chrome Book to make use of as their gadget to support Blended Learning in the classroom was offered to teachers and students in the study. An experimental research method was used in the research. One classroom employed blended learning for a year and another traditional model. The data was collected and analyzed to see the effects on student achievement rates with blended learning and the traditional classroom. MAP data was collected from 5th-grade classrooms. The A t-test was administered and assessed to see

the likely consequence on student achievement with an added Blended Learning component. The research results revealed that there was not much significant difference between the achievement scores under both models.

4. Harahap, et. al. (2019) made an effort to study the impact of Blended Learning on Student's Achievement and Science Process Skills in the Plant Tissue Culture Course. The site utilized as learning media for this study in a blended learning class was developed using HTML, PHP, and JavaScript. Blending was with graphic media such as PowerPoint, books, and animation in online mode and Lecture and Discussion in offline mode. The quasi-experimental method was used by the researcher. The population of the study was all Semester VIII students of the biology education program. The sample of the study was two classes, chosen using the cluster random sampling technique. One class was taught using conventional learning strategy whereas the other class was taught using Blended Learning Strategy. It was concluded that the Blended Learning methodology is found significantly more efficient in improving students' achievement and science process skills in plant tissue culture courses as compared to the conventional learning methodology.

5. Kazu, et. al. (2014) compared the effect of the Blended Learning environment model on high school students' academic achievement. The objectives of the study were to compare two learning environments based on the academic achievement grades of the students in a Blended Learning environment and a traditional face-to-face learning environment and to assess the effectiveness of a blended learning environment in biology courses. Brainstorming, research-study learning method, question answer technique in offline mode and Web-based learning environment, and preparation of a blog page to provide for distance learning were used online mode. An experimental method was used for the research. The study was conducted with 54 twelfth-grade participants 19 males and 8 females for the

experiment group and 18 males and 9 females for the control group. The sample was chosen by Cluster random sampling technique. Web-based learning environment was used for the experimental group. The study revealed that the students who have studied in a Blended Learning environment are academically more successful than the students who have studied in a traditional learning environment.

6. Stockwell BR, et. al. (2015) conducted a study to find whether Blended Learning Improves Science Education. Altogether 111 students were enrolled in the study. A two-by-two study design was used in the study, in which the effects of both video versus textbook pre-class assignments and lecturing with instructor-demonstrated problems versus lecturing with student problem-solving in class were evaluated. The study suggests that a blended teaching approach, which uses video assignments in advance of each class to arouse interest in the topic and offer foundational knowledge, tied with lectures having in-class problem solving, was a more effective strategy for science education as compared with conventional approaches. It was important to note that video assignments did not improve student exam performance on their own but did increase attendance and satisfaction.

7. Yapici et. al. (2012) attempted to determine the effect of the Blended Learning model on high school students' biology achievement and their attitudes towards the internet. In the online mode, to create the online dimension of the blended learning environment, a website was designed by using MOODLE LMS wherein the students were given an assignment that they were supposed to search for before coming to the classroom. In the offline mode, assignments were presented and the subject was taught in the face-to-face setting via the question and answer and discussion methods. In the study, the pre-test-post-test control-group design was used. The study was carried out with 107 ninth-grade students for the academic year of 2009-2010. Groups were decided randomly. The experimental group was

taught using the Blended Learning model, while in the control group was taught using the traditional method. Data was collected by using an internet attitude scale and an achievement test. Data was analyzed by mean scores, independent ‘t’ tests, and paired samples ‘t’ tests were used. The research results showed that the Blended Learning model added more to the students' biology achievement as compared to conventional methods of teaching and that the students developed statistically significant attitudes toward the Internet.

2.6 STUDIES RELATED TO THE PERCEPTION OF BLENDED LEARNING CONDUCTED IN INDIA

1. Alekya Ch (2018) attempted to study the perception of the Blended Learning approach among English language teachers in secondary schools of north coastal districts of Andhra Pradesh. One of the objectives of the study was to probe into the Perception of Secondary School English Teachers towards the introduction of the Blended Learning Approach. The sample randomly selected for the research consisted of 750 Secondary School English Language Teachers of the North Coastal Districts of Andhra Pradesh. Teacher Perception towards the Blended Learning scale was the tool used by the researcher. The analysis of the research was done by using Means, Standard Deviations, and Pearson’s Product Moment Correlations. The findings of the research revealed a positive effect on perception towards the Blended Learning approach among English language teachers in secondary schools of north coastal districts of Andhra Pradesh.

2. Maria Josephine (2016) studied the effectiveness of a Blended Learning Programme on Academic Achievement in the Teaching of Physical Science among Student Teachers of Puducherry. One of the objectives of the study was to study the perception of student teachers towards the Blended Learning Programme in both experimental and control groups before and after implementation of the Blended Learning Programme concerning the i)

General ii) Interactivity iii) Knowledge Creation iv) Content v) Technology benefit vi) Satisfaction All activities like video conferencing technique, PowerPoint presentation, video presentation, action planning, and reflection method were uploaded on learning Platform EDMODO in Online Mode and brainstorming method, team teaching method, discussion, small group discussion, debate, Lecture Method were used Offline mode. Data was analyzed quantitatively and qualitatively using Mixed method research for quantitative research the quasi-experimental approach was used. A purposive sampling technique was employed in the research. Two groups, the experimental group and the control group taken as intact groups were assigned as the participants of the study. The intact group of 29 student teachers from one College of education was considered the experimental group, whereas the intact group of 24 student teachers from another College of education was considered the control group. The teaching of physical science paper for the experimental group was taught using a Blended learning program, whereas the Conventional method of teaching was used to teach the same paper for the control group. The Intervention program lasted for eight weeks. Tools used in the research by the researcher were teacher-made achievement tests in the teaching of physical science and students' Perception scale on the Blended Learning Program. Data Analysis was done by using both descriptive and inferential techniques. Descriptive statistics such as mean and standard deviation were used whereas inferential statistics technique includes t-test, Wilcoxon Sign Rank test, and Mann Whitney U test. For the quantitative analysis of data, Statistical Package for Social Sciences (SPSS 19.0) was used. The findings of the study revealed that students in the experimental group had a high perception of the Blended Learning Programme compared to that of the control group.

3. Nita Devi (2022) researched to study the perceptions of teachers and students regarding Blended Learning based on Learning Styles of Secondary Schools in Jammu District. A quantitative research approach was used in the research. The sample of the study was

selected by using the Stratified Random Sampling technique. 54 teachers and 648 ninth-grade students formed the study sample. Tools used in the research were a Learning Style Inventory and Questionnaires. Analysis of data was done by using statistical techniques like Mean, Quartiles, t-test, and ANOVA. Results of the study showed that the secondary school teachers and students had positive perceptions regarding Blended Learning. Both teachers and students have shown a leaning toward the Blended Learning approach. The findings of the study also showed that the male teachers were found to have added encouraging perceptions of Blended Learning than the female teachers. Female teachers showed less motivation for the implementation of the Blended Learning approach. The study also showed that Blended Learning has an optimistic impact on the academic achievement of the students.

4. Smita Tanwar (2022) compared the effectiveness of Blended Learning with traditional teaching methods. One of the key objectives was to explore students' perceptions of Blended Learning. The Blended Learning strategies employed in the study included the use of online resources, videos, PowerPoint presentations, and teacher-guided discussions. The research followed an experimental method with a pre-test and post-test design. The study sample consisted of 80 students from two different schools, divided into an experimental group, which received instruction through Blended Learning, and a control group, which was taught using traditional methods. Data collection tools included an achievement test for class VIII Civics and a perception scale for both teachers and students regarding Blended Learning. Data analysis involved the use of Mean, Standard Deviation, and t-tests. The results showed that students in the Blended Learning group outperformed those in the traditional teaching group. Additionally, students developed a more positive perception of Blended Learning when taught using these strategies

2.7 STUDIES RELATED TO THE PERCEPTION OF BLENDED LEARNING CONDUCTED OUTSIDE OF INDIA

1. Chen and Jones (2007) compared Blended Learning Vs. traditional classroom settings. The objectives of the study were to compare students' assessments of course effectiveness and overall satisfaction with the course. The blended Learning section group received instruction in online mode, but in which students met in class on a limited number of occasions, whereas the other group received traditional teaching. A survey method was used in the study. Results of the research revealed that the overall perceptions of the course, instructor, and learning outcomes were positive for both groups.

2. Farmer, R. G. (2009) investigated the effectiveness of a wiki as an online collaborative learning tool within a face-to-face course in higher education, and evaluated the usage of a wiki, as an efficient OCC device in comparison to erstwhile collaborative ways, within a constructivist supported team collaborative learning project set in an IT Course of first-year university. Group reports were prepared either by utilizing the wiki or other collaborative means by the smaller groups of students. Students' learning outcomes were evaluated for effectiveness and knowledge creation. The study also assessed students' interaction within their teams and concerning the collaborative learning experience examined students' perceptions. For the three perception variables, a hierarchical multiple linear regression was performed. Statistical significance was shown only for Technology Benefits as one perception factor. An assessment of the individuals concluded that prior computer awareness was a noteworthy interpreter of students' perception of technology benefits. The analysis of student perceptions toward the collaborative learning experience showed a mean score for each factor that leans toward the "agree" side. This study did not reveal any significant difference between wiki and non-wiki groups as to students' perception.

3. Graham, C. R., & Robison, R. (2007) conducted a study to understand faculty experience in designing and teaching Blended Learning courses at Brigham Young University The purpose of this qualitative study was to understand the teachers' skill in designing and training Blended Learning courses at Brigham Young University (BYU). 10 teachers who had notable experiences with blended learning methodology were presented with a series of open questions in the first stage of the study. More effective use of classroom time, increased flexibility in meeting time constraints of both student and professor and greater ability to meet the needs of individual students were three major benefits from the blended learning experience that were shown as the perception of the faculty through interview. The main apprehension raised in the interviews were questionable course rigidity, student self-selection procedure, technological support, organizational encouragement, and computer user-friendliness.

4. Ja'ashan, M. M. N. H. (2015) studied Perceptions and Attitudes towards Blended Learning of the Students at the University of Bisha for English Courses. The important objective of the study was to identify the perceptions of the students towards blended learning of English courses. The survey method was used in the research to gather data information. 130 students formed the sample of the study. A simple random sampling technique was used in the study. A questionnaire was used to collect the data in the study. This study concluded that the student’s perceptions of Blended Learning were positive in terms of the three domains in the questionnaire.

5. Sun, Z. Et.al. (2017) in their study exploring the collaborative learning effect in Blended Learning environments investigated the social interactive network of students, level of knowledge building, and perception level of usefulness in online and mobile collaborative learning environments in higher education. The experimental method was used in the research. Seventy-eight college students majoring in information engineering participated

formed the sample in the experiment. Social media messaging app WeChat and Learning management system MOODLE were used as mobile and online collaborative learning settings. The following results were found by mixing methods of social network analysis, content analysis, and questionnaire: (1) the collaborative social networks generated in this study showed that students had tighter interaction relationships in MOODLE than in WeChat; (2) deeper level of knowledge building in collaboration and interaction through MOODLE than WeChat was observed; and (3) MOODLE got higher perception level than WeChat because of its usefulness for collaboration.

2.8 STUDIES RELATED TO ATTITUDE TOWARDS BLENDED LEARNING CONDUCTED IN INDIA

1. Alekya Ch (2018) studied the attitude and perception towards the Blended Learning approach among English language teachers in secondary schools of north coastal districts of Andhra Pradesh. One of the objectives of the study was to probe into the Attitude of Secondary School English Teachers toward the introduction of the Blended Learning Approach. The sample selected for the research consisted of 750 Secondary School English Language Teachers of the North Coastal Districts of Andhra Pradesh. The sampling technique was the simple random sampling technique. The tool used by the researcher was the Teacher Attitude Towards Blended Learning Scale. The analysis of the research was done by using Means, Standard Deviations, and Pearson's Product Moment Correlations. The findings of the research revealed a positive effect on attitudes towards the Blended Learning approach among English language teachers in secondary schools of north coastal districts of Andhra Pradesh.

2. ALICE ABRAHAM CHACKO (2019) studied the communication skills of secondary students concerning their attitude toward Blended Learning and academic achievement. The objectives of the study were to study the favourable or unfavourable attitudes towards

blended learning of the students and to study the level of academic achievement of the students. A quantitative paradigm was selected for the study by the researcher. 894 school students studying in higher secondary schools situated in the Union Territory of Puducherry, India formed the sample of the study. Data was collected by using the normative survey method in the study by the researcher. The tools used by the researcher in the study were the Communication Skills Scale, Attitude Towards Blended Learning Scale, and Academic Achievement Test. Data Analysis was done by using the test of significance ('t'- test), and correlation coefficient ('r'- test). The study revealed that the student shows a neutral attitude towards Blended Learning.

3. Pattabiraman R (2023) identified higher secondary students' attitudes towards Blended Learning concerning Blended Learning interests and environment. One of the objectives of the study was to study the favourableness or unfavourableness attitude towards Blended Learning of higher secondary students. A normative survey method was employed in the study. 702 students studying in the higher secondary schools situated in Kanchipuram district of Tamilnadu, India formed the sample of the study. The sample selection was done using the Purposive sampling technique. Attitude towards blended learning scale was used as a tool by the researcher. The test of significance ('t'- test) was used to find out the significance of the difference between the means of the attitude towards blended learning scores. The study revealed that higher secondary school students had having neutral Attitude towards Blended Learning.

2.9 STUDIES RELATED TO THE ATTITUDE OF BLENDED LEARNING CONDUCTED OUTSIDE OF INDIA

1. Alseweed (2013) investigated the attitude of the students toward using conventional learning, Blended Learning, and virtual class learning at the university level. The results of

the study reveal that there is a significant difference in students' attitudes in favour of Blended Learning.

2. Fakhir, Z., & Ibrahim, M. (2018) conducted a study on how effective Blended Learning is when implemented in a class of grade 6 students being taught English. The major objective was to identify the effect of Blended Learning on the achievement of students and to analyze attitudes towards implementing Blended Learning in the sixth-grade students enrolled in private primary schools of Amman/Jordan. The study was quasi-experimental. The sample of the study was comprised of 50 female students selected from two schools selected purposively. PowerPoint slides, flashcards, computers, data shows, and resources were adopted as Blended Learning material in online mode whereas face-to-face meetings with the instructor were included as offline activities. Data for the study was collected using the Achievement test and attitude scale. The results revealed that blended learning was an effective strategy for teaching English to grade 6 students and had a positive effect on the attitudes of the sixth-grade students towards Blended Learning.

3. Ja'ashan, M. M. N. H. (2015) in the case study conducted at the University of Bisha studied students' perceptions and attitudes towards Blended Learning for English Courses. The main purpose of the study was to recognize the attitude of the students towards blended learning of English courses. The survey method was used in the research to gather data information. 130 students formed the sample of the study. The simple random sampling technique was used in the study for sample selection. The data was collected using a Questionnaire. The findings of the study revealed a positive attitude of students towards Blended Learning in terms of the three domains in the questionnaire.

4. Najeh Rajeh Alsalhi, et. al (2019) Investigated the effects of Blended Learning on ninth-grade students' attitudes toward using it. One of the objectives of the study was to examine

the attitudes of ninth-grade students in the intermediate stage, United Arab Emirates. A quasi-experimental design was used in the research. 112 participants in the study were divided into an experimental group and a control group. The computerized educational program, an online learning platform through which activities were implemented online, PowerPoint presentations, illustrations, animations, and other relevant video clips were uploaded in online mode, and lectures, explanations, and experiments were conducted in a Blended manner. The findings of the study revealed that the experimental group's attitude was more positive towards using Blended Learning.

5. Zhu, Au & Yates (2013) studied University students' attitudes toward online learning in a Blended Learning environment. 120 student teachers formed the study sample. Blending was between traditional modes of teaching, like lectures and tutorials, and online learning, like online course materials, participation in online forums, blogs, and wikis, communication through email, and application of online learning tools. The pre-and post-test and course participation (developed from the data of the students' weekly reports and online forum transcripts) were included in Phase One and interviews were included in Phase Two. At the end of the course, the students were found out to be more positive toward online learning.

2.10 SUMMARY OF THE REVIEW RELATED TO BLENDED LEARNING CONDUCTED IN INDIA

The review of the research studies showed the blending of various online learning technologies like a combination of Web-based online self-interactive learning, Online live interactions, development of Class Website on Google Sites, Screen-o-Caste, Presentation Tube, U-Tube, PowerPoint Presentations, Google Class Room, WhatsApp Group, Skype, Video Lesson Package, Computer-assisted Instruction with CD ROM Blogs, Podcasts, PPT Voice over etc. with various methods of teaching like Lecture method, Lecture cum

demonstration method, Project method, Group projects, Discussion method. The reviews also show researchers using different models of Blended Learning like the Station rotation model, Lab rotation model Flipped classroom model, and MOODLE. There was a blending of audio-video and Online clippings, interactive educational CDs, video conferencing techniques, student forum and e-content Web/Computer Learning, lab activities, demonstration-based activities, SLM, TLM, Debates, discussion blended with other face-to-face teaching methods.

The findings from the above studies show that Blended Learning is effective, interesting, and offers better satisfaction to the learners. It helps in the improvement of cognitive absorption, behavioural intention, and academic achievement and is a superior method for creative thinking to a conventional method. It has a positive impact in terms of attitude towards Blended Learning of the students. It helps reduce academic anxiety concerning self-efficacy. A more positive perception of the Blended Learning method is observed. Learning Environmental Education is more effective. The conceptual understanding, written expressions, as well as achievement of the students get better because of the blended learning approach. There is a positive effect of Blended Learning on critical thinking, problem-solving, science process skills, achieving the educational goals, and satisfaction of the students. It is also helpful in immediate learning and retention.

As far as the science subjects are concerned it was found that the Blended Learning Approach is an effective method for facilitating learning in Physics at the secondary level, improving the achievement of the students in physical science, having an optimistic impact on students' critical thinking, problem-solving, science process skills and achievement. Attitude toward Physics was encouraging and students performed better when they were taught with blended mode.

In the context of perception, it was found that students in the experimental group developed a high perception of the Blended Learning Programme. A positive effect on the perception of the blended learning approach was seen. The same was the case with the attitude towards the blended learning approach, which was positive. However, some incidents of neutral attitude towards the blended learning approach among secondary school and higher secondary school students were also observed.

2.11 SUMMARY OF THE REVIEW RELATED TO BLENDED LEARNING CONDUCTED OUTSIDE OF INDIA

Research studies conducted outside India show a variety of modes like enriched web technologies (such as video conferences, Learning Management Systems, Discussion blogs, etc.), PowerPoint slides, flashcards, computers, Handout before the class, virtual classrooms, online learning platform group presentations, lectures, tutorial, explanations, and experiments, Discussion, Brainstorming, research-study learning method, question answer technique and problem-solving using Flipped Classroom, MOODLE blended with face–to–face teaching methods.

The conclusions drawn were, that Blended Learning is valuable and effectual. It has an average level of effectiveness related to students' motivation, students' collaboration, and communication. It was found to be more effective than the Conventional method in terms of achievement and the improvement of verbal creative thinking skills. MOODLE is valuable for student independence and learning outcomes. It has a positive effect on the learning outcomes in a blended environment. There is an increase in self-directed learning skills. Some cases showed increased vigor, enthusiasm, autonomy, and student learning outcomes, especially in analyzing discourse after the appliance of the MOODLE-based blended learning method.

The studies have shown a profound impact on academic achievement in science education. Blended learning not only supplements academic achievement but also fosters the development of essential scientific skills and competencies like students' science process skills.

It has a positive impact on attitudes. There was a significant difference in students' attitudes in favour of Blended Learning which boosted their attitudes toward studying. A positive impact on the attitude of social media support was developed. The attitude of students in general is in favour of Blended Learning. The positive effect on the attitudes towards Blended Learning is found in sixth, ninth, and even university students.

A positive perception of Blended Learning was the result. It is a more effective strategy for science education. Video assignments increased attendance and satisfaction. MOODLE creates a higher perception level.

2.12 RESEARCH GAP

Subject Area

Although Blended Learning has been popular for about a decade, investigators still find Blended Learning to be a complex concept that requires further investigation regardless of the subject.

Although there are several studies on Blended Learning from different subject areas, still it can be presumed that more research should be conducted to investigate how Blended Learning is conducted in other subject areas that are considered decisive for students' performance assessment. This could help investigators and educators to evaluate the different Blended Learning designs and assessment approaches in various subjects.

Participants

Most of the studies targeted students as stakeholders (Higher Education followed by Primary Secondary, Higher secondary teacher education, and Health) and neglected key actors for Blended Learning adoption, such as policymakers, administrators, principals, Etc. So, more research should be conducted to strap up the influence of Blended Learning on major actors.

Learning Models

Teachers have limited knowledge about Blended Learning models and that is the reason teachers always face challenges on how to design Blended Learning Strategies in online and offline settings. Therefore, more research needs to be conducted by employing various Blended Learning models like the flipped Classroom model, Station rotation model, Flex Model, and A la Carte model. The study can be also conducted by applying mixed models.

Technology

The different technologies used and the intervention to design the online and offline versions of each Blended Learning Model. The review showed that the use of MOODLE (8 studies) and EDMODO (1 study) as a learning management system had a positive response from the students.

Outcome

The two categories of outcomes are psychological and behavioural outcomes. The psychological outcome includes students' self-regulation toward learning, satisfaction, and engagement, self-regulation, including authenticity, personalization, learner control, scaffolding, and interaction. The most investigated behavioural outcome is academic performance. Behavioural Outcome also includes skill progression and cooperation. There is scope to investigate more than one type of outcome.

Issues

Issues include lack of ICT skills, infrastructure issues such as internet-related problems and lack of personal computers, course preparation time, design model and cost of technologies and course quality content, student engagement, and student isolation. Teachers' difficulties in the ease of use of some technologies while creating a Blended Learning course, such as in recording videos, uploading videos, and using online learning platforms. Also, students' technological complexity challenges, such as accessing online educational resources or uploading their materials to the online learning environment. ICT infrastructure is also a crucial layer, such as a lack of basic technologies, including the internet, computers, and projectors, which can limit the implementation of Blended Learning courses. The above-mentioned issues can be investigated.

Context

It is known that the accomplishment of any innovation depends upon the context in which it is implemented. The introduction and transfer of successful innovation from one country to another, one society to another, and one institution to another depends upon multiplicity and diversity of contextual factors. If we have to implement Blended Learning instruction in our schools, we must have a thorough understanding of the existing context.

But despite this, not many studies have been conducted on Blended Learning in India. Moreover, none of the studies on Blended Learning have been conducted in the state of Goa. Blended Learning has still not become a common instructional strategy in science in our country. This might be because teachers don't have appropriate awareness regarding Blended Learning and its execution in the classroom. This necessitates much research on Blended Learning in the state of Goa.

Blending of Online and Offline modes

The review of all the studies show blending of various online learning technologies like a combination of web-based online self-interactive learning, online live interactions, Development of Class Website on Google Sites , Screen-o-Caste, Presentation Tube, U-Tube, Power Point Teaching, Google Class Room, WhatsApp Group, Skype, Video Lesson Package, Computer assisted Instruction with CD ROM Blogs, Podcasts, PPT Voice over enriched web technologies (such as video-conference, Learning Management System, Discussion blogs, etc.) ,, flash cards, computer, Handout before the class, virtual classroom, online learning platform MS word documents, PDF documents, audio clippings, video clippings and online test components, Online Clippings ,interactive educational CDs, Various texts, animations, videos and links to different websites, video conferencing technique, animations, students forum and e-content Web/Computer Based Learning Images, sounds, text, illustration, Chrome Book graphic media, Web based learning environment, and blog page etc. with various methods of teaching like lecture method, Lecture cum demonstration method, project method, group projects, discussion method. Face-to-face, lab activities, Demonstration activities, Teaching in the classroom, Games, SLM, TLM, Debates, Discussion, Lecturing and Projects, group assignments, group projects and group demonstrations, brainstorming methods, team teaching methods, Field visits, case studies, Laboratory work, Roleplay, Surveys, Interviews and Project work, Campaigns, open forum lectures, explanations, and experiments, research-study learning method, question answer technique and problem-solving (offline mode).

As far as the researcher's knowledge is concerned none of the studies under reference are conducted by blending Lesson videos, Discussion Forum, Chat, and quizzes in online mode with the Discussion method, learning by doing method, survey integrated with the

discussion method, and case study method in offline mode using flipped classroom model of Blended Learning through MOODLE as a Learning Management System.

This helped the researcher to study the effectiveness of Blended Learning Strategies on academic achievement of VIII grade students in science using MOODLE as a Learning Management system in the State of Goa.

This chapter helped well to comprehend the research problem, identify the research gap, formulate objectives, frame hypotheses inside the conceptual framework, and plan the methodology for the study.

CHAPTER III

METHODOLOGY

3.1 INTRODUCTION

The present study aims to design and develop Blended Learning Strategies to study the effectiveness of Blended Learning Strategies on the academic achievement of grade VIII students in science by identifying suitable technology and pedagogical practices. This chapter presents the logical sequence that the researcher has followed to attain the essential data for the present study. The vital objective of this chapter is to present the method employed in the study, research Design of the study, population and sample of the study, sample and sampling technique used in the study, tools used for data collection in the study, construction and validation of research tools, experimentation and statistical technique used in the analysis of data in the research.

RESEARCH DESIGN

In the present study, the researcher wants to study the effect of Blended Learning Strategies on students' academic achievement. The main objective of the researcher is to know how the Blended Learning Strategies bring about a change in the academic achievement of the students. This means change in academic achievements is dependent on the Blended Learning Strategies. Hence, the academic achievement of students is the 'dependent variable', and the Blended Learning Strategy is the ‘independent variable’. However, it would be too ambitious to state that the findings of this research can be generalized at this stage because many more experiments and consistent efforts only will help in generalization. From the three categories of experimental design, namely experimental design, quasi-experimental design, and true experimental design, the researcher opted for true experimental design, where the pre-test- post-test equivalent groups design was adopted.

The two equivalent groups involved in the study were namely Experimental Group and the Control group. The experimental group was taught by using Blended Learning Strategies and the control group was taught by using conventional methods of teaching.

The independent variable in the study was Blended Learning Strategies; the dependent variables were Academic Achievement, perception of Blended Learning, and attitude towards Blended Learning of grade VIII students in science subjects. The controlled and intervening variables were previous achievements in science concepts, which are prerequisites for mastering the new topic, physical environment and environmental barriers, length of instruction, etc., and boredom, fatigue, excitement, and mood of the students in the situation, respectively.

3.2 POPULATION AND SAMPLE

The population in the present study refers to all grade VIII students of Pernem Taluka of North Goa District of the state of Goa. Pernem Taluka has approximately an area of 251.68 Sq. Kms. with 34 schools spread over the area. There are 28 aided Schools and 6 Government Schools. The total number of students in all these schools was 1112. Among these, 568 students were male, and 544 students were female. All the schools in the population follow the NCERT syllabus at the early secondary level.

3.2.1 SAMPLING

The sample for each stage of the study was drawn from 34 schools in Pernem Taluka. The study involved different samples for various stages, including a) the construction and validation of the achievement test, b) the design and development of Blended Learning Strategies, and c) the experimentation phase of the study.

a) **For the construction and validation of the achievement test:** The process involved two stages: a pilot study and the final administration. After the test was constructed and validated, it was administered to a different sample.

- The pilot study sample consisted of 25 students from one school, selected using a simple random sampling technique.
- The final administration sample comprised 96 students from three different schools which were not part of the pilot study. A cluster sampling technique was used for this stage.

b) **For the design and development of Blended Learning Strategies:** The sample for the pilot study included students from four different schools, which were separate from those used for the achievement test construction and validation. A cluster sampling technique was again used for selecting this sample

c) For Experimentation

It was observed that the socioeconomic status of all the students in the population selected was the same. The facilities like computers, internet, and projectors provided in the schools in Pernem Taluka were also similar. Thus, a total of 83 students of two divisions of grade VIII from one of the schools selected randomly from Pernem Taluka of the state of Goa were the sample for the present study. The students were divided into two equivalent groups by considering their scores in science subjects in the previous term. The number of students in the experimental group and control group were 41 and 42, respectively. Simple Random sampling techniques were used. Three students from the experimental group missed the Pre-test and post-test or did not attend the intervention program, and four students from the control group either missed the pre-test or post-test. The three students in the experimental group and four students in the control group were not included in the analysis and finally, a group of 76 students formed the sample. The experimental group consisted of 38 students and the control group consisted of 38 students. Thus, both groups were equal in all respects.

3.3 TOOLS FOR DATA COLLECTION

The tools used for data collection are of many types. They may be adopted, adapted, or developed by the researcher. In case the researcher develops the tool, it is mandatory to get it validated by the experts. Most of the tools have been developed to yield quantitative data. Based on the objectives of the study, the following tools are used by the researcher:

i) Achievement test for grade VIII students in science - Constructed and Standardised by the researcher.

ii) Students Perception Scale on Blended Learning by Robert G. Farmer (2009) - adapted and validated by the researcher.

iii) Students Attitude Scale Towards Blended Learning by Roland Birbal, et al. (2018) – adapted and validated by the researcher.

3.4 CONSTRUCTION AND VALIDATION OF ACHIEVEMENT TEST IN SCIENCE

The construction and validation of achievement tests in science play a decisive role in research by helping the assessment of interventions, guidelines, and things influencing science achievement, as well as adding to the progress of evaluation tools and informing educational practices. Achievement tests may be utilised to measure the effectiveness of educational interventions, such as new teaching techniques, curricular modifications, or educational programs designed and developed to enhance science learning outcomes. The impact of these interventions on students' knowledge and skills in science can be assessed by comparing Pre-test and Post-test scores.

The major steps of the construction of the achievement test are: -

- Planning of the achievement test
- Preparation of the achievement test

- Try out and Evaluation of the achievement test

Planning of Achievement tests in science involves careful consideration of learning objectives, content coverage, assessment formats, cognitive levels, item types, fairness and equity, and logistical consideration for the administration of tests such as scheduling, test administration procedure, and scoring to create valid, reliable, and meaningful assessment of students learning outcomes. To construct an achievement test in science, the researcher studied the reference material. A blueprint that ensures that the assessment is balanced, comprehensive, and aligned with the instructional goal was prepared by taking into account factors such as weightage to objectives, weightage to the content area, and weightage to forms of questions. The test was planned to measure the remembering, understanding, applying, analysing, and skills of the students.

The 'Delphi Technique' (Retrieved from an article by Ubaidullah, et. al, 2020).) was used to construct the achievement test. The different sources used for item development were textbooks, reference books, published question papers, question banks, and reputed standardised tests of achievement in science. Achievement test in science was constructed by considering six levels of cognitive learning of revised Bloom's taxonomy (Anderson and Krathwohl, 2001). Items were made to test the attainment of five learning objectives, namely remembering, understanding, applying, and analysing from the cognitive domain and skills from the psychomotor domain.

Conducting try-outs and evaluation of achievement tests in research is necessary for certifying the worth, quality, reliability, validity, and fairness of the evaluation tool, eventually enhancing the credibility and truthfulness of the research findings. Try-outs permit researchers to recognize and address any prejudices or unfairness in the test items.

This includes ensuring that the language, content, and format of the test are proper and handy to all test takers, regardless of their background or characteristics.

3.4.1 PURPOSE OF ACHIEVEMENT TEST IN SCIENCE

The purpose of writing achievement tests in science is to create meaningful insight into students' learning outcomes, enlighten evidence-based educational practices, and add to science education. By investigating students' performance on explicit test items, the researcher can recognise the strong points and flaws in students' understanding of the science topic. The purpose of achievement tests in science in the present study is to measure the extent to which the learners have acquired knowledge and understanding of scientific concepts, principles, and processes. To measure the extent to which the learner can apply the acquired knowledge and understanding, to analyse the given situation, and to assess the development of skills in the learner.

3.4.2 ITEM WRITING

Items are intended to cover a variety of topics and cognitive levels to present a complete evaluation of students' knowledge. Item writing makes certain that the tests sufficiently cover these outcomes and present convincing and consistent measures of student achievement. Item writing makes sure that the test items are allied with curriculum benchmarks and precisely evaluate student achievement, giving stakeholders trustworthy information about student performance and the efficiency of educational programs. Item writing involves cautious thought to the clarity, accuracy, and fairness of test items. Quality assurance processes help make certain that test items are free from prejudice and precisely measure the intentional content and skills. Content analysis was done to include all the types of items from the content of the subject matter under consideration. A pool of 193 items was made based on a grade VIII science textbook published by the Directorate of Education,

Govt of Goa. The items constructed were based on the objectives of remembering, understanding, applying, analysing, and skills. The items were of the type, Multiple choice, Fill in the blanks, Match the Pair, True or false, State, Name, Correlation (for 1 Mark Each), Write short answers (2 marks each), long answers question and Drawings (4 marks Each).

3.4.3 ITEM SELECTION

Item selection involves deciding items that correspond to a variety of difficulty levels, from easy to difficult. This allows for differentiation among students and gives a more precise measure of their capabilities. Comparing the difficulty levels also makes certain that the test is neither too easy nor too difficult for the target population. Choosing high-quality items is necessary for certifying the reliability and validity of the test. Items should be free from vagueness, prejudice, and mistakes and should precisely measure the intended content and skills. Item selection intends to make sure that the test is reasonable and unbiased for all students, regardless of background or demographic characteristics. This includes choosing items that are free from cultural or gender bias. For item selection, after the test was prepared, the test was given to the experts to find the relevance of the items. On receiving responses from the experts, 43 non-relevant items were removed from the test. These non-relevant items include Fill-in-the-blank-type questions, State, Name (for 1 Mark), write short answers questions (for 2 marks), and Long answers questions (for 4 Marks).

3.4.4 PILOT STUDY

The purpose of conducting a pilot study for an achievement test in science research is to consider the practicability and efficiency of the test before full-scale implementation. A pilot study is typically a small-scale version of the main study and serves several purposes. A pilot study allows the researcher to identify any logistical or technical issues with the administration process, such as timing constraints, ambiguous questions, etc, so that necessary adjustments and refinements to the test items, instructions, or scoring procedures

can be made to improve its overall quality and effectiveness. The pilot study was done on a small sample similar to the larger sample to be tested later. There were 150 items in the test for the pilot study. The test was personally administered to 25 students studying in grade VIII of one of the schools Pernem Taluka, to confirm the estimated time. Moreover, the ambiguous and similar items were also eliminated from the test. The school for the pilot study was selected by a simple random sampling technique.

3.4.5 ITEM ANALYSIS

Item analysis is a crucial step in evaluating the quality and effectiveness of test items in achievement tests, particularly to determine difficulty index and discriminating power. To analyse items and evaluate the test, the researcher prepared a blueprint for the test before constructing the achievement test in science. (***Appendix- 1***.)

The achievement test in science for item analysis consisted of 127 items for 138 marks. Achievement test in science before item analysis is given in ***Appendix- 2.***

It was administered to 96 students from three different schools selected from Pernem Taluka. A cluster sampling technique was used. The test was scored as per the scoring key prepared by the researcher. (***Appendix 3.)***

3.4.5.1 DIFFICULTY INDEX

Finding the difficulty index facilitates recognising which test items are appropriately challenging for students based on their educational background. The information is helpful for researchers in deciding on test items that successfully measure students' mastery of science content without being too easy or too difficult. Test items that are constantly too easy or too difficult may not successfully measure students' knowledge and may need to be attuned to develop the whole quality of the evaluation. Test items with suitable difficulty levels add to the reliability and validity of the test results, presenting precise and significant information about students' achievement in science. According to (Kelly,1939) the ideal

range for the difficulty index of test items should be between 0.4 and 0.6. It is based on the principle that test items within this range are considered moderately difficult, meaning they are neither too easy nor too difficult for the intended population of test-takers.

Accordingly, the Difficulty Index (DI) of the items was decided upon, and the items were finalised.

3.4.5.2 DISCRIMINATIVE POWER

The purpose of finding the discriminating power of an achievement test in science is to measure the amount to which every test item efficiently differentiates between students of changing levels of knowledge. Assessing the discriminating power of test items helps to recognise which items efficiently discriminate between high-achieving students and low-achieving students. The discriminating power of test items serves as an indicator of the overall quality of the achievement test.

According to (Ebel & Frisbie,1986), the discriminating power of an excellent test item usually lies at 0.3 and above. Discriminating Power (DP) for each item was also calculated by the researcher and the items for the final test were finalised.

Table: - 3.1 Item analysis

Sr. No	ITEM No.	Difficulty Index	Discriminating Power	Item analysis
1	IA 1	0.7	0.16	Rejected
2	2	0.18	0.37	Rejected
3	3	0.08	0.08	Rejected
4	4	0.45	0.33	Accepted
5	5	0.6	0.41	Accepted
6	6	0.45	0.33	Accepted

7	7	0.47	0.37	Accepted
8	8	0.16	0.08	Accepted
9	9	0.54	0.33	Accepted
10	B 1	0.41	0.5	Accepted
11	2	0.54	0.33	Accepted
12	3	0.54	0.33	Accepted
13	4	0.58	0.5	Accepted
14	5	0.47	0.37	Accepted
15	C 1	0.08	0.08	Rejected
16	D a)	0.41	0.5	Accepted
17	b)	0.41	0.5	Accepted
18	c)	0.41	0.66	Accepted
19	d)	0.43	0.54	Accepted
20	E	0.54	0.66	Accepted
21	F 1	0.62	0	Rejected
22	2	0.2	0.25	Rejected
23	3	0.45	0.83	Accepted
24	4	0.56	0.33	Accepted
25	5	0.5	0.33	Accepted
26	6	0.47	0.45	Accepted
27	8	0.6	0.5	Accepted
28	9	0.45	0.33	Accepted
29	10	0.52	0.83	Accepted
30	G a)	0.41	0.33	Accepted
31	b)	0.43	0.45	Accepted

32	c)	0.41	0.5	Accepted
33	d)	0.41	0.83	Accepted
34	II A 1	0.41	0.5	Accepted
35	2	0.43	0.62	Accepted
36	3	0.18	0.29	Rejected
37	4	0.5	0.58	Accepted
38	5	0.12	0	Rejected
39	6	0.43	0.37	Accepted
40	7	0.12	0	Rejected
41	8	0.52	0.7	Accepted
42	9	0.41	0.83	Accepted
43	10	0.2	0.08	Rejected
44	B 1	0.45	0.33	Accepted
45	2	0.5	0.33	Accepted
46	3	0.43	0.37	Accepted
47	4	0.52	0.54	Accepted
48	C 1	0.06	0.04	Rejected
49	D a)	0.41	0.41	Accepted
50	b)	0.41	0.5	Accepted
51	c)	0.43	0.37	Accepted
52	d)	0.54	0.41	Accepted
53	E	0.41	0.33	Accepted
54	F 1	0.41	0.5	Accepted
55	2	0.54	0.62	Accepted
56	3	0.43	0.54	Accepted

57	4	0.45	0	Rejected
58	5	0.083	0.08	Rejected
59	6	0.43	0.33	Accepted
60	7	0.54	0.75	Accepted
61	9	0.41	0.41	Accepted
62	10	0.41	0.5	Accepted
63	G a)	0.22	0.29	Rejected
64	b)	0.06	-0.04	Rejected
65	c)	0.04	0.08	Rejected
66	d)	0.22	0.29	Rejected
67	H	0.47	0.62	Accepted
68	IIIA 1	0.58	0.33	Accepted
69	2	0.41	0.33	Accepted
70	3	0.41	0.58	Accepted
71	4	0.45	0.33	Accepted
72	5	0.45	0.33	Accepted
73	6	0.45	0.58	Accepted
74	7	0.41	0.375	Accepted
75	8	0.25	0	Rejected
76	9	0.14	-0.04	Rejected
77	B 1	0.43	0.45	Accepted
78	2	0.54	0.5	Accepted
79	3	0.56	0.45	Accepted
80	4	0.6	0.37	Accepted
81	5	0.52	0.291	Rejected

82	C 1	0.02	0.04	Rejected
83	2	0	0	Rejected
84	E	0.47	0.37	Accepted
85	F 1	0.5	0.33	Accepted
86	2	0.2	0.2	Rejected
87	3	0.5	0.33	Accepted
88	4	0.12	0.25	Rejected
89	5	0.47	0.54	Accepted
90	6	0.58	0.37	Accepted
91	7	0.16	0	Rejected
92	8	0.43	0.62	Accepted
93	9	0.22	0.04	Rejected
94	10	0.31	0.29	Accepted
95	G a)	0.31	0.54	Rejected
96	b)	0.25	0.25	Rejected
97	c)	0.37	0.41	Rejected
98	d)	0.33	0.25	Rejected
99	IV A 1	0.41	0.37	Accepted
100	2	0.5	0.33	Accepted
101	3	0.45	0.41	Accepted
102	4	0.41	0.33	Accepted
103	5	0.56	0.62	Accepted
104	6	0.14	0.04	Rejected
105	7	0.45	0.41	Accepted
106	8	0.41	0.75	Accepted

107	9	0.41	0.5	Accepted
108	10	0.2	0.33	Rejected
109	B 1	0.58	0.41	Accepted
110	2	0.52	0.45	Accepted
111	3	0.45	0.5	Accepted
112	4	0.52	0.45	Accepted
113	C 1	0.14	0.2	Rejected
114	D a)	0.52	0.45	Accepted
115	b)	0.41	0.41	Accepted
116	c)	0.5	0.41	Accepted
117	d)	0.45	0.58	Accepted
118	E 2	0.25	0.16	Rejected
119	3	0.45	0.66	Accepted
120	4	0.43	0.62	Accepted
121	5	0.47	0.54	Accepted
122	6	0.5	0.5	Accepted
123	7	0.5	0.41	Accepted
124	F a)	0.29	0.58	Rejected
125	b)	0.33	0.41	Rejected
126	c)	0.29	0.33	Rejected
127	d)	0.14	0.29	Rejected

3.4.6 ACHIEVEMENT TEST IN SCIENCE FOR FINAL ADMINISTRATION

The achievement test in science for final administration consisted of 88 items for 100 marks. The types of questions included in the test were Multiple choice questions, True or false questions, Match the pair questions (for 1 mark each), and Drawing questions (For 4 Marks each).

3.4.6.1 BLUEPRINT FOR ACHIEVEMENT TEST IN SCIENCE FOR FINAL ADMINISTRATION

The blueprint for achievement tests in science for final administration is as follows: -

1. WEIGHTAGE TO OBJECTIVES

Table 3.2: -Weightage to Objectives

Sr. No	Objectives	Marks	Percentage
1	Remembering	19	19
2	Understanding	42	42
3	Applying	07	07
4	Skills	16	16
5	Analysing	16	16
	Total	**100**	**100**

2. WEIGHTAGE TO THE CONTENT AREA

Table 3.3: Weightage to content area

Sr. No	Content	Marks	Percentage
1	Some Natural Phenomena	24	24
2	Light	25	25
3	Stars and Solar System	25	25
4	Pollution of air and Water	26	26
	Total	**100**	**100**

3. WEIGHTAGE TO FORMS OF QUESTIONS

Table 3.4: -Weightage to forms of question.

Sr. No	Forms of Question	Marks	Percentage
1	Objective	84	84
2	Skill (Drawing)	16	16
	Total	**100**	**100**

(Appendix ***4***)

3.4.7 VALIDITY OF THE ACHIEVEMENT TEST IN SCIENCE

The purpose of ensuring the validity of an achievement test in science is to certify that the test precisely measures what it meant to measure, which is usually the remembering, understanding, applying, analysing, and skills that students have acquired in the subject of

science. To validate the final version of the achievement test in science finalised using the 'Delphi Technique', and for further examination of the content, the test was again sent to 5 experts. Responses from the experts found the content of the test sufficient to find the effectiveness of Blended Learning Strategies on the Academic Achievement of grade VIII students in science. The final draft of the achievement test in science as a pre-test and post-test is given ***in Appendix 5.*** A fresh scoring key was prepared to score the test items. (***Appendix 6)***

3.4.8 RELIABILITY OF THE ACHIEVEMENT TEST IN SCIENCE

The purpose of assessing the reliability of the achievement test is to certify that the test constantly measures what it is intended to measure. Reliability testing helps to recognise any errors in the test that may influence the accuracy and validity of the results. It certifies that the test results are similar over time. Reliability testing also measures whether the test scores are reliable across diverse groups of students, such as varied demographic groups. Finding the reliability of an achievement test in science is necessary for certifying the excellence, validity, fairness, and comparability of the test results.

The reliability of the test was achieved by the split-half method by using the Spearman Coefficient correlation formula. Then, the correlation coefficient between the two halves of the students was calculated and found to be 0.89. Hence, the constructed achievement test was found to have adequate measures of reliability. The formula is as follows: -

$$\text{Reliability on full test} = \frac{2 \times \text{Reliability on } ½ \text{ test}}{1 + \text{Reliability on } ½ \text{ test}}$$

3.5 STUDENTS' PERCEPTION SCALE ON BLENDED LEARNING BY ROBERT G. FARMER (2009).

Perception scales are frequently utilised to assess the efficiency of interventions, programs, or policies. By determining participants' perceptions, researchers can measure changes in beliefs or behaviour that result from the intervention. This assessment helps determine whether the intervention attained its intended outcomes and offers precious feedback for program improvement or refinement.

A Perception scale by Robert G. Farmer (2009) was adapted for Blended Learning Strategy. It was validated by the experts and used to seek grade VIII students' perceptions of Blended Learning. There were 29 items in the students' perception scale with a five-point Likert type. Each statement was assigned weightage ranging from 1 as Strongly disagree, 2 as Disagree, 3 as Neutral, 4 as Agree, and 5 as Strongly agree. The tool with 29 items was presented to a panel of experts. The panel of experts was requested to give suggestions and comments on the structure and appropriateness of items. The panel scrutinised the tool and expressed satisfaction with its content. Some of the items were restructured and refined based on the suggestions of the experts. This perception scale was administered to grade VIII students of the experimental Group. (A***ppendix 7)***

3.6 STUDENTS' ATTITUDE SCALE TOWARDS BLENDED LEARNING BY ROLAND BIRBAL, et. al. (2018)

The key purpose of using an attitude scale toward Blended Learning is to measure students' acceptance and readiness to participate in the Blended Learning Program. This includes students' attitudes and beliefs regarding the combination of online and traditional face-to-face learning modalities. Understanding students' attitudes assists researchers in measuring

students' willingness to be involved with the Blended Learning format to adapt instructional strategies accordingly.

An Attitude scale by Roland Birbal et al. (2018) on Blended Learning Program was modified appropriately for use in the present study to seek grade VIII students' attitudes toward Blended Learning.

There were 24 items in the students' attitude scale with a five-point Likert type. Each statement was assigned weightage ranging from 1 as Strongly disagree, 2 as Disagree, 3 as Neutral, 4 as Agree, and 5 as Strongly agree. The tool with 24 items was presented to a panel of experts. The panel of experts was requested to give suggestions and comments on the structure and appropriateness of items. The panel scrutinised the tool and expressed satisfaction with its content. Some of the items were restructured and refined based on the suggestions of the experts. This attitude scale was administered to grade students of the experimental Group. (***Appendix 8)***

3.7 DEVELOPMENT OF BLENDED LEARNING STRATEGIES

Developing effective Blended Learning Strategies involves watchful planning, considerate integration of instructional modalities, concern for learner wants, and specific, measurable, achievable, and relevant objectives that are aligned with course goals, curriculum standards, and student requirements. It requires the identification of appropriate instructional materials, resources, and activities that align with learning objectives and meet varied learner desires, choosing a Blended Learning model that best fits instructional goals, content, and context. It also requires the selection of appropriate technology tools and platforms to support Blended Learning activities and make possible communication, collaboration, and content delivery, creating high-quality online content that is engaging, interactive, and reachable to learners and developing multimedia resources such as video lectures, podcasts, interactive

simulations, and online quizzes that meets diverse learning styles and preferences. It also includes designing interactive learning activities, discussions, and collaborative projects that promote active engagement and interaction among students and evaluating the effectiveness of Blended Learning Strategies in achieving learning objectives and meeting learner needs.

3.7.1 IDENTIFICATION OF SUITABLE TECHNOLOGY

The purpose of the identification of suitable technology for Blended Learning is to identify those technologies that maximise the educational experiences, improve learning outcomes, encourage involvement and interaction, contribute distinguishing instructions, facilitate resource use, promote wistful practice, and organise learners for accomplishment in the digital age. The technologies chosen should assist interactive, appealing, and tailored learning experiences that offer varied student wants and learning styles. It should support anytime, anywhere learning, allowing students to connect with study materials and team up with peers despite geographical or time restraints. It should help in various types of communication, group effort, and interaction, together with synchronous and asynchronous activities, discussions, group projects, and feedback mechanisms. It should rationalize course deliverance, organization, and supervision, as well as make possible well-organized evaluation, grading, and feedback procedures for teachers as well as permit teachers to modify teaching content, activities, and evaluation to individual learner wants, offering personalized learning ways as required.

Platforms like MOODLE, Canvas, Blackboard, or Google Classroom offer central hubs for organising course materials, assignments, quizzes, discussions, and grading. These platforms make communication between instructors and students easy and permit the delivery of multimedia content. Tools such as Zoom, Microsoft Teams, or Google Meet facilitate live virtual lectures, discussions, and office hours, encouraging synchronised

interaction between instructors and students. Platforms such as Slack, Microsoft Teams, or Discord make communication and collaboration among students easy, facilitating group projects, peer feedback, and informal discussions. They encourage a sense of community and promote active participation.

To identify the suitable technology to develop Blended Learning Strategies, the researcher reviewed the ten studies to find the effectiveness of Blended learning in academic achievement, perception, attitude, etc. From the review of these studies, it was found that MOODLE as a Learning Management System was successfully employed by the researchers of the studies.

The available various technologies (LMS) were also analyzed by the researcher by considering 1) the advantages of a user-friendly interface that is easy to navigate for both instructors and students, supporting multimedia content, discussion forums, assignment submissions, and grading, with clear instructions and the organization supports various types of content, including text, images, videos, audio files, presentations, and interactive multimedia. supporting diverse assessment methods, including quizzes, surveys, assignments, discussions, and peer reviews, and facilitating communication and collaboration among instructors and students through discussion forums, chat, messaging, announcements, and group workspaces 2) Disadvantages3) Deployment–like a desktop application, Mobile application, cloud-based 4) Type-Academic LMS or corporate LMS or Both5) Whom it is for – educators, teachers trainers or for business and6) Cost- with licensing fees or free or both. On analysing the available Technologies and reviewing the studies, the researcher selected MOODLE (LMS) for his study. (***Appendix 9 and 10***)

3.7.2 IDENTIFICATION OF SUITABLE PEDAGOGICAL PRACTICES.

The purpose of identifying suitable pedagogical practices for Blended Learning is to produce appealing, efficient, and comprehensive learning experiences that influence the benefits of both online and face-to-face instruction, support students 'achievement, and promote enduring learning skills.

The use of the flipped classroom model of Blended learning engages students with the course material before coming to class, which permits for more interactive and appealing face-to-face sessions focused on discussions, problem-solving, and application of knowledge. For interactive and engaging face-to-face sessions focussed on discussion problem solving, application of the knowledge, and to achieve the objectives of higher thought processes, the researcher decided to use the discussion method, learning by doing method, survey integrated with discussion method, and case study method.

Also, after reviewing the available studies on blended learning, it was found by the researcher that, none of the studies is conducted blending Lesson video, Discussion Forum, Chat, Quiz in online mode with discussion method, learning by doing method, survey integrated with discussion method and case study method in offline mode using flipped classroom model of Blended Learning. So, the researcher decided to blend lesson videos, discussion forums, chats, quiz in online mode with the discussion method, the learning-by-doing method, a survey integrated with the discussion method, and a case study method in offline mode. To develop Blended Learning Strategies the researcher analyzed a grade VIII science textbook published by the Directorate of Education, Govt of Goa. The researcher analyzed each concept from each chapter of the grade VIII science textbook for the consideration of various methods of teaching like discussion method, learning by doing, survey integrated with discussion method, case study method, etc. (***Appendix 11)***

3.7.3 SELECTION OF ASSURE MODEL

Several models were employed in the various studies like Al-Jazar Model used by Maria Josephine (2016), the Blended Learning design developed by Huang and Zhou (2005) used by Dhanya Krishnan (2011) and Rajani Gupta (2020), the Supplemental Model developed by Twigg (2003) and Program Flow Model developed by Bersin and Associates (2004) used by Pandey Archana (2023), Gilly Salmon's Five –stage model employed by Anju Arvind M (2019) for the development of Blended Learning Strategies.

The researcher followed the **ASSURE Model** developed by Heinrich and Molenda (1999). The reasons for selecting the ASSURE model by the researcher are as follows: -The ASSURE model can not only blend technology with conventional classroom teaching but also provide students with the modified experience they require to enlarge their views. ASSURE is a learner-centric instructional design model, wherein the learners are continuously being analyzed and well-studied. This facilitates continuing programs associated with learners' wants and makes certain that the content and objectives are constructive to learning. The ASSURE model is exclusive because it encourages planning and delivering learning materials through integrated technology and media. ASSURE Model promotes high interactivity, link, and support for students despite their location. Furthermore, the ASSURE model keeps a regular focus on students and the progress of defined learning objectives.

The six Stages involved in the ASSURE model for designing and developing Blended Learning Strategies are: -

A: Analyse Learner

S: State goals and objectives

S: Select Method and Media

U: Utilize Media and Technology

R: Require Learner Participation

E: Evaluate and Revise.

The Researcher used the ASSURE model to design and develop the following Blended Learning Strategies based on the above stages:

1. Learn at home, discuss at school
2. Learn at home, do it at school
3. Learn and survey at home, discuss at school
4. Learn at home, Discuss Cases at school

3.7.3.1 STRATEGY 1: LEARN AT HOME, DISCUSS AT SCHOOL

Blending between Lesson Videos through the MOODLE Platform (Online) and Discussion method (Offline)

A: Analysing Learner

Analysing the Learner stage includes recognition of students' hopes, targets, choices, and desires so that a Blended Learning Strategy can be produced that presents students with a valid world benefit. It includes identification of students' familiarity with technology in terms of mobile tablets or computers, Identification of students' previous knowledge of the matter to be taught, and identification of students' learning styles, whether students are inclined to like collaborative and group learning, prefer to learn to employ computers or other gadgets, like fun learning. It also includes the Identification of students' traits like whether students are used to learning alone, whether students are well-known with internet use, whether some students choose to study independently and some choose groups, whether students are still learning under the teacher's direction as a facilitator.

S: Stating goals and objectives

This stage includes the establishment of the objectives for Blended Learning Strategies, including performance goals. These goals and objectives should clearly state what the learner will be able to get out of the program once they complete the class. Objectives should be concrete, testable, and demonstrable. Objectives can be students will be able to state, define, name, list, explain, describe, and illustrate. Apply, analyze, etc.

One of the objectives of the study was to study the effectiveness of a Blended Learning Strategy on the academic achievement of grade VIII students in science. The following objectives can be formulated in behavioral terms as per Bloom's Taxonomy, to be achieved by the students.

Chapter of Science Textbook: -Some Natural Phenomena

The students will be able to remember, understand, apply, analyze, and develop skills about the following concepts: - Safety, finding a Safe Place, Do's and Don'ts during a Thunderstorm, Lightning Conductors, Earthquakes, Activity 1.5, What is an Earthquake? What Causes an Earthquake? Protection against Earthquakes.

Chapter of Science Textbook: - Light

The students will be able to remember, understand, apply, analyze, and develop skills about the following concepts: -Care of the Eyes, Visually Challenged persons can read and write, what is the Braille System?

Chapter of Science Textbook: - Stars and the Solar System

The students will be able to remember, understand, apply, analyze, and develop skills about the following concepts: -The Solar System, The Sun, The Planets, Activity 3.9, Activity 3.10, Some other Members of the Solar System, Asteroids, Comets. Meteors and Meteorites, Artificial Satellites.

Chapter of Science Textbook: - Pollution of Air and Water

The students will be able to remember, understand, apply, analyze, and develop skills about the following concepts: -Water Pollution, Activity 4.5, 4.7 How does Water get Polluted? Activity 4.6

S: Selection of Method and Media

This stage includes the selection of online learning content, multimedia, both online and classroom exercises, and materials that will give out teaching goals and objectives. This may also pertain to modifying current teaching content to meet the changing needs of the students. When deciding on methods and media, one should keep in mind how to adopt current learning materials into the desired format, who the learners are, and where the learners will learn from. Learning Methods or strategies could be based on Flipped Classroom.

Selection of Suitable Pedagogical Practice: The use of the flipped classroom model of Blended Learning engages students with the course material before coming to class, which permits for more interactive and appealing face-to-face sessions focused on discussions, problem-solving, and application of knowledge. For interactive and engaging face-to-face sessions focussed on discussion problem solving, application of the knowledge, and to achieve the objectives of higher thought processes, the researcher decided to use the discussion method, learning by doing method, survey integrated with discussion method, and case study method.

Also, after reviewing the available studies on blended learning, it was found by the researcher that none of the studies is conducted blending Lesson video, Discussion Forum, Chat, Quiz in online mode with discussion method, learning by doing method, survey integrated with discussion method and case study method in offline mode using flipped

classroom model of Blended Learning. So, the researcher decided to blend lesson videos, discussion forums, chats, quiz in online mode with the discussion method, the learning-by-doing method, a survey integrated with the discussion method, and the case study method in offline mode. To develop Blended Learning Strategies the researcher analyzed a grade VIII science textbook published by the Directorate of Education, Govt of Goa. The researcher analysed each concept from each chapter of the grade VIII science textbook for the consideration of various methods of teaching like discussion method, learning by doing, survey integrated with discussion method, case study method, etc. From these methods, the researcher selected the discussion method for the Blended Learning Strategy titled "**Learn at home, discuss at school".**

Selection of Suitable Technology:

The available various technologies (LMS) were analyzed by the researcher by considering 1) the advantages of a user-friendly interface that is easy to navigate for both instructors and students, supporting multimedia content, discussion forums, assignment submissions, and grading, with clear instructions and the organization supports various types of content, including text, images, videos, audio files, presentations, and interactive multimedia. supporting diverse assessment methods, including quizzes, surveys, assignments, discussions, peer reviews, and facilitating communication and collaboration among instructors and students through discussion forums, chat, messaging, announcements, and group workspaces 2) Disadvantages 3) Deployment–like desktop application, Mobile application, cloud-based 4) Type-Academic LMS or corporate LMS or Both 5) Whom it is for – educators, teachers trainers or for business and 6) Cost- with licensing fees or free or both. On analysing the available Technologies and reviewing the studies, the researcher selected MOODLE (Learning Management System) for his study. (www.udeshnatekar.com)

U: Utilization of Media and Technology

This stage in the ASSURE Model is concerned with how to make use of the identified suitable pedagogical practices and identified and selected technology efficiently. Lesson videos to be delivered to the students were prepared according to the syllabus and the lesson plans. With the aim that students could learn them outside the classroom independently, lesson Videos were uploaded on the MOODLE platform. Also, the researcher oriented students about the use of MOODLE so that students can easily access MOODLE at their own pace. Learners were prepared by explaining to them about learning outcomes. The students were given an understanding of how to learn using the flipped classroom method. Along with video presentations, collaborative activities were incorporated. Collaborative activities were in the form of group discussions, group projects, and group demonstrations. Even groups were encouraged to discuss the topic with the whole class by sharing their thought on the topic. Evaluation of the presentation of other groups was also done through collaborative efforts. The students were also provided a learning experience employing a discussion forum through MOODLE. Quizzes questions were used to get feedback from students about the topic. These quiz questions were asked after completing the topic to examine the understanding of students about the concept taught. Quiz questions were multiple choices, fill in the blanks and match the pair questions.

R: Required Learner Participation

Students were instructed to log into the MOODLE Platform through (www.udeshnatekar.com). So that the students could learn the subject matter outside of the classroom. Students were allowed to study according to their learning comfort conditions. Students were motivated to carry out discussions and upload the answers on the MOODLE platform to the question given by the teacher.

E: Evaluation and Revision of the Blended Learning Strategy

The Blended Learning Strategy was assessed utilizing field trials and was accordingly modified. At the end of each module, quizzes were provided to assess the effectiveness of the content taught. These questions were added to check the knowledge, and understanding of the students, to check how the students apply the acquired knowledge, and to analyze the given situation. The researcher provided remedies to students, whether online or face-to-face, to resolve the problems encountered by the students. The lesson plan for the Blended Learning Strategy "**Learn at home, discuss at school"** is attached as ***Appendix 12.***

3.7.3.2 STRATEGY 2: -LEARN AT HOME, DO IT AT SCHOOL

Blending between Lesson Videos through the MOODLE platform (Online) and learning by doing method (Offline)

A: Analyzing Learner

Analysing the Learner stage includes recognition of students' hopes, targets, choices, and desires so that a Blended Learning Strategy can be produced that presents students with a valid world benefit. It includes identification of students' familiarity with technology in terms of mobile tablets or computers, Identification of students' previous knowledge of the matter to be taught, identification of students' learning styles, whether students are inclined to like collaborative and group learning, prefer to learn to employ computers or other gadgets, like fun learning. It also includes the Identification of students' traits like whether students are used to learning alone, whether students are well-known with internet use, whether some students choose to study independently and some choose groups, whether students are still learning under the teacher's direction as a facilitator.

S: Stating goals and objectives

This stage includes the establishment of the objectives for Blended Learning Strategies, including performance goals. These goals and objectives should clearly state what the learner will be able to get out of the program once they complete the class. Objectives should be concrete, testable, and demonstrable. Objectives can be students will be able to state, define, name, list, explain, describe, and illustrate. apply, analyse, etc.

One of the objectives of the study was to study the effectiveness of a Blended Learning Strategy on the academic achievement of grade VIII students in science. The following objectives can be formulated in behavioural terms as per Bloom's Taxonomy, which is to be achieved by the students.

Chapter of Science Textbook: -Some Natural Phenomena

The students will be able to remember, understand, apply, analyze, and develop skills about the following concepts: -Lightning, Charging by Rubbing, Types of Charges and their Interaction, Activity 1.3, Transfer of Charge, Activity 1.4, The Story of Lightning,

Chapter of Science Textbook: - Light

The students will be able to remember, understand, apply, analyze, and develop skills about the following concepts: -What makes Things visible, Laws of Reflection, Activity 2.1, Activity 2.2, Activity 2.3, Regular and Diffused Reflection, Activity 2.4, Reflected light can be Again, Multiple Images Activity 2.5, Kaleidoscope, Activity 2.6, Activity 2.7, Sunlight & White or Coloured, 2.7 What is inside our eyes? Activity 2.8, Activity 2.9, Activity 2.10

Chapter of Science Textbook: - Stars and the Solar System

The students will be able to remember, understand, apply, analyze, and develop skills about the following concepts: -Moon, Activity 3.1Activity 3.2Activity 3.3The Moon Surface

Chapter of Science Textbook: - Pollution of Air and Water

The students will be able to remember, understand, apply, analyze, and develop skills in the following concepts: What is Potable water and how is water Purified? Activity 4.7, What Can be Done?

S: Selection of Method and Media

This stage includes the selection of online learning content, multimedia, both online and classroom exercises, and materials that will give out teaching goals and objectives. This may also pertain to modifying current teaching content to meet the changing needs of the students. When deciding on methods and media, one should keep in mind how to adopt current learning materials into the desired format, who the learners are, and where the learners will learn from. Learning Methods or strategies could be based on Flipped Classroom.

Selection of Suitable Pedagogical Practice: The use of the flipped classroom model of Blended Learning engages students with the course material before coming to class, which permits for more interactive and appealing face-to-face sessions focused on discussions, problem-solving, and application of knowledge. For interactive and engaging face-to-face sessions focussed on discussion problem solving, application of the knowledge and to achieve the objectives of higher thought processes the researcher decided to use discussion method, learning by doing method, survey integrated with discussion method, and case study method.

Also, after reviewing the available studies on blended learning, it was found by the researcher that, none of the studies is conducted blending Lesson videos, Discussion forums, Chat, Quizzes in online mode with discussion method, learning by doing method, surveys integrated with discussion method and case study method in offline mode using flipped classroom model of Blended Learning. So, the researcher decided to blend lesson videos,

discussion forums, chats, quiz in online mode with the discussion method, learning by-doing methods, the survey integrated with the discussion method, and the case study method in offline mode. To develop Blended Learning Strategies the researcher analyzed a grade VIII science textbook published by the Directorate of Education, Govt of Goa. The researcher analyzed each concept from each chapter of the grade VIII science textbook for the consideration of various methods of teaching like discussion method, learning by doing, survey integrated with discussion method, case study method, etc. From these methods, the researcher selected the learning-by-doing method for the Blended Learning Strategy titled "**Learn at home, do it at school".**

Selection of Suitable Technology: -The available various technologies (LMS) were analyzed by the researcher by considering 1) Advantages-like user-friendly interface that is easy to navigate for both instructors and students, supporting multimedia content, discussion forums, assignment submissions, and grading, with clear instructions and the organization supports various types of content, including text, images, videos, audio files, presentations, and interactive multimedia. supporting diverse assessment methods, including quizzes, surveys, assignments, discussions, and peer reviews, and facilitating communication and collaboration among instructors and students through discussion forums, chat, messaging, announcements, and group workspaces 2) Disadvantages 3) Deployment–like a desktop application, Mobile application, cloud-based 4) Type-Academic LMS or corporate LMS or Both 5) Whom it is for – educators, teachers trainers or for business and 6) Cost- with licensing fees or free or both. On analysing the available Technologies and reviewing the studies, the researcher selected MOODLE (Learning Management System) for his study. (www.udeshnatekar.com)

U: Utilization of Media and Technology

This stage in the ASSURE Model is concerned with how to make use of the identified suitable pedagogical practices and identified and selected technology efficiently. Lesson videos to be delivered to the students were prepared according to the syllabus and the lesson plans. With the aim that students could learn them outside the classroom independently, lesson Videos were uploaded on the MOODLE platform. Also, the researcher oriented students to the use of MOODLE so that students could easily access MOODLE at their own pace. Learners were prepared by explaining to them about learning outcomes. The students were given an understanding of how to learn using the flipped classroom method. Along with video presentations, collaborative activities were incorporated. Collaborative activities were in the form of group discussions, group projects, and group demonstrations. Even groups were encouraged to discuss the topic with the whole class by sharing their thought on the topic. Evaluation of the presentation of other groups was also done through collaborative efforts. The students were also provided learning experience utilizing a discussion forum through MOODLE. Quizzes questions were used to get feedback from students about the topic. These quiz questions were asked after completing the topic to examine the student's understanding of the concept taught. Quiz questions were multiple choices, fill in the blanks and match the pair questions.

R: Required Learner Participation

Students were instructed to log into the MOODLE Platform through (www.udeshnatekar.com). So that the students could learn the subject matter exterior of the classroom. Students were allowed to study according to their learning comfort conditions. Students were motivated to carry out discussions and upload the answers to the questions given by the teacher.

E: Evaluation and Revision of the Blended Learning Strategy

The Blended Learning Strategy was assessed utilizing field trials and was accordingly modified. At the end of each module, quizzes were provided to assess the effectiveness of the content taught. These questions were added to check the student's knowledge and understanding, to check how the students applied the acquired knowledge, and to analyze the given situation. The researcher provided remedies to students, whether online or face-to-face, to resolve the problems encountered by the students. The lesson plan for the Blended Learning Strategy "**Learn at home, do it at school"** is attached as ***Appendix 13.***

3.7.3.3 STRATEGY 3: LEARN AND SURVEY AT HOME, DISCUSS AT SCHOOL

Blending between lesson videos through the MOODLE Platform (Online) and surveys integrated with discussion methods (Offline)

A: Analyzing Learner

Analysing the Learner stage includes recognition of students' hopes, targets, choices, and desires so that a Blended Learning Strategy can be produced that presents students with a valid world benefit. It includes identification of students 'familiarity with technology in terms of mobile tablets or computers, Identification of students' previous knowledge of the matter to be taught, identification of students' learning styles, whether students are inclined to like collaborative and group learning, prefer to learn to employ computers or other gadgets, like fun learning. It also includes Identification of students' traits like whether students are used to learning alone, whether students are well-known with internet use, whether some students choose to study independently and some choose groups, whether students are still learning under the teacher's direction as a facilitator.

S: Stating goals and objectives

This stage includes the establishment of the objectives for Blended Learning Strategies, including performance goals. These goals and objectives should clearly state what the learner will be able to get out of the program once they complete the class. Objectives should be concrete, testable, and demonstrable. Objectives can be students will be able to state, define, name, list, explain, describe, and illustrate. Apply, analyze, etc.

One of the objectives of the study was to study the effectiveness of a Blended learning strategy on the academic achievement of grade VIII students in science. The following objectives can be formulated in behavioral terms as per Bloom's Taxonomy, to be achieved by the students.

Chapter of Science Textbook; -POLLUTION OF AIR AND WATER

The students will be able to remember, understand, apply, analyze, and develop skills about the following concepts: -Air Pollution, Activity 4.1, 4.2 How does Air Get Polluted? Activity 4.2, Activity 4.3.

S: Selection of Method and Media

This stage includes the selection of online learning content, multimedia, both online and classroom exercises, and materials that will give out teaching goals and objectives. This may also pertain to modifying current teaching content to meet the changing needs of the students. When deciding on methods and media, one should keep in mind how to adopt current learning materials into the desired format, who the learners are, and where the learners will learn from. Learning Methods or strategies could be based on Flipped Classroom.

Selection of Suitable Pedagogical Practice: The use of the flipped classroom model of Blended Learning engages students with the course material before coming to class, which

permits for more interactive and appealing face-to-face sessions focused on discussions, problem-solving, and application of knowledge. For interactive and engaging face-to-face sessions focussed on discussion problem solving, application of the knowledge, and to achieve the objectives of higher thought processes, the researcher decided to use the discussion method, learning by doing method, survey integrated with discussion method, and case study method.

Also, after reviewing the available studies on blended learning, it was found by the researcher that, none of the studies is conducted blending Lesson videos, Discussion Forum, Chat, Quizzes in online mode with discussion methods, learning by doing methods, surveys integrated with discussion method and case study method in offline mode using flipped classroom model of Blended Learning. So, the researcher decided to blend lesson videos, discussion forums, chats, quiz in online mode with the discussion method, the learning-by-doing method, a survey integrated with the discussion method, and the case study method in offline mode. To develop Blended Learning Strategies the researcher analysed a grade VIII science textbook published by the Directorate of Education, Govt of Goa. The researcher analyzed each concept from each chapter of the grade VIII science textbook for the consideration of various methods of teaching like discussion method, learning by doing, survey integrated with discussion method, case study method, etc. From these methods, the researcher selected a survey integrated with a discussion Method for the Blended Learning Strategy titled "**Learn and survey at home, discuss at school.**

Selection of Suitable Technology: -The available various technologies (LMS) were analyzed by the researcher by considering 1) Advantages-like user-friendly interface that is easy to navigate for both instructors and students, supporting multimedia content, discussion forums, assignment submissions, and grading, with clear instructions and the organization supports various types of content, including text, images, videos, audio files, presentations,

and interactive multimedia. Supporting diverse assessment methods, including quizzes, surveys, assignments, discussions, and peer reviews, and facilitating communication and collaboration among instructors and students through discussion forums, chat, messaging, announcements, and group workspaces 2) Disadvantages 3) Deployment–like a desktop application, Mobile application, cloud-based 4) Type-Academic LMS or corporate LMS or Both 5) Whom it is for – educators, teachers trainers or for business and 6) Cost- with licensing fees or free or both. On analyzing the available Technologies and by reviewing the studies, the researcher selected MOODLE (Learning Management System) for his study. (www.udeshnatekar.com)

U: Utilization of Media and Technology

This stage in the ASSURE Model is concerned with how to make use of the identified suitable pedagogical practices and identified and selected technology efficiently. Lesson videos to be delivered to the students were prepared according to the syllabus and the lesson plans. With the aim that students could learn them outside the classroom independently lesson Videos were uploaded on the MOODLE platform. Also, the researcher oriented students about the use of MOODLE so that students can easily access MOODLE at their own pace. Learners were prepared by explaining to them about learning outcomes. The students were given an understanding of how to learn using the flipped classroom method. Along with video presentations, collaborative activities were incorporated. Collaborative activities were in the form of group discussions, group projects, and group demonstrations. Even groups were encouraged to discuss the topic with the whole class by sharing their thought on the topic. Evaluation of the presentation of other groups was also done through collaborative efforts. The students were also provided learning experience utilizing a discussion forum through MOODLE. Quizzes questions were used to get feedback from students about the topic. These quiz questions were asked after completing the topic to

examine the understanding of students about the concept taught. Quiz questions were multiple choices, fill in the blanks and match the pair questions.

R: Required Learner Participation

Students were instructed to log into the MOODLE Platform through (www.udeshnatekar.com). So that the students could learn the subject matter exterior of the classroom. Students were allowed to study according to their learning comfort conditions. Students were motivated to carry out discussions and upload the answers to the questions given by the teacher.

E: Evaluation and Revision of the Blended Learning Strategy.

The Blended Learning Strategy was assessed utilizing field trials and was accordingly modified. At the end of each module, quizzes were provided to assess the effectiveness of the content taught. These questions were added to check the knowledge, and understanding of the students, to check how the students apply the acquired knowledge, and to analyze the given situation. The researcher provided remedies to students, whether online or face-to-face, to resolve the problems encountered by the students. The lesson plan for the Blended Learning Strategy "**Learn and survey at home, discuss at school"** is attached in ***Appendix 14.***

3.7.3.4 STRATEGY 4: LEARN AT HOME, DISCUSS CASE AT SCHOOL

Blending between lesson videos through the MOODLE platform (Online) and Case study method (Offline)

A: Analyzing Learner

Analysing the Learner stage includes recognition of students' hopes, targets, choices, and desires so that a Blended Learning Strategy can be produced that presents students with a

suitable world benefit. It includes identification of students 'familiarity with technology in terms of mobile tablets or computers, Identification of students' previous knowledge of the matter to be taught, identification of students' learning styles like whether students are inclined to like collaborative and group learning, prefer to learn to employ computers or other gadgets, like fun learning. It also includes Identification of students' traits like whether students are used to learning alone, whether students are well-known with internet use, whether some students choose to study independently and some choose groups, whether students are still learning under the teacher's direction as a facilitator.

S: Stating goals and objectives

This stage includes the establishment of the objectives for Blended Learning Strategies, including performance goals. These goals and objectives should clearly state what the learner will be able to get out of the program once they complete the class. Objectives should be concrete, testable, and demonstrable. Objectives can be students will be able to state, define, name, list, explain, describe, illustrate, apply, analyse, etc.

One of the objectives of the study was to study the effectiveness of a Blended Learning Strategy on the academic achievement of grade VIII students in science. The following objectives can be formulated in behavioural terms as per Bloom's Taxonomy, which is to be achieved by the students.

Chapter of Science Textbook; -POLLUTION OF AIR AND WATER

The students will be able to remember, understand, apply, analyse, and develop skills about the following concepts: -Case Study – The Taj Mahal,4.4 Greenhouse Effect,4.5 What can be done?

S: Selection of Method and Media

This stage includes the selection of online learning content, multimedia, both online and classroom exercises, and materials that will give out teaching goals and objectives. This may also pertain to modifying current teaching content to meet the changing needs of the students. When deciding on methods and media, one should keep in mind how to adopt current learning materials into the desired format, who the learners are, and where the learners will learn from. Learning Methods or strategies could be based on Flipped Classroom.

Selection of Suitable Pedagogical Practice: The use of the flipped classroom model of Blended Learning engages students with the course material before coming to class, which permits for more interactive and appealing face-to-face sessions focused on discussions, problem-solving, and application of knowledge. For interactive and engaging face-to-face sessions focussed on discussion problem solving, application of the knowledge, and to achieve the objectives of higher thought processes, the researcher decided to use the discussion method, learning by doing method, survey integrated with discussion method, and case study method.

Also, after reviewing the available studies on blended learning, it was found by the researcher that none of the studies is conducted blending Lesson video, Discussion Forum, Chat, Quiz in online mode with discussion method, learning by doing method, survey integrated with discussion method and case study method in offline mode using flipped classroom model of Blended Learning. So, the researcher decided to blend lesson videos, discussion forums, chats, quiz in online mode with the discussion method, the learning-by-doing method, a survey integrated with the discussion method, and the case study method in offline mode. To develop Blended Learning Strategies the researcher analyzed a grade VIII science textbook published by the Directorate of Education, Govt of Goa. The

researcher analyzed each concept from each chapter of the grade VIII science textbook for the consideration of various methods of teaching like discussion method, learning by doing, survey integrated with discussion method, case study method, etc. From these methods, the researcher selected the case study method for Blended Learning Strategy titled "**Learn at home, Discuss Case at school".**

Selection of Suitable Technology: The available various technologies (LMS) were analyzed by the researcher by considering 1) Advantages-like user-friendly interface that is easy to navigate for both instructors and students, supporting multimedia content, discussion forums, assignment submissions, and grading, with clear instructions and the organization supports various types of content, including text, images, videos, audio files, presentations, and interactive multimedia. supporting diverse assessment methods, including quizzes, surveys, assignments, discussions, and peer reviews, and facilitating communication and collaboration among instructors and students through discussion forums, chat, messaging, announcements, and group workspaces 2) Disadvantages 3) Deployment–like desktop application, Mobile application, cloud-based 4) Type-Academic LMS or corporate LMS or Both 5) Whom it is for – educators, teachers trainers or for business and 6) Cost- with licensing fees or free or both. On analyzing the available Technologies and by reviewing the studies, the researcher selected MOODLE (Learning Management System) for his study. (www.udeshnatekar.com)

U: Utilization of Media and Technology

This stage in the ASSURE Model is concerned with how to make use of the identified suitable pedagogical practices and identified and selected technology efficiently. Lesson videos to be delivered to the students were prepared according to the syllabus and the lesson plans. With the aim that students could learn them outside the classroom independently lesson Videos were uploaded on the MOODLE platform. Also, the researcher oriented

students about the use of MOODLE so that students can easily access MOODLE at their own pace. Learners were prepared by explaining to them about learning outcomes. The students were given an understanding of how to learn using the flipped classroom method. Along with video presentations, collaborative activities were incorporated. Collaborative activities were in the form of group discussions, group projects, and group demonstrations. Even groups were encouraged to discuss the topic with the whole class by sharing their thought on the topic. Evaluation of the presentation of other groups was also done through collaborative efforts. The students were also provided learning experience utilizing a discussion forum through MOODLE. Quizzes questions were used to get feedback from students about the topic. These quiz questions were asked after completing the topic to examine the understanding of students about the concept taught. Quiz questions were multiple choices, fill in the blanks and match the pair questions.

R: Required Learner Participation

Students were instructed to log into the MOODLE Platform through (www.udeshnatekar.com). So that the students could learn the subject matter exterior of the classroom. Students were allowed to study according to their learning comfort conditions. Students were motivated to carry out discussions and upload the answers to the questions given by the teacher.

E: Evaluation and Revision of the Blended Learning Strategy

The Blended Learning Strategy was assessed utilising field trials and was accordingly modified. At the end of each module, quizzes were provided to assess the effectiveness of the content taught. These questions were added to check the knowledge, and understanding of the students, to check how the students apply the acquired knowledge, and to analyse the given situation. The researcher provided remedies to students, whether online or face-to-face, to resolve the problems encountered by the students. The lesson plan for the Blended

Learning Strategy "**Learn at home, discuss the case at school"** is attached as ***Appendix 15.***

3.7.4 PILOT STUDY

A pilot study for Blended Learning Strategies was conducted in four different schools in Pernem Taluka. The researcher provided orientation sessions for the teachers involved in the pilot study. Schools were selected using a cluster sampling technique. Based on the feedback received from the teachers, the Blended Learning strategies were revised and improved.

The modified Blended Learning Strategies were then submitted to experts for validation, focusing on content, instructions, objectives, and other relevant aspects. Further adjustments were made based on their suggestions

3.8 PROCEDURE FOR DATA COLLECTION

In this study, the researcher employed a quantitative research method to evaluate the effectiveness of the Blended Learning Strategy on the academic achievement of eighth-grade students in science. Blended Learning Strategies were used as innovative teaching methods, integrating technology with traditional instruction to enhance the performance of students in the experimental group.

Step 1: Determining the Quantitative Research Method The researcher selected a quantitative research design to produce strong and reliable results for the study.

Step 2: Identifying the Rationale for the Quantitative Method Since the study used an experimental approach, the quantitative method was deemed the most suitable for achieving the desired outcomes.

Step 3: Identifying the Data Collection Strategy A quantitative data collection procedure was chosen for this study.

Step 4: Developing Quantitative Questions Academic achievement test questions were constructed for pre-tests and post-tests for both the experimental and control groups. Additionally, Likert-type scales were used to measure students' perceptions and attitudes toward Blended Learning.

Step 5: Collecting Quantitative Data Quantitative data were collected from both the experimental and control group students through academic achievement tests. Perception and attitude scales were also administered to the experimental group.

Step 6: Analyzing the Data The collected data were analysed using quantitative methods.

Step 7: Writing the Report The final report was written based on the results of the quantitative data analysis

3.9 EXPERIMENTATION

The purpose of experimentation in research is to establish causality, test hypotheses, achieve control and precision, avoid replication and generalizability, identify boundary conditions, and inform practical applications and interventions.

The implementation stage outlines the administration of the constructed tools, including the achievement test for grade VIII science, as well as the scales measuring students' perceptions of Blended Learning and their attitudes towards it. This stage also details the use of the Learning Management System and the intervention applied to the experimental group.

3.9.1 ADMINISTRATION OF ACHIEVEMENT TEST IN SCIENCE AS PRE-TEST

The constructed achievement test was administered as a pre-test to evaluate the academic achievement of grade VIII students in science for both the experimental and control groups. The test duration was two and a half hours, and all necessary instructions were provided to the students beforehand. Once completed, the tests were scored, and the results were recorded as the pre-test scores for both the experimental and control groups.

3.9.2 EXPERIMENTAL INTERVENTION

The intervention was conducted for twenty-three sessions, with each session lasting one hour. Spanning a total of seven weeks, the intervention included both online and face-to-face learning components. The schedule and time allocation for each mode of learning are outlined below.

Table 3.5: Schedule of the experimental intervention program

(Total 7 weeks Duration, 23 Concepts)

Sr. No	Date	Activity
	30/01/2023	Administration of Achievement test as Pre- test
	31/01/2023	Orientation of Students
1	04/02/2023	15.1Lighting, The Sparks that the Greeks Knew About
2	06/02/2023	15.2 Charging by Rubbing
3	08/01/2023	15.3 Types of Charges and Their Interaction,
		Transfer of charge
4	10/02/2023	15.4 Transfer of Charge
5	13/02/2023	15.5 The Story of Lightning
		15.6 Lightning Safety

		Finding a Safe Place
		Dos and Don’ts during a thunderstorm
6	15/02/2023	15.7 Earthquakes
		what is an earthquake?
		what causes an earthquake?
		Protection against Earthquakes
7	17/02/2023	16.1 What Makes Things Visible
8	20/02/2023	16.2 Laws of Reflection
9	22/02/2023	16.3 Regular and Diffused Reflection,16.4 Reflected Light
		can be Reflected again
10	24/02/2023	16.5 Multiple Images
		Kaleidoscope,16.6 Sunlight & White or coloured
11	27/02/2023	16.7 What is Inside Our Eyes?
12	01/03/2023	16.8 Care of the Eyes
13	02/03/2023	16.9 Visually Challenged Persons Can Read and
		Write,16.10 What is the Braille System
14	04/03/2023	17.1 The Moon
		The Moon’s Surface
15	06/03/2023	17.2 The Stars
16	08/03/2023	17.3 Constellations
17	09/03/2023	17.4 The Solar System
		The Sun
		The Planets
		Mercury (Budh)
		Venus (Shukra)

		The Earth (Prithvi) Mars (Mangal) Jupiter (Brihaspatil) Saturn (Shani) Uranus and Neptune
18	11/03/2023	17.5 Some Other Members of the Solar System Asteroids Comets Meteors and Meteorites Artificial Satellites
19	13/03/2023	18.1 Air Pollution,18.2 How does Air get polluted?
20	15/03/2023	18.3 Case Study - The Taj Mahal,18.4 Greenhouse Effect,18.5 What Can Be Done?
21	17/03/2023	18.6 Water Pollution, 18.7 How does water get polluted?
22	18/03/2023	18.8 What is potable water and how is water Purified?
23	21/03/2023	Administration of Achievement test as Post-test
24	22/032023	Administration of students' perception of the Blended Learning scale
25	23/03/2023	Administration of students' attitudes towards the Blended Learning scale

3.9.3 DURATION OF THE INTERVENTION PROGRAMME

The researcher conducted a three-day orientation program to familiarize the eighth-grade students in the experimental group with Blended Learning Strategies and the MOODLE platform. All students received basic training and instructions during this period. The intervention program commenced on January 30, 2023, and concluded on March 23, 2023, spanning seven weeks. In total, the students participated in twenty-three hours of instruction.

3.9.4 DETAILS OF THE INTERVENTION PROGRAMME

The researcher was given access to the MOODLE platform using a unique username and password for the experimental group. A group named "HPHS Science Chapter" was created for the study, and the group code was shared with the experimental group students, allowing them to join the online learning community. The researcher engaged with students via the discussion forum, where materials such as lesson videos, discussion questions, and quizzes were posted. All classes were pre-scheduled using the MOODLE planner to ensure an organized learning experience.

3.9.4.1 USE OF TEACHING-LEARNING PLATFORM (MOODLE)

MOODLE (Modular Object-Oriented Dynamic Learning Environment) was utilized as the platform for implementing Blended Learning Strategies. It is a free, secure platform that facilitates collaboration between teachers and students. MOODLE allows educators to seamlessly integrate a variety of learning activities using constructivist approaches. As a safe online learning space, it enables ongoing discussions, frequent interaction through posts, access to assignments and events, participation in online quizzes, and real-time chat between teachers and students.

3.9.4.2 USE OF FLIPPED CLASSROOM MODEL OF BLENDED LEARNING

The flipped classroom model of Blended Learning using MOODLE for the online components and integration of various active learning methods like discussion method, learning by doing, survey integrated with discussion method, and case study for the offline components were implemented in the following manner to create a dynamic and engaging learning environment.

Online Mode (Using MOODLE)

Key topics and concepts to be covered online were identified. Learning objectives and outcomes were defined. Appropriate resources (videos) for each topic were chosen. The material was uploaded onto MOODLE. Pre-class activities such as watching video lessons were assigned. Pre-class discussions and Q&A sessions were uploaded through the Discussion forum of MOODLE to achieve lower-level objectives like remembering and understanding. Interactive elements like quizzes to engage students were incorporated after every lesson and at the end of the chapter. Students' progress and engagement were tracked through Moodle analytics. Students were provided with timely feedback and support.

Offline Mode (Face-to-Face Classroom)

Discussion Method

Open-ended questions to stimulate critical thinking were posed through a worksheet. Structured discussions based on online materials were facilitated. The teacher provided the required guidance. Group presentation was facilitated.

Learning by Doing

Hands-on activities, experiments, or projects that align with online content were designed. Clear instructions and necessary materials for the activities were provided. Students were allowed to work in groups, fostering collaboration and practical application of concepts. Open-ended questions to stimulate critical thinking and problem-solving were posed through a worksheet. Group presentation was facilitated.

Survey Integrated with discussion method

Surveys were conducted by the students after watching the video provided online through MOODLE. Survey results were used to guide discussions and address any misconceptions. Group presentation was facilitated.

Case Study Method

The case study was provided to the students through MOODLE. Students were organized into groups to analyze and discuss the case studies. Group presentation was facilitated.

3.9.5 ADMINISTRATION OF ACHIEVEMENT TEST IN SCIENCE AS POST-TEST

Immediately following the intervention, a post-test on achievement was administered to both the experimental and control group students. The same question paper used for the pre-test was utilized for the post-test. Once the tests were completed, they were scored and recorded as the post-test achievement scores.

3.9.6 ADMINISTRATION OF STUDENTS' PERCEPTION SCALE

Immediately after the intervention, a Likert-type scale was administered to the experimental group to assess their perception of Blended Learning. The test results were scored and recorded as the "Perceptions of Blended Learning" scores. (A detailed description of the students' perception scale is provided in section 3.5.)

3.9.7 ADMINISTRATION OF STUDENTS' ATTITUDE SCALE

Immediately following the intervention, a Likert-type scale was administered to the experimental group to assess their attitudes toward Blended Learning. The test results were scored and recorded as the "Attitudes toward Blended Learning" scores. (A detailed description of the students' attitude scale is provided in section 3.6.)

3.9.8 SCORING KEY

The scoring key was used to evaluate the test items. Each correct answer received one mark, while incorrect answers received zero. The total marks were then calculated as the post-test achievement scores. For the perception scale, each statement was weighted as follows: 1 for Strongly Disagree, 2 for Disagree, 3 for Neutral, 4 for Agree, and 5 for Strongly Agree. The

total scores were calculated as the perception scores. Similarly, for the attitude scale, each statement was assigned the same weightage, from 1 for Strongly Disagree to 5 for Strongly Agree, and the total scores were calculated as the attitude scores.

3.10 STATISTICAL ANALYSIS OF DATA

The data collected was in pre-post format regarding students' academic achievement in science. The independent 't' test compares the mean between two independent groups while the correlated 't' test compares the mean within the same group across different conditions or time points. Since it was required to compare means between two independent groups and also within the groups across different time points, the researcher used an independent 't' test and correlated 't' test in the statistical analysis of data.

ANCOVA is a precious statistical tool to deal with potential confounding variables and improve the validity and interpretation of research findings. The purpose of using ANCOVA in the present study is to manage the effects of covariates, increase precision and statistical power, improve sensitivity to perceive treatment effects, and eliminate pre-existing group differences if any.

The purpose of finding Cohen's d value in the present study is to measure the magnitude of differences between groups, understand the practical significance of research findings, and give a more comprehensive understanding of the effects being studied.

The chi-square test for goodness of fit in the analysis of the perception scale and attitude scale was used to assess whether the observed frequencies of responses fit the expected distribution based on a theoretical model or hypothesis.

The methodology employed to create data and verification of hypotheses formulated for the present study was discussed in this chapter. The various stages of data collection and the

manipulation of experimental variables to create data are presented. The collected data are grouped and analyzed with the help of suitable statistical techniques to meet significant results and conclusions, which are presented in the next chapter.

CHAPTER IV

DATA ANALYSIS AND INTERPRETATION

4.1 INTRODUCTION

Blended Learning, an instructional approach that combines online and face-to-face learning, has gained significant attention in education as a potential tool to enhance students' learning outcomes. In today's fast-growing educational landscape, integrating technology and pedagogy has become supreme in nurturing active and efficient learning environments. The paradigm shift in the direction of Blended Learning Strategies underlines the call for educators to proficiently steer the fusion of traditional teaching methodologies with innovative digital tools. This introduction presents as a pioneer in an in-depth discovery into the analysis of suitable technology and pedagogical practices intended to design and develop impactful Blended Learning Strategies.

Blended Learning, branded by its synthesis of face-to-face instruction with online learning components, presents a resourceful framework catering to varied learning styles. However, its flourishing implementation pivots upon a thorough technology, pedagogy, and content configuration. As such, educators are tasked with discriminating the most suitable technological tools and pedagogical approaches to organize a harmonious blend that makes best use of student commitment and achievement.

The centre of this analysis investigates the complex interaction between technology and pedagogy, identifying that the selection of suitable tools must be informed by pedagogical principles tailored to the precise requirements and objectives of the learning context. Moreover, this discovery underlines the significance of implementing a student-centred approach, wherein technological incorporation serves as a channel for dynamic learning experiences that give power to learners to build knowledge, cooperate effectively, and develop critical thinking skills.

Through a careful integration of digital resources, teaching methodologies, and evaluation strategies, educators can exploit the transformative potential of Blended Learning to develop a broad, appealing, and inspiring learning environment.

This study investigates the effectiveness of Blended Learning on science achievement among grade VIII students. A total of 83 students of two divisions of grade VIII from one of the schools selected randomly from Pernem Taluka of the state of Goa were the sample for the present study. The students were divided into two equivalent groups by considering their scores in science subjects in the previous term. The numbers of students in the experimental group and control group were 41 and 42, respectively. Simple Random sampling techniques were used. 3 students from the experimental group missed the Pre-test and post-test or did not attend the intervention program, and 4 students from the control group either missed the pre-test or post-test. The 3 students in the experimental group and 4 students in the control group were not included in the analysis and finally, a group of 76 students formed the sample. The experimental group consisted of 38 students and the control group consisted of 38 students. Pre and post-tests were administered to assess the students' science achievement levels. The data collected was in pre-post format regarding their academic achievement in science subjects. Both descriptive and inferential techniques were used in the data analysis. Descriptive statistics such as mean, median, standard deviation, kurtosis, and skewness were used. Inferential statistics technique includes parametric tests namely the correlated t-test, independent t-test, and ANCOVA.

Students' Perception of Blended Learning strategies and students' attitudes towards Blended Learning was also studied in the present study. Inferential statistic technique includes non-parametric test namely Chi-Square-Test for goodness of fit.

4.2 ANALYSIS OF SUITABLE TECHNOLOGY AND PEDAGOGICAL PRACTICES TO DESIGN AND DEVELOP BLENDED LEARNING STRATEGIES

Objective 1: -To design and develop Blended Learning Strategies by identifying suitable technology and pedagogical practices for teaching selected concepts in science from the prescribed course of study at grade VIII.

4.2.1 IDENTIFICATION OF SUITABLE TECHNOLOGY

The purpose of identification of suitable technology for Blended Learning is to identify those technologies that maximise the educational experiences, improve learning outcomes, encourage involvement and interaction, contribute distinguishing instructions, facilitate resource use, promote wistful practice, and organise learners for accomplishment in the digital age. The technologies chosen should assist interactive, appealing, and tailored learning experiences that offer varied student wants and learning styles. It should support anytime, anywhere learning, allowing students to connect with study materials and team up with peers despite geographical or time restraints. It should help in various types of communication, group effort, and interaction, together with synchronous and asynchronous activities, discussions, group projects, and feedback mechanisms. It should rationalise course deliverance, organisation, and supervision, as well as make possible well-organized evaluation, grading, and feedback procedures for teachers as well as permit teachers to modify teaching content, activities, and evaluation to individual learner wants, offering personalised learning ways as required.

Platforms like MOODLE, Canvas, Blackboard, or Google Classroom offer central hubs for organising course materials, assignments, quizzes, discussions, and grading. These platforms make communication between instructors and students easy and permit the delivery of multimedia content. Tools such as Zoom, Microsoft Teams, or Google Meet

facilitate live virtual lectures, discussions, and office hours, encouraging synchronised interaction between instructors and students. Platforms such as Slack, Microsoft Teams, or Discord make communication and collaboration among students easy, facilitating group projects, peer feedback, and informal discussions. They encourage a sense of community and promote active participation.

To identify the suitable technology to develop Blended Learning strategies, the researcher reviewed ten studies to find the effectiveness of blended learning in terms of academic achievement, perception, attitude, etc. From the review of these studies, it was found that MOODLE as a Learning Management System was successfully employed by the researchers of the studies.

The available various technologies (LMS) were also analysed by the researcher by considering 1) the advantages of a user-friendly interface that is easy to navigate for both instructors and students, supporting multimedia content, discussion forums, assignment submissions, and grading, with clear instructions and organisation, technologies which support various types of content, including text, images, videos, audio files, presentations, and interactive multimedia, supporting diverse assessment methods, including quizzes, surveys, assignments, discussions, and peer reviews, and facilitating communication and collaboration among instructors and students through discussion forums, chat, messaging, announcements, and group workspaces 2) Disadvantages 3) Deployment–like a desktop application, Mobile application, cloud-based 4) Type-Academic LMS or corporate LMS or Both 5) Whom it is for – educators, teachers trainers or for business and 6) Cost- with licensing fees or free or both. On analysing the available technologies and reviewing the studies, the researcher selected MOODLE (LMS) for his study. (Appendix ***9 and 10***)

Findings: The findings of this analysis emphasise a series of features that influence the selection of suitable technology for Blended Learning, concerning user-friendly interface, support for multimedia content, support for diverse assessment methods, facilitation of communication and collaboration among teachers and students, deployment of the technology, type of the technology, whom the technology is meant for and cost-effectiveness.

4.2.2 IDENTIFICATION OF SUITABLE PEDAGOGICAL PRACTICES.

The purpose of identifying suitable pedagogical practices for Blended Learning is to produce appealing, efficient, and comprehensive learning experiences that influence the benefits of both online and face-to-face instruction, support students' achievement, and promote enduring learning skills.

The use of the flipped classroom model of Blended Learning engages students with the course material before coming to class, which permits for more interactive and appealing face-to-face sessions focused on discussions, problem-solving, and application of knowledge. For interactive and engaging face-to-face sessions focussed on discussion problem solving, application of the knowledge, and to achieve the objectives of higher thought processes, the researcher decided to use the discussion method, learning by doing method, survey integrated with discussion method, and case study method.

Also, after reviewing the available studies on Blended Learning, it was found by the researcher that none of the studies was conducted by blending Lesson videos, Discussion Forums, Chat, Quizzes in online mode with discussion methods, learning by doing methods, survey integrated with discussion method and case study method in offline mode using flipped classroom model of Blended Learning. So, the researcher decided to blend lesson videos, discussion forums, chat, quiz in online mode with the discussion method, the

learning-by-doing method, the survey integrated with the discussion method, and the case study method in offline mode. To develop Blended Learning Strategies, the researcher analysed a grade VIII science textbook published by the Directorate of Education, Govt of Goa. The researcher analysed each concept from each chapter of the grade VIII science textbook for the consideration of various methods of teaching like discussion method, learning by doing, survey integrated with discussion method, case study method, etc. ***(Appendix 11)***

The findings of this analysis highlight the importance of mixing lively learning approaches such as discussions, case studies, learning by doing, and surveys integrated with discussions for the encouragement of deeper understanding, critical thinking, and knowledge application amongst learners and promoting an interactive and active learning experience.

Conclusion: By implementing these technologies and evidence-based practices, teachers can produce engaging, all-encompassing, and successful learning experiences that promote student achievement in Blended Learning environments.

4.3 QUANTITATIVE ANALYSIS

In quantitative type of research, numerical data is collected, analysed, and interpreted to comprehend phenomena, relationships, or trends. Data gathered is analysed using statistical techniques to recognise patterns, relationships, or differences among variables. Quantitative research looks to create findings that can be generalised to a larger population further than the sample studied, assuming the sample is representative. Quantitative research engages both parametric and non-parametric tests based on the distribution and assumption of the data. Parametric tests are suitable when data meet up the assumptions of normality, homogeneity of variances, and linearity. The parametric tests used in this research are the ‘t’ test and ANCOVA. The ‘t’ test is used to find the differences in mean scores of

achievements in science among grade VIII students in the experimental and control group, whereas ANCOVA is used to reduce within-group error variance and elimination of compounds. Non-parametric tests, on the other hand, are distribution-free tests that do not rely on precise assumptions about the population distribution. These tests are frequently used when data disobey the assumptions necessary for parametric tests or when data are calculated on ordinal or nominal scales There are three major variables in the study. They are i) Academic Achievement in science of grade VIII students, ii) Student's Perception of Blended Learning Strategies and iii) student's Attitude towards Blended Learning Strategies. The variable academic achievement in science of grade VIII students is analysed using a t-test and ANCOVA, and the other variables, student's perception about Blended Learning Strategies and Student's Attitude, are analysed using the Chi-Square Test for the goodness of fit.

4.3.1 DESCRIPTIVE ANALYSIS

Descriptive statistics of academic achievement of the experimental group and control group were carried out for Pre-test and Post-test. The mean, median, standard deviation, range, skewness, and kurtosis were calculated for the academic achievement variables and are shown in Table 4.1. The values of the mean and median of all the Pre-test scores do not differ significantly, and therefore, the distribution is inferred to be normal. The value of skewness of the pre-test scores of the dependent variables falls between +1 and -1, and the kurtosis values between +2 and -2. This, yet again, leads to the fact that the distribution is normal and thus ensures the normality of distribution, which is one of the basic assumptions of the t-test.

4.3.1.1 DESCRIPTIVE ANALYSIS OF VARIABLE ACADEMIC ACHIEVEMENT

Table 4.1 FOR DESCRIPTIVE ANALYSIS OF VARIABLE ACADEMIC ACHIEVEMENT OFGRADE VIII STUDENTS

Group	Dependent Variable	N	Pre-test/Post-test	Mean	Median	SD	Skewness	Kurtosis
Experimental	Academic Achievement	38	Pre-test	28.03	27.00	12.08	0.48	-0.44
		38	Post-test	64.21	69.00	16.4	-0.31	-1.15
Control	Academic Achievement	38	Pre-test	29.79	28.00	8.35	-0.22	-0.75
		38	Post-test	34.08	33.00	10.89	0.58	0.61

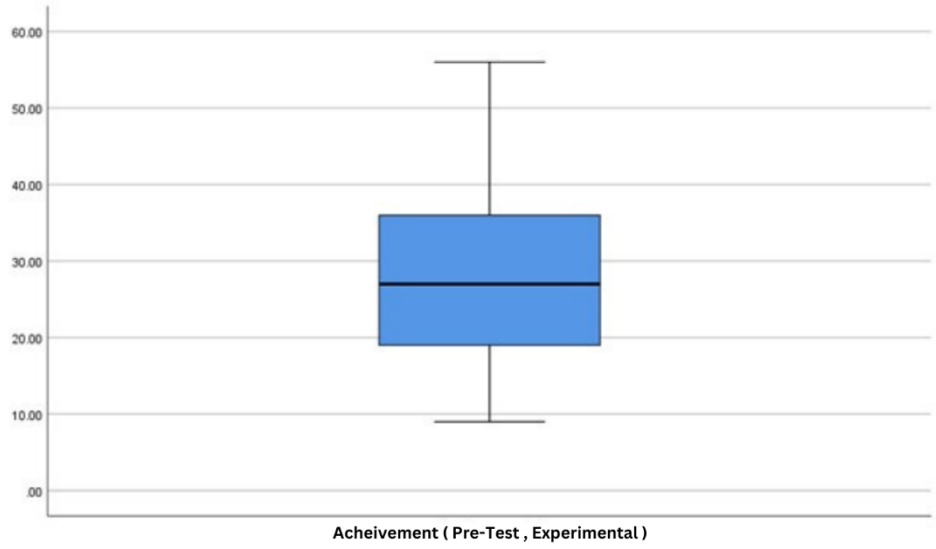


Figure No.4. 1 shows the outliers data regarding Blended Learning among grade VIII students' pre-test of academic achievement in science for the experimental group

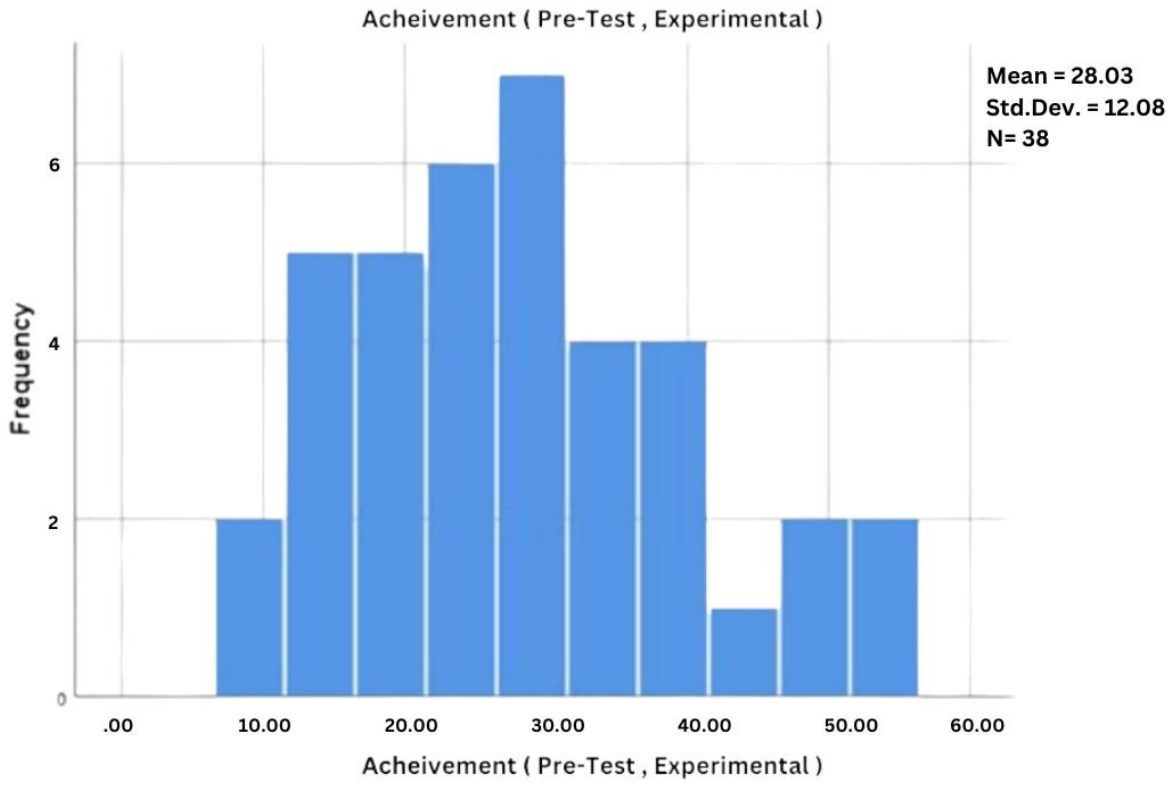


Figure No. 4. 2 shows the histogram regarding Blended Learning among grade VIII students' pre-test of academic achievement in science for the experimental group

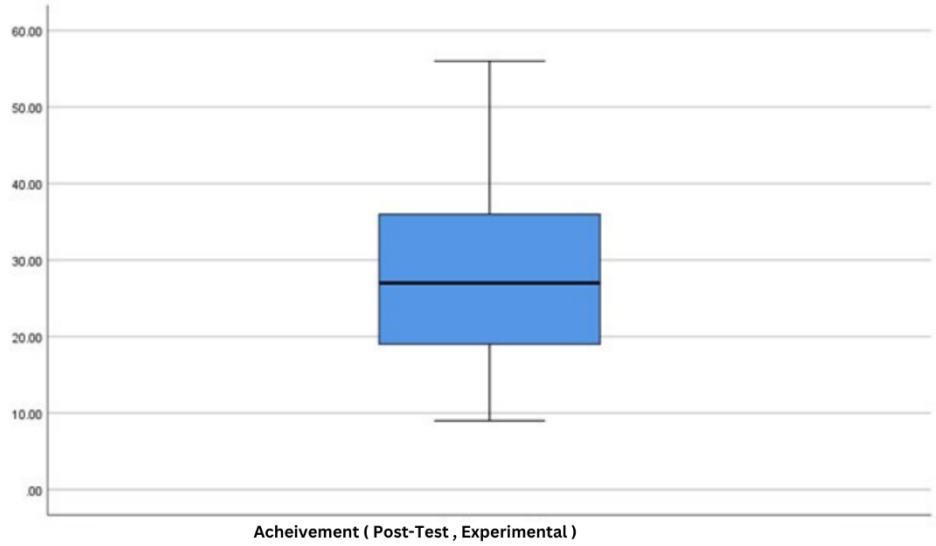


Figure No.4. 3 shows the outliers data regarding Blended Learning among grade VIII students' post-test of academic achievement in science for the experimental group

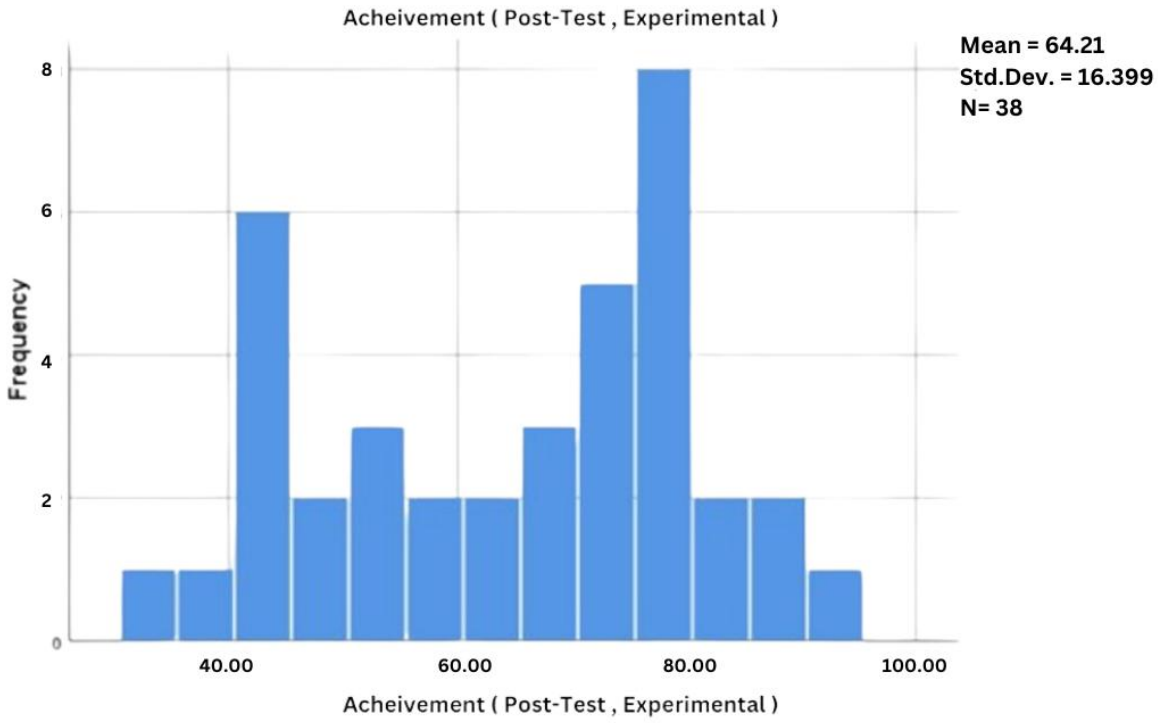


Figure No. 4.4 shows the histogram regarding Blended Learning among grade VIII students' post-test of academic achievement in science for the experimental group

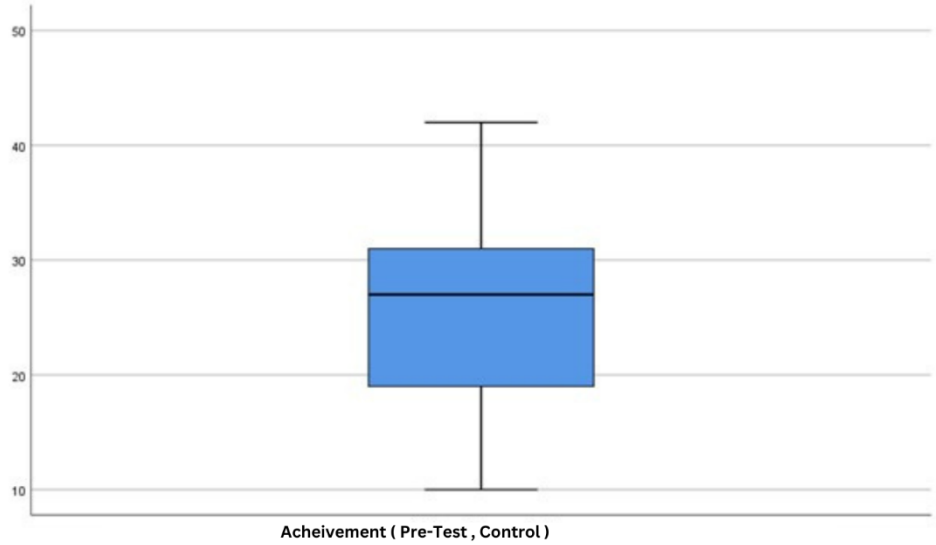


Figure No.4.5 shows the outliers data regarding Blended Learning among grade VIII students' pre-test of academic achievement in science for the control group

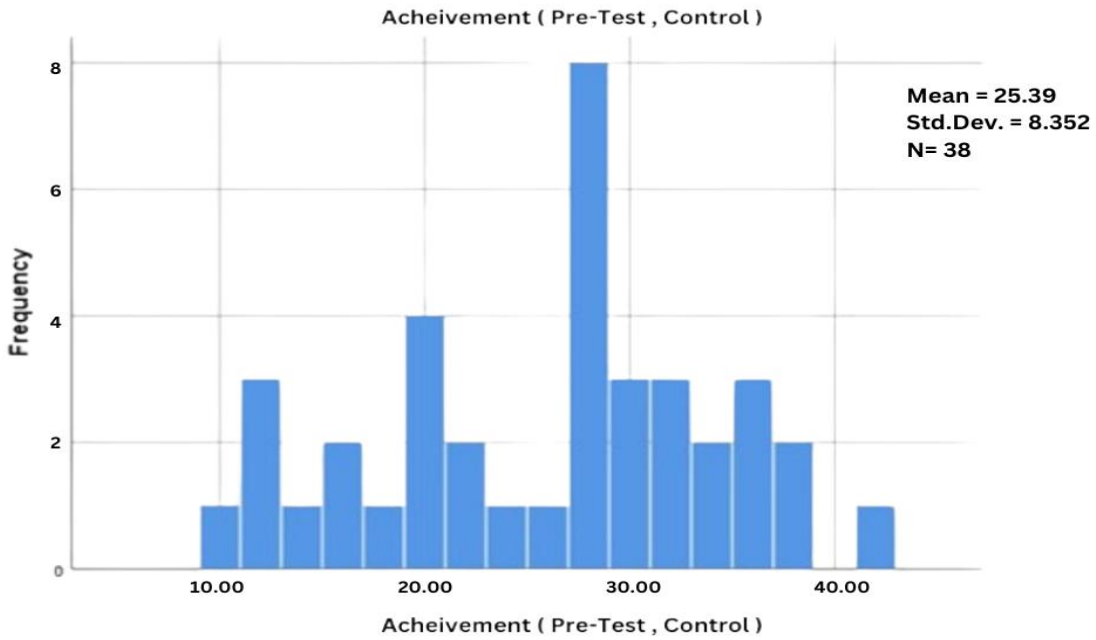


Figure No. 4.6 shows the histogram regarding Blended Learning among grade VIII students' pre-test of academic achievement in science for the control group

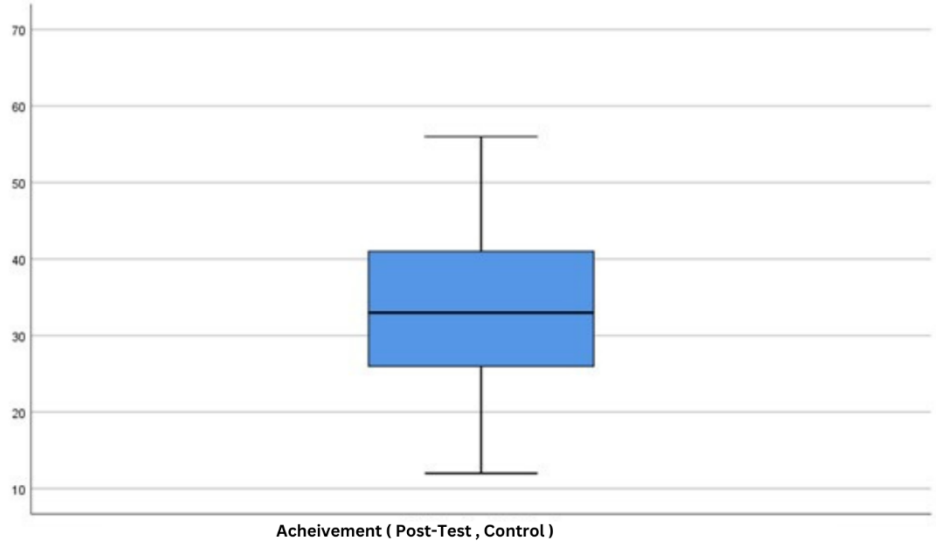


Figure No. 4.7 shows the outliers data regarding Blended Learning among grade VIII students' post-test of academic achievement in science for the control group

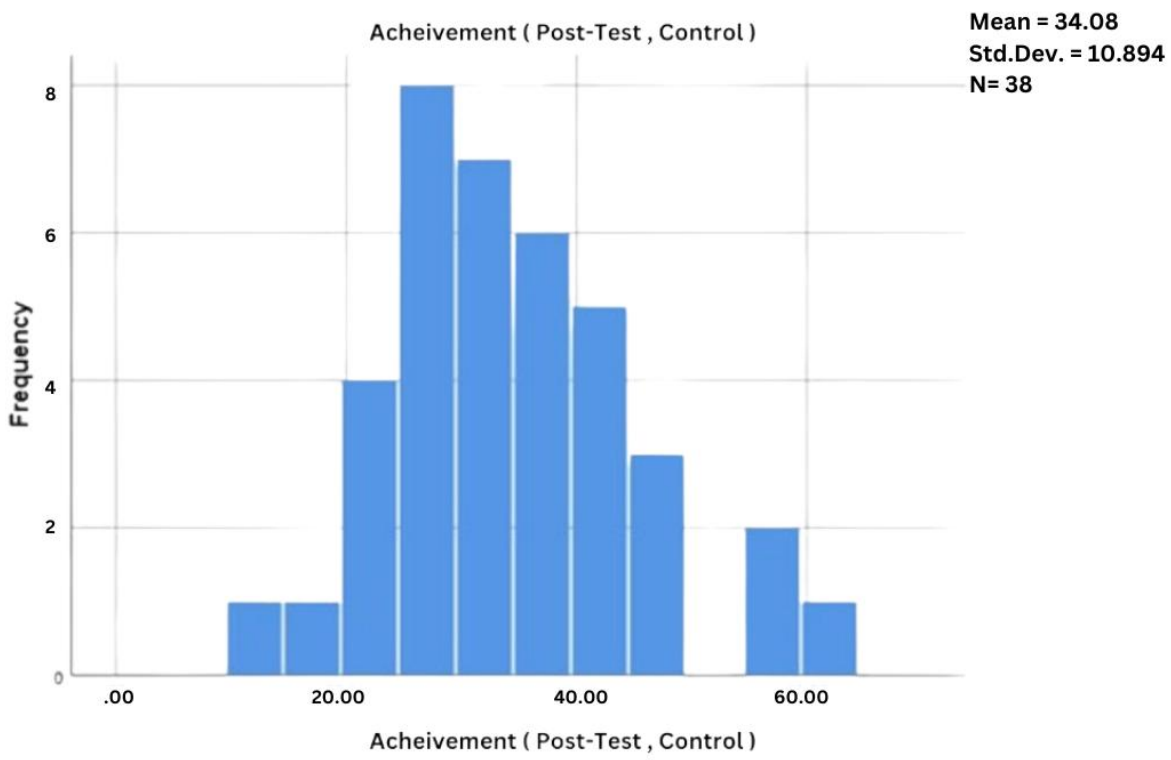


Figure No.4.8 shows the histogram regarding Blended Learning among grade VIII students' post-test of academic achievement in science for the control group

The above table and figures explain the normality of the academic scores in science of eighth-grade students for the control and experimental groups in the research.

4.3.2 INFERENTIAL ANALYSIS

The inferential analysis is valuable in experimental research design to evaluate the performance of two experimental and control groups on academic achievement. Two types of tests, namely parametric test and non-parametric test, are possible in inferential analysis. In parametric, independent 't' test and correlated 't' test are used to compare the difference between two groups based on their performance scores. A non-parametric test, the Chi-Square-Test for the goodness of fit, is used to find students' perceptions of Blended Learning and students' attitudes towards Blended Learning.

4.3.2.1 PARAMETRIC TEST OF VARIABLE ACADEMIC ACHIEVEMENT FOR EXPERIMENTAL GROUP AND CONTROL GROUP.

Both independent t-tests and correlated t-tests are important statistical tools used in data analysis. But they serve different purposes depending on the characteristics of the data. Independent t-tests are valuable in experimental studies where researchers want to compare the effects of different treatments or interventions on separate groups. The correlated t-test is commonly used in pre and post-test designs, where measurements are taken before and after the intervention or treatment.

ANCOVA is a valuable tool in data analysis when there is a need to control for confounding variables, increase statistical power, enhance the precision of estimates, homogenise groups, adjust for pre-existing differences, or obtain more accurate effect size estimates. It allows researchers to gain a better understanding of the relationships between independent and dependent variables while considering the influence of covariates.

4.3.2.1.1 CORRELATED 't' TEST FOR THE VARIABLE ACADEMIC ACHIEVEMENT OF EXPERIMENTAL GROUP

Objective 2: To study the effectiveness of Blended Learning Strategies on the academic achievement of grade VIII students in science.

H_1:- There is no significant difference in Pre-test and Post-test scores of grade VIII students in science taught using Blended Learning Strategies.

Table 4.2 shows the mean, standard deviation, degrees of freedom, t-values, significance level, and Cohen's d for the pre-post-test of the experimental group

Tests	Mean	SD	r value	t value	P value	Cohen's d
Pre-Test	28.03	12.08	0.573	16.27	0.000	2.51
Post Test	64.21	16.39				

When df 37, 2.021 for 0.05 and 2.704 for 0.01 level of significance

Observations: From the above table, it is observed that the calculation of the mean for the pre-test is 28.03, and the standard deviation is 12.08. The calculation of the mean for the post-test is 64.21, and the standard deviation is 16.39 for the eighth-grade students in the experimental group for Academic achievement in science. A correlation of 0.573 is calculated from the pre and post-test scores of eighth-grade students' academic achievement in science. With the help of the above calculations, the 't' value was drawn to be 16.27, and the $p < 0.01$ level of significance. The calculated 't' value is greater than the table value, indicating that the difference between the two means is significant. Cohen's d (2.51) was calculated to find out the effect size through the 't' value and the sample, and it was found to be large in effect size.

Table 4.2 explains the significant difference between the pre and post-tests for the academic achievement in science scores of eighth-grade students for the experimental group in the research due to the intervention managed by the researcher.

Interpretation: It seems that the students comprehend the concepts in science much better when face-to-face interactions follow the MOODLE, which is evident from the higher Mean, SD, and effect with higher magnitude found using Cohen's d.

Findings: There is a significant difference between the pre-test and post-test of the experimental group for Academic achievement in science among grade VIII students.

Thus, Objective No. 2- To study the effectiveness of Blended Learning Strategies on the academic achievement of grade VIII students in science is achieved.

Hence, Null Hypothesis No. 1- There is no significant difference in Pre-test and Post-test scores of grade VIII students in science taught using Blended Learning Strategies stands rejected.

Conclusion: It is concluded that using Blended-learning Strategies is effective in teaching science to grade VIII students.

4.3.2.1.2 CORRELATED 't' TEST FOR THE VARIABLE ACADEMIC ACHIEVEMENT OF CONTROL GROUP

Objective 3: To compare the effectiveness of Blended Learning Strategies and Conventional methods of teaching the learning process on the academic achievement of grade VIII students in science.

H_2: - There is no significant difference in pre-test and post-test scores of grade VIII students in science taught the conventional method of teaching

Table 4.3 shows the mean, standard deviation, degrees of freedom, t-values, significance level, and Cohen's d for the pre-post-test of the Control group

Tests	Mean	SD	r value	t value	P value	Cohen's d
Pre-Test	29.79	8.35	0.623	1.927	0.0617	0.44
Post Test	34.08	10.89				

When df37, 2.021 for 0.05 and 2.704for 0.01 level of significance

Observations: From the above table, it is observed that the calculation of the mean for the pre-test is 29.79, and the standard deviation is 8.35. The calculation of the mean for the post-

test is 34.08, and the standard deviation is 10.89 for the eighth-grade students in the control group for Academic achievement in science. A correlation of 0.623 is calculated from the pre-and post-test scores of eighth-grade students' academic achievement in science. With the help of the above calculations, the value was drawn to be 1.927 and the $p > 0.05$ level of significance. The calculated value is smaller than the table value, indicating that the difference between the two means is not significant. Cohen's d (0.44) was calculated to find out the effect size through the value and sample, and it was found to be low in effect size.

Interpretation: The rise in the mean and SD is a natural phenomenon; the difference is by chance due to the natural development and understanding of students through conventional teaching methods. However, the calculated 't' value is not up to a significant level.

Findings: There is no significant difference between the pre-test and post-test of the control group for Academic achievement in science among grade VIII students.

Hence, the null hypothesis- There is no significant difference in pre-test and post-test scores of grade VIII students in science taught using conventional method of teaching is accepted.

Conclusion: It is concluded that although the conventional method imparts some knowledge, they are not at par with Blended-learning Strategies, which are more effective in teaching science to grade VIII students.

4.3.2.1.3 INDEPENDENT 't' TEST FOR THE VARIABLE ACADEMIC ACHIEVEMENT OF EXPERIMENTAL AND CONTROL GROUP (PRE-TEST)

H_3: - There is no significant difference in the pre-test score of grade VIII students in science taught using Blended Learning Strategies and conventional methods of teaching.

Table 4.4 shows the mean, standard deviation, degrees of freedom, t values and significance level, and Cohen's d for the pre-test of the control and experimental group

Group	Mean	SD	N	t value	P value	Cohen's d
Control	29.79	8.35	38	0.739	0.046	0.17
Experimental	28.03	12.08	38			

When df 74, 1.99 for 0.05, and 2.64 for 0.01 level of significance

Observations: From the above table, it is observed that the calculation of the mean for the pre-test is 29.79, and the standard deviation is 8.35. The calculation of the mean is 28.03, and the standard deviation is 12.08 for the pre-test of the experimental group of eighth-grade students. With the help of the above calculations, the t value was drawn to be 0.739, and the $p < 0.05$ level of significance. The calculated 't' value is smaller than the table value, indicating that the difference between the two means is not significant. Cohen's d (0.17) is calculated to find out the effect size through the 't' value and sample, and it is found to be very small in effect size. The result reveals that there is no significant difference between the control and experimental groups.

Interpretations: The negligible difference in the mean and little difference in the SD is perhaps because both the groups were made equivalent considering their scores in science in the previous term.

Findings: There is no significant difference in Pre-test scores of grade VIII students in science taught using Blended Learning Strategies and conventional methods of teaching.

Hence, the hypothesis-There is no significant difference in the Pre-test scores of grade VIII students in science taught using Blended Learning Strategies and the conventional method of teaching is accepted.

Conclusion: It can be concluded that in any experimental study, the groups must be equivalent so that correct results are achieved, which is a prerequisite for a flawless study.

4.3.2.1.4 INDEPENDENT 't' TEST FOR THE VARIABLE ACADEMIC ACHIEVEMENT OF EXPERIMENTAL AND CONTROL GROUP (POST-TEST)

H_4: - There is no significant difference in post-test scores of grade VIII students in science taught using Blended Learning Strategies and conventional methods of teaching.

Table 4.5 shows the mean, standard deviation, degrees of freedom, t values and significance level, and Cohen's d for the post-test of the control and experimental group

Group	Mean	SD	N	t value	P value	Cohen's d
Control	34.08	10.89	38	9.435	0.000	2.16
Experimental	64.21	16.39	38			

When df74, 1.99 for 0.05, and 2.64 for 0.01 level of significance

Observations: From the above table, it is observed that the calculation of the mean for the post-test is 34.08, and the standard deviation is 10.89. The calculation of the mean is 64.21, and the standard deviation is 16.39 for the post-test of the experimental group of eighth-grade students. With the help of the above calculations, the 't' value was drawn, which is 9.435, and the $p < 0.01$ level of significance. The calculated 't' value is greater than the table value, indicating that the difference between the two means is significant. Cohen's d (2.16) is calculated to find out the effect size through the t value and sample, and it is found to be large in effect size.

Interpretation: It seems that the students comprehend the concepts in science much better when face-to-face interactions follow the MOODLE, as compared to only face-to-face

interaction, which is evident from the higher Mean, SD, and large size effect found using Cohen's d.

Findings: There is a significant difference in the post-test of the experimental group for Academic achievement in science among grade VIII students.

Hence, the Null Hypothesis- There is no significant difference in Post-test scores of grade VIII students in science taught using Blended Learning Strategies and conventional methods of teaching stands rejected.

Conclusion: It is concluded that using Blended Learning Strategies is more effective in teaching science to grade VIII students than conventional methods of teaching.

The ANCOVA is carried out in the research to reduce within-group error variance and elimination of compounds. Levene's Test of Equality of Error Variances and pairwise comparison is also shown in the table below.

Table 4.6 Pre and Post-test Scores of the Experimental and Control Groups on Academic achievement in science subject

Groups	**N**	**Pre-Test**		**Post Test**		**Mean differences**
		Mean	**SD**	**Mean**	**SD**	
Control	38	29.79	8.35	34.08	10.89	4.29
Experimental	38	28.03	12.08	64.21	16.39	36.18
Mean differences		1.76	--	30.13	--	**31.89**

Levene's Test of Equality of Error Variances			
Dependent Variable: Post-test			
F	df1	df2	Sig.
1.333	1	74	.252

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.

Table 4.6 indicates the pre-and post-test mean and SD for the experimental and control groups on the academic achievement scores. The mean and SD for the control group pre-test were 29.79 (8.35) and 34.08 (10.89), respectively. In the case of the experimental group, the pre- and post-test mean and SD were 28.03 (12.08) and 64.21 (16.39), respectively. Statistical calculations of the academic achievement of grade VIII students in science subjects denote that in all four groups, the distribution of scores was approximately normal.

However, it appears that the respondents in the two groups had positive effects on the academic achievement of grade VIII students in science subjects. However, it is not possible to draw meaningful conclusions only based on means and standard deviation values. Levene's test of equality of error variances for the post-academic achievement of an eighth-grade student in a science subject shows no significant difference at 0.05 levels. So, the assumption of normality for the analysis of the ANCOVA was carried out through this test. Therefore, the collected data in this study were treated using ANCOVA. A summary of the ANCOVA is presented in Table 4.7.

Table 4.7 Shows ANCOVA for testing the effect of the intervention Program on the academic achievement of grade VIII students in the science subject of the Experimental group.

Sources of variance	Sum of Squares	Df	Mean Square	F	Sig.
Group	679.21	1	679.21	7.12	0.009
Pre-test	11.60	1	11.60	0.122	0.728
Error	6960.24	73	95.35		
Total	7651.05	75			

a. R Squared = 0.172 (Adjusted R Squared = 0.149)

The effect of an intervention program on post-adjusted means of academic achievement in science was examined by using ANCOVA with pre-test scores as a covariate. As seen from the above table, the post-test was treated as a dependent variable, and significant F ratios of 7.12 (when df are 1 and 73) were obtained for the experimental and control groups, respectively, indicating significant differences in post-adjusted academic achievement in science scores based on the intervention program between the experimental and control groups. From the pre-test treated as the baseline for research in the above table, the F ratios of 0.12 (when df are 1 and 73) were obtained for the pre-test of the control and experimental groups, and there was no significant difference found, so we conclude that the treatment effect on the post-test in the experimental group was only because of the interventional program managed by the researcher in research.

A post-hoc comparison was performed using the accurate method to determine which of the experimental and control groups showed significant differences in the post-adjusted

academic achievement scores. Pair-wise comparisons among the groups were determined, the result of which is that the mean difference of 31.89 is depicted in Table 4.6. It is also clearly depicted in Figure 4.9 of the estimated marginal means, which shows that the experimental group is greater than the control group in post-tests.

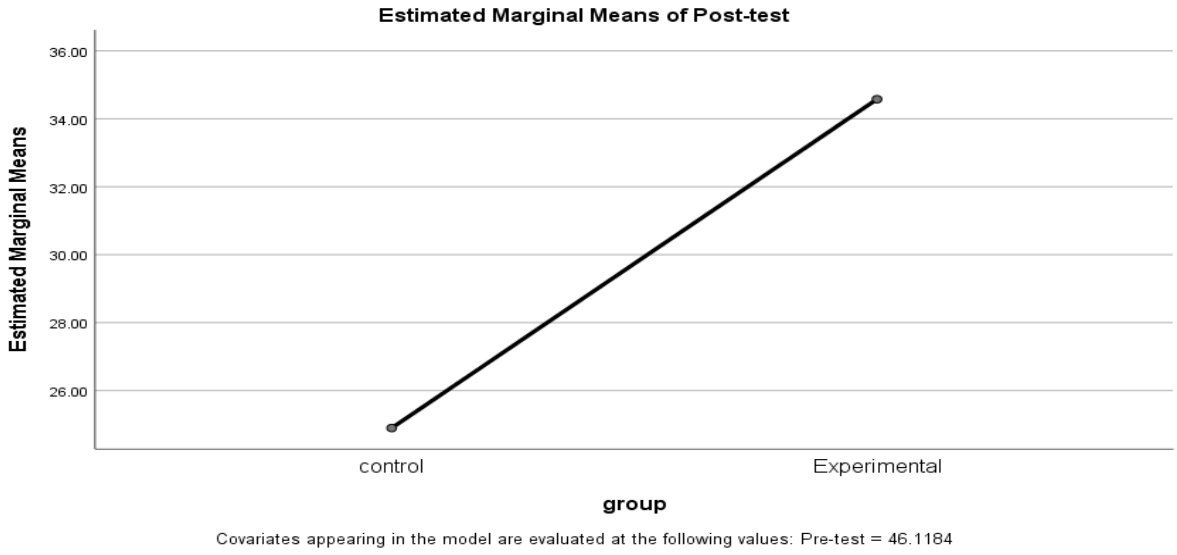


Figure 4.9 shows the marginal mean difference between the control and experimental groups for post-test scores on academic achievement of eighth grade in science subject

Interpretations: Interpretations of the results of an Analysis of Covariance (ANCOVA) testing the effect of an intervention program on academic achievement of grade VIII students in science examine that there is a significant overall effect of Blended Learning on academic achievement after controlling the effects of covariates. A higher adjusted mean for the experimental group compared to the control group suggests a positive effect of the Blended Learning Strategies.

Findings: Findings from ANCOVA offer important insights into the effectiveness of Blended Learning Strategies on academic achievement among eighth-grade students in the science subject. Blended Learning exhibits a statistically significant effect; it implies that

the Blended Learning Strategies have influenced academic achievement among eighth-grade students in science.

Conclusion: The implementation of Blended Learning has established significant effectiveness in improving the academic achievement of grade VIII students in science. The integration of online resources, interactive multimedia content, and individualized learning experiences has successfully added to conventional classroom teaching, promoting deeper commitment and comprehension of scientific concepts among students. As teachers persist in holding innovative pedagogical practices and influencing technology-enhanced learning environments, the incorporation of Blended Learning embraces the enormous potential for dynamic educational renovation and authorizing students to be successful academically in the digital age.

DISCUSSION

For the experimental group, Blended Learning Strategies combine a discussion method, a learning-by-doing method, a survey integrated with the discussion method, and a case study method with an online learning platform (MOODLE) to produce an interactive learning environment for both teachers and students. The study revealed that these innovative classroom methods enhanced students' teaching and learning abilities. The results showed that the experimental group, which was exposed to Blended Learning strategies, demonstrated significant improvement in academic achievement among grade VIII students compared to the control group, which was taught using conventional methods ($t = 9.435$, $p = 0.000 < 0.01$)

For the control group, a traditional teaching method was employed. The findings indicate that this conventional approach also contributed to enhancing students' teaching and learning abilities. The results show that the control group, which was taught using the conventional

method, experienced some improvement in academic achievement, though it was not statistically significant ($t = 1.927$, $p = 0.0617 > 0.05$).

In the independent sample t-test, both the pretest and post-test scores of the experimental and control groups were compared. The results indicated no significant difference in the mean scores between the experimental and control groups at the 0.05 level in the pretest ($t = 0.739$, $p = 0.046 < 0.05$). However, a significant difference was observed in the post-test, with the experimental group outperforming the control group at the 0.01 level ($t = 9.435$, $p = 0.000 < 0.01$). Many research findings support the effectiveness of Blended Learning Strategies on students' academic achievement in science at the secondary level. Almasaeid, T. F. (2014) investigated the effect of using a Blended Learning Strategy on achievement and attitudes in teaching science among 9th-grade students. Images, sounds, video clips, sound effects, and text together were used as Blended Learning Strategies for the designed class. The study showed a positive impact on achievement skills and attitudes of 9th-grade students in science. Alsalhi, et. al. (2019) examined the effects of Blended learning on ninth-grade students' achievement in science and their attitudes toward using it in the intermediate stage, in the United Arab Emirates. The computerized educational program utilized an online learning platform to implement activities such as PowerPoint presentations, illustrations, animations, and relevant video clips. Lectures, explanations, and experiments were conducted in a Blended Learning format. The study's findings showed a statistically significant difference in favour of the experimental group compared to the control group. Harahap et al. (2019) explored the impact of Blended Learning on students' achievement and science process skills in a Plant Tissue Culture course. The online platform for the blended class was developed using HTML, PHP, and JavaScript and combined graphic media such as PowerPoint, books, and animations with lectures and discussions conducted offline. The study concluded that Blended Learning significantly improved students'

achievement and science process skills in plant tissue culture compared to traditional learning methods. Similarly, Kazu et al. (2014) compared the effects of a Blended Learning environment on high school students' academic achievement. The study utilised offline methods like brainstorming, research-study learning, and question-and-answer techniques, alongside online methods such as web-based learning and blog page preparation for distance learning. The results revealed that students in the Blended Learning environment outperformed those in the traditional learning environment. Yapici et al. (2012) investigated the effect of the Blended Learning model on high school students' biology achievement and their attitudes toward the internet, demonstrating the positive impact of Blended Learning on student success. In the online mode, to create the online dimension of the blended learning environment, a website was designed by using MOODLE LMS wherein the students were given an assignment that they were supposed to search for before coming to the classroom. In the offline mode, assignments were presented and the subject was taught in the face-to-face setting via the question and answer and discussion methods. The research results showed that the Blended Learning model added more to the students' biology achievement as compared to conventional methods of teaching

Chitra P.S. (2017) combined face-to-face instruction, lab activities, demonstrations, classroom teaching, games, SLM (Self-Learning Materials), TLM (Teaching-Learning Materials), debates, and online video clippings to study the effectiveness of Blended Learning in teaching science to ninth-grade students. The findings revealed that Blended Learning was more effective than conventional methods across four different types of schools. Dhanya Krishnan (2011) examined the impact of a Blended Learning strategy on higher-order thinking and science learning among secondary school students. One key objective was to assess the effect of Blended Learning on students' science achievement. The study concluded that the Blended Learning strategy had a positive effect on students'

critical thinking, problem-solving, science process skills, and overall academic achievement. Manpreet Kaur (2023) investigated the impact of Blended Learning strategies on scientific attitudes and learning outcomes in science and mathematics among secondary school students. The study concluded that Blended Learning significantly contributes to achieving educational goals and improving learning outcomes. Mishra, Namrata (2021) compared the effectiveness of Blended Learning supported by ICT and cooperative learning strategies on the achievement of learners of secondary schools. Tools used in the study were a video for ICT in Blended Learning Strategy. Lesson plans for cooperative learning strategy without using any type of ICT tool and self-developed tool on achievement of learners. The research results revealed that Blended Learning and cooperative learning are better than traditional learning. Mohammad (2013) studied the effectiveness of blended learning in the achievement of physics of 8th-standard students. The findings of this study revealed that Blended Learning is a more effective strategy than the conventional strategy for the academic achievement in physics of 8th-standard students. Monicka, M. (2021) investigated the effectiveness of e-learning and Blended Learning of science at the high school level. Learning materials were provided through live and recorded videos, recorded lectures, animations, student forums, and e-content, in online mode and Field visits, lecture cum demonstration in offline mode. The finding of the study revealed that ninth-grade students who received Blended Learning courses performed better than students who received e-learning and traditional teaching methods. Nair, Tara (2016) examined the effect of Blended Learning Strategies on achievement and social and environmental attitudes of students at the secondary level in Biology. Blending was between Instructor-led classrooms, Discussion, Field visits, case studies, Laboratory work, Roleplay, Surveys, Interviews and Project work, Campaigns, open forums, debate in offline mode, and Web/Computer Based Learning in online mode. The findings of the study revealed that Blended Learning presents

a significant boost in the effectiveness of learning. Naseerali, M. K. (2022) carried out a study to find the efficiency of the Blended Learning approach among secondary school students in the achievement of educational objectives. Based on the findings, it was concluded that the blended Learning Approach is an effective method for facilitating learning in Physics at the secondary level of education. Neetika (2021) analysed the effect of Blended Learning on adolescents' academic performance motivation and course satisfaction in science. The researcher used the Blended Learning Program: 7-E's Learning Cycle model in the research. Blending was through the 7 Es of Blended Learning in the form of online videos, PowerPoint presentations, and classroom activities. The findings showed that the Blended Learning Strategies proved effective and valuable in promoting the Academic Performance, Motivation, and Course satisfaction of 9th-grade adolescents in science. S, Sripriya. (2022) investigated the effectiveness of the Blended Learning method in learning the chemistry periodic table among tenth-standard students. The website for BLM was designed and developed with the help of application software, allowing the displaying of a variety of information related to Chemistry (Periodic Table) in one place including short learning modules, animated topics, mind maps, tests, quizzes, etc. and constructivist methods in a blended manner. ASSURE model was adopted for developing a Blended Learning Program. The findings of the study revealed that the performance of students taught using Blended Learning was higher than those taught using the traditional approach. Vahora, Samir. A. (2020) investigated the effectiveness of the Blended Learning program on achievement in chemistry in class IX. The Educational Technology and Management Academy (ETMA) design template was used by the researcher in the development of the Blended Learning Programme (BLP). Self-learning, Collaborative learning, experimentation, Group work, Buzzing Demonstration, Illustration, Brainstorming, Questioning, group discussion, Lecture, and E-content were used in a

blended manner. The results concluded that the students of the experimental group used higher-order thinking skills and hence proved that the effectiveness of Blended Learning program was more effective than the traditional teaching.

4.3.2.2 NON-PARAMETRIC TESTS OF VARIABLE STUDENTS' PERCEPTION AND STUDENTS' ATTITUDE.

The chi-square test for goodness of fit is a non-parametric test, frequently used to find out whether observed categorical data fit a definite theoretical distribution. It works as:-

Null Hypothesis (H0): The observed data follow a specific theoretical distribution.

Alternative Hypothesis (H1): The observed data do not follow the specific theoretical distribution.

The test involves comparing the observed frequencies of different categories with the expected frequencies under the null hypothesis. The expected frequencies are calculated based on the theoretical distribution.

The test statistic, chi-square (χ^2), measures the difference between the observed and expected frequencies.

Under the null hypothesis, the chi-square statistic follows a chi-square distribution with degrees of freedom equal to the number of categories minus 1. By comparing the calculated chi-square statistic with the critical value from the chi-square distribution at a chosen significance level, one can determine whether to reject the null hypothesis.

If the calculated chi-square statistic exceeds the critical value, it suggests that there is a significant difference between the observed and expected frequencies, leading to the rejection of the null hypothesis.

The chi-square goodness-of-fit test is non-parametric because it does not rely on any assumptions about the underlying distribution of the data. It only requires categorical data.

In the present study, the researcher used the Chi-Square-Test for goodness of fit because the test is appropriate when dealing with categorical data, where observations are sorted into categories, and as it provides a formal statistical framework for testing hypotheses about whether observed frequencies match expected frequencies based on a theoretical distribution.

4.3.2.2.1 CHI-SQUARE-TEST FOR GOODNESS OF FIT OF VARIABLE STUDENTS' PERCEPTION FOR EXPERIMENTAL GROUP

Students' perceptions of Blended Learning serve as an indicator of its efficiency, providing precious insights into their attitudes, preferences, and experiences within this mixed-learning environment. By examining these perceptions through a lens of inquisition and expression, educators and researchers can gather precious insights into the factors that power student's involvement, motivation, and learning outcomes within the Blended Learning framework.

Blended Learning, which combines traditional face-to-face instruction with online components, has gained popularity in recent years due to COVID-19, while perceptions may vary among individual students because of engagement, autonomy, flexibility, social interactions, different learning styles, and many more factors.

Blended Learning often incorporates interactive and multimedia elements, such as videos, simulations, and online discussions, which has made science lessons more engaging for students. This active participation has enhanced their understanding and interest in the subject. Blended Learning provides students with the flexibility to access learning materials and complete assignments at their own pace and convenience. This flexibility allows

students to take ownership of their learning and manage their time effectively. While many students are comfortable using technology, some may face challenges navigating online platforms or accessing reliable internet connections. Technical difficulties have sometimes hindered the learning experience and caused frustration for students.

Blended Learning can limit face-to-face interactions with peers and teachers compared to traditional classroom settings. Some students have missed the social aspects of traditional classrooms, such as collaborative group work or immediate teacher support. Blended Learning often provides opportunities for personalized learning experiences. Online resources and platforms have offered adaptive learning tools that cater to individual students' needs, allowing them to progress at their own pace and receive targeted support. Moving from traditional classroom settings to Blended Learning has been challenging for some students, especially if they are not accustomed to online learning environments. Adjusting to new routines, managing time effectively, and staying motivated without direct supervision requires a period of adaptation.

It is important to note that individual experiences and perceptions vary based on factors such as prior exposure to technology, access to resources, teacher support, and personal learning preferences. Additionally, perceptions of Blended Learning have evolved since researchers' knowledge during COVID-19.

Further, the tables interpret the perception towards Blended Learning of eighth grade in science subjects with the Chi-Square Test for Goodness of Fit. The chi-square test for goodness of fit is used to determine whether a categorical variable follows a hypothesized distribution.

For this test, the researcher ends up with a p-value that tells us whether we should reject the null hypothesis of the test. The p-value tells us whether the results of the test are significant, but it does not tell us the effect size of the test.

How to Calculate Phi (φ):

Phi is calculated as $\varphi = \sqrt{(X^2 / n)}$

where X^2 is the Chi-Square test statistic.

n = total number of observations

The phi effect size interpretation is below 0.29 for a small effect size, 0.30 to 0.49 for a medium effect size and 0.50 or greater for a large effect size.

Objective 4: To study the perception of the grade VIII students of the Blended Learning strategy concerning Content provided, Technology benefit, and Satisfaction.

H_5: - There is no significant difference in perception about Blended Learning strategies concerning content provided among the grade VIII students.

Table No. 4.8 shows the responses and percentage for the statement "The organization of each lesson was easy to follow" (Item No. 1)

	Strongly disagree	Disagree	Neutral	Agree	Strongly Agree	Total
Responses	0	0	2	18	18	**38**
Percentage	**0%**	**0%**	**5.26%**	**47.3%**	**47.34%**	**100%**

Data Analysis:

Table No. 4.8 discloses the responses to "The organization of each lesson was easy to follow". There was a total of 38 students in the experimental group; it was found that no one

responded to disagree and disagree strongly, 2 were undecided, 18 agreed, and 18 strongly agreed to the statement. In other words, 5.26 percent of the students were neutral, 47.34 percent agreed, and 47.34 percent strongly agreed.

Data Interpretation:

The statement "The organization of each lesson was easy to follow" is supported by the fact that it was responded to by 36 students out of 38; the percentage is 95. No one respondent strongly disagreed or disagreed, which means the perception of students towards the organization of each lesson was easy to follow, which is interesting and supports learning. The percentage of observed data cannot be accurately interpreted, so goodness-of-fit tests help determine if the observed data aligns with what is expected. Decisions can be made based on the outcome of the hypothesis test.

Table No. 4.9 shows the responses and percentage for the statement "What is expected through assignments was clearly stated." (Item No. 3)

	Strongly disagree	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**	**Total**
Responses	0	0	1	25	12	**38**
Percentage	**0%**	**0%**	**2.63%**	**65.75%**	**31.56%**	**100%**

Data Analysis:

Table No. 4.9 discloses the responses to "What is expected through assignments was clearly stated". There was a total of 38 students in the experimental group; it was found that no one responded to Strongly disagree and disagree, one was undecided, 25 agreed, and 12 strongly agreed to the statement. In other words, 2.63 percent of the students were neutral, 65.75 percent agreed, and 31.56 percent strongly agreed.

Data Interpretation:

The statement “What is expected through assignments was clearly stated” is supported by the fact that it was responded to by 37 students out of 38; the percentage is 97. No one respondent strongly disagreed or disagreed, which means the perception of students towards what is expected through assignments was clearly stated, which is interesting and supports learning. The percentage of observed data cannot be accurately interpreted, so goodness-of-fit tests help determine if the observed data aligns with what is expected. Decisions can be made based on the outcome of the hypothesis test.

Table No. 4.10 shows the responses and percentage for the statement “Activities were planned carefully” (Item No. 4)

	Strongly disagree	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**	**Total**
Responses	0	0	3	26	9	**38**
Percentage	**0%**	**0%**	**7.89%**	**68.38%**	**23.67%**	**100%**

Data Analysis:

Table No. 4.10 discloses the responses to “Activities were planned carefully”. There was a total of 38 students in the experimental group; it was found that no one responded to Strongly disagree and disagree, 3 were undecided, 26 agreed, and 9 strongly agreed to the statement. In other words, 7.89 percent of the students were neutral, 68.38 percent agreed, and 23.67 percent strongly agreed.

Data Interpretation:

The statement "Activities were planned carefully" is supported by the fact that it was responded to by 35 students out of 38; the percentage is 92. No one responded strongly disagreed or disagreed, which means the perception of students towards Activities was

carefully planned, which was interesting and supported learning. The percentage of observed data cannot be accurately interpreted, so goodness-of-fit tests help determine if the observed data aligns with what is expected. Decisions can be made based on the outcome of the hypothesis test.

Table No. 4.11 shows the responses and percentages for the statement "The Teaching was designed at an appropriate level" (Item No. 10)

	Strongly disagree	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**	**Total**
Responses	2	0	3	13	20	**38**
Percentage	**5.26%**	**0%**	**7.89%**	**34.19%**	**52.60%**	**100%**

Data Analysis:

Table No. 4.11 discloses the responses to "The Teaching was designed at an appropriate level". There were a total of 38 students in the experimental group; it has been found that 2 responded to Strongly disagree, no one to disagree, 3 were undecided, 13 agreed, and 20 strongly to the statement. In other words, 5.26 percent of the students strongly disagreed, 7.89 percent were neutral, 34.19 percent agreed, and 52.60 percent strongly agreed.

Data Interpretation:

The statement "The Teaching was designed at an appropriate level" is supported by the fact that it was responded to by 33 students out of 38; the percentage is 87. No one responded and disagreed, which means the perception of students is that the teaching was designed at an appropriate level, which is interesting and supports learning. The percentage of observed data cannot be accurately interpreted, so goodness-of-fit tests help determine if the observed

data aligns with what is expected. Decisions can be made based on the outcome of the hypothesis test.

Table No. 4.12 shows the responses and percentages for the statement "The entire course was difficult to follow" (Item No. 12)

	Strongly disagree	Disagree	Neutral	Agree	Strongly Agree	Total
Responses	19	11	5	2	1	**38**
Percentage	**49.97%**	**28.93%**	**13.15%**	**5.26%**	**2.63%**	**100%**

Data Analysis:

Table No. 4.12 discloses the responses to "The entire course was difficult to follow". There was a total of 38 students in the experimental group; it was found that 19 responded to Strongly disagree, 11 to disagree, 05 were undecided, 2 agreed, and 1 strongly agreed to the statement. In other words, 49.97 percent of the students strongly disagreed, 28.93 percent disagreed, 13.15 percent were neutral, 5.26 percent agreed, and 2.63 percent strongly agreed.

Data Interpretation:

The statement "The entire course was difficult to follow" is not supported by the fact that it was responded to by 30 students out of 38; the percentage is 79. which means the perception of students is that the entire course was not difficult to follow, which is interesting and supports learning. The percentage of observed data cannot be accurately interpreted, so goodness-of-fit tests help determine if the observed data aligns with what is expected. Decisions can be made based on the outcome of the hypothesis test.

Table No. 4.13 shows the responses and percentage for the statement "The entire course was a waste of time" (Item No.:13)

	Strongly disagree	Disagree	Neutral	Agree	Strongly Agree	Total
Responses	9	25	2	1	1	**38**
Percentage	**23.67%**	**65.75%**	**5.26%**	**2.63%**	**2.63%**	**100%**

Data Analysis:

Table No. 4.13 discloses the responses to "The entire course was a waste of time". There was a total of 38 students in the experimental group; it has been found that 9 responded to Strongly disagree, 25 to disagree, 2 were undecided, 1 agreed, and 1 strongly agreed to the statement. In other words, 23.67 percent of the students strongly disagreed, 65.75 percent disagreed, 5.26 percent were neutral, 2.63 percent agreed, and 2.63 percent strongly agreed.

Data Interpretation:

The statement "The entire course was a waste of time" is not supported by the fact that it was responded to by 34 students out of 38; the percentage is 90. which means the perception of students is that the entire course was not a waste of time, which is interesting and supports learning. The percentage of observed data cannot be accurately interpreted, so goodness-of-fit tests help determine if the observed data aligns with what is expected. Decisions can be made based on the outcome of the hypothesis test.

Table No. 4.14 Chi-Square Tests for goodness of fit (for Item No. 1,3,4,10,12,13)

Item No	N	Chi-Square Statistic Value	Effect size phi	Significance (2-Sided)
1	38	47.79	1.12	0.000
3	38	63.316	1.29	0.000
4	38	63.316	1.29	0.000
10	38	38.579	1.01	0.000
12	38	29.368	0.88.	0.000
13	38	55.684	1.21	0.000

The goodness-of-fit chi-square test is a statistical test used to determine whether the observed frequencies of a variable match the expected frequencies derived from a theoretical distribution. For item at no. 1,3,4,10, 12, and 13 in the student's perception scale the test resulted in Chi-Square statistic values with 4 degrees of freedom, which are not in the 95% region of acceptance (9.4877). The observed effect size phi is large. This indicates that the magnitude of the difference between the observed and expected data is large.

The p-value of 0.000 indicates that the probability of obtaining a Chi-Square statistic assuming the null hypothesis that the observed data fit the expected distribution, is very low. There is evidence to state that the observation of this sample may be the same as that of the population.

Findings: Based on the results of the Chi-Square test the p-value for the items at no.1,3,4,10, 12, and 13 in the student's perception scale was calculated as 0.000 for each item and since the p-value ($p < 0.05$) is below the chosen significance level, the null hypothesis -There is

no significant difference in perception about Blended Learning Strategiesconcerning content provided among the grade VIII students is rejected.

Conclusion: The findings of the study indicate that with regards to the content provided by Blended Learning, the students found the organization of each lesson easy to follow, assignments were clearly stated, activities were planned carefully, the presentation of the content through videos and discussion forum was clear, the teaching was designed appropriately per the level of students, the entire course was not difficult to follow and there was no wastage of time.

H_6: - There is no significant difference in perception about Blended Learning strategies concerning technology benefits among grade VIII students.

Table No.4.15 shows the responses and percentage for the statement "The structure of the environment helped me to focus on learning"

	Strongly disagree	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**	**Total**
Responses	0	0	3	26	9	**38**
Percentage	**0%**	**0%**	**7.89%**	**68.38%**	**23.67%**	**100%**

Data Analysis:

Table No.4.15 discloses the responses to "The structure of the environment helped me to focus on learning". There was a total of 38 students in the experimental group; it was found that no one responded to Strongly disagree and disagree, 3 were undecided, 26 agreed, and 9 strongly agreed to the statement. In other words, 7.89 percent of the students were neutral, 68.38 percent agreed, and 23.67 percent strongly agreed.

Data Interpretation:

The statement “The structure of the environment helped me to focus on learning” is supported by the fact that it was responded to by 35 students out of 38; the percentage is 92. No one respondent strongly disagreed or disagreed, which means the perception of students towards the structure of the environment helped them to focus on learning, which is interesting and supports learning. The percentage of observed data cannot be accurately interpreted, so goodness-of-fit tests help determine if the observed data aligns with what is expected. Decisions can be made based on the outcome of the hypothesis test.

Table No.4.16 shows the responses and percentage for the statement “The online content provided through MOODLE was very easy to understand”

	Strongly disagree	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**	**Total**
Responses	0	0	9	12	17	**38**
Percentage	**0%**	**0%**	**23.67%**	**31.56%**	**44.71%**	**100%**

Data Analysis:

Table No. 4.16 discloses the responses to “The online content provided through MOODLE was very easy to understand”. There was a total of 38 students in the experimental group; it was found that no one responded to Strongly disagree and disagree, 9 were undecided, 12 agreed, and 17 strongly agreed to the statement. In other words, 23.67 percent of the students were neutral, 31.56 percent agreed, and 44.71 percent strongly agreed.

Data Interpretation:

The statement "The online content provided through MOODLE was very easy to understand" is supported by the fact that it was responded to by 29 students out of 38; the

percentage is 76. No one respondent strongly disagreed or disagreed, which means the perception of students towards the online content provided through MOODLE was very easy to understand, which is interesting and supports learning. The percentage of observed data cannot be accurately interpreted, so goodness-of-fit tests help determine if the observed data aligns with what is expected. Decisions can be made based on the outcome of the hypothesis test.

Table No. 4.17 shows the responses and percentage for the statement "The Activities given in the course helped me to develop skills"

	Strongly disagree	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**	**Total**
Responses	0	0	12	12	14	**38**
Percentage	**0%**	**0%**	**31.56%**	**31.56%**	**36.82%**	**100%**

Data Analysis:

Table No. 4.17 discloses the responses to "The Activities given in the course helped me to develop skills". There were a total of 38 students in the experimental group; it was found that no one responded to Strongly disagree and disagree, 12 were undecided, 12 agreed, and 14 strongly agreed to the statement. In other words, 31.56 percent of the students were neutral, 31.56 percent agreed, and 36.82 percent strongly agreed.

Data Interpretation:

The statement "The Activities given in the course helped me to develop skills" is supported by the fact that it was responded to by 26 students out of 38; the percentage is 68. No one respondent strongly disagreed or disagreed, which means the perception of students is that the activities given in the course helped them to develop skills, which is interesting and

supports learning. The percentage of observed data cannot be accurately interpreted, so goodness-of-fit tests help determine if the observed data aligns with what is expected. Decisions can be made based on the outcome of the hypothesis test.

Table No. 4.18 shows the responses and percentage for the statement "The course provided through lessons increased the quantity of the content I learned"

	Strongly disagree	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**	**Total**
Responses	0	0	5	18	15	**38**
Percentage	**0%**	**0%**	**13.15%**	**47.34%**	**39.45%**	**100%**

Data Analysis:

Table No.4.18 discloses the responses to "The course provided through lessons increased the quantity of the content I learned." There was a total of 38 students in the experimental group; it was found that no one responded to Strongly disagree and disagree, 5 were undecided, 18 agreed, and 15 strongly agreed to the statement. In other words, 13.15 percent of the students were neutral, 47.34 percent agreed, and 39.45 percent strongly agreed.

Data Interpretation:

The statement "The course provided through lessons increased the quantity of the content I learned" is supported by the fact that it was responded to by 33 students out of 38; the percentage is 87. No one respondent strongly disagreed or disagreed, which means the perception of students is that the course provided through lessons increased the quantity of the content students learned, which is interesting and supports learning. The percentage of observed data cannot be accurately interpreted, so goodness-of-fit tests help determine if the

observed data aligns with what is expected. Decisions can be made based on the outcome of the hypothesis test.

Table No. 4.19 shows the responses and percentage for the statement "I was able to chat with other students in this subject through MOODLE"

	Strongly disagree	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**	**Total**
Responses	0	1	2	19	16	**38**
Percentage	**0%**	**2.63%**	**5.26%**	**49.97%**	**42.08%**	**100%**

Data Analysis:

Table No. 4.19 discloses the responses to "I was able to chat with other students in this subject through MOODLE". There was a total of 38 students in the experimental group; it was found that no one responded to Strongly disagree, one to disagree, 2 were undecided, 19 agreed, and 16 strongly agreed with the statement. In other words, 2.63 percent of the students disagreed, 5.26 percent were neutral, 49.97 percent agreed, and 42.08 percent strongly agreed.

Data Interpretation:

The statement "I was able to chat with other students in this subject through MOODLE" is supported by the fact that it was responded to by 35 students out of 38; the percentage is 92. No one respondent strongly disagreed, which means the perception of students is that they were able to chat with other students in this subject through MOODLE, which is interesting and supports learning. The percentage of observed data cannot be accurately interpreted, so goodness-of-fit tests help determine if the observed data aligns with what is expected. Decisions can be made based on the outcome of the hypothesis test.

Table No. 4.20 shows the responses and percentage for the statement "I could ask my teacher what I do not understand"

	Strongly disagree	Disagree	Neutral	Agree	Strongly Agree	Total
Responses	0	0	0	9	29	**38**
Percentage	**0%**	**0%**	**0%**	**23.67%**	**76.27%**	**100%**

Data Analysis:

Table No. 4.20 discloses the responses to "I could ask my teacher what I do not understand". There were a total of 38 students in the experimental group; it was found that no one responded to Strongly disagree, disagree, and were undecided, 9 agreed, and 29 strongly agreed with the statement. In other words, 23.67 percent of the students agreed, and 76.27 percent strongly agreed.

Data Interpretation:

The statement "I could ask my teacher what I do not understand" is supported by the fact that it was responded to by all 38 students out of 38; the percentage is 100. No one respondent strongly disagreed, disagreed, or was neutral, which means the perception of students is that they could ask their teacher what they did not understand, which is interesting and supports learning. The percentage of observed data cannot be accurately interpreted, so goodness-of-fit tests help determine if the observed data aligns with what is expected. Decisions can be made based on the outcome of the hypothesis test.

Table No. 4.21 shows the responses and percentage for the statement "I could ask other students what I did not understand"

	Strongly disagree	Disagree	Neutral	Agree	Strongly Agree	Total
Responses	1	0	2	12	23	**38**
Percentage	**2.63%**	**0%**	**5.26%**	**31.56%**	**60.49%**	**100%**

Data Analysis:

Table No. 4.21 discloses the responses to "I could ask other students what I did not understand". There was a total of 38 students in the experimental group, and it was found that one responded Strongly disagree, no one disagreed, 2 were undecided, 12 agreed, and 23 strongly agreed with the statement. In other words, 2.63 percent of the students strongly disagreed, 5.26 percent were neutral, 31.56 percent agreed, and 60.49 percent strongly agreed.

Data Interpretation:

The statement "I could ask other students what I did not understand" is supported by the fact that it was responded to by 35 students out of 38; the percentage is 92. No one respondent disagreed, which means the perception of students is that they could ask other students what they did not understand, which is interesting and supports learning. The percentage of observed data cannot be accurately interpreted, so goodness-of-fit tests help determine if the observed data aligns with what is expected. Decisions can be made based on the outcome of the hypothesis test.

Table No. 4.22 shows the responses and percentage for the statement "Other students responded promptly to my request for help"

	Strongly disagree	Disagree	Neutral	Agree	Strongly Agree	Total
Responses	0	0	3	13	22	**38**
Percentage	**0%**	**0%**	**7.89%**	**34.19%**	**57.86%**	**100%**

Data Analysis:

Table No. 4.22 discloses the responses to "Other students responded promptly to my request for help". There was a total of 38 students in the experimental group, and it was found that no one responded to Strongly disagree and disagreed, 3 were undecided, 13 agreed, and 22 strongly agreed to the statement. In other words, 7.89 percent of the students were neutral, 34.19 percent agreed, and 57.86 percent strongly agreed.

Data Interpretation:

The statement "Other students responded promptly to my request for help" is supported by the fact that it was responded to by 35 students out of 38; the percentage is 92. No one respondent strongly disagreed or disagreed, which means the perception of students is that other students responded promptly to my request for help, which is interesting and supports learning. The percentage of observed data cannot be accurately interpreted, so goodness-of-fit tests help determine if the observed data aligns with what is expected. Decisions can be made based on the outcome of the hypothesis test.

Table No. 4.23 shows the responses and percentage for the statement "The teacher gave me quick comments on my work"

	Strongly disagree	Disagree	Neutral	Agree	Strongly Agree	Total
Responses	0	0	3	10	25	**38**
Percentage	**0%**	**0%**	**7.89%**	**26.3%**	**65.75%**	**100%**

Data Analysis:

Table No. 4.23 discloses the responses to "The teacher gave me quick comments on my work". There was a total of 38 students in the experimental group, and it was found that no one responded to Strongly disagree and disagreed, 3 were undecided, 10 agreed, and 25 strongly agreed with the statement. In other words, 7.89 percent of the students were neutral, 26.30 percent agreed, and 65.75 percent strongly agreed.

Data Interpretation:

The statement "Other students responded promptly to my request for help" is supported by the fact that it was responded to by 35 students out of 38; the percentage is 92. No one respondent strongly disagreed or disagreed, which means the perception of students is that the teacher gave them quick comments on their work, which is interesting and supports learning. The percentage of observed data cannot be accurately interpreted, so goodness-of-fit tests help determine if the observed data aligns with what is expected. Decisions can be made based on the outcome of the hypothesis test.

Table No. 4.24 shows the responses and percentage for the statement "My classmates and I could regularly evaluate each other's work"

	Strongly disagree	Disagree	Neutral	Agree	Strongly Agree	Total
Responses	0	0	3	7	28	**38**
Percentage	**0%**	**0%**	**7.89%**	**18.41%**	**73.64%**	**100%**

Data Analysis:

Table No. 4.24 discloses the responses to "My classmates and I could regularly evaluate each other's work". There was a total of 38 students in the experimental group, and it was found that no one responded to Strongly disagreed and disagreed, 3 were undecided, 7 agreed, and 28 strongly agreed with the statement. In other words, 7.89 percent of the students were neutral, 18.41 percent agreed, and 73.64 percent strongly agreed.

Data Interpretation:

The statement "My classmates and I could regularly evaluate each other's work" is supported by the fact that it was responded to by 35 students out of 38; the percentage is 92. No one respondent strongly disagreed or disagreed, which means the perception of students is that their classmates and they could regularly evaluate each other's work, which is interesting and supports learning. The percentage of observed data cannot be accurately interpreted, so goodness-of-fit tests help determine if the observed data aligns with what is expected. Decisions can be made based on the outcome of the hypothesis test.

Table No. 4.25 shows the responses and percentage for the statement "Using MOODLE app was easy"

	Strongly disagree	Disagree	Neutral	Agree	Strongly Agree	Total
Responses	0	2	4	9	23	**38**
Percentage	**0%**	**5.26%**	**10.52%**	**23.67%**	**60.49%**	**100%**

Data Analysis:

Table No. 4.25 discloses the responses to "Using the MOODLE app was easy". There was a total of 38 students in the experimental group, and it was found that no one responded to Strongly disagreed, 2 disagreed, 4 were undecided, 9 agreed, and 23 strongly agreed with the statement. In other words, 5.26 percent of the students disagreed, 10.52 percent were neutral, 23.67 percent agreed, and 60.49 percent strongly agreed.

Data Interpretation:

The statement Using the MOODLE app was easy" is supported by the fact that it was responded to by 32 students out of 38; the percentage is 84. No one respondent strongly disagreed or disagreed, which means the perception of students is that using the MOODLE app is easy, which is interesting and supports learning. The percentage of observed data cannot be accurately interpreted, so goodness-of-fit tests help determine if the observed data aligns with what is expected. Decisions can be made based on the outcome of the hypothesis test.

Table No. 4.26 shows the responses and percentage for the statement "The Videos provided were easily available"

	Strongly disagree	Disagree	Neutral	Agree	Strongly Agree	Total
Responses	1	0	9	14	14	**38**
Percentage	**2.63%**	**0%**	**23.67%**	**36.82%**	**36.82%**	**100%**

Data Analysis:

Table No. 4.26 discloses the responses to "The Videos provided were easily Available". There was a total of 38 students in the experimental group, and it was found that one responded Strongly disagreed, no one disagreed, 9 were undecided, 14 agreed, and 14 strongly agreed with the statement. In other words, 2.63 percent of the students strongly disagreed, 23.67 percent were neutral, 36.82 percent agreed, and 36.82 percent strongly agreed.

Data Interpretation:

The statement "The Videos provided were easily Available" is supported by the fact that it was responded to by 28 students out of 38; the percentage is 73. No one respondent strongly disagreed or disagreed, which means the perception of students is that the Videos provided were easily Available, which is interesting and supports learning. The percentage of observed data cannot be accurately interpreted, so goodness-of-fit tests help determine if the observed data aligns with what is expected. Decisions can be made based on the outcome of the hypothesis test.

Table No. 4.27 shows the responses and percentage for the statement "The online material provided to me was available to me all the time"

	Strongly disagree	Disagree	Neutral	Agree	Strongly Agree	Total
Responses	0	0	1	13	24	**38**
Percentage	**0%**	**0%**	**2.63%**	**34.19%**	**63.12%**	**100%**

Data Analysis:

Table No. 4.27 discloses the responses to "The online material provided to me was available to me all the time". There was a total of 38 students in the experimental group, and it was found that no one responded to Strongly disagreed, and disagreed, 1 was undecided, 13 agreed, and 24 strongly agreed to the statement. In other words, 2.63 percent of the students strongly were neutral, 34.19 percent agreed, and 63.12 percent strongly agreed.

Data Interpretation:

The statement "The online material provided to me was available to me all the time" is supported by the fact that it was responded to by 37 students out of 38; the percentage is 97. No one responded strongly disagreed or disagreed, which means the perception of students is that the online material provided to them was available to them all the time, which is interesting and supports learning. The percentage of observed data cannot be accurately interpreted, so goodness-of-fit tests help determine if the observed data aligns with what is expected. Decisions can be made based on the outcome of the hypothesis test.

Table No. 4.28 shows the responses and percentage for the statement "I was able to learn at my speed"

	Strongly disagree	Disagree	Neutral	Agree	Strongly Agree	Total
Responses	0	0	2	10	26	**38**
Percentage	**0%**	**0%**	**5.26%**	**26.32%**	**66.42%**	**100%**

Data Analysis:

Table No. 4.28 discloses the responses to "I was able to learn at my speed". There was a total of 38 students in the experimental group, and it was found that no one responded to Strongly disagreed, and disagreed, 2 were undecided, 10 agreed, and 26 strongly agreed to the statement. In other words, 5.26 percent of the students strongly were neutral, 26.32 percent agreed, and 66.42 percent strongly agreed.

Data Interpretation:

The statement "I was able to learn at my speed" is supported by the fact that it was responded to by 36 students out of 38; the percentage is 95. No one respondent strongly disagreed or disagreed, which means the perception of students is that I was able to learn at my speed, which is interesting and supports learning. The percentage of observed data cannot be accurately interpreted, so goodness-of-fit tests help determine if the observed data aligns with what is expected. Decisions can be made based on the outcome of the hypothesis test.

Table No. 4.29 shows the responses and percentage for the statement "I decided when to learn"

	Strongly disagree	Disagree	Neutral	Agree	Strongly Agree	Total
Responses	0	0	3	15	20	**38**
Percentage	**0%**	**0%**	**7.90%**	**39.47%**	**52.63%**	**100%**

Data Analysis:

Table No. 4.29 discloses the responses to "I decided when to learn". There was a total of 38 students in the experimental group, and it was found that no one responded to Strongly disagreed, and disagreed, 3 were undecided, 15 agreed, and 20 strongly agreed to the statement. In other words, 7.90 percent of the students strongly were neutral, 39.47 percent agreed, and 52.63 percent strongly agreed.

Data Interpretation:

The statement "I decided when to learn" is supported by the fact that it was responded to by 35 students out of 38; the percentage is 92. No one responded strongly disagreed or disagreed, which means the perception of students is that I decided when to learn, which is interesting and supports learning. The percentage of observed data cannot be accurately interpreted, so goodness-of-fit tests help determine if the observed data aligns with what is expected. Decisions can be made based on the outcome of the hypothesis test.

Table No. 4.30 shows the responses and percentage for the statement "I was able to learn how to use Moodle App quickly"

	Strongly disagree	Disagree	Neutral	Agree	Strongly Agree	Total
Responses	0	0	0	10	28	**38**
Percentage	**0%**	**0%**	**0%**	**26.32%**	**73.68%**	**100%**

Data Analysis:

Table No.4.30 discloses the responses to "I was able to learn how to use Moodle App quickly". There were a total of 38 students in the experimental group, and it was found that no one responded to Strongly disagreed, disagreed, and were undecided, 10 agreed, and 28 strongly agreed to the statement. In other words, 26.32 percent agreed, and 73.68 percent strongly agreed.

Data Interpretation:

The statement "I was able to learn how to use Moodle App quickly" is supported by the fact that it was responded to by 38 students out of 38; the percentage is 100. No one respondent strongly disagreed or disagreed, which means the perception of students is that I was able to learn how to use Moodle App quickly, which is interesting and supports learning. The percentage of observed data cannot be accurately interpreted, so goodness-of-fit tests help determine if the observed data aligns with what is expected. Decisions can be made based on the outcome of the hypothesis test.

Table No. 4.31 shows the responses and percentage for the statement "My skills to use mobile improved"

	Strongly disagree	Disagree	Neutral	Agree	Strongly Agree	Total
Responses	2	3	7	9	17	**38**
Percentage	**5.26%**	**7.90%**	**18.42%**	**23.68%**	**44.74%**	**100%**

Data Analysis:

Table No. 4.31 discloses the responses to "My skills to use mobile improved". There was a total of 38 students in the experimental group, and it was found that 2 responded Strongly disagreed, 3 disagreed, 7 were undecided, 9 agreed, and 17 strongly agreed with the statement. In other words, 5.26 percent strongly disagreed, 7.90 percent disagreed, 18.42 percent neutral, 23.68 percent agreed and 44.74 percent strongly agreed.

Data Interpretation:

The statement "My skills to Use Mobile improved" is supported by the fact that it was responded to by 26 students out of 38; the percentage is 68. There was a minimum number of respondents who strongly disagreed or disagreed, which means the perception of students is that My skills to use mobile improved, which is interesting and supports learning. The percentage of observed data cannot be accurately interpreted, so goodness-of-fit tests help determine if the observed data aligns with what is expected. Decisions can be made based on the outcome of the hypothesis test.

Table No. 4.32 shows the responses and percentage for the statement "I felt that I cannot use the mobile phone as my classmate use"

	Strongly disagree	Disagree	Neutral	Agree	Strongly Agree	Total
Responses	20	15	0	0	3	**38**
Percentage	**52.6%**	**39.45%**	**0%**	**0%**	**7.89%**	**100%**

Data Analysis:

Table No. 4.32 discloses the responses to "I felt that I cannot use the mobile phone as my classmate use". There was a total of 38 students in the experimental group, and it was found that 20 responded Strongly disagree, 15 disagreed, no one was undecided, agreed, and 3 strongly agreed with the statement. In other words, 52.60 percent of the students strongly disagreed, 39.45 percent disagreed, and 7.89 percent strongly agreed.

Data Interpretation:

The statement "I felt that I cannot use the mobile phone as my classmate use" is supported by the fact that it was responded to by 35 students out of 38; the percentage is 92. No one respondent was neutral or agreed, which means the perception students felt that they cannot use mobile phones as their classmates use, which is interesting and supports learning. The percentage of observed data cannot be accurately interpreted, so goodness-of-fit tests help determine if the observed data aligns with what is expected. Decisions can be made based on the outcome of the hypothesis test.

Table No. 4.33 Chi-Square Tests for goodness of fit (for Items no. 2,6,8,9,14 to 19, and items no. 22 to 29**).**

Item No	N	Chi-Square Statistic Value	Effect size phi	Significance (2-Sided)
2	38	62.789	1.28	0.000
6	38	29.632	0.88	0.000
8	38	25.68	0.82	0.000
9	38	37.526	0.99	0.000
14	38	43.842	1.07	0.000
15	38	83.316	1.48	0.000
16	38	51.211	1.16	0.000
17	38	49.10	1.14	0.000
18	38	58.579	1.24	0.000
19	38	72.789	1.38	0.000
22	38	44.895	1.09	0.000
23	38	24.368	0.80	0.000
24	38	60.158	1.26	0.000
25	38	60.158	1.30	0.000
26	38	45.421	1.09	0.000
27	38	78.316	1.44	0.000
28	38	18.842	0.70	0.000
29	38	45.421	1.09	0.000

The goodness-of-fit chi-square test is a statistical test used to determine whether the observed frequencies of a variable match the expected frequencies derived from a theoretical

distribution. For the items at no.2,6,8,9, items at no. 14 to 19, and items at no. 22 to 29 in the students' perception scale the test resulted in a Chi-Square statistic with 4 degrees of freedom, which are not in the 95% region of acceptance (9.4877). The observed effect size phi is large.

The p-value of 0.000 indicates that the probability of obtaining a Chi-Square statistic, assuming the null hypothesis that the observed data fit the expected distribution, is very low. There is evidence to state that the observation of this sample may be the same as that of the population.

Findings: Based on the results of the Chi-Square test the p-value for the items at no.2,6,8,9, items at no. 14 to 19, and items at no. 22 to 29 is calculated as 0.000 for each item and since the p-value ($p < 0.05$) is below the chosen significance level, the null hypothesis- There is no significant difference in perception about Blended Learning Strategies concerning technology benefit among the grade VIII students is rejected.

Conclusion: Concerning technology benefits the findings of the study indicate that the students found the structure of the environment helpful in learning, the online content provided through MOODLE was very easy to understand, the activities given in the course helped the students to develop skills, the lessons enriched their content knowledge, interaction with other students and teacher was facilitated through MOODLE, assessing each other's work, accessing videos using the MOODLE app was easy as the students could learn at own pace, time available and at any place. The important achievement of the students learning to use the MOODLE app is the development of skills to use mobile with confidence.

H_7: - There is no significant difference in perception about Blended Learning strategies concerning satisfaction among the grade VIII students.

Table No. 4.34 shows the responses and percentage for the statement "I learned a great deal from this course"

	Strongly disagree	Disagree	Neutral	Agree	Strongly Agree	Total
Responses	0	0	2	20	16	**38**
Percentage	**0%**	**0%**	**5.26%**	**52.60%**	**42.08%**	**100%**

Data Analysis:

Table No. 4.34 discloses the responses to "I learned a great deal from this course". There was a total of 38 students in the experimental group; it has been found that no one responded to Strongly disagree and disagree, 2 were undecided, 20 agreed, and 16 strongly agreed to the statement. In other words, 5.26 percent of the students were neutral, 52.60 percent agreed, and 42.08 percent strongly agreed.

Data Interpretation:

The statement "I learned a great deal from this course" is supported by the fact that it was responded to by 36 students out of 38; the percentage is 95. No one respondent strongly disagreed or disagreed, which means the perception of students is that they learned a great deal from this course, which is interesting and supports learning. The percentage of observed data cannot be accurately interpreted, so goodness-of-fit tests help determine if the observed data aligns with what is expected. Decisions can be made based on the outcome of the hypothesis test.

Table No. 4.35 shows the responses and percentage for the statement "I look forward to learning using the same method in the future"

	Strongly disagree	Disagree	Neutral	Agree	Strongly Agree	Total
Responses	3	1	15	8	11	**38**
Percentage	**7.89%**	**2.63%**	**39.45%**	**21.04%**	**28.93%**	**100%**

Data Analysis:

Table No. 4.35 discloses the responses to "I look forward to learning using the same method in the future". There was a total of 38 students in the experimental group; it was found that 3 responded to Strongly disagree, 1 to disagree, 15 were undecided, 8 agreed, and 11 strongly agreed to the statement. In other words, 7.89 percent of the students strongly disagreed, 2.63 percent disagreed, 39.45 percent were neutral, 21.04 percent agreed, and 28.93 percent strongly agreed.

Data Interpretation:

The statement "I look forward to learning using the same method in the future" is supported by the fact that 19 students responded to it out of 38; the percentage is 50. which means the perception of students is that they look forward to learning using the same method in the future, which is interesting and supports learning. However, 39 percent of students were neutral respondents, which is ambiguous to the statement. The percentage of observed data cannot be accurately interpreted, so goodness-of-fit tests help determine if the observed data aligns with what is expected. Decisions can be made based on the outcome of the hypothesis test.

Table No. 4.36 shows the responses and percentage for the statement "I learned a great deal through discussions with my classmates"

	Strongly disagree	Disagree	Neutral	Agree	Strongly Agree	Total
Responses	0	0	4	20	14	**38**
Percentage	**0%**	**0%**	**10.52%**	**52.60%**	**36.82%**	**100%**

Data Analysis:

Table No. 4.36 discloses the responses to "I learned a great deal through discussions with my classmates". There was a total of 38 students in the experimental group, and it was found that no one responded to Strongly disagreed and disagreed, 4 were undecided, 20 agreed, and 14 strongly agreed with the statement. In other words, 10.52 percent of the students were neutral, 52.60 percent agreed, and 36.82 percent strongly agreed.

Data Interpretation:

The statement "I learned a great deal through discussions with my classmates" is supported by the fact that it was responded to by 34 students out of 38; the percentage is 89. No one respondent strongly disagreed or disagreed, which means the perception of students is that students learned a great deal through discussions with their classmates, which is interesting and supports learning. The percentage of observed data cannot be accurately interpreted, so goodness-of-fit tests help determine if the observed data aligns with what is expected. Decisions can be made based on the outcome of the hypothesis test.

Table No. 4.37 shows the responses and percentage for the statement "My social skills improved during the course"

	Strongly disagree	Disagree	Neutral	Agree	Strongly Agree	Total
Responses	0	7	3	12	16	**38**
Percentage	**0%**	**18.41%**	**7.89%**	**31.56%**	**42.08%**	**100%**

Data Analysis:

Table No. 4.37 discloses the responses to "My social skills improved during the course". There was a total of 38 students in the experimental group, and it was found that no one responded to Strongly disagreed,7 disagreed, 3 were undecided, 12 agreed, and 16 strongly agreed with the statement. In other words, 18.41 percent of the students disagreed, 7.89 percent were neutral, 31.56 percent agreed, and 42.08 percent strongly agreed.

Data Interpretation:

The statement "My social skills improved during the course" is supported by the fact that it was responded to by 28 students out of 38; the percentage is 74. No one respondent strongly disagreed or disagreed, which means the perception of students is that their social skills improved during the course, which is interesting and supports learning. The percentage of observed data cannot be accurately interpreted, so goodness-of-fit tests help determine if the observed data aligns with what is expected. Decisions can be made based on the outcome of the hypothesis test.

Table No. 4.38 Chi-Square Tests for goodness of fit (for Item No. 7, 11, 20, 21)

Item No	N	Chi-Square Statistic Value	Effect size phi	Significance (2-Sided)
7	38	48.842	1.13	0.000
11	38	17.263	0.67	0.000
20	38	42.526	1.06	0.000
21	38	22.263	0.77	0.000

The goodness-of-fit chi-square test is a statistical test used to determine whether the observed frequencies of a variable match the expected frequencies derived from a theoretical distribution. For the item at no. 7,11,20 and 21in students' perception scale the test resulted in a Chi-Square statistic with 4 degrees of freedom, which is not in the 95% region of acceptance (9.4877). The observed effect size phi is large. This indicates that the magnitude of the difference between the observed and expected data is large.

The p-value of 0.000 indicates that the probability of obtaining a Chi-Square statistic assuming the null hypothesis that the observed data fit the expected distribution, is very low. There is evidence to state that the observation of this sample may be the same as that of the population.

Findings: Based on the results of the Chi-Square test the p-value for the item at no. 7,11,20 and 21 is calculated as 0.000 for each item and since the p-value ($p < 0.05$) is below the chosen significance level, the null hypothesis - There is no significant difference in perception about Blended Learning Strategies concerning satisfaction among the grade VIII students is rejected.

Conclusion: Concerning overall satisfaction, the findings of the study reveal that the students understood the importance of discussion with classmates. The students look forward to using the same method, as it enhances social skills because of the boosted self-confidence which is an important aspect of social life.

Overall conclusion about students' perception of Blended Learning: Grade VIII students exhibit an encouraging perception of the Blended Learning strategy, underlining the eminence of content, technology benefits, and overall satisfaction with the learning experience. Students' responses highlight the effectiveness of Blended Learning in promoting involvement, learning outcomes, and student-centred methods, making it a worthy educational model for present classrooms.

DISCUSSION

One of the standout features of Blended Learning that gathers positive feedback from students is its capacity to cover content more broadly than conventional methods alone. Students can go through the content through videos, textbooks, online articles, interactive simulations, and more, all of which provide to different learning preferences and help in strengthening the material from various angles. This widespread entree to information empowers a deeper understanding and a larger knowledge base. The incorporation of technology in Blended Learning is another vastly acclaimed component. It not only eases accessing and interacting with content but also improves the learning experience through advanced tools and methods. The accessibility of widespread online resources and support systems, including teacher interactions, and peer discussions, improves student satisfaction as students feel well-supported in learning challenges. The positive perception of students towards Blended Learning Strategies regarding content coverage, technology benefits, and overall satisfaction underlines the effectiveness of Blended Learning, as these strategies are

likely to enhance student engagement, learning outcomes, and satisfaction. The results indicate that the experimental group that was exposed to the Blended Learning Program showed significant improvement in their perception towards Blended Learning Strategies. Many research findings support the perception of Blended Learning Strategies for teaching and learning purposes. Chen and Jones (2007) compared Blended Learning Vs. traditional classroom settings. Results of the research revealed that the overall perceptions of the course, instructor, and learning outcomes were positive for both groups. Ja'ashan, M. M. N. H. (2015) studied Perceptions and Attitudes towards Blended Learning of the Students at the University of Bisha for English Courses. This study concluded that the student's perceptions of Blended Learning were positive in terms of the three domains in the questionnaire. Sun, Z. et al. (2017) in their study exploring the collaborative learning effect in Blended Learning environments investigated the social interactive network of students, level of knowledge building, and perception level of usefulness in online and mobile collaborative learning environments in higher education. The following results were found by mixing methods of social network analysis, content analysis, and questionnaire: (1) the collaborative social networks generated in this study showed that students had tighter interaction relationships in MOODLE than in WeChat; (2) deeper level of knowledge building in collaboration and interaction through MOODLE than WeChat was observed; and (3) MOODLE got higher perception level than WeChat because of its usefulness for collaboration. Alekya Ch (2018) attempted to study the perception of the Blended Learning approach among English language teachers in secondary schools of north coastal districts of Andhra Pradesh. The findings of the research revealed a positive effect on perception towards the Blended Learning approach among English language teachers in secondary schools of north coastal districts of Andhra Pradesh. Maria Josephine (2016) studied the effectiveness of a Blended Learning Programme on Academic Achievement in the Teaching

of Physical Science among Student Teachers of Puducherry. All activities like video conferencing technique, PowerPoint presentation, video presentation, action planning, and reflection method were uploaded on the learning Platform EDMODO in Online Mode and brainstorming method, team teaching method, discussion, small group discussion, debate, Lecture Method were used Offline mode. The findings of the study revealed that students in the experimental group had a high perception of the Blended Learning Programme compared to that of the control group. Nita Devi (2022) researched to study the perceptions of teachers and students regarding Blended Learning based on Learning Styles of Secondary Schools in Jammu District. The findings of the study also showed that the male teachers were found to have added encouraging perceptions of Blended Learning than the female teachers. Female teachers showed less motivation for the implementation of the Blended Learning approach. Smita Tanwar (2022) compared the effectiveness of Blended Learning to traditional teaching. The findings revealed that the students developed a more positive perception of the Blended Learning method when taught using Blended Learning Strategies.

4.3.2.2.2 CHI-SQUARE-TEST FOR GOODNESS OF FIT OF VARIABLE STUDENTS' ATTITUDE FOR EXPERIMENTAL GROUP

Students' attitudes towards Blended Learning summarize their beliefs, feelings, and tendencies toward this hybrid educational concept. Understanding and interpreting these attitudes is vital as they considerably manipulate involvement, motivation, and eventually, the efficacy of Blended Learning initiatives. By looking into the tone of students' attitudes, educators and researchers can gain precious insights into the factors that outline student reception and confrontation towards Blended Learning.

The attitude towards blended learning among eighth-grade students in the science subject can vary depending on various factors, including the students' prior experience with blended

learning, their learning styles, the quality of the blended learning program, and the support they receive from teachers and parents.

Blended learning often incorporates interactive and multimedia elements, which can make the science subject more engaging for eighth-grade students. It allows them to explore concepts through virtual simulations, videos, and interactive activities, which can enhance their understanding and interest in the subject. Blended learning offers students the flexibility to learn at their own pace and in their preferred learning style. This autonomy can empower students to take ownership of their learning and feel more in control of their academic progress.

Eighth-grade students are generally comfortable with technology and may appreciate the use of digital tools and resources in their science learning. Blended learning provides an opportunity to leverage technology and utilize online platforms, educational apps, and virtual labs, which can appeal to their tech-savvy nature. Blended learning can foster collaboration among students through online discussion forums, group projects, and virtual classrooms.

Eighth-grade students may enjoy working with their peers on scientific activities, sharing ideas, and collectively solving problems, which can enhance their learning experience. While many students may embrace blended learning, some may face challenges with technology access, internet connectivity, or navigating online platforms. It is crucial to address these barriers to ensure that all students can fully participate and benefit from the blended learning approach. The attitude of eighth-grade students towards blended learning in the science subject can be positive, as it offers an opportunity for interactive, flexible, and collaborative learning experiences. However, it is essential to provide proper support,

resources, and guidance to maximize their engagement and ensure a successful blended learning environment.

Further, the tables interpret the attitude towards blended learning of eighth grade in science subjects with the Chi-Square Test for Goodness of Fit. The chi-square test for goodness of fit is used to determine whether a categorical variable follows a hypothesized distribution. For this test, researcher end up with a p-value that tells us whether we should reject the null hypothesis of the test. The p-value tells us whether the results of the test are significant, but it does not tell us the effect size of the test.

How to Calculate Phi (φ):

Phi is calculated as $\varphi = \sqrt{(X2 / n)}$

where X2 is the Chi-Square test statistic.

n = total number of observations

The phi effect size interpretation is below 0.29 for a small effect size, 0.30 to 0.49 for a medium effect size and 0.50 or greater for a large effect size.

Objective 5: To find the attitude of the grade VIII students towards the Blended Learning strategy concerning Online learning, Classroom learning, Online interaction, Technology, Learning flexibility, and Online environment.

H_8: - There is no significant difference in attitude towards Blended Learning Strategies concerning online learning among the grade VIII students.

Table No. 4.39 shows the responses and percentage for the statement "I like online learning through MOODLE as it provides more information".

	Strongly disagree	Disagree	Neutral	Agree	Strongly Agree	Total
Responses	0	0	3	10	25	**38**
Percentage	**0.00%**	**0.00%**	**7.89%**	**26.30%**	**65.75%**	**100%**

Data Analysis:

Table No. 4.39 discloses the responses to "I like online learning through MOODLE as it provides more information". There was a total of 38 students in the experimentalgroup; it was found that no one responded to disagree and disagree strongly, 3 were undecided, 10 agreed, and 25 strongly agreed with the statement. In other words, 7.89 percent of the students were neutral, 26.30 percent agreed, and 65.75 percent strongly agreed.

Data Interpretation:

The statement "I like online learning through MOODLE as it provides more information" is supported by the fact that it was responded to by 35 students out of 38; the percentage is 92.No one respondent strongly disagreed or disagreed, which means that online learning through MOODLE, it provides more information, is interesting, and supports learning.The percentage of observed data cannot be accurately interpreted, so goodness-of-fit tests help determine if the observed data aligns with what is expected. Decisions can be made based on the outcome of the hypothesis test.

Table No. 4.40 shows the responses and percentage for the statement "I use my time better when studyingonline through MOODLE"

	Strongly disagree	Disagree	Neutral	Agree	Strongly Agree	Total
Responses	0	0	2	18	18	**38**
Percentage	**0.00%**	**0.00%**	**5.26%**	**47.34%**	**47.34%**	**100%**

Data Analysis:

Table No. 4.40 discloses the responses to "I like online learning through MOODLE as it provides more information". There were a total of 38 students in the experimentalgroup; it was found that no one responded to Strongly disagree and disagree, 2 were undecided, 18 agreed, and 18 strongly agreed to the statement. In other words, 5.26 percent of the students were neutral, 47.34 percent agreed, and 47.34 percent strongly agreed.

Data Interpretation:

The statement "I use my time better when studying online through MOODLE" is supported by the fact that it was responded to by 36 students out of 38; the percentage is 95. No one respondent strongly disagreed or disagreed, which means the students use their time better when studying online through MOODLE, which is interesting and supports learning. The percentage of observed data cannot be accurately interpreted, so goodness-of-fit tests help determine if the observed data aligns with what is expected. Decisions can be made based onthe outcome of the hypothesis test.

Table No. 4.41 shows the responses and percentage for the statement "Online learning through MOODLE encourages me for my studies".

	Strongly disagree	Disagree	Neutral	Agree	Strongly Agree	Total
Responses	0	0	8	7	23	**38**
Percentage	**0.00%**	**0.00%**	**21.04%**	**18.41%**	**60.49%**	**100%**

Data Analysis:

Table No. 4.41 discloses the responses to "Online learning through MOODLEencourages me for my studies". There were a total of 38 students in the experimental group; itwas found that no one responded to Strongly disagree and disagree, 8 were undecided, 7 agreed, and 23 strongly agreed to the statement. In other words, 21.04 percent of the students were neutral, 18.41 percent agreed, and 60.49 percent strongly agreed.

Data Interpretation:

The statement "Online learning through MOODLE encourages me for my studies" is supported by the fact that it was responded to by 30 students out of 38; the percentage is 79. No one respondent strongly disagreed or disagreed, which means Online learning through MOODLE encourages students' studies, which is interesting and supports learning. The percentage of observed data cannot be accurately interpreted, so goodness-of-fit tests help determine if the observed data aligns with what is expected. Decisions can be madebased on the outcome of the hypothesis test.

Table No. 4.42 shows the responses and percentage for the statement "Online learning through MOODLEmakes me more responsible for my studies"

	Strongly disagree	Disagree	Neutral	Agree	Strongly Agree	Total
Responses	3	0	15	8	12	**38**
Percentage	**7.89%**	**0.00%**	**39.45%**	**21.04%**	**31.56%**	**100%**

Data Analysis:

Table No. 4.42 discloses the responses to "Online learning through MOODLEmakes me more responsible for my studies". There was a total of 38 students in the experimental group; it was found that 3 strongly disagreed, no one disagreed, 3 were undecided, 10 agreed, and 25 strongly agreed to the statement. In other words, 7.89 percent of the students strongly disagreed, 39.45 percent agreed, 21.04 percent agreed, and 31.56 percent strongly agreed.

Data Interpretation:

The statement "Online learning through MOODLE makes me more responsible for my studies" is supported by the fact that it was responded to by 20 students out of 38; the percentage is 53. No one respondent disagreed, which means online learning through MOODLE makes students more responsible for their studies, which is interesting and supports learning. The percentage of observed data cannot be accurately interpreted, so goodness-of-fit tests help determine if the observed data aligns with what is expected. Decisions can be made based on the outcome of the hypothesis test.

Table No. 4.43 shows the responses and percentage for the statement "I believe Classroom learning is effective than online learning."

	Strongly disagree	Disagree	Neutral	Agree	Strongly Agree	Total
Responses	7	11	12	5	3	**38**
Percentage	**18.41%**	**28.93%**	**31.56%**	**13.15%**	**7.89%**	**100%**

Data Analysis:

Table No. 4.43 discloses the responses to "I believe classroom learning is more effective than online learning". There were a total of 38 students in the experimental group; it was found that 7 strongly disagreed, 11 disagreed, 12 were undecided, 5 agreed,and 3 strongly with the statement In other words, 18.41 percent of the students strongly disagreed, 28.93 disagreed, 31.56 were neutral, 13.15 percent agreed, and 7.89 percent strongly agreed.

Data Interpretation:

The statement "I believe classroom learning is more effective than online learning" is supported by the fact that it was responded to by 18 students out of 38; the percentage is 47. This means the students did not believe classroom learning was more effective than online learning, which is an ambivalent response. The percentage of observed data cannot be accurately interpreted, so goodness-of-fit tests help determine if the observed data aligns with what is expected. Decisions can be made based on the outcome of the hypothesis test.

Table No. 4.44 Chi-Square-Test for goodness of fit (for Items No. 1 to 5)

Item No	N	Chi-Square Statistic Value	Effect size phi	Significance (2-Sided)
1	38	58.579	1.24	0.000
2	38	47.789	1.12	0.000
3	38	46.474	1.11	0.000
4	38	20.158	0.73	0.000
5	38	7.789	0.45	0.135

The goodness-of-fit chi-square test is a statistical test used to determine whether the observed frequencies of a variable match the expected frequencies derived from a theoretical distribution. For items no. 1 to 5, the test resulted in a Chi-Square statistic with 4 degrees of freedom, which is not in the 95% region of acceptance (9.4877). The observed effect size phi is large, except at item no. 5 which is medium. This indicates that the magnitude of the difference between the observed andexpected data is large.

The p-value of 0.000 for items no 1 to 4 indicates that the probability of obtaining a Chi-Square statistic assuming the null hypothesis that the observed data fit the expected distribution, is very low. There is evidence to state that the observation of this sample may be the same as that of the population.

Findings: Based on the results of the Chi-Square test the p-value for the item at no. 1 to 4 in the students' attitude scale is calculated as 0.000 for each item and the p-value ($p < 0.05$) is below the chosen significance level, the null hypothesis - There is no significant difference in attitude towards Blended Learning Strategies concerning online learning among the grade VIII students is rejected.

Based on the results of the Chi-Square test the p-value for the item at no. 5 in the students' attitude scale is calculated as 0.135 and the p-value ($p > 0.05$) is above the chosen significance level. However, the statement **"I believe Classroom learning is more effective than online learning."** is a negative statement which means that the students found Blended Learning classroom to be effective. Hence the null hypothesis - There is no significant difference in attitude towards Blended Learning Strategies concerning online learning among the grade VIII students is rejected

Conclusion: The findings of the study reveal that the students (about 80%) found online learning through MOODLE better as it encouraged them to study, and made them more responsible in the context of studying. However, about 20% of students did not agree with the statements.

H_9:- There is no significant difference in attitude towards Blended Learning Strategies concerning classroom learning among the grade VIII students.

Table No. 4.45 shows the responses and percentage for the statement "I like to learn in a group, but I can learn on my own as well."

	Strongly disagree	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**	**Total**
Responses	0	1	8	21	8	**38**
Percentage	**0.00%**	**2.63%**	**21.04%**	**55.23%**	**21.04%**	**100%**

Data Analysis:

Table No. 4.45 discloses the responses to "I like to learn in a group, but I can learn on my own as well". There was a total of 38 students in the experimental group; it was found that no one responded to Strongly disagree, 1 disagreed, 8 were undecided, 21 agreed, and 8

strongly agreed to the statement. In other words, 2.63 percent of the students disagreed, 21.04 neutral, 55.23 percent agreed, and 21.04 percent strongly agreed.

Data Interpretation:

The statement "I like to learn in a group, but I can learn on my own as well" is supportedby the fact that it was responded to by 35 students out of 38; the percentage is 92. No one respondent strongly disagreed, which means the students like to learn in a group but can also learn on their own, which is interesting and supports learning. The percentage of observed data cannot be accurately interpreted, so goodness-of-fit tests help determine if the observed data aligns with what is expected. Decisions can be made based on the outcome of the hypothesis test.

Table No. 4.46 shows the responses and percentage for the statement "I find learning through discussionwith others is more effective."

	Strongly disagree	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**	**Total**
Responses	0	4	25	9	0	**38**
Percentage	**0.00%**	**10.52%**	**65.75%**	**23.67%**	**0.00%**	**100%**

Data Analysis:

Table No. 4.46 discloses the responses to "I find learning through discussion with others is more effective". There was a total of 38 students in the experimentalgroup; it was found that no one responded to Strongly disagree, 4 disagreed, 25 were undecided, 9 agreed, and no one strongly agreed to the statement. In other words, 10.52 percent of the students disagreed, 65.75 were neutral, and 23.67 percent agreed.

Data Interpretation:

The statement "I find learning through discussion with others is more effective" is

supported by the fact that it was responded to by 25 students out of 38; the percentage is 66. No one respondent strongly disagreed or strongly agreed, which means the students find learning through discussion with others not effective, which is an ambivalent response. The percentage of observed data cannot be accurately interpreted, so goodness-of-fit tests help determine if the observed data aligns with what is expected. Decisions can be made based on the outcome of the hypothesis test.

Table No.4.47 shows the responses and percentage for the statement "I learn better through demonstrated activities".

	Strongly disagree	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**	**Total**
Responses	0	0	10	18	10	**38**
Percentage	**0.00%**	**0.00%**	**26.30%**	**47.34%**	**26.30%**	**100%**

Data Analysis:

Table No. 4.47 discloses the responses to "I learn better through demonstrated activities". There were a total of 38 students in the experimental group; it was found that no one responded to Strongly disagree and disagree, 10 were undecided, 18 agreed, and 10 strongly agreed to the statement.In other words, 26.30 percent of the students were neutral, 47.34 percent agreed, and 26.30 percent strongly agreed.

Data Interpretation:

The statement "I learn better through demonstrated activities" is supported by the fact that it was responded to by 28 students out of 38; the percentage is 64. No one respondent strongly disagreed or disagreed, which means the students learn better throughdemonstrated activities that are interesting and support learning. The percentage of observed data cannot

be accurately interpreted, so goodness-of-fit tests help determine if the observed data aligns with what is expected. Decisions can be made based on the outcome of the hypothesis test.

Table No. 4.48 Chi-Square Tests for goodness of fit (for Items No. 6 to 8)

Item No	N	Chi-Square Statistic Value	Effect size phi	Significance (2-Sided)
6	38	37.000	0.99	0.000
7	38	57.000	1.23	0.000
8	38	30.947	0.90	0.000

The goodness-of-fit chi-square test is a statistical test used to determine whether the observed frequencies of a variable match the expected frequencies derived from a theoretical distribution. For items no. 6 to 8, the test resulted in a Chi-Square statistic with 4 degrees of freedom, which is not in the 95% region of acceptance (9.4877). The observed effect size phi is large. This indicates that the magnitude of the difference between the observed andexpected data is large.

The p-value of 0.135 indicates that the probability of obtaining a Chi-Square statistic assuming the null hypothesis that the observed data fit the expecteddistribution, is very low. There is evidence to state that the observation of this sample may be the same as that of the population.

Findings: Based on the results of the Chi-Square test the p-value for the item at no. 6 to 8 is calculated as 0.000 for each item and since the p-value ($p < 0.05$) is below the chosen significance level, the null hypothesis - There is no significant difference in attitude towards Blended Learning Strategies concerning classroom learning among the grade VIII students is rejected.

Conclusion: Concerning classroom learning the findings of the study show that, students prefer to be with classmates in a face-to-face situation, which is human nature to be in the groups. The students found that the demonstrations in actual situations are more appealing as far as skills development is concerned.

H_{10}: - There is no significant difference in attitude towards Blended Learning Strategies concerning online interaction among the grade VIII students.

Table No. 4.49 shows the responses and percentage for the statement "I was able to communicateeffectively with others using online technologies (e.g. chat, discussion forum)".

	Strongly disagree	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**	**Total**
Responses	2	5	4	18	9	**38**
Percentage	**5.26%**	**13.15%**	**10.52%**	**47.34%**	**23.67%**	**100%**

Data Analysis:

Table No. 4.49 discloses the responses to "I was able to communicate effectively with others using online technologies (e.g., chat, discussion forum)." There was atotal of 38 students in the experimental group; it was found that 2 strongly disagreed, 5 disagreed, 4 were undecided, 18 agreed, and 9 strongly agreed to the statement.In other words, 5.26 percent of the students strongly disagreed, 13.15 disagreed, 10.52 were neutral, 47.34 percent agreed, and 23.67 percent strongly agreed.

Data Interpretation:

The statement "I was able to communicate effectively with others using online technologies (e.g., chat, discussion forum)" is supported by the fact that it was responded to by 27

students out of 38; the percentage is 71. This means the students were able to communicate effectively with others using online technologies like chat, discussion forums, etc., which is interesting and supports learning. The percentage of observed data cannot be accurately interpreted, so goodness-of-fit tests help determine if the observed data aligns withwhat is expected. Decisions can be made based on the outcome of the hypothesis test.

Table No. 4.50 shows the responses and percentage for the statement "I was able to contact my teachereasily online"

	Strongly disagree	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**	**Total**
Responses	1	0	9	12	16	**38**
Percentage	**2.63%**	**0.00%**	**23.67%**	**31.56%**	**42.08%**	**100%**

Data Analysis:

Table No. 4.50 discloses the responses to "I was able to contact my teacher easily online". There was a total of 38 students in the experimental group, and it has been found that one responded to Strongly disagree, one responded to disagree, 9 were undecided, 12 agreed, and 16 strongly agreed to the statement. In other words, 2.63 percent of the students strongly disagreed, 23.67 percent were neutral, 31.56 percent agreed, and 42.08 percent strongly agreed.

Data Interpretation:

The statement " I was able to contact my teacher easily online " is supported by the factthat it was responded to by 28 students out of 38; the percentage is 75. No one respondent disagreed, which means that the students were able to contact their teacher easily online, which is interesting and supports learning. The percentage of observed data cannot be

accurately interpreted, so goodness-of-fit tests help determine if the observed data aligns withwhat is expected. Decisions can be made based on the outcome of the hypothesis test.

Table No. 4.51 shows the responses and percentage for the statement "I was able to express myself clearly online through my writing"

	Strongly disagree	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**	**Total**
Responses	0	0	3	15	20	**38**
Percentage	**0.00%**	**0.00%**	**7.89%**	**39.45%**	**52.60%**	**100%**

Data Analysis:

Table No. 4.51 discloses the responses to "I was able to express myself online through my writing". There was a total of 38 students in the experimental group;it was found that no one responded to Strongly disagree and disagree, 3 were undecided, 15 agreed, and 20 strongly agreed to the statement. In other words, 7.89 percent of the students were neutral, 39.45 percent agreed, and 52.60 percent strongly agreed.

Data Interpretation:

The statement "I was able to express myself online through my writing" is supported by the fact that it was responded to by 35 students out of 38; the percentage is 92. No one respondent strongly disagreed or disagreed, which means the students were able to express themselves online through their writing, which is interesting and supports learning. The percentage of observed data cannot be accurately interpreted, so goodness-of-fit tests help determine if the observed data aligns with what is expected.Decisions can be made based on the outcome of the hypothesis test.

Table. No. 4.52 Chi-Square Tests for goodness of fit (for Items No. 9 to 11)

Item No	N	Chi-Square Statistic Value	Effect size phi	Significance (2-Sided)
9	38	21.210	0.75	0.000
10	38	25.421	0.82	0.000
11	38	45.421	1.09	0.000

The goodness-of-fit chi-square test is a statistical test used to determine whether the observed frequencies of a variable match the expected frequencies derived from a theoretical distribution. For items no. 9 to 11, the test resulted in a Chi-Square statistic with 4 degrees offreedom, which is not in the 95% region of acceptance (9.4877). The observed effect size phi is large. This indicates that the magnitude of the difference between the observed and expected data is large.

The p-value of 0.000 indicates that the probability of obtaining a Chi-Square statistic assuming the null hypothesis that the observed data fit the expected distribution, is very low. There is evidence to state that the observation of this samplemay be the same as that of the population in that students were able to express themselves online through their writing.

Findings: Based on the results of the Chi-Square test the p-value for the item at no. 9 t0 11 is calculated as 0.000 for each item and since the p-value ($p < 0.05$) is below the chosen significance level, the null hypothesis -There is no significant difference in attitude towards Blended Learning Strategies concerning online interaction among the grade VIII students is rejected.

Conclusion: With regards to online interaction, the findings of the study identified that the students were comfortable as online communication with peers and teachers was easy. Also,

the students could express themselves online clearly which helps boost their self-confidence further.

H_{11}: - There is no significant difference in attitude towards Blended Learning Strategies concerning technology among the grade VIII students.

Table No. 4.53 shows the responses and percentage for the statement "I am comfortable using my mobile".

	Strongly disagree	Disagree	Neutral	Agree	Strongly Agree	Total
Responses	0	5	1	6	26	**38**
Percentage	**0.00%**	**13.15%**	**2.63%**	**15.78%**	**68.38%**	**100%**

Data Analysis:

Table No. 4.53 discloses the responses to "I am comfortable using my mobile". There were a total of 38 students in the experimental group; it was found that noone responded to Strongly disagree, 5 disagreed, 1 was undecided, 6 agreed, and 26 strongly agreed to the statement. In other words, 13.15 percent of the students disagreed, 2.63 neutral, 15.78 percent agreed, and 68.38 percent strongly agreed.

Data Interpretation:

The statement "I am comfortable using my mobile" is supported by the fact that it was responded to by 32 students out of 38; the percentage is 84. No one respondent strongly disagreed, which means the students were comfortable using their mobile devices for MOODLE and online learning, which is interesting and supports learning. The percentage of observed data cannot be accurately interpreted, so goodness-of-fit tests help determine if the observed data aligns with what is expected. Decisions can be made based on the outcome of the hypothesis test.

Table No. 4.54 shows the responses and percentage for the statement "I believe MOODLE is a usefulplatform for learning."

	Strongly disagree	Disagree	Neutral	Agree	Strongly Agree	Total
Responses	2	0	14	5	17	**38**
Percentage	**5.26%**	**0.00%**	**36.82%**	**13.15%**	**44.71%**	**100%**

Data Analysis:

Table No. 4.54 discloses the responses to "I believe MOODLE is a useful platform for learning". There were a total of 38 students in the experimental group; it wasfound that 2 Strongly disagreed, no one disagreed, 14 were undecided, 5 agreed, and 17 strongly agreed with the statement. In otherwords, 5.26 percent of the students were strongly disagreed, 36.82 neutral, 13.15 percent agreed, and 44.71 percent strongly agreed.

Data Interpretation:

The statement "I believe MOODLE is a useful platform for learning" is supported by the fact that it was responded to by 22 students out of 38; the percentage is 58. No one respondent disagreed, which means the students believe MOODLE is a useful platform for learning, is interesting and supports learning. The percentage of observed data cannot be accurately interpreted, so goodness-of-fit tests help determine if the observed data aligns withwhat is expected. Decisions can be made based on the outcome of the hypothesis test.

Table No. 4.55 shows the responses and percentage for the statement "I am comfortable using the MOODLE app."

	Strongly disagree	Disagree	Neutral	Agree	Strongly Agree	Total
Responses	0	2	10	12	14	**38**
Percentage	**0.00%**	**5.26%**	**26.30%**	**31.56%**	**36.82%**	**100%**

Data Analysis:

Table No. 4.55 discloses the responses to "I am comfortable using the MOODLEapp". There were a total of 38 students in the experimental group; it was found that no one responded to Strongly disagree, 2 disagreed, 10 were undecided, 12 agreed, and 14 strongly agreed to the statement In other words, 5.26 percent of the students disagreed, 26.30 neutral, 31.56 percent agreed, and 36.82 percent strongly agreed.

Data Interpretation:

The statement "I am comfortable using the MOODLE app" is supported by the fact that it was responded to by 26 students out of 38; the percentage is 68. No one respondent strongly disagreed, which means the students were comfortable while using the MOODLE app, which is interesting and supports learning. The percentage of observed data cannot be accurately interpreted, so goodness-of-fit tests help determine if the observed data aligns withwhat is expected. Decisions can be made based on the outcome of the hypothesis test.

Table No. 4.56 shows the responses and percentage for the statement "I think we should use the MOODLE app in learning."

	Strongly disagree	Disagree	Neutral	Agree	Strongly Agree	Total
Responses	0	0	8	19	11	**38**
Percentage	**0.00%**	**0.00%**	**21.04%**	**49.97%**	**28.93%**	**100%**

Data Analysis:

Table No. 4.56 discloses the responses to "I think we should use MOODLEapp in learning". There were a total of 38 students in the experimental group; it was foundthat no one responded to Strongly disagree and disagree, 8 were undecided, 19 agreed, and 11strongly agreed. In other words,21.04 percent of the students were neutral, 49.97 percent agreed, and 28.93 percent strongly agreed.

Data Interpretation:

The statement "I think we should use the MOODLE app in learning" is supported by the fact that it was responded to by 30 students out of 38; the percentage is 79. No one respondent strongly disagreed or disagreed, which means the students should use the MOODLE app for learning because it is interesting and supports learning. The percentage of observed data cannot be accurately interpreted, so goodness-of-fit tests help determine if the observed data aligns with what is expected. Decisions can be made based on the outcome of the hypothesis test.

Table No. 4.57 shows the responses and percentage for the statement "I am comfortable in using the MOODLE app to exchange knowledge with others."

	Strongly disagree	Disagree	Neutral	Agree	Strongly Agree	Total
Responses	0	1	6	7	24	**38**
Percentage	**0.00%**	**2.63%**	**15.78%**	**18.41%**	**63.12%**	**100%**

Data Analysis:

Table No.4.57 discloses the responses to "I am comfortable in using the MOODLE app to exchange knowledge with others". There were a total of 38 students in the experimental group; it was found that no one responded to Strongly disagree, 1 disagreed, 6 were undecided, 7 agreed, and 24 strongly agreed to the statement. In other words, 2.63 percent of the studentsdisagreed, 15.78 neutral, 18.41 percent agreed, and 63.12 percent strongly agreed.

Data Interpretation:

The statement "I am comfortable using the MOODLE app to exchange knowledge with others" is supported by the fact that it was responded to by 31 students out of 38; the percentageis 82. No one respondent strongly disagreed, which means the students were comfortable using the MOODLE app to exchange knowledge with others, which is interesting and supports learning. The percentage of observed data cannot be accurately interpreted, so goodness-of-fit tests help determine if the observed data aligns with what is expected.Decisions can be made based on the outcome of the hypothesis test.

Table No. 4.58 Chi-Square Tests for goodness of fit (for Items No. 12 to 16)

Item No	N	Chi-Square Statistic Value	Effect size phi	Significance (2-Sided)
12	38	59.105	1.25	0.000
13	38	29.632	0.88	0.000
14	38	20.421	0.73	0.000
15	38	33.842	0.94	0.000
16	38	49.105	1.14	0.000

The goodness-of-fit chi-square test is a statistical test used to determine whether the observed frequencies of a variable match the expected frequencies derived from a theoretical distribution. For items no 12 to 16, the test resulted in a Chi-Square statistic with 4 degrees offreedom, which is not in the 95% region of acceptance (9.4877). The observed effect size phi is large. This indicates that the magnitude of the difference between the observed and expected data is large.

The p-value of 0.000 indicates that the probability of obtaining a Chi-Square statistic assuming the null hypothesis that the observed data fit the expected distribution, is very low. There is evidence to state that the observation of this samplemay be the same as that of the population.

Findings: Based on the results of the Chi-Square test the p-value for the item at no. 12 to 16 is calculated as 0.000 for each item and since the p-value ($p < 0.05$) is below the chosen significance level, the null hypothesis -There is no significant difference in attitude towards Blended Learning Strategies concerning technology among the grade VIII students is rejected.

Conclusion: The findings of the study concerning technology reveal that the use of technology has enhanced the skills of using the mobile, MOODLE app which in turn facilitated the students to interact and exchange the knowledge acquired with other students.

H_{12}: - There is no significant difference in attitude towards Blended Learning Strategies concerning learning flexibility among the grade VIII students.

Table No. 4.59 shows the responses and percentage for the statement "I can have unlimited access toonline material"

	Strongly disagree	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**	**Total**
Responses	0	3	8	25	2	**38**
Percentage	**0.00%**	**7.89%**	**21.04%**	**65.75%**	**5.26%**	**100%**

Data Analysis:

Table No. 4.59 discloses the responses to "I can have unlimited access toonline material". There was a total of 38 students in the experimental group; it was foundthat no one responded to Strongly disagree, 3 disagreed, 8 were undecided, 25 agreed, and 2 strongly agreed to the statement. In other words,7.89 percent of the students disagreed, 21.04 percent were neutral, 65.75 percent agreed, and 5.26 percent strongly agreed.

Data Interpretation:

The statement "I like online learning through MOODLE as it provides more information" is supported by the fact that it was responded to by 27 students out of 38; the percentage is 71.No one respondent strongly disagreed, which means the students can have unlimited access to online material that is interesting and supports learning. The percentage of observed data cannot be accurately interpreted, so goodness-of-fit tests help determine if

the observed data aligns with what is expected. Decisions can be made based on the outcome of the hypothesis test.

Table No. 4.60 shows the responses and percentage for the statement "I would like to decide where Iwant to study."

	Strongly disagree	Disagree	Neutral	Agree	Strongly Agree	Total
Responses	0	0	3	28	7	**38**
Percentage	**0.00%**	**0.00%**	**7.89%**	**73.64%**	**18.41%**	**100%**

Data Analysis:

Table No. 4.60 discloses the responses to "I would like to decide whereI want to study". There was a total of 38 students in the experimental group; it was foundthat no one responded to Strongly disagree and disagree, 3 were undecided, 28 agreed, and 7 strongly agreed to the statement. In other words,7.89 percent of the students were neutral, 73.64 percent agreed, and 18.41 percent strongly agreed.

Data Interpretation:

The statement "I would like to decide where I want to study" is supported by the fact that it was responded to by 35 students out of 38; the percentage is 92. No one respondent strongly disagreed or disagreed, which means the students would like to decidewhere they want to study, which is interesting and supports learning. The percentage of observed data cannot be accurately interpreted, so goodness-of-fit tests help determine if the observed data aligns with what is expected. Decisions can be made based on the outcome of the hypothesis test.

Table No. 4.61 shows the responses and percentage for the statement "I like to study at my speed."

	Strongly disagree	Disagree	Neutral	Agree	Strongly Agree	Total
Responses	0	0	4	12	22	**38**
Percentage	**0.00%**	**0.00%**	**10.52%**	**31.56%**	**57.86%**	**100%**

Data Analysis:

Table No. 4.61 discloses the responses to "I like to study at my speed". There was a total of 38 students in the experimental group; it was found that no one responded to Strongly disagree and disagree, 14 were undecided, 12 agreed, and 22 strongly agreed to the statement. In other words, 10.52 percentof the students were neutral, 31.56 percent agreed, and 57.86 percent strongly agreed.

Data Interpretation:

The statement "I like to study at my speed" is supported by the fact that it was responded to by 34 students out of 38; the percentage is 89. No one respondent strongly disagreed or disagreed, which means the students like to study at their own pace, whichis interesting and supports learning. The percentage of observed data cannot be accurately interpreted, so goodness-of-fit tests help determine if the observed data aligns with what is expected. Decisions can be made based on the outcome of the hypothesis test.

Table No. 4.62 shows the responses and percentage for the statement "I would like to decide when I want to study."

	Strongly disagree	Disagree	Neutral	Agree	Strongly Agree	Total
Responses	4	0	0	17	17	**38**
Percentage	**10.52%**	**0.00%**	**0.00%**	**44.71%**	**44.71%**	**100%**

Data Analysis:

Table No. 4.62 discloses the responses to "I would like to decide when Iwant to study". There was a total of 38 students in the experimental group; it was found that 4 Strongly disagreed, no one responded to disagree and undecided, 17 agreed, and 17strongly agreed to the statement. In other words,10.52 percent of the students strongly disagreed, 44.71 percent agreed, and 44.71 percentstrongly agreed.

Data Interpretation:

The statement "I would like to decide when I want to study" is supported by the fact that it was responded to by 34 students out of 38; the percentage is 89. No one respondent disagreed or was neutral, which means the students would like to decide when theywant to study, which is interesting and supports learning. The percentage of observed data cannot be accurately interpreted, so goodness-of-fit tests help determine if the observed data aligns with what is expected. Decisions can be made based on the outcome of the hypothesis test.

Table No. 4.63 Chi-Square Tests for goodness of fit (for Items No. 17 to 20)

Item No	N	Chi-Square Statistic Value	Effect size phi	Significance (2-Sided)
17	38	54.368	1.20	0.000
18	38	72.789	1.38	0.000
19	38	46.737	1.11	0.000
20	38	40.158	1.03	0.000

The goodness-of-fit chi-square test is a statistical test used to determine whether the observed frequencies of a variable match the expected frequencies derived from a theoretical distribution. For items at No. 17 to 20 the test resulted in a Chi-Square statistic with 4 degrees offreedom, which is not in the 95% region of acceptance (9.4877). The observed effect size phi is large. This indicates that the magnitude of the difference between the observed and expected data is large.

The p-value of 0.000 indicates that the probability of obtaining a Chi-Square statistic assuming the null hypothesis that the observed data fit the expected distribution, is very low. There is evidence to state that the observation of this samplemay be the same as that of the population in that students would like to decide when they wantto study.

Findings: Based on the results of the Chi-Square test the p-value for the item at no. 17 to 20 is calculated as 0.000 for each item and since the p-value ($p < 0.05$) is below the chosen significance level, the null hypothesis -There is no significant difference in attitude towards Blended Learning strategies concerning learning flexibility among the grade VIII students is rejected.

Conclusion: Concerning learning flexibility, the findings of the study show that students were stress-free as decision-making about what, when, and where to study was easy. This is an advantageous mental state for learning.

H_{13}: - There is no significant difference in attitude toward Blended Learning Strategies concerning the online environment among grade VIII students.

Table No. 4.64 shows the responses and percentage for the statement "I get bored when studying online."

	Strongly disagree	Disagree	Neutral	Agree	Strongly Agree	Total
Responses	9	10	6	2	11	**38**
Percentage	**23.67%**	**26.30%**	**15.78%**	**5.26%**	**28.93%**	**100%**

Data Analysis:

Table No. 4.64 discloses the responses to "I get bored when studying online". There were a total of 38 students in the experimental group; it was found that 9 strongly disagreed, 10 disagreed, 6 were undecided, 2 agreed, and 11 strongly agreed to the statement. In other words, 23.67 percent of the students strongly disagreed, 26.30 percent disagreed, 15.78 percent were neutral, 5.26 percent agreed, and 28.93 percent strongly agreed.

Data Interpretation:

The statement "I get bored when studying online" is supported by the fact that it was responded to by 19 students out of 38; the percentage is 50. This means the students do not get bored when studying online, which is interesting and supports learning. The percentage ofobserved data cannot be accurately interpreted, so goodness-of-fit tests help determine if the observed data aligns with what is expected. Decisions can be made based on the

outcome of the hypothesis test.

Table No. 4.65 shows the responses and percentage for the statement "I find it very difficult to study online."

	Strongly disagree	Disagree	Neutral	Agree	Strongly Agree	Total
Responses	9	16	4	3	6	**38**
Percentage	**23.67%**	**42.08%**	**10.52%**	**7.89%**	**15.78%**	**100%**

Data Analysis:

Table No. 4.65 discloses the responses to "I find it very difficult to studyonline". There was a total of 38 students in the experimental group; it was found that 9 strongly disagreed, 16 disagreed, 4 were undecided, 3 agreed, and 6 strongly agreed to the statement. In other words, 23.67 percent of the students strongly disagreed, 42.08 percent disagreed, 10.52 percent were neutral, 7.89 percent agreed, and 15.78percent strongly agreed.

Data Interpretation:

The statement "I find it very difficult to study online" is supported by the fact that it was responded to by 25 students out of 38; the percentage is 66. This means the students didnot find it very difficult to study online, which is interesting and supports learning. The percentage of observed data cannot be accurately interpreted, so goodness-of-fit tests help determine if the observed data aligns with what is expected. Decisions can be made based on the outcome of the hypothesis test.

Table No. 4.66 shows the responses and percentage for the statement "I am more likely to missassignment due dates in an online environment."

	Strongly disagree	Disagree	Neutral	Agree	Strongly Agree	Total
Responses	8	18	6	2	4	**38**
Percentage	**21.04%**	**47.34%**	**15.78%**	**5.26%**	**10.52%**	**100%**

Data Analysis:

Table No. 4.66 discloses the responses to "I am more likely to miss assignment due dates in an online environment". There was a total of 38 students in the experimental group; it was found that 8 strongly disagreed, 18 disagreed, 6 were undecided,2 agreed, and 4 strongly agreed to the statement. In other words, 21.04 percent of the students strongly disagreed, 47.34 percent disagreed, 15.78 percent were neutral, 5.26 percent agreed, and 10.52 percent stronglyagreed.

Data Interpretation:

The statement "I am more likely to miss assignment due dates in an online environment"is supported by the fact that it was responded to by 26 students out of 38; the percentage is 68.This means the students were more likely to not miss assignment due dates in an online environment that is interesting and supports learning. The percentage of observed data cannot be accurately interpreted, so goodness-of-fit tests help determine if the observed data alignswith what is expected. Decisions can be made based on the outcome of the hypothesis test.

Table No. 4.67 shows the responses and percentage for the statement "I feel alone in an online environment".

	Strongly disagree	Disagree	Neutral	Agree	Strongly Agree	Total
Responses	7	23	4	3	1	**38**
Percentage	**18.41%**	**60.49%**	**10.52%**	**7.89%**	**2.63%**	**100%**

Data Analysis:

Table No. 4.67 discloses the responses to "I feel alone in an online environment". There was a total of 38 students in the experimental group; it was found that 7 strongly disagreed, 23 disagreed, 4 were undecided, 3 agreed, and 1 strongly agreed to the statement. In other words, 18.41 percent of the studentsstrongly disagreed, 60.49 percent disagreed, 10.52 percent were neutral, 7.89 percent agreed, and 2.63 percent strongly agreed.

Data Interpretation:

The statement "I feel alone in an online environment" is supported by the fact that it was responded to by 30 students out of 38; the percentage is 79. This means the students didnot feel alone in an online environment, which is interesting and supports learning. The percentage of observed data cannot be accurately interpreted, so goodness-of-fit tests help determine if the observed data aligns with what is expected. Decisions can be made based on the outcome of the hypothesis test.

Table No. 4.68 Chi-Square Tests for goodness of fit (for Items No. 21 to 24)

Item No	N	Chi-Square Statistic Value	Effect size phi	Significance (2-Sided)
21	38	7.158	0.43	0.136
22	38	14.368	0.61	0.000
23	38	20.421	0.73	0.000
24	38	41.474	1.04	0.000

The goodness-of-fit chi-square test is a statistical test used to determine whether the observed frequencies of a variable match the expected frequencies derived from a theoretical distribution. For items No. 21 to 24, the test resulted in a Chi-Square statistic with 4 degrees offreedom, which is not in the 95% region of acceptance (9.4877). The observed effect size phi is large. This indicates that the magnitude of the difference between the observed and expected data is large.

The p-value of 0.000 indicates that the probability of obtaining a Chi-Square statistic assuming the null hypothesis that the observed data fit the expected distribution, is very low. There is evidence to state that the observation of this samplemay be the same as that of the population in that students did not feel alone in an online environment.

Findings: Based on the results of the Chi-Square test the p-value for the item at no. 21 to 24 in the students' attitude scale is calculated as 0.000 for each item and since the p-value ($p < 0.05$) is below the chosen significance level, the null hypothesis - There is no significant difference in attitude towards Blended Learning Strategies concerning the online environment among the grade VIII students is rejected.

Based on the results of the Chi-Square test the p-value for the item at no. 21 in the students' attitude scale is calculated as 0.135 and the p-value ($p > 0.05$) is above the chosen significance level. However, considering that the statement **"I feel alone in an online environment"** is negative, it means that the students were not getting bored when taught using Blended Learning Strategies. Hence the null hypothesis - There is no significant difference in attitude towards Blended Learning Strategies concerning the online environment among the grade VIII students is rejected.

Conclusion: As far as the online environment is concerned, about 33% of the respondents were inclined to the negative side. This percentage is less than 40% and can be considered as good as negligible. The same can be considered as the normal human tendency.

Overall conclusion about students' attitude towards Blended Learning: Grade VIII students demonstrated a positive attitude towards Blended Learning Strategies, identifying the benefits of integrating online and classroom elements. Students' optimistic viewpoint towards online learning, classroom interaction, technology integration, learning flexibility, and the online environment highlight the effectiveness of Blended Learning Strategies in meeting the varied needs and preferences of present learners.

DISCUSSION

Students usually display a positive attitude towards the online components of Blended Learning because online learning permits students to access content from anywhere. The use of multimedia (videos, podcasts, interactive simulations) in online modules can make learning more appealing and can accommodate to different learning styles. While the digital aspects are frequently highlighted, the conventional classroom element is equally valued for face-to-face interactions with peers and teachers to help build relationships and enhance learning through direct engagement and instant feedback. Despite physical distances, online

forums, chat groups, and virtual meetings let students feel connected with peers. Regular use of technology helps students build digital skills that are vital in the modern digital world. Students value the ability to control their learning pace, which allows students to devote more time on exciting concepts and advance swiftly through familiar material. Learning resources and support are available around the clock, allowing students to learn according to their schedules. Many research findings support the attitude towards Blended Learning Strategies for teaching and learning purposes.

Alseweed (2013) investigated the attitude of the students toward using conventional learning, Blended Learning, and virtual class learning at the university level. The results of the study reveal that there is a significant difference in students' attitudes in favor of Blended Learning. Fakhir, Z., & Ibrahim, M. (2018) conducted a study on how effective Blended Learning is when implemented in a class of grade 6 students being taught English.

The results revealed that blended learning was an effective strategy for teaching English to grade 6 students and had a positive effect on the attitudes of the sixth-grade students towards Blended Learning.

Ja'ashan, M. M. N. H. (2015) in the case study conducted at the University of Bisha studied students' perceptions and attitudes towards Blended Learning for English Courses. The findings of the study revealed a positive attitude of students towards Blended Learning in terms of the three domains in the questionnaire. Najeh Rajeh Alsalhi, et. al (2019) Investigated the effects of Blended Learning on ninth-grade students' attitudes toward using it. The findings of the study revealed that the experimental group's attitude was more positive towards using Blended Learning. Zhu, Au & Yates (2013) studied University students' attitudes toward online learning in a Blended Learning environment. At the end of the course, the students were found out to be more positive toward online learning. Alekya

Ch (2018) studied the attitude and perception towards the Blended Learning approach among English language teachers in secondary schools of north coastal districts of Andhra Pradesh. The findings of the research revealed a positive effect on attitudes towards the Blended Learning approach among English language teachers in secondary schools of north coastal districts of Andhra Pradesh.

CHAPTER V

SUMMARY AND MAJOR FINDINGS

The chapter presents an overview of the study, objectives, hypothesis, major findings, and suggestions for future research.

5.1 OVERVIEW

The study was carried out to find the effectiveness of Blended Learning on the academic achievement of grade VIII students in science. Suitable technology and pedagogical practices were identified to design and develop Blended Learning Strategies for students of the experimental group. An achievement test on science for grade VIII students was also developed to be administered to experimental and control groups. An attempt was made to study the students' perception of Blended Learning concerning content provided, technology benefits and satisfaction, and Students' attitudes towards Blended Learning concerning online learning, classroom learning, online interaction, technology, learning flexibility, and online environment after implementation of the strategies.

5.2 OBJECTIVES OF THE STUDY

1. To design and develop Blended Learning Strategies by identifying suitable technology and pedagogical practices for teaching selected concepts in science from the prescribed course of study at grade VIII.
2. To study the effectiveness of Blended Learning Strategies on the academic achievement of grade VIII students in science.
3. To compare the effectiveness of Blended Learning Strategies and Conventional methods of the teaching-learning process on academic achievement of grade VIII students in science.
4. To study the perception of the grade VIII students of the Blended Learning Strategy concerning content provided, technology benefit, and satisfaction.

5. To find the attitude of the grade VIII students towards the Blended Learning Strategy concerning online learning, classroom learning, online interaction, technology, learning flexibility, and online environment.

5.3 HYPOTHESES OF THE STUDY

1) There is no significant difference in pre-test and post-test scores of grade VIII students in science taught using Blended Learning Strategies.
2) There is no significant difference in pre-test scores of grade VIII students in science taught using Blended Learning Strategies and conventional methods of teaching.
3) There is no significant difference in post-test scores of grade VIII students in science taught using Blended Learning Strategies and conventional methods of teaching.
4) There is no significant difference in pre-test and post-test scores of grade VIII students in science-taught conventional methods of teaching.
5) There is no significant difference in perception of Blended Learning strategies concerning content among the grade VIII students.
6) There is no significant difference in perception of Blended Learning strategies concerning technology benefits among grade VIII students.
7) There is no significant difference in perception of Blended Learning Strategies concerning satisfaction among the grade VIII students.
8) There is no significant difference in attitude towards Blended Learning strategies concerning online learning among grade VIII students.
9) There is no significant difference in attitude towards Blended Learning Strategies concerning classroom learning among the grade VIII students.
10) There is no significant difference in attitude towards Blended Learning strategies concerning online interaction among the grade VIII students.

11) There is no significant difference in attitude towards Blended Learning strategies concerning technology among the grade VIII students.
12) There is no significant difference in attitude towards Blended Learning strategies concerning learning flexibility among the grade VIII students.
13) There is no significant difference in attitude towards Blended Learning Strategies concerning the online environment among the grade VIII students.

5.4 REVIEW OF RELATED LITERATURE AND STUDIES

In all, 79 research studies were reviewed. They were categorised under the heads of studies related to Blended Learning conducted in India. (22 Studies), Studies related to Blended Learning conducted outside of India. (25 Studies), Studies related to Blended Learning and academic achievement in science conducted in India. (15 Studies), Studies related to Blended Learning and academic achievement in science conducted outside of India. (07 studies), Studies related to the Perception of Blended Learning conducted in India. (04 studies), Studies related to the Perception of Blended Learning were conducted outside of India. (05 studies), Studies related to attitudes towards Blended Learning conducted in India. (03 Studies), Studies related to attitudes towards blended learning were conducted outside of India (05 Studies). 39 studies were conducted in India, and 40 studies were conducted outside of India.

The studies related to Academic Achievement were 31 in number, 09 studies related to the perception of Blended Learning, and 08 studies related to attitude toward Blended Learning

Studies related to Blended Learning conducted in India.

The review of the research studies shows the blending of various online learning technologies like a combination of web-based online self-interactive learning, online live interactions, Development of Class Website on Google Sites, Screen-o-Caste, Presentation

Tube, U-Tube, PowerPoint Teaching, Google Class Room, WhatsApp Group, Skype, Video Lesson Package, Computer-assisted Instruction with CD ROM Blogs, Podcasts, PPT Voice over etc. with various methods of teaching like lecture method, Lecture cum demonstration method, project method, group projects, discussion method.

The reviews also show researchers using different models of Blended Learning, such as the station rotation model, lab rotation model, flipped classroom model, and MOODLE, as a learning management system.

The review showed a positive response from the students and confirmed that Blended Learning is effective, and interesting and offers better satisfaction to the learners, improved cognitive absorption, behavioural intention, creative thinking, problem-solving, and academic achievement. Blended Learning is a superior method for imparting Geography education and helps reduce academic anxiety concerning self-efficacy. However, one study explored the communication skills of secondary students concerning their attitude towards Blended Learning and found an average level of academic achievement.

Studies related to Blended Learning conducted outside of India.

Research studies show a variety of modes like enriched web technologies (such as video conferences, Learning Management Systems, Discussion blogs, etc.), PowerPoint slides, flashcards, computers, Hand-out before the class, virtual classrooms, online learning platforms blended with face–to–face with the teacher, individual assessments and group presentations. The review shows the use of the Flipped Classroom (FC) Model and the involvement of MOODLE Blended Learning as a network-based learning solution to find the effect of Blended Learning on students' academic achievement. However, one study revealed that using MOODLE in Blended Learning has an average level of effectiveness

related to students' motivation, students' achievements, and students' collaborations and communication.

The research studies explored the impact of Blended e-Learning on students' achievement and attitudes toward utilising e-learning, pointed out considerable differences among the teaching methods and in the achievement test, scores towards Blended Learning, significant differences in students' attitudes, and satisfaction in favour of Blended Learning. However, one exploratory study on online learning versus Blended Learning revealed no significant differences between the online and blended conditions. The review also found that the blended approach was more effective than the Conventional method in terms of achievement and the improvement of verbal creative thinking skills, found an increase in science attitude and self-directed learning skills, and a positive impact on the attitude of social media-supported learning group and self-directed learning skills while investigating the effectiveness of Blended Learning in science education. One study reported deficiencies in policy, schools, and training providers. In contrast, one study showed increased vigour, enthusiasm, autonomy, and student learning outcomes, especially in analysing discourse after the appliance of the MOODLE-based Blended Learning method and promoted the use of MOODLE Blended Learning as a network-based learning solution or online. One study evaluated an international Blended Learning cooperation project in biology teacher education.

Studies related to Blended Learning and academic achievement in science conducted in India.

Review of studies related to the present study with the variable academic achievement shown (online mode) blended with face-to-face classrooms, Face-to-face lab activities, Demonstration based activities, Teaching in the classroom, Games, SLM, TLM, Debates,

Discussion, Lecture cum Demonstration, Lecturing and Project, group assignments, group projects and group demonstrations, brainstorming method, team teaching method, Lecture Method, Field visit, case study, Laboratory work, Role-play, Surveys, Interviews and Project work, Campaigns, open forum (offline mode)

The review shows the use of the Station Rotation model of Blended Learning and concluded Blended Learning Approach was an effective method for facilitating learning in Physics at the secondary level of education. The review also shows the use of the learning platform EDMODO and reveals Blended Learning as an effective program in improving the achievements of the students in teaching physical science.

Concerning Academic achievements in science, the studies highlighted the effectiveness of the Blended Learning strategy with a large effect size in the achievement of science education, e quest score and ICT readiness score of student teachers, an optimistic impact on student's critical thinking, problem-solving, science process skills and achievement, encouraged attitude towards Physics over conventional teaching and contributed more towards achieving the educational goals. Studies also showed Blended Learning and cooperative learning are better than traditional learning. The review also showed that the Blended Learning Strategies proved effective and valuable in promoting the Academic Performance, Motivation, and Course satisfaction of 9th-grade adolescents in science.

Studies related to Blended Learning and academic achievement in science conducted outside of India.

Research studies show a variety of Blended Learning modes like Images, sounds, video clips, sound effects, text, PowerPoint presentations, illustration, animations, Chrome Book graphic media, animation, Web-based learning environment, and blog page (online mode) were blended with lectures, explanations, and experiments, Discussion, Brainstorming,

research-study learning method, question answer technique and problem-solving (offline mode)

The review showed the use of MOODLE LMS and proved that the Blended Learning model added more to the students' achievement

A review of the studies showed a positive impact of Blended Learning on achievement skills and attitudes and concluded that the Blended Learning methodology is more efficient in improving students' achievement and science process skills in plant tissue culture courses as compared to the conventional learning methodology. However, few studies revealed no significant difference between the achievement scores under both the models and that video assignments did not improve student exam performance on their own but did increase attendance and satisfaction**.**

Studies related to the Perception of Blended Learning conducted in India.

A review of studies related to the present study with regards to the perception of Blended Learning includes all the activities like video conferencing technique, PowerPoint presentation, video presentation, online resources, videos, action planning and reflection method in Online Mode, and brainstorming method, team teaching method, discussion, small group discussion, debate, Lecture Method in offline mode. The studies show the use of EDMODO as a Learning Platform, and the perception of the students of Blended Learning was high.

The review found more positive perceptions towards Blended Learning, students who learn in the Blended Learning approach have a better conceptual understanding than the students who learn in conventional methods of teaching, found a positive effect perception of the Blended Learning approach among English language teachers in secondary schools and showed that the students developed a more positive perception towards Blended Learning

method when taught using Blended Learning Strategies. However, one study showed that male teachers were found to have more encouraging perceptions of Blended Learning than female teachers. Female teachers showed less motivation for the implementation of the Blended Learning approach.

Studies related to the Perception of Blended Learning conducted outside of India.

Research studies examined the social interaction networks of students, knowledge-building levels, and perceived usefulness in online and mobile collaborative learning environments in higher education. These studies used the social media messaging app WeChat and the Learning Management System (LMS) MOODLE as the platforms for mobile and online collaboration. By employing a combination of social network analysis, content analysis, and questionnaires, the findings revealed that: (1) students had stronger interaction networks in MOODLE compared to WeChat; (2) collaboration and interaction through MOODLE led to deeper knowledge-building than through WeChat; and (3) MOODLE was perceived as more useful than WeChat.

The review found that the overall perceptions of the Blended Learning Program, instructor, and learning outcomes were positive and that Blended Learning benefitted in the more effective use of classroom time, increased flexibility in meeting time constraints of both student and teacher and greater ability to meet the needs of individual students, which was shown as the perception of the faculty through interview.

Studies related to Attitudes towards Blended Learning conducted in India.

A review of studies related to the present study shows that computerized educational programs, online learning platforms, PowerPoint presentations, illustrations, animations, online forums, blogs, and wikis, communication through email, and other relevant video

clips in online mode and lectures, tutorial, explanations, and experiments were conducted in offline mode in Blended manner.

The studies identified the attitude of students in favor of Blended Learning showing a positive attitude towards Blended Learning.

Concerning attitude toward Blended Learning positive effect on attitude towards Blended Learning approach was identified among English language teachers in secondary schools. However, few studies found neutral attitudes towards Blended Learning among secondary school students and higher secondary school students respectively.

As far as the researcher's knowledge is concerned, none of the studies under reference are conducted by blending Lesson videos, Discussion Forum, Chat, and quizzes in online mode with the Discussion method, learning by doing method, survey integrated with the discussion method, and case study method in offline mode using flipped classroom model of Blended Learning through MOODLE as a Learning Management System.

5.5 VARIABLES

Blended Learning Strategies, academic achievement, perception of Blended Learning, and attitude toward Blended Learning are the four major variables operated in the study.

Independent variable- Blended Learning Strategies is the independent variable. Two different methods of teaching, face-to-face and technology-enhanced online learning using MOODLE, were blended for the study.

Dependent variables- Academic achievement, perception of Blended Learning, and attitude towards Blended Learning are the dependent variables in the study. The variable perception of Blended Learning Strategies is studied under the dimensions of content provided, technology benefits, and overall satisfaction. The variable Attitude towards

Blended Learning Strategies is studied under the dimensions of Online learning, Classroom learning, Online interaction, Technology, Learning flexibility, and Online environment.

5.6 POPULATION AND SAMPLE

The population in the present study refers to all grade VIII students of Pernem Taluka of North Goa District of the state of Goa. Pernem Taluka has approximately an area of 251.68 Sq. Kms. with 34 schools spread over the area. There are 28 aided Schools and 6 Government Schools. The total number of students in all these schools was 1112. Among these568 students were male students and 544 students were female students. All the schools in the population follow the NCERT syllabus at the early secondary level.

5.6.1 SAMPLING

It was observed that the socioeconomic status of all the students in the population selected was the same. The facilities like computers, internet, and projectors provided in the schools in Pernem Taluka were also similar. Thus, a total of 83 students of two divisions of grade VIII from one of the schools selected randomly from Pernem Taluka of the state of Goa were the sample for the present study. The students were divided into two equivalent groups by considering their scores in science subjects in the previous term. The number of students in the experimental group and control group were 41 and 42, respectively. Simple Random sampling techniques were used. Three students from the experimental group missed the Pre-test and post-test or did not attend the intervention program, and four students from the control group either missed the pre-test or post-test. The 3 students in the experimental group and 4 students in the control group were not included in the analysis and finally, a group of 76 students formed the sample. The experimental group consisted of 38 students and the control group consisted of 38 students. Thus, both groups were equal in all respects.

5.7 TOOLS USED FOR DATA COLLECTION

i. Achievement test for grade VIII students in science. -Constructed and standardised by the researcher

ii. Students Perception Scale on Blended Learning by Robert G. Farmer (2009) - adapted and validated by the researcher.

iii. Students Attitude Scale Towards Blended Learning by Roland Birbal et al. (2018) – adapted and validated by the researcher.

5.7.1 ACHIEVEMENT TEST FOR GRADE VIII STUDENTS IN SCIENCE

The 'Delphi Technique' (Retrieved from an article by Ubaidullah et al., 2020).) was used to construct the achievement test. The different sources used for item development were textbooks, reference books, published question papers, question banks, and reputed standardized tests of achievement in science. Achievement test in science was constructed by considering six levels of cognitive learning of revised Bloom's taxonomy (Anderson and Krathwohl, 2001). Items were made to test the attainment of five learning objectives namely remembering, understanding, applying, and analysing from the cognitive domain and skills from the psychomotor domain.

Item Writing

To include all the types of items from the content of the subject matter under consideration, content analysis was done. A pool of 193 items based on a grade VIII science textbook published by the Directorate of Education, Govt. of Goa was made. The items constructed were based on the objectives of remembering, understanding, applying, analysing, and skills. The items were of the type, Multiple choice, Fill in the blanks, Match the Pair, True or false, State, Name, Correlation (for 1 Mark Each), Write short answers (2 marks each), long answers question and Drawings (4 marks Each).

Item Selection

After preparing the test for item selection, the test was given to the experts to find the relevance of the items. On receiving expert responses, 43 non-relevant items were removed from the test. These non-relevant items include fill-in-the-blank type questions, State, Name (for 1 Mark), write short answers questions (for 2 marks), and Long answers questions (for 4 Marks)

Pilot study

The pilot study was done on a small sample similar to the larger sample, which will be tested later. There were 150 items in the test for the pilot study. The test was personally administered to 25 students studying in grade VIII of one of the schools in Pernem Taluka to confirm the estimated time. Moreover, the ambiguous and similar items were also eliminated from the test. The school for the pilot study was selected by a simple random sampling technique.

Item analysis

To analyze items and to evaluate the test the researcher prepared a blueprint of the test before constructing the achievement test in science. The achievement test in science for item analysis consisted of 127 items for 138 marks. The items were of the type, Multiple choice, Match the Pair, True or false, Correlation (for 1 Mark Each), and Drawings (4 marks Each). It was administered to 96 students from three different schools selected from PernemTaluka. A cluster sampling technique was used. Scoring of the test was done as per the scoring key prepared by the researcher.

Item Difficulty

According to (Kelly,1939) the ideal range for the difficulty index of test items should be between 0.4 and 0.6. It is based on the principle that test items within this range are

considered moderately difficult, meaning they are neither too easy nor too difficult for the intended population of test-takers.

Accordingly, the Difficulty Index (DI) of the items was decided, and the items were finalized.

Discriminating Power

According to (Ebel & Frisbie,1986), the discriminating power of an excellent test item usually lies at 0.3 and above. Discriminating Power (DP) for each item was also calculated by the researcher, and the items for the final test were finalised.

Achievement Test in Science for final administration

After item analysis, the blueprint for the achievement test for final administration was prepared, and based on the blueprint, the achievement test in science for final administration was prepared with a fresh scoring key.

Validity of the achievement test in science.

To validate the final version of the achievement test in science finalised using the 'Delphi Technique', and for further examination of the content, the test was sent to 5 experts. Responses from the experts found the content of the test sufficient to find the effectiveness of Blended Learning Strategies on the Academic Achievement of grade VIII students in science.

Reliability of the Achievement Test in Science

The reliability of the test was achieved by using the split-half method and the Spearman Coefficient correlation formula. Then, the correlation coefficient between the two halves of the students was calculated and found to be 0.89. Hence, the constructed achievement test was found to have adequate measures of reliability.

5.7.2 PERCEPTION SCALE TO FIND GRADE VIII STUDENTS' PERCEPTION OF BLENDED LEARNING

A Perception scale on Blended Learning developed by (Robert G. Farmer, 2009), modified by the researcher, and validated by the experts to seek grade VIII students' perception of Blended Learning was implemented in the present study. The number of questions and the wording of some of the items were changed. The dimensions of the perception scale were content provided, technology benefit, and overall satisfaction.

5.7.3 ATTITUDE SCALE TO FIND THE ATTITUDE OF GRADE VIII STUDENTS TOWARD BLENDED LEARNING

The attitude scale on Blended Learning developed by Dr Roland Birbal, Dr Mala Ramdass, and Mr Cyril Harripaul (2018), modified by the researcher and validated by the experts to find VIII grade students' attitudes towards Blended Learning was implemented in the study. The number of questions and the wording of some of the items were changed. The factors of the attitude scale were online learning, Classroom learning, Online interaction, Technology, Learning flexibility, Online environment

5.8 DESIGN OF BLENDED LEARNING STRATEGIES

Identification of Suitable Technology

To identify the suitable technology to develop Blended Learning Strategies the researcher reviewed the ten studies to find the effectiveness of Blended Learning on academic achievement, perception, attitude, etc. From the review of these studies, it was found that MOODLE as a learning management system was successfully employed by the researchers.

The researcher also analysed the available various technologies (LMS) by considering 1) the advantages of a user-friendly interface that is easy to navigate for both instructors and students, supporting multimedia content, discussion forums, assignment submissions, and

grading, with clear instructions and the organisation supports various types of content, including text, images, videos, audio files, presentations, and interactive multimedia, supporting diverse assessment methods, including quizzes, surveys, assignments, discussions, and peer reviews, and facilitating communication and collaboration among instructors and students through discussion forums, chat, messaging, announcements, and group workspaces 2) Disadvantages3) Deployment–like a desktop application, Mobile application, cloud-based 4) Type-Academic LMS or corporate LMS or Both5) Whom it is for – educators, teachers trainers or for business and6) Cost- with licensing fees or free or both. After analysing the available technologies and reviewing the studies, the researcher selected MOODLE (LMS) for his study.

To identify the suitable technology to design and develop Blended Learning Strategies, the researcher reviewed the studies to find the effectiveness of Blended Learning on academic achievement, perception, attitude, etc. The available various technologies (LMS) were also analysed by the researcher by considering Pros, Cons, Deployment, type, whom it is for, and Pricing. On analysing the available Technology and reviewing the studies, the researcher selected Moodle (LMS) for his study to identify suitable pedagogical practices to design and develop Blended Learning Strategies. The researcher analysed the Science textbook for grade VIII students. The researcher analysed each concept from each chapter of the grade VIII science textbook by considering various methods of teaching, such as discussion, learning by doing, survey method, case study method, etc.

Identification of Suitable Pedagogical Practices

The use of the flipped classroom model of Blended Learning engages students with the course material before coming to class, which permits for more interactive and appealing face-to-face sessions focused on discussions, problem-solving, and application of knowledge. For interactive and engaging face-to-face sessions focussed on discussion

problem solving, application of the knowledge and to achieve the objectives of higher thought processes the researcher decided to use the discussion method, learning by doing method, survey integrated with discussion method, and case study method.

Also, after reviewing the available studies on Blended Learning, it was found by the researcher that, none of the studies were conducted blending Lesson video, Discussion Forum, Chat, Quiz in online mode with discussion method, learning by doing method, survey integrated with discussion method and case study method in offline mode using flipped classroom model of Blended Learning. So, the researcher decided to blend lesson videos, discussion forums, chats, quiz in online mode with the discussion method, the learning-by-doing method, a survey integrated with the discussion method, and a case study method in offline mode. To develop Blended Learning Strategies, the researcher analysed a grade VIII science textbook published by the Directorate of Education, Govt. of Goa. The researcher analysed each concept from each chapter of the grade VIII science textbook for the consideration of various methods of teaching like discussion method, learning by doing, survey integrated with discussion method, case study method, etc.

The researcher followed the **ASSURE Model** developed by Heinrich and Molenda (1999). The reasons for selecting the ASSURE model by the researcher are as follows: - The ASSURE model provides a clear, step-by-step process for planning instruction, ensuring that all critical components are considered. ASSURE is a learner-centric instructional design model wherein the learners are continuously being analysed and well-studied. The ASSURE model can not only blend technology with conventional classroom teaching but also provide students with the modified experience they require to enlarge their views. The model encourages the thoughtful selection and use of technology and media, enhancing the learning experience and keeping it current with technological advances. The ASSURE model

promotes the active participation of students in the learning process through activities and hands-on experiences. The model includes steps for assessing student learning and the effectiveness of instruction. Emphasizes the importance of setting clear, measurable learning objectives. The ASSURE model can be adapted to various educational contexts, subjects, and grade levels.

The six Stages involved in the ASSURE model for designing and developing Blended Learning Strategies are: -

A: Analyse Learner: - Identify the characteristics of the learners (age, background, skills, learning styles, etc.).

S: State goals and objectives: - Define what learners will achieve by the end of the lesson (specific, measurable, attainable, relevant, time-bound objectives).

S: Select Method and Media: - Choose appropriate instructional methods, media, and materials to achieve the objectives.

U: Utilize the Media and Technology: - Plan how to implement the selected media and materials effectively.

R: Require Learner Participation: - Design activities that require active involvement and participation from learners.

E: Evaluate and Revise: - Assess the effectiveness of the instruction and make necessary revisions.

The Researcher followed the ASSURE model to design and develop the following Blended Learning Strategies based on the above stages:

1. Learn at home, discuss at school
2. Learn at home, do it at school
3. Learn and survey at home, discuss at school

4. Learn at home, Discuss Cases at school

Strategy 1: -Learn at home, discuss at school

Blending between Video Lessons through the MOODLE Platform (Online) and Discussion method (Offline)

Strategy 2: -Learn at home, do it at school

Blending between Video Lessons through the MOODLE Platform (Online) and learning by doing method (Offline)

Strategy 3: -Learn and survey at home, discuss at school

Blending between Video Lessons through the MOODLE Platform (Online) and survey method (Offline)

Strategy 4: -Learn at home, Discuss Cases at school

Blending between video lessons through the MOODLE Platform (Online) and Case study method (Offline)

A pilot study was conducted for Blended Learning Strategies in four different schools. Orientation of teachers for the Pilot study of the Blended Learning Strategies to be conducted in four different schools was done by the researcher. The schools for the pilot study were selected using a cluster sampling technique. Based on the feedback from the teachers from the schools the Blended Learning Strategies were modified.

The designed and developed Blended Learning Strategies were given to the experts for Validation in terms of content, instructions, objectives, etc., and based on suggestions, the same was modified.

The validated Blended Learning Strategies were used in the present study.

5.9 DATA COLLECTION.

Four chapters from the chapters to be taught in the science subject in the term were selected. First, the pre-test was administered to both groups. Four chapters in science were taught to the experimental group using Blended Learning strategies. The control group was taught by their class teacher using regular classroom teaching. At the end of the teaching, a post-test was administered to all students of both the control and experimental groups. After the intervention, a Likert-type scale to find students' perception of Blended Learning and students' attitude towards Blended Learning was administered to the experimental group.

5.10 DATA ANALYSIS

Descriptive and inferential techniques were used in the data analysis. Descriptive statistics such as Mean, Median, Standard deviation, Skewness, and Kurtosis were used. In Inferential analysis, the parametric tests used were the correlated 't' test, independent 't-test, ANCOVA, and non-parametric test Chi-Square test for Goodness of fit to analyse the collected data.

5.11 FINDINGS OF THE STUDY

Objective 1: To design and develop Blended Learning Strategies by identifying suitable technology and pedagogical practices for teaching selected concepts in science from the prescribed course of study at grade VIII.

To identify Suitable Technology

Findings: - The findings of this analysis emphasise a series of features that influence the selection of suitable technology for Blended Learning, concerning user-friendly interface, support for multimedia content, support for diverse assessment methods, facilitation of communication and collaboration among teachers and students, deployment of the

technology, type of the technology, whom the technology is meant for and cost-effectiveness.

To identify Suitable Pedagogical Practices

Findings: -The findings of this analysis highlight the importance of mixing lively learning approaches such as discussions, case studies, learning by doing, and surveys integrated with discussions for the encouragement of deeper understanding, critical thinking, and knowledge application amongst learners and promoting an interactive and active learning experience.

Conclusion: By implementing these technologies and evidence-based practices, teachers can produce engaging, all-encompassing, and successful learning experiences that promote student achievement in Blended Learning environments.

Objective 2: To study the effectiveness of Blended Learning Strategies on the academic achievement of grade VIII students in science

H_1: - There is no significant difference in Pre-test and Post-test scores of grade VIII students in science taught using Blended Learning Strategies.

Findings: The 't' value was drawn to be 16.27 at $p < 0.01$ level of significance. The calculated 't' value is greater than the table value, indicating that the difference between the two means is significant. Cohen's d (2.51) was calculated to find out the effect size through the 't' value and the sample, and it was found to be large in effect size. So, there is a significant difference between the pre-test and post-test of the experimental group for Academic achievement in science among grade VIII students.

Hence, Null Hypothesis No. 1 - There is no significant difference in Pre-test and Post-test scores of grade VIII students in science taught using Blended Learning Strategies stands rejected.

Conclusion: It can be concluded that using Blended-learning Strategies is effective in teaching science to grade VIII students.

Objective 3: To compare the effectiveness of Blended Learning Strategies and Conventional methods of teaching the learning process on the academic achievement of grade VIII students in science.

H_2: -There is no significant difference in pre-test and post-test scores of grade VIII students in science taught the conventional method of teaching

Findings: The 't' value was drawn to be 1.927 at $p > 0.05$ level of significance. The calculated value is smaller than the table value, indicating that the difference between the two means is not significant. Cohen's d (0.44) was calculated to find out the effect size through the value and sample, and it was found to be low in effect size. So, there is no significant difference between the pre-test and post-test of the control group for Academic achievement in science among grade VIII students.

Hence, the null hypothesis -There is no significant difference in pre-test and post-test scores of grade VIII students in science taught using conventional method of teaching is accepted.

Conclusion: It can be concluded that although the conventional method imparts some knowledge, it is not at par with Blended-Learning Strategies, which are more effective in teaching science to grade VIII students.

H_3: - There is no significant difference in the pre-test score of grade VIII students in science taught using Blended Learning Strategies and conventional methods of teaching.

Findings: The **'**t' value was drawn to be 0.739, and the $p < 0.05$ level of significance. The calculated 't' value is smaller than the table value, indicating that the difference between the two means is not significant. Cohen's d (0.17) is calculated to find out the effect size through the 't' value and sample, and it is found to be very small in effect size. So there is no significant difference in pre-test scores of grade VIII students in science taught using Blended Learning Strategies and conventional methods of teaching.

Hence, the hypothesis- There is no significant difference in the Pre-test scores of grade VIII students in science taught using Blended Learning Strategies and the conventional method of teaching is accepted.

Conclusion: It can be concluded that in any experimental study, the groups must be equivalent so that correct results are achieved, which is a prerequisite for a flawless study.

H_4: -There is no significant difference in post-test scores of grade VIII students in science taught using Blended Learning Strategies and conventional methods of teaching.

Findings: The 't' value was drawn, which is 9.435 at $p < 0.01$ level of significance. The calculated 't' value is greater than the table value, indicating that the difference between the two means is significant. Cohen's d (2.16) is calculated to find out the effect size through the t value and sample, and it is found to be large in effect size. So, there is a significant difference between the post-test scores of grade VIII students in science taught using Blended Learning Strategies and conventional methods of teaching

Hence, the Null Hypothesis - There is no significant difference in Post-test scores of grade VIII students in science taught using Blended Learning Strategies and conventional methods of teaching stands rejected.

Conclusion: It can be concluded that using Blended-learning Strategies is effective in teaching science to grade VIII students as compared to conventional methods of teaching.

To reduce within-group error variance and elimination of compounds, the ANCOVA is carried out in the research

Findings: Findings from ANCOVA offer important insights into the effectiveness of Blended Learning Strategies on academic achievement among eighth-grade students in the science subject. Blended Learning exhibits a statistically significant effect; it implies that the Blended Learning Strategies have influenced academic achievement among eighth-grade students in science.

Conclusion: The implementation of Blended Learning has established significant effectiveness in improving the academic achievement of grade VIII students in science. The integration of online resources, interactive multimedia content, and individualized learning experiences has successfully added to conventional classroom teaching, promoting deeper commitment and comprehension of scientific concepts among students. As teachers persist in holding innovative pedagogical practices and influencing technology-enhanced learning environments, the incorporation of Blended Learning embraces the enormous potential for dynamic educational renovation and authorizing students to be successful academically in the digital age.

Objective 4: To study the perception of the grade VIII students of the Blended Learning strategy concerning Content provided, Technology benefit, and Satisfaction.

H_5: -There is no significant difference in perception about Blended Learning strategies concerning content provided among the grade VIII students.

Findings: Based on the results of the Chi-Square test, the p-value for the items at no., 1,3,4,10, 12, and 13 in the student's perception scale was calculated as 0.000 for each item, and since the p-value ($p < 0.05$) is below the chosen significance level, the null hypothesis -There is no significant difference in perception about Blended Learning Strategiesconcerning content provided among the grade VIII students is rejected.

Conclusion: The findings of the study indicate that with regards to the content provided by Blended Learning, the students found the organisation of each lesson easy to follow, assignments were clearly stated, activities were planned carefully, the presentation of the content through videos and discussion forum was clear, the teaching was designed appropriately per the level of students, the entire course was not difficult to follow and there was no wastage of time.

H_6: -There is no significant difference in perception about Blended Learning strategies concerning technology benefits among the grade VIII students.

Findings: Based on the results of the Chi-Square test, the p-value for the items at no.2,6,8,9, items at no. 14 to 19, and items at no. 22 to 29 is calculated as 0.000 for each item and since the p-value ($p < 0.05$) is below the chosen significance level, the null hypothesis- There is no significant difference in perception about Blended Learning Strategies concerning technology benefit among the grade VIII students is rejected.

Conclusion: Concerning technology benefits, the findings of the study indicate that the students found the structure of the environment helpful in learning, the online content

provided through MOODLE was very easy to understand, the activities given in the course helped the students to develop skills, the lessons enriched their content knowledge, interaction with other students and teacher was facilitated through MOODLE, assessing each other's work, accessing videos using the MOODLE app was easy as the students could learn at own pace, time available and any place. The important achievement of students learning to use the MOODLE app is the development of skills in using mobile phones with confidence.

H_7: -There is no significant difference in perception about Blended Learning Strategies concerning satisfaction among the grade VIII students.

Findings: Based on the results of the Chi-Square test, the p-value for the item at no. 7,11,20 and 21 is calculated as 0.000 for each item and since the p-value ($p < 0.05$) is below the chosen significance level, the null hypothesis - There is no significant difference in perception about Blended Learning Strategies concerning satisfaction among the grade VIII students is rejected.

Conclusion: Concerning overall satisfaction, the findings of the study reveal that the students understood the importance of discussion with classmates. The students look forward to using the same method, as it enhances social skills and boosts self-confidence, which is an important aspect of social life.

Overall conclusion about students' perception of Blended Learning: -Grade VIII students exhibit an encouraging perception of the Blended Learning strategy, underlining the eminence of content, technology benefits, and overall satisfaction with the learning experience. Students' responses highlight the effectiveness of Blended Learning in promoting involvement, learning outcomes, and student-centred methods, making it a worthy educational model for present classrooms.

Objective 5: To find the attitude of the grade VIII students towards the Blended Learning strategy concerning Online learning, Classroom learning, Online interaction, Technology, Learning flexibility, and Online environment.

H_8: - There is no significant difference in attitude towards Blended Learning Strategies concerning online learning among the grade VIII students.

Findings: Based on the results of the Chi-Square test, the p-value for the item at no. 1 to 4 in the students' attitude scale is calculated as 0.000 for each item, and the p-value ($p < 0.05$) is below the chosen significance level, the null hypothesis - There is no significant difference in attitude towards Blended Learning Strategies concerning online learning among the grade VIII students is rejected.

Based on the results of the Chi-Square test, the p-value for the item at no. 5 in the students' attitude scale is calculated as 0.135, and the p-value ($p > 0.05$) is above the chosen significance level. However, the statement **"I believe Classroom learning is more effective than online learning"** is a negative statement, which means that the students found the Blended Learning classroom to be effective.

Hence, the null hypothesis - There is no significant difference in attitude towards Blended Learning Strategies concerning online learning among the grade VIII students is rejected

Conclusion: The findings of the study reveal that the students (about 80%) found online learning through MOODLE better as it encouraged them to study, and made them more responsible in the context of studying. However, about 20% of students did not agree with the statements.

H_9: -There is no significant difference in attitude towards Blended Learning Strategies concerning classroom learning among the grade VIII students.

Findings: Based on the results of the Chi-Square test, the p-value for the item at no. 6 to 8 is calculated as 0.000 for each item, and since the p-value ($p < 0.05$) is below the chosen significance level, the null hypothesis - There is no significant difference in attitude towards Blended Learning Strategies concerning classroom learning among the grade VIII students is rejected.

Conclusion: Concerning classroom learning, the findings of the study show that students prefer to be with classmates in a face-to-face situation, which is human nature to be in groups. The students found that the demonstrations in actual situations are more appealing as far as skills development is concerned.

H_{10}: -There is no significant difference in attitude towards Blended Learning strategies concerning online interaction among the grade VIII students.

Findings: Based on the results of the Chi-Square test, the p-value for the item at no. 9 t0 11 is calculated as 0.000 for each item, and since the p-value ($p < 0.05$) is below the chosen significance level, the null hypothesis -There is no significant difference in attitude towards Blended Learning Strategies concerning online interaction among the grade VIII students is rejected.

Conclusion: With regards to online interaction, the findings of the study identified that the students were comfortable as online communication with peers and teachers was easy. Also, the students could express themselves clearly online, which helped boost their self-confidence further.

H_{11}: -There is no significant difference in attitude towards Blended Learning strategies concerning technology among the grade VIII students.

Findings: Based on the results of the Chi-Square test, the p-value for item at no. 12 to 16 is calculated as 0.000 for each item, and since the p-value ($p < 0.05$) is below the chosen significance lev the null hypothesis -There is no significant difference in attitude towards Blended Learning Strategies concerning technology among the grade VIII students is rejected.

Conclusion: The findings of the study concerning technology reveal that the use of technology has enhanced the skills of using the mobile MOODLE app, which in turn facilitated the students to interact and exchange the knowledge acquired with other students.

H_{12}: -There is no significant difference in attitude towards Blended Learning strategies concerning learning flexibility among the grade VIII students.

Findings: Based on the results of the Chi-Square test, the p-value for the item at no. 17 to 20 is calculated as 0.000 for each item, and since the p-value ($p < 0.05$) is below the chosen significance level**,** the null hypothesis -There is no significant difference in attitude towards Blended Learning strategies concerning learning flexibility among the grade VIII students is rejected.

Conclusion: Concerning learning flexibility, the findings of the study show that students were stress-free as decision-making about what, when, and where to study was easy. This is an advantageous mental state for learning.

H_{13}: -There is no significant difference in attitude toward Blended Learning strategies concerning the online environment among grade VIII students.

Findings: Based on the results of the Chi-Square test, the p-value for the item at no. 21 to 24 in the students' attitude scale is calculated as 0.000 for each item and since the p-value (p

< 0.05) is below the chosen significance level, the null hypothesis - There is no significant difference in attitude towards Blended Learning Strategies concerning the online environment among the grade VIII students is rejected.

Based on the results of the Chi-Square test, the p-value for the item at no. 21 in the students' attitude scale is calculated as 0.135, and the p-value ($p > 0.05$) is above the chosen significance level. However, considering that the statement **"I feel alone in an online environment."** is negative, it means that the students were not getting bored when taught using Blended Learning Strategies. Hence the null hypothesis - There is no significant difference in attitude towards Blended Learning Strategies concerning the online environment among the grade VIII students is rejected.

Conclusion: -As far as the online environment is concerned, about 33% of the respondents were inclined to the negative side. This percentage is less than 40% and can be considered as good as negligible. The same can be considered as the normal human tendency.

Overall conclusion about students' attitude towards Blended Learning:- Grade VIII students demonstrated a positive attitude towards Blended Learning Strategies, identifying the benefits of integrating online and classroom elements. Students' optimistic viewpoint towards online learning, classroom interaction, technology integration, learning flexibility, and the online environment highlight the effectiveness of Blended Learning Strategies in meeting the varied needs and preferences of present learners.

5.12 MAJOR CONCLUSIONS OF THE STUDY

1. The evidence supports the effectiveness of the Blended Learning strategy in improving the academic achievement of grade VIII students in science. This method can significantly boost student engagement by utilising technology and multimedia content, making science topics more captivating and interactive. Effective

preparation of teachers to integrate technology into their teaching methods is crucial for maximising the effectiveness of the Blended Learning Strategy.

2. There is evidence of the successful design and development of Blended Learning Strategies for teaching selected science concepts from the prescribed grade VIII course. These strategies involve identifying appropriate technology and pedagogical practices that prove effective in enhancing learning methods and teacher training.

3. Blended Learning Strategies exhibit higher academic achievements among grade VIII students in science compared to the traditional teaching and learning processes at the same grade level.

4. Students show appreciation for the diverse range of content available in Blended Learning environments. Interactive and multimedia-rich materials contribute to increased engagement and comprehension of the subject matter. Combining traditional classroom interactions with online activities offers a varied range of learning experiences, potentially leading to higher satisfaction levels.

5. Students exhibit a positive attitude towards Blended Learning due to its flexibility, technological engagement, interactive learning opportunities, perceived effectiveness, intrinsic motivation, and balanced approach.

5.13 RECOMMENDATIONS

Based on the findings of this study, the following recommendations are proposed:

1. Blended Learning should be encouraged as a key teaching strategy for science in schools.
2. The curriculum should be designed to allow sufficient flexibility for integrating Blended Learning while ensuring timely completion of the syllabus.

3. Teachers should have opportunities to engage with experts in the field of Blended Learning.
4. Teachers should be motivated to attend workshops and training sessions on Blended Learning.
5. Students should receive orientation on Blended Learning and how to effectively engage with it.
6. Schools should provide the necessary technological resources to support the implementation of Blended Learning.

5.14 SUGGESTIONS FOR FURTHER RESEARCH

The following are recommendations for further exploration in the area of Blended Learning:

1. Investigate the effectiveness of Blended Learning in various school subjects.
2. Conduct studies on Blended Learning across different student grade levels.
3. Explore the application of specific Blended Learning approaches in different states.
4. Assess the effectiveness of integrating a particular pedagogical method with a modern instructional technique.

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APPENDIX 1

BLUE PRINT FOR ACHIEVEMENT TEST BEFORE ITEM ANALYSIS

"A STUDY OF EFFECTIVENESS OF BLENDED LEARNING ON THE ACADEMIC ACHIEVEMENT OF GRADE VIII STUDENTS IN SCIENCE".

Name of the researcher: Udesh Ramakant Natekar

Name of the Guide: - Dr. Anna Neena George

BLUEPRINT FOR THE TEACHER-MADE TEST

1) WEIGHTAGE TO OBJECTIVES

Sr. No	Objectives	Marks	Percentage
1	Remembering	33	25
2	Understanding	58	43
3	Applying	11	08
4	Skills	16	11
5	Analyzing	20	13
	Total	138	100

2) WEIGHTAGE TO THE CONTENT AREA

Sr. No	Content	Marks	Percentage
1	Some Natural Phenomena	35	26
2	Light	40	28
3	Stars and Solar System	34	25
4	Pollution of air and Water	29	21
	Total	138	100

3) WEIGHTAGE TO FORM OF QUESTIONS

Sr. No	Forms of Question	Marks	Percentage
1	Objective	122	89
2	Skill (Drawing)	16	11
	Total	138	100

APPENDIX 2

ACHIEVEMENT TEST – PRE-TEST AND POST-TEST (BEFORE ITEM ANALYSIS)

"A STUDY OF EFFECTIVENESS OF BLENDED LEARNING ON THE ACADEMIC ACHIEVEMENT OF GRADE VIII STUDENTS IN SCIENCE".

Name of the researcher: Udesh Ramakant Natekar

Name of the Guide: - Dr. Anna Neena George

Name of the Student: -_____

Name of the School: -_____

Supervisors Signature: -_____

Class: VIII **Subject: Science**

Total Marks: 138

Instructions: - 1. All questions are compulsory

2. Figures to the right indicate full marks

Duration: - 3 hours

I A. Select and write the most appropriate alternative (a, b, c, d) from those given below each statement. (9 marks)

1. The safe place during Lightning is _____
(a) Open place
(b) Open Vehicles
(c) A house or building
(d) Near a pole

2. _____of the following can be charged with static electricity
(a) Metal
(b) Alloy
(c) Insulator
(d) Semiconductor

3. During lightning air is normally _____
(a) a good conductor
(b) a bad conductor
(c) both (a) and (b)
(d) none of these

4. Earthquakes can cause _____

(a) floods (b) landslides
(c) tsunamis (d) All of the above

5. Consider the following statements and tick the answer from the codes given below
I. Sudden shaking or trembling of the earth which lasts for a very short time is called an earthquake.
II. Fragmented outermost layers of earth collide or brush past each other.
Codes
(a) Statement I is true, but Statement II is false
(b) Statement II is true, but Statement I is false
(c) Both the statements are true, but Statement II is not a correct explanation of Statement I
(d) Both the statements are true and Statement II is the correct explanation of Statement I

6. Landslides are caused_____
(a) due to earthquakes
(b) due to sudden rock failures
(c) when the base of a slope is over-steepened by excavation or river erosion
(d) All of the above

7. Which of the following statements related to earthquakes is not correct?
_____
(a) The record of the seismic waves is called a seismograph
(b) The seismograph records the seismogram
(c) The Richter scale is not linear but logarithmic
(d) The seismic waves originate from the focus

8. Consider the following terms.
A. Lightning B. Landslide
C. Thundering D. Tsunami
E. Floods
Earthquakes can cause _____
(a) B, D, and E
(b) B and E
(c) A, B, and C
(d) Only A

9. What happens when two bodies are rubbed against each other?
_____
(a) They acquire equal and similar charges.
(b) They acquire equal and opposite charges.
(c) They acquire different charges but in different amounts depending upon their masses.
(d) They do not acquire any charge

B. State whether the given statements are true or false. (4 marks).
1. We cannot predict cyclones. **( )**
2. The electric charges produced by rubbing are called static charges. **( )**

3. The plates of the outermost layer of the earth are always in continuous motion**. ( )**
4. During an earthquake, we should take shelter under a heavy table. **( )**

C. Observe the correlation between the words of the first pair and complete the second pair (1 Mark)

1. Charges of a different kind: Attraction: Charges of the same kind: _____

D. Match each item from Column A with its most appropriate function from Column B and rewrite the pairs (4 Marks)

Column A	Column B
a) Lightning Conductor	i) Causes Lightning
b) Electroscope	ii) Records tremors
c) Seismograph	iii) Tests whether a body is electrically charged
d) Earthing	iv) causes movement of plates
	v) Avoids shock due to leakage of current
	vi) saves from the damage of lightning

Ans:-

E. Draw a neat diagram of a simple Electroscope and label a) Aluminum foil b) cardboard (4 Marks)

F. Select and write the most appropriate alternative (a, b, c, d) from those given below each statement. (9 marks)

1. Movement of air due to atmospheric pressure is called_____
(a) wind
(b) air current
(c) cyclone
(d) None of these

2. Which of the following situations is correct for the formation of wind current?

_____

(a) Movement of air from the equator to poles and from poles to the equator
(b) Movement of air from sea to land and land to sea

(c) Both (a) and (b)
(d) Neither (a) nor (b)

3. Consider the following statements and tick the answer from the codes given below
I. Air exerts pressure.
II Air always moves from a high-pressure area to a low-pressure area.
Codes
(a) Statement I is true, but Statement II is false
(b) Statement II is true, but Statement I is false
(c) Both statements are true and Statement II is the correct explanation for Statement I.
(d) Both statements are true, but Statement II is not a correct explanation for Statement I

4. The falling water of rain along with the rising warm air produces _____
(a) cyclones
(b) thunderstorm
(c) wind
(d) None of these

5. A cyclone consists of a wall of water inside it because of the _____
(a) low pressure in its eye
(b) high pressure in its eye
(c) high-speed wind
(d) gravitation

6. Which of the following is correct? _____
(a) Tornadoes formed over the sea are called water spouts
(b) Tropical cyclones in the Gulf of Mexico are called Hurricanes
(c) Both (a) and (b)
(d) Neither (a) nor (b)

7. Suppose you are in a car and there is a thunderstorm. Which of the following is the best way to protect yourself from possible harm?

_____
(a) Remaining in the car
(b) Getting out of the car and taking cover under the car
(c) Running to a nearby tree
(d) Getting out and standing under an electric pole

8. Which of the following is/are affected by lightning? _____
(a) TV.
(b) Radio
(c) Telephone
(d) All of the above

9. Which of the following statements is NOT true?

_____

(a) Lightning and sparks from woolen clothing are essentially the same phenomena.
(b) When you rub a plastic scale on dry hair, it acquires charge.
(c) A glass rod when rubbed with silk acquires a negative charge.
(d) Static charges are called so because they do not move by themselves.

G. Match each item from Column A with its most appropriate function from Column B and rewrite the pairs (4 Marks)

Column A	Column B
a) Volcano	i) Causes steak of light
b) Lightning	ii) Records Tremors
c) Plate	iii) Outermost layer of earth
d) Crust	iv) Saves Buildings from earthquakes
	v) Fragments of the outermost layer of Earth
	vi) Causes earthquake

Ans:-

II A. Select and write the most appropriate alternative (a, b, c, d) from those given below each statement. (10 marks)

1. The incident ray makes an angle of 30˚ with the reflecting surface. Therefore, the angle of the incident is _____
(a) 30˚
(b) 80˚
(c) 90˚
(d) 20˚

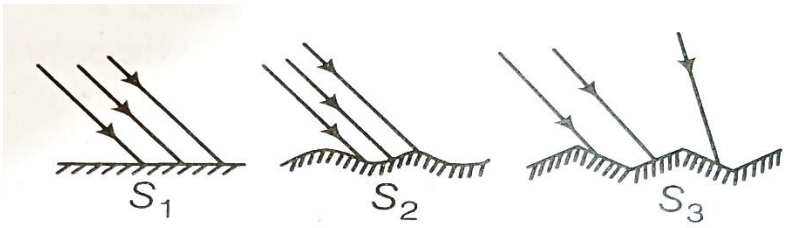
2. An object 10cm high is placed at a distance of 50 cm from a plane mirror. The size of the image will be _____
(a) 20 cm
(b) 40cm
(c) 10cm
(d) 100cm

3. If the angle of Incidence is 80˚, then the angle of reflection will be _____
(a) 80˚
(b) 100˚
(c) 160˚
(d) 20˚

4. When the angle between two plane mirrors is 60˚, images formed by the mirrors will be _____

(a) 5
(b) 6
(c) 7
(d) 8

5. Light is falling on the surfaces S_1 S_2 and S_3 as shown below.



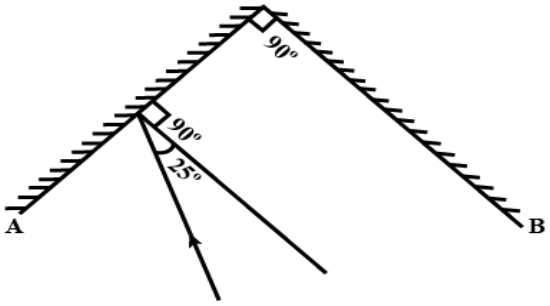
The surfaces on which the angle of incidence is equal to the angle of reflection_____
(a) $S_1$and S_3
(b) All the three surfaces
(c) S_1 and S_2
(d) S_2 and S_3

5. The image formed by a plane mirror is: _____
(a). Virtual, behind the mirror, and enlarged.
(b). Virtual, behind the mirror and of the same size as the object.
(c). Real, at the surface of the mirror and enlarged.
(d). Real, behind the mirror and of the same size as the object

6. Ritu is standing in front of a plane mirror. The distance between Ritu and her image is 10 m. If she moves 2 m towards the mirror, then the distance between Ritu and her image is (d) _____
(a) 10 m
(b) 8 m
(c) 12 m
(d) 6 m

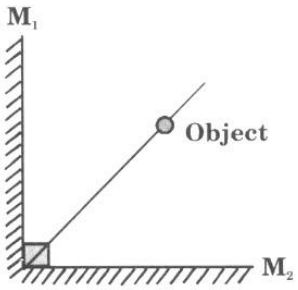
7. If you hold a pen in your right hand and stand in front of the mirror, the pen will be in the left hand in the image. This phenomenon is called_____
a) lateral inversion
(b) diffraction
(c) reflection
(d) inversion

8. Two mirrors A and B are placed at right angles to each other. A ray of light incident on mirror A at an angle of 25° falls on mirror B after reflection. The angle of reflection for the ray reflected from mirror B would be _____



(a) 25° (b) 50°
(c) 65° (d) 115°

9. An object is placed near two perpendicular plane mirrors shown in the figure. How many images will be formed? _____



(a) 1
(b) 2
(c) 3
(d) 4

B. State whether the given statements are true or false. (4 Marks)

1. Deficiency of vitamin B causes night blindness. ( )
2. In the Braille system, patterns are made with coloured dots. ( )
3. Rainbow forms due to dispersion. ( )
4. Diffused reflection is due to the failure of laws of reflection. ( )

C. Observe the correlation between the words of the first pair and complete the second pair (1 Mark)

1. Changing the direction of light: reflection:: Splitting up of light: _____

D. Match Each Phenomenon from Column A with its most appropriate meaning or process from Column B and rewrite the pairs (4 Marks)

Column A	Column B
a) Dispersion	i) Lasting impressions of an image on the retina
b) Reflection	ii) Changing directions of rays of light
c) Diffusion of light	iii) Splitting of white light into colors
d) Virtual Image	iv) Scattering of light
	v) having a foggy eyesight
	vi) Apparent meeting of rays

Ans: -

E. Draw a neat diagram to show the formation of the image of an object in a plane mirror. Label the object and the image. (4 Marks)

F. Select and write the most appropriate alternative (a, b, c, d) from those given below each statement. (9 marks)

1. There are 11 letters in the word EXAMINATION. How many letters of this word are not changed when the word is seen in a plane mirror? _____

(a) 11
(b) 5
(c) 8
(d) 9

2. For a normal eye, in an adult, what is the least distance of distinct vision?

_____

(a)5 to 8 cm
(b)10 to 15 cm
(c) 20 to 25 cm
d)30 to 35 cm

3. Rahul's Ear was paining so he visited to ENT Doctor where he saw the doctor use a mirror to observe the inside ear. Which of the following is used by E.N.T. doctors?

_____

(a)Convex mirror
(b)Convex lens
(c) Plane mirror
(d) Concave mirror

4. The image formed by a camera and a simple microscope are respectively_____

(a) real and real
(b) real and virtual
(c) virtual and virtual
(d) virtual and real

5. Myopia can be corrected by using a _____

(a) concave lens
(b) convex lens
(c) opaque lens
(d) microlens

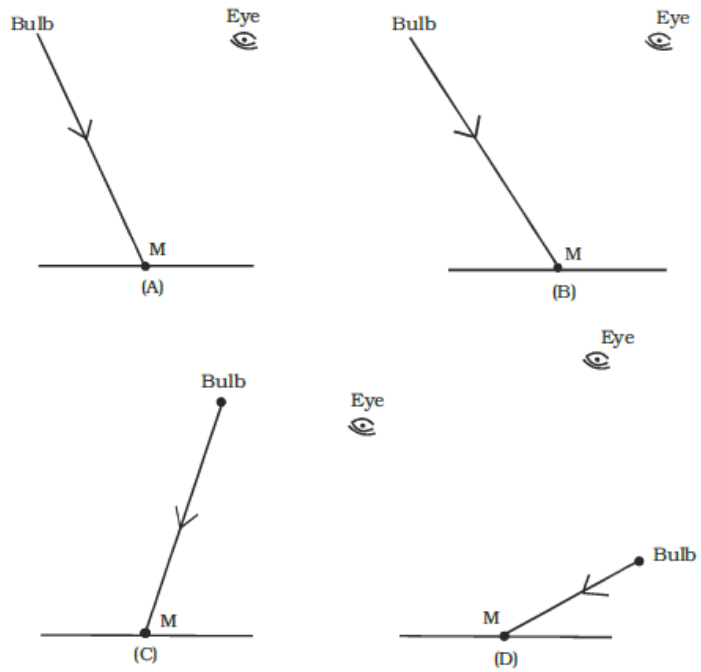
6. In the retina of the eye, the area having no sensory cells is called _____
(a) iris
(b) Blindspot
(c) cornea
(d) Dark spot

7. Which of the following works on the concept of multiple reflections?

_____
(a) Telescope
(b) Binoculars
(c) Kaleidoscope
(d) Sunglasses

8. A tiny mirror M is fixed on a piece of cardboard placed on a table. The cardboard is illuminated by light from a bulb. The position of the eye with respect to the position of the bulb is shown in Figures A, B, C, and D. In which position mirror will be visible?

_____



(a) A
(b) B
(c) C
(d) D

9. The characteristics of an eye disease are given below. _____

(i) Eyesight becomes foggy
(ii) Eye lens becomes cloudy
(iii) There is a loss of vision
In which of the following are the above characteristics observed?
(a)Myopia
(b)Presbyopia
(c) Hypermetropia
(d)) Cataract

G. Match Each part of the eye from Column A with its most appropriate function from Column B and rewrite the pairs (4 Marks)

Column A	Column B
a) Iris	i) Protects the eyes
b) Pupil	ii) Decides the colour of the eyes
c) Eye lens	iii) allows light to enter the eyes
d) Optic nerve	iv) Focuses light on the retina
	v) Regulates the light entering the eye
	vi) transmits sensations to the brain

Ans: -

H. Draw a neat diagram of the human eye and label a) Cornea b) Iris (4 Marks)

III A. Select and write the most appropriate alternative (a, b, c, d) from those given below each statement. (9 marks)

1. The period between a full moon day and a new moon day is of _____
(a) 29 days
(b) 30 days
(c) 15 days
(d) 365 days

2. If a star is 1000 light years away from the earth, then the star as we see today is _____
(a) What it exists today
(b) What it existed 1000 years ago
(c) What it would be after 1000 years

(d) What it existed 500 years ago.

3. There are _____planets in solar system
(a) 9
(b) 10
(c) 8
(d) 11

4. On a new moon day, _____
(a) The earth is between the Sun and the moon.
(b) The moon is between the Earth and the Sun
(c) The Sun is between the earth and the moon.
(d) The earth and moon are at right angles with respect to the Sun.

5. A light year measures _____
(a) The time of rotation of planets
(b) The sun's light falling on earth in a year
(c) The brightness of light
(d) The distance between celestial objects.

6. Read the given statements and select the correct option.
Statement 1: Saturn could float if put in water.
Statement 2: Saturn is less dense than water.

(a) Both statements 1 and 2 are true and statement 2 is the correct explanation of statement 1.
(b) Both statements 1 and 2 are true but statement 2 is not the correct explanation of statement 1.
(c) Statement 1 is true but statement 2 is false.
(d) Both statements 1 and 2 are false.

7. Which one of the following pairs of planets is known as gas giants?

_____

(a) Saturn and Mars
(b) Venus and Mercury
(c) Venus and Neptune
(d) Saturn and Jupiter

8. Which of the given planets is the brightest?

_____

(a) Mercury
(b) Venus
(c) Mars
(d) Jupiter

9. A star which appears blue will be (d) _____
(a) As hot as Sun

(b) Cooler than Sun
(c) Very cold indeed
(d) Much hotter than the Sun.

B. State whether the given statements are true or false. (5 Marks)

1. The Sun is a satellite. ( )
2. Orion is seen during the winter season. ( )
3. Saturn and Uranus have rings around them. ( )
4. The stars have light of their own. ( )
5. Mercury is the earth's nearest planet. ( )

C. Observe the correlation between the words of the first pair and complete the second pair **(2 Marks)**

1. . Stars: Seen because of their own light: Planets:_____.
2. Saptarshi: For locating Pole Star:: Orion:_____

E. Draw Sketches to show the relative positions of prominent stars in a) Ursa Major b) Orion **(4 Marks)**

F. Select and write the most appropriate alternative (a, b, c, d) from those given below each statement. **(10 marks)**

1. We cannot see stars during day time because_____
(a) They are less bright during daytime
(b) They do not exist during day time
(c) The sunlight is bright during day time
(d) They are hidden by the Sun

2. The possibility of a cyclone can be predicted with the help of _____
(a) Natural satellites
(b) Artificial satellites
(c) Asteroids
(d) Meteorites

3. The other name for Meteor is _____
(a) Running star
(b) Sleeping star
(c) walking star
(d) Shooting star

4. _____is a constellation that looks like a distorted letter W or M.

(a) Orion
(b) Great Bear
(c) Cassiopeia
(d) Leo Major

5. Two friends, Nita and Rita, were arguing. Their argument was about Neil Armstrong hearing sounds while on the moon. Nita argued that Neil Armstrong couldn't have heard any sound. While Rita was convinced Neil Armstrong heard sounds. Who won the argument and why?_____.

(a) Nita, as there is no medium on the moon. Hence no sound.
(b) Rita, as there is the atmosphere. Hence sound travels.
(c) Both (a) and (b)
(d) Neither(a) nor (b)

6. Suppose a new planet is discovered between Uranus and Neptune. Its time period would be_____

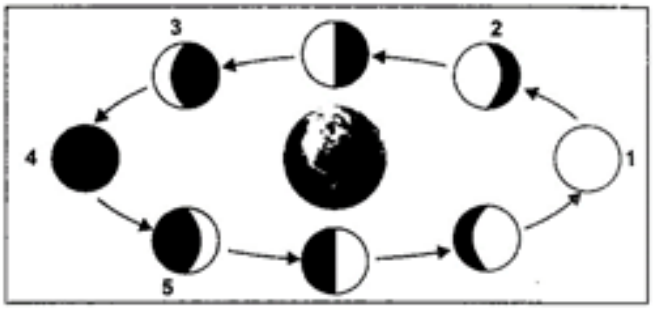
a) less than that of Neptune
(b) more than that of Neptune
(c) equal to that of Neptune or Uranus
(d) less than Uranus

7. If standing on the surface of the moon, we throw a ball upward, then the ball would _____

(a) directly fall down from the point it is released.
(b) hang in space.
(c) go up and then come back to the surface of the moon.
(d) keep going up never to come back.

8. Phases of the Moon are as shown in the figure. Which of the following options shows the correct labeling?

_____



(a) 1 - Full Moon, 2 - Waning gibbous Moon, 3 - Waning crescent Moon, 4 - New Moon, 5 - Waxing crescent Moon
(b) 1 - New Moon, 2 - Waxing gibbous Moon, 3 - Waning crescent Moon, 4 - Full Moon, 5 - Waxing crescent Moon

(c) 1 - Waning crescent Moon, 2 - Waning gibbous Moon, 3 - Full Moon, 4 - New Moon, 5 - Waxing crescent Moon
(d) 1 - New Moon, 2 - Waning gibbous Moon, 3 - Waning crescent Moon, 4 - Full Moon, 5 - Waxing gibbous Moon

9 The tail of a comet points away from the Sun due to _____
(a) Centrifugal force
(b) Electrical repulsion
(c) Attraction of comet due to other planets
(d) Radiation pressure.

10. Seema wanted to see the moon on the 15th day after the full moon day. However, when she went to her terrace, she couldn't see the moon. What could be the reason?

_____

i. There were trees blocking her view
ii. It was the new moon day
iii. It was a clear sky
iv. There were clouds blocking her view.

(a) Only i
(b) Only ii
(c) Both i and ii
(d) Both iii and iv

G. Match each celestial object from column A with its most appropriate type from Column B and rewrite the pairs (4 Marks)

Column A	Column B
a) Sun	i) A comet
b) Orion	ii) An asteroid
c) Moon	iii) A satellite
d) Mars	iv) A planet
	v) A constellation
	vi) A star

Ans:-

IV A. Select and write the most appropriate alternative (a, b, c, d) from those given below each statement. (10 marks)

1. The gases that cause acid rain are _____
(a) Carbon monoxide and carbon dioxide.

(b) Carbon dioxide and sulphur dioxide
(c) Sulphur dioxide and nitrogen dioxide
(d) Nitrogen dioxide and carbon dioxide.

2. The gas that contributes to the greenhouse effect is _____
(a) Carbon monoxide
(b) Carbon dioxide
(c) Sulphur dioxide
(d) Nitrogen dioxide

3. Substance used in Refrigerators which pollutes air is_____
(a) CNG
(b) LPG
(c) Chlorofluorocarbons
(d) Toxic Chemicals

4. Ganga action plan was launched in _____year
(a) 1977
(b) 1985
(c) 2020
(d) 1998

5. Air pollution causes _____
(a). Global warming
(b). Respiratory problems
(c.) Soil erosion
(d). None of these

6. Which of the following procedures will give you water free from all impurities?

_____
(a) Chlorine tablets
(b) Boiling
(c) Distillation
(d) Filtration

7. Which of the following is not a way to conserve water?

_____
(a) Replace
(b) Reuse
(c) Reduce
(d) Recycle

8. Your friend witnessed a forest fire in Bandipur in the year 2019. She is a bronchitis patient who then had difficulty breathing for days. What could be the reason? _____

i. Air Pollutants
ii. Forest air
iii.. Carbon Monoxide gas
iv. Climate change

(a). Only i
(b). Only iv
(c). Both i and iii
(d). Both iii and iv

9. Tina went to a restaurant with her family to have dinner. The next morning she complained about a severe stomach ache. _____

i. She ate a healthy meal
ii. She drank portable water
iii. She drank impure water
iv. She ate Non-Veg food

(a). Only i
(b) Only iii
(c). Both ii and iii
(d). Both iii and iv

10. You are on your way to school and you always come across a busy intersection. You wait at the Zebra Crossing. What will you witness? _____

i. Contaminated air
ii. A lot of Greenery
iii. People covering their face
iv. People enjoying the que of vehicles

(a). Only i
(b). Only iv
(c). Both i and iii
(d). Both iii and iv

B. State whether the given statements are true or false. (4 marks)

1. Rapid growth of algae on the surface of the water is known as algal bloom. ( )
2. Acid rain does not affect the soil and plants. ( )
3. CFCs damage the ozone layer of the atmosphere. ( )
4. Global warming is a serious threat to life on Earth. ( )

C. Observe the correlation between the words of the first pair and complete the second pair (1 Mark)

1. Filtration: removes insoluble substances: :Boiling: _____

D. Match Each gas from Column A with its most appropriate effect from column B and rewrite the pairs (4 Marks)

Column A	Column B
a) Nitrogen	i) Absorbs harmful radiations.
b) Carbon monoxide	ii) Reduces oxygen-carrying capacity
c) Oxygen	iii) Causes yellowing of marble
d) Ozone	iv) Reduces the protective layer of atmosphere
	v) Highest proportion in air
	vi) Inhaled by a human being

Ans:-

E. Select and write the most appropriate alternative (a, b, c, d) from those given below each statement. (6 Marks)

1. Trapping of the earth's radiations by the atmosphere of the earth is called _____

(a) Acid rain
(b) Smog
(c) Global warming
(d) Greenhouse effect

2. 'Ganga Action Plan' has been undertaken_____

(a) To clean the Ganga waters
(b) To increase the level of the Ganga waters
(c) To make the Ganga River navigable
(d) To use the Ganga waters for drinking

3. The respiratory diseases like asthma are caused due to the presence of _____

(a) Carbon monoxide in the atmosphere
(b) Carbon particles in the atmosphere
(c) Carbon dioxide in the atmosphere
(d) Sulphur dioxide in the atmosphere

4. CNG is _____

(a). Polluted fuel
(b). Clean fuel
(c). Harmful fuel
(d) None

5. Tina was hesitant to take a dip in the Ganga river at Kanpur, Uttar Pradesh. She noticed something. _____

i. It was polluted
ii. The Ganga Action Plan worked
iii. Garbage is disposed off properly
iv. People defecating in the river

(a). Only i
(b). Only ii
(c). Both i and iii
(d). Both i and iv

6. Ana went fishing with her father. She noticed many dead fish floating.

_____

i. The lakes ecosystem is healthy
ii. Industrial discharge
iii. The water quality has degraded
iv. Fishermen are killing the fish

(a). Only ii
(b). Only iv
(c). Both ii and iii

(d). Both ii and iv

F. Match Each item from Column A with its most appropriate item from column B and rewrite the pairs **(4 Marks)**

Column A	**Column B**
a) Marble cancer	i) Smog
b) Agents that Pollutes	ii) Portable water
c) Asthama	iii) Weedicides and pesticides
d) Agricultural pollutants	iv) Caused by smog
	v) Pollutants
	vi) Corrosion of marble

Ans:-

APPENDIX 3

ACHIEVEMENT TEST SCORING KEY BEFORE ITEM ANALYSIS (PRETEST AND POSTTEST)

"A STUDY OF EFFECTIVENESS OF BLENDED LEARNING ON THE ACADEMIC ACHIEVEMENT OF GRADE VIII STUDENTS IN SCIENCE".

Name of the researcher: Udesh Ramakant Natekar

Name of the Guide: - Dr. Anna Neena George

I A. Select and write the most appropriate alternative (a, b, c, d) from those given below each statement. (9 marks)

1. (c) A house or building
2. (c) Insulator
3. (a) a good conductor
4. (d) All of the above
5. (d) Both the statements are true and Statement II is the correct explanation of Statement I
6. (d) All of the above
7. (d) The seismic waves originate from a focus
8. (a) B, D and E
9. b) They acquire equal and opposite charges.

B. State whether the given statements are true or false. (5 marks).

1.(F)
2.(T)
3. (T)
5. (T)

C. Observe the correlation between the words of the first pair and complete the second pair (1 Mark)

1. Repulsion

D. Match each item from Column A with its most appropriate function from Column B and rewrite the pairs (4 Marks)

Ans:-

a) vi)
b) v)
c) ii)
d) v)

E. Draw a neat diagram of a simple Electroscope and label a) Aluminum foil b) cardboard (2 marks for correct drawing 2 marks for correct labeling)(4 Marks)

F. Select and write the most appropriate alternative (a, b, c, d) from those given below each statement. (9 marks)

1. (a) wind
2. (a) Movement of air from the equator to poles and from poles to the equator
3. (d) Both statements are true, but Statement II is not a correct explanation for Statement I
4. (b) thunderstorm
5. (c) high-speed wind
6. (c) Both (a) and (b)
7. (a) Remaining in the car
8. (d) All of the above
9.(c) A glass rod when rubbed with silk acquires a negative charge.

G. Match each item from Column A with its most appropriate function from Column B and rewrite the pairs (4 Marks)

Ans:-

a) vi)
b) i)
c) v)
d) iii)

II A. Select and write the most appropriate alternative (a, b, c, d) from those given below each statement. (10 marks)

1. (a) 30˚
2. c) 10cm
3. (a) 80˚
4. (b) 6
5. (b) All the three surfaces
6. (b). Virtual, behind the mirror and of the same size as the object
7. (d) 6 m
8. (a) lateral inversion
9. (c) 65°
10. (c) 3

B. State whether the given statements are true or false. (4 Marks)

1.(F)
2.(F)
3.(T)
4.(F)

C. Observe the correlation between the words of the first pair and complete the second pair (1 Mark)

1 Dispersion

D. Match Each Phenomenon from Column A with its most appropriate meaning or process from Column B and rewrite the pairs (4 Marks)

Ans:-

a) iii)
b) ii)

c) iv)
d) vi)

E. Draw a neat diagram to show the formation of the image of an object in a plane mirror. Label the object and the image. (2 Marks for correct drawing 2 marks for correct Labeling) (4 Marks)

F. Select and write the most appropriate alternative (a, b, c, d) from those given below each statement. (9 marks)

1. (c) 8
2. (c) 20 to 25 cm
3. (d) Concave mirror
4. (b) real and virtual
5. (a) concave lens
6. (b) Blindspot
7. (c) Kaleidoscope
8. (a) A
9. (d))Cataract

G. Match Each part of the eye from Column A with its most appropriate function from Column B and rewrite the pairs (4 Marks)

Ans:-

a) ii)
b) v)
c) iv)
d) vi)

H. Draw a neat diagram of the human eye and label a) Cornea b) Iris (4 Marks)
(2 marks for Correct drawing and 2 marks for correct labeling)

III A. Select and write the most appropriate alternative (a, b, c, d) from those given below each statement. (9 marks)

1. (c) 15 days
2. (b) What it existed 1000 years ago
3. (c)8
4. (b) The moon is between the Earth and the Sun
5. (b) The sun's light falling on earth in a year
6. (a) Both statements 1 and 2 are true and statement 2 is the correct explanation of statement 1.
7. (d) Saturn and Jupiter
8. (b) Venus
9. (d) Much hotter than Sun

B. State whether the given statements are true or false.. (5 Marks)

1. (F)
2. (T)

3 (T)
4 (T)
5 (F)

C. Observe the correlation between the words of the first pair and complete the second pair (2 Marks)

1. Seen by the reflected light of the sun.
2. For Locating Sirius

E. Draw Sketches to show the relative positions of prominent stars in a) Ursa major b) Orion (2marks for correct Drawing 2 marks for correct labeling) (4 Marks)

F. Select and write the most appropriate alternative (a, b, c, d) from those given below each statement. (10 marks)

1. (c) The sunlight is bright during day time
2. (a) Natural satellites
3. (d) Shooting star
4. (c) Cassiopeia
5. (a)Nita, as there is no medium on the moon. Hence no sound.
6. (a) less than that of Neptune
7. (c) go up and then come back to the surface of the moon.
8. (a) 1 - Full Moon, 2 - Waning gibbous Moon, 3 - Waning crescent Moon, 4 - New Moon, 5 - Waxing crescent Moon
9 (d) Radiation pressure
10. (b) Only ii

G. Match each celestial object from column A with its most appropriate type from Column B and rewrite the pairs (4 Marks)

Ans:-

a) vi)
b) v)
c) iii)
d) iv)

IV A. Select and write the most appropriate alternative (a, b, c, d) from those given below each statement. (10 marks)

1. (c) Sulphur dioxide and nitrogen dioxide
2. (b) Carbon dioxide
3. (c) Chlorofluorocarbons
4. (b) 1985
5. (b). Respiratory problems
6. (c) Distillation
7. (a) Replace
8. (c). Both i and iii
9. (b) Only iii
10. (c). Both i and iii

B. State whether the given statements are true or false. (4 marks)

1. (T)
2. (F)
3. (T)
4. (T)

C. Observe the correlation between the words of the first pair and complete the second pair (2 Marks)

1. : Kills germs and bacteria

D. Match Each gas from Column A with its most appropriate effect from column B and rewrite the pairs (4 Marks)

Ans:-

a) v)
b) iv)
c) vi)
d) i)

E. Select and write the most appropriate alternative (a, b, c, d) from those given below each statement. (6 Marks)

1. (d) Greenhouse effect
2. (a) To clean the Ganga waters
3. (a) Carbon monoxide in the atmosphere
4. (b). Clean fuel
5. (d). Both i and iv
6. (c). Both ii and iii

F. Match Each item from Column A with its most appropriate item from column B and rewrite the pairs (4 Marks)

Ans:-

a) vi)
b) v)
c) iv)
d) iii)

APPENDIX 4

BLUE PRINT FOR ACHIEVEMENT TEST AFTER ITEM ANALYSIS

"A STUDY OF EFFECTIVENESS OF BLENDED LEARNING ON THE ACADEMIC ACHIEVEMENT OF GRADE VIII STUDENTS IN SCIENCE".

Name of the researcher: Udesh Ramakant Natekar

Name of the Guide: - Dr. Anna Neena George

BLUEPRINT FOR THE TEACHER-MADE TEST

1) WEIGHTAGE TO OBJECTIVES

Sr. No	Objectives	Marks	Percentage
1	Remembering	19	19
2	Understanding	42	42
3	Applying	07	07
4	Skills	16	16
5	Analyzing	16	16
	Total	100	100

2) WEIGHTAGE TO THE CONTENT AREA

Sr. No	Content	Marks	Percentage
1	Some Natural Phenomena	24	24
2	Light	25	25
3	Stars and Solar System	25	25
4	Pollution of air and Water	26	26
	Total	100	100

3) WEIGHTAGE TO FORM OF QUESTIONS

Sr. No	Forms of Question	Marks	Percentage
1	Objective	84	84
2	Skill (Drawing)	16	16
	Total	100	100

APPENDIX 5

ACHIEVEMENT TEST – PRE-TEST AND POST-TEST (AFTER ITEM ANALYSIS)

"A STUDY OF EFFECTIVENESS OF BLENDED LEARNING ON THE ACADEMIC ACHIEVEMENT OF GRADE VIII STUDENTS IN SCIENCE."

Name of the researcher: Udesh Ramakant Natekar

Name of the Guide: - Dr. Anna Neena George

Name of the Student: -_____

Name of the School: -_____

Supervisors Signature: -_____

Class: VIII **Duration: - 2 and ½ Hours**

Subject: Science **Total Marks: 100**

Instructions: - 1. All questions are compulsory
2. Figures to the right indicate full marks

I A. Select and write the most appropriate alternative (a, b, c, d) from those given below each statement. (6 marks)

1. During lightning air is normally _____
(a) a good conductor
(b) a bad conductor
(c) both (a) and (b)
(d) none of these

2. Earthquakes can cause _____
(a) floods (b) landslides
(c) tsunamis (d) All of the above

3. Consider the following statements and tick the answer from the codes given below
I. Sudden shaking or trembling of the earth which lasts for a very short time is called an earthquake.
II. Fragmented outermost layers of earth collide or brush past each other.
Codes
(a) Statement I is true, but Statement II is false
(b) Statement II is true, but Statement I is false
(c) Both the statements are true, but Statement II is not a correct explanation of Statement I
(d) Both the statements are true and Statement II is the correct explanation of Statement I

_____

4. Landslides are caused_____
(a) due to earthquakes

(b) due to sudden rock failures
(c) when the base of a slope is over steepened by excavation or river erosion
(d) All of the above

5. Which of the following statements related to earthquakes is not correct?
(a) The record of the seismic waves is called a seismograph
(b) The seismograph records the seismogram
(c) The Richter scale is not linear but logarithmic
(d) The seismic waves originate from the focus

---

6. Consider the following terms.
A. Lightning B. Landslide
C. Thundering D. Tsunami
E. Floods
Earthquakes can cause _____
(a) B, D, and E
(b) B and E
(c) A, B, and C
(d) Only A

B. State whether the given statements are true or false. (4 marks).

1. We cannot predict cyclones. ( )
2. The electric charges produced by rubbing are called static charges. ( )
3. The plates of the outermost layer of the earth are always in continuous motion.( )
4. During an earthquake, we should take shelter under a heavy table. ( )

C. Match each item from Column A with its most appropriate function from Column B and rewrite the pairs (4 Marks)

Column A	Column B
a) Lightning Conductor	i) Causes Lightning
b) Electroscope	ii) Records tremors
c) Seismograph	iii) Tests whether a body is electrically charged
d) Earthing	iv) causes movement of plates
	v) Avoids shock due to leakage of current
	vi) saves from the damage of lightning

Ans:-

D. Draw a neat diagram of a simple Electroscope and label a) Aluminum foil b) cardboard (4 Marks)

E. Select and write the most appropriate alternative (a, b, c, d) from those given below each statement. (6 marks)

1. Consider the following statements and tick the answer from the codes given below

I. Air exerts pressure.

II Air always moves from a high-pressure area to a low-pressure area.

Codes

(a) Statement I is true, but Statement II is false

(b) Statement II is true, but Statement I is false

(c) Both statements are true and Statement II is the correct explanation for Statement I.

(d) Both statements are true, but Statement II is not a correct explanation for Statement I

_____

2. The falling water of rain along with the rising warm air produces _____

(a) cyclones

(b) thunderstorm

(c) wind

(d) None of these

3. A cyclone consists of a wall of water inside it because of the _____

(a) low pressure in its eye

(b) high pressure in its eye

(c) high-speed wind

(d) gravitation

4. Which of the following is correct?

(a) Tornadoes formed over the sea are called water spouts

(b) Tropical cyclones in the Gulf of Mexico are called Hurricanes

(c) Both (a) and (b)

(d) Neither (a) nor (b)

_____

5. Suppose you are in a car and there is a thunderstorm. Which of the following is the best way to protect you from possible harm?

_____

(a) Remaining in the car

(b) Getting out of the car and taking cover under the car

(c) Running to a nearby tree

(d) Getting out and standing under an electric pole

6. Which of the following statements is NOT true
(a) Lightning and sparks from woolen clothing are essentially the same phenomena.
(b) When you rub a plastic scale on dry hair, it acquires charge.
(c) A glass rod when rubbed with silk acquires a negative charge.
(d) Static charges are called so because they do not move by themselves.

II A. Select and write the most appropriate alternative (a, b, c, d) from those given below each statement. (6 marks)

1. The incident ray makes an angle of 30˚ with the reflecting surface. Therefore, the angle of incident is _____
(a) 30˚
(b) 80˚
(c) 90˚
(d) 20˚

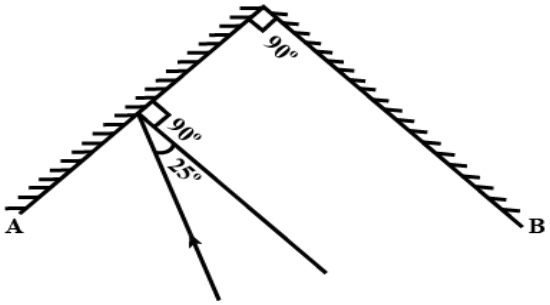
2. An object 10cm high is placed at a distance of 50 cm from a plane mirror. The size of the image will be _____
(a) 20 cm
(b) 40cm
(c) 10cm
(d) 100cm

3. When the angle between two plane mirrors is 60˚, images formed by the mirrors will be _____
(a) 5
(b) 6
(c) 7
(d) 8

4. The image formed by a plane mirror is: _____
(a). Virtual, behind the mirror, and enlarged.
(b). Virtual, behind the mirror and of the same size as the object.
(c). Real, at the surface of the mirror and enlarged.
(d). Real, behind the mirror and of the same size as the object

5. If you hold a pen in your right hand and stand in front of the mirror, the pen will be in the left hand in the image. This phenomenon is called_____
(a) lateral inversion
(b) diffraction
(c) reflection
(d) inversion

6. Two mirrors A and B are placed at right angles to each other. A ray of light incident on mirror A at an angle of 25° falls on mirror B after reflection. The angle of reflection for the ray reflected from mirror B would be



(a) 25° (b) 50°
(c) 65° (d) 115°

B. State whether the given statements are true or false. (4 Marks)

1. Deficiency of vitamin B causes night blindness. ( )
2. In the Braille system, patterns are made with coloured dots.. ( )
3. Rainbow forms due to dispersion. ( )
4. Diffused reflection is due to the failure of laws of reflection.. ( )

C. Match Each Phenomenon from Column A with its most appropriate meaning or process from Column B and rewrite the pairs (4 Marks)

Column A	Column B
a) Dispersion	i) Lasting impressions of an image on the retina
b) Reflection	ii) Changing directions of rays of light
c) Diffusion of light	iii) Splitting of white light into colours
d) Virtual Image	iv) Scattering of light
	v) having a foggy eyesight
	vi) Apparent meeting of rays

D. Draw a neat diagram to show the formation of the image of an object in a plane mirror. Label the object and the image. (4 Marks)

E. Select and write the most appropriate alternative (a, b, c, d) from those given below each statement. (7 marks)

1. There are 11 letters in the word EXAMINATION. How many letters of this word are not changed when the word is seen in a plane mirror?
(a) 11
(b) 5
(c) 8
(d) 9

2. For a normal eye, in an adult, what is the least distance of distinct vision?
(a)5 to 8 cm
(b)10 to 15 cm
(c) 20 to 25 cm
d)30 to 35 cm

_____

3. Rahul's Ear was paining so he visited to ENT Doctor where he saw the doctor use a mirror to observe the inside ear. Which of the following is used by E.N.T. doctors?

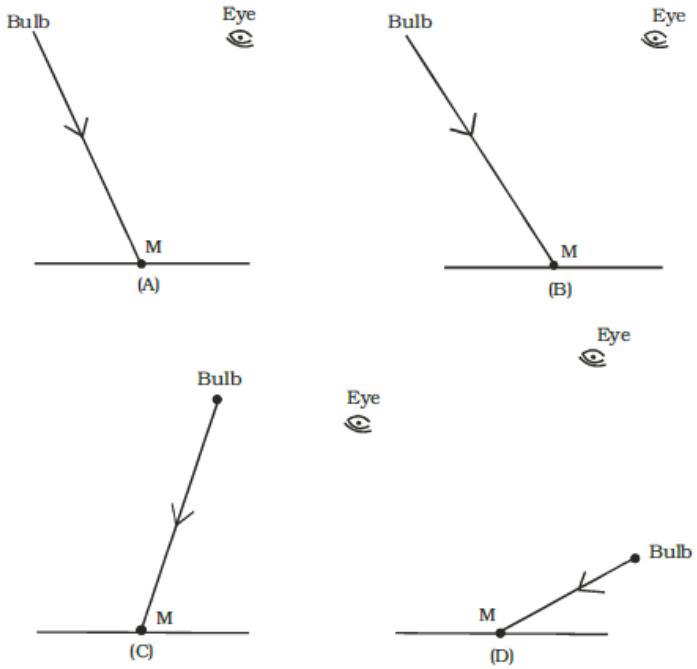
_____
(a)Convex mirror
(b)Convex lens
(c) Plane mirror
(d) Concave mirror

4. In the retina of the eye, the area having no sensory cells is called _____
(a) Iris
(b) Blindspot
(c) Cornea
(d) Dark spot

5. Which of the following works on the concept of multiple reflections?

_____
(a) Telescope
(b) Binoculars
(c) Kaleidoscope
(d) Sunglasses

6. A tiny mirror M is fixed on a piece of cardboard placed on a table. The cardboard is illuminated by light from a bulb. The position of the eye with respect to the position of the bulb is shown in Figures A, B, C, and D. In which position mirror will be visible?



(a) A
(b) B
(c) C
(d) D

_____

7. The characteristics of an eye disease are given below.
(i) Eyesight becomes foggy
(ii) Eye lens becomes cloudy
(iii) There is a loss of vision
In which of the following are the above characteristics observed
(a)Myopia
(b)Presbyopia
(c) Hypermetropia
(d))Cataract

_____

F. Draw a neat diagram of the human eye and label a) Cornea b) Iris (4 Marks)

III A. Select and write the most appropriate alternative (a, b, c, d) from those given below each statement. (7 marks)

1. The period between a full moon day and a new moon day is of _____.
(a) 29 days
(b) 30 days
(c) 15 days
(d) 365 days

2. If a star is 1000 light years away from the earth, then the star as we see today is _____.
(a) What it exists today
(b) What it existed 1000 years ago
(c) What it would be after 1000 years
(d) What it existed 500 years ago.

3. There are _____ planets in the solar system
(a) 9
(b) 10
(c) 8
(d) 11

4. On a new moon day,_____.
(a) The earth is between the Sun and the moon.
(b) The moon is between the Earth and the Sun
(c) The Sun is between the earth and the moon.
(d) The earth and moon are at right angles with respect to the Sun.

5. A light year measures _____.
(a) The time of rotation of planets
(b) The sun's light falling on earth in a year
(c) The brightness of light
(d) The distance between celestial objects.

6. Read the given statements and select the correct option.
Statement 1: Saturn could float if put in water.
Statement 2: Saturn is less dense than water.
(e) Both statements 1 and 2 are true and statement 2 is the correct explanation of statement 1.
(f) Both statements 1 and 2 are true but statement 2 is not the correct explanation of statement 1.
(g) Statement 1 is true but statement 2 is false.
(h) Both statements 1 and 2 are false.

---

7. Which one of the following pairs of planets is known as gas giants?
(a) Saturn and Mars
(b) Venus and Mercury

(c) Venus and Neptune
(d) Saturn and Jupiter

_____

B. State whether the given statements are true or false. (4 Marks)

1. The Sun is a satellite. ( )
2. Orion is seen during the winter season. ( )
3. Saturn and Uranus have rings around them. ( )
4. The stars have light of their own. ( )

C. Match each celestial object from column A with its most appropriate type from Column B and rewrite the pairs (4 Marks)

Column A	Column B
a) Sun	i) A comet
b) Orion	ii) An asteroid
c) Moon	iii) A satellite
d) Mars	iv) A planet
	v) A constellation
	vi) A star

Ans:-

D. Draw Sketches to show the relative positions of prominent stars in a) Ursa Major b) Orion (4 Marks)

E. Select and write the most appropriate alternative (a, b, c, d) from those given below each statement. (6 marks)

1. We cannot see stars during day time because _____.
(a) They are less bright during daytime
(b) They do not exist during day time
(c) The sunlight is bright during day time
(d) They are hidden by the Sun

2. The other name for Meteor is _____
(a) Running star
(b) Sleeping star

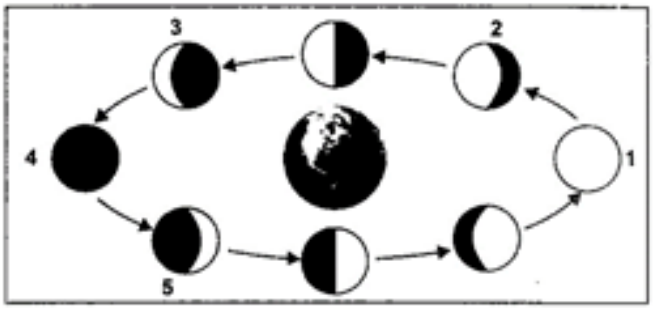
(c) walking star
(d) Shooting star

3. Two friends, Nita and Rita, were arguing. Their argument was about Neil Armstrong hearing sounds while on the moon. Nita argued that Neil Armstrong couldn't have heard any sound. While Rita was convinced Neil Armstrong heard sounds. Who won the argument and why? _____

(e) Nita, as there is no medium on the moon. Hence no sound.
(f) Rita, as there is the atmosphere. Hence sound travels.
(g) Both (a) and (b)
(h) Neither(a) nor (b)

4. Suppose a new planet is discovered between Uranus and Neptune. Its time period would be_____
(a) less than that of Neptune
(b) more than that of Neptune
(c) equal to that of Neptune or Uranus
(d) less than Uranus

5. Phases of the Moon are as shown in the figure. Which of the following options shows the correct labeling?
_____



(a) 1 - Full Moon, 2 - Waning gibbous Moon, 3 - Waning crescent Moon, 4 - New Moon, 5 - Waxing crescent Moon
(b) 1 - New Moon, 2 - Waxing gibbous Moon, 3 - Waning crescent Moon, 4 - Full Moon, 5 - Waxing crescent Moon
(c) 1 - Waning crescent Moon, 2 - Waning gibbous Moon, 3 - Full Moon, 4 - New Moon, 5 - Waxing crescent Moon
(d) 1 - New Moon, 2 - Waning gibbous Moon, 3 - Waning crescent Moon, 4 - Full Moon, 5 - Waxing gibbous Moon

6. Seema wanted to see the moon on the 15th day after the full moon day. However, when she went to her terrace, she couldn't see the moon. What could be the reason?
_____

i. There were trees blocking her view
ii. It was the new moon day

iii. It was a clear sky
iv. There were clouds blocking her view.

(a) Only i
(b) Only ii
(c) Both i and ii
(d) Both iii and iv

IV A. Select and write the most appropriate alternative (a, b, c, d) from those given below each statement. (7 marks)

1. The gases that cause acid rain are _____.
(a) Carbon monoxide and carbon dioxide.
(b) Carbon dioxide and sulphur dioxide
(c) Sulphur dioxide and nitrogen dioxide
(d) Nitrogen dioxide and carbon dioxide.

2. The gas that contributes to the greenhouse effect is _____.
(a) Carbon monoxide
(b) Carbon dioxide
(c) Sulphur dioxide
(d) Nitrogen dioxide

3. Substance used in Refrigerators which pollutes air is _____
(a) CNG
(b) LPG
(c) Chlorofluorocarbons
(d) Toxic Chemicals

4. Ganga action plan was launched in _____ year
(a) 1977
(b) 1985
(c) 2020
(d) 1998

5. Air pollution causes _____
(a). Global warming
(b). Respiratory problems
(c.) Soil erosion
(d). None of these

6. Which of the following is not a way to conserve water?
(a) Replace
(b) Reuse
(c) Reduce
(d) Recycle

_____

7. Your friend witnessed a forest fire in Bandipur in the year 2019. She is a bronchitis patient who then had difficulty breathing for days. What could be the reason?

i. Air Pollutants ii. Carbon Monoxide gas
iii. Forest air iv. Climate change

(a). Only i
(b). Only iv
(c). Both i and iii
(d). Both iii and iv

_____

B. State whether the given statements are true or false. (4 marks)

1. Rapid growth of algae on the surface of the water is known as an algal bloom. ( )
2. Acid rain does not affect the soil and plants. ( )
3. CFCs damage the ozone layer of the atmosphere. ( )
4. Global warming is a serious threat to life on Earth. ( )

C. Match Each gas from Column A with its most appropriate effect from column B and rewrite the pairs (4 Marks)

Column A	Column B
a) Nitrogen	i) Absorbs harmful radiations.
b) Carbon monoxide	ii) Reduces oxygen carrying capacity
c) Oxygen	iii) Causes yellowing of marble
d) Ozone	iv) Reduces the protective layer of atmosphere
	v) Highest proportion in air
	vi) Inhaled by a human being

Ans:-

D. Select and write the most appropriate alternative (a, b, c, d) from those given below each statement. (7 Marks)

1. 'Ganga Action Plan' has been undertaken _____
(a) To clean the Ganga waters
(b) To increase the level of the Ganga waters
(c) To make the Ganga River navigable
(d) To use the Ganga waters for drinking

2. The respiratory diseases like asthma are caused due to the presence of _____
(a) Carbon monoxide in the atmosphere
(b) Carbon particles in the atmosphere
(c) Carbon dioxide in the atmosphere

(d) Sulphur dioxide in the atmosphere

3. CNG is a _____
(a). Polluted fuel
(b). Clean fuel
(c). Harmful fuel
(d) None

4. Tina was hesitant to take a dip in the Ganga River at Kanpur, Uttar Pradesh. She noticed something.

i.It was polluted
ii. The Ganga Action Plan worked
iii. Garbage is disposed off Properly
iv. People defecating in the river

(a). Only i
(b). Only ii
(c). Both i and iii
(d). Both i and iv

_____

5.. Ana went fishing with her father. She noticed many dead fish floating

i. The lakes ecosystem is healthy
ii. Industrial discharge
iii. The water quality has degraded
iv. Fishermen are killing the fish

(a). Only ii
(b). Only iv
(c). Both ii and iii
(d). Both ii and iv

_____

4) Tina went to a restaurant with her family to have dinner. The next morning she complained about a severe stomach ache.

i. She ate a healthy meal
ii. She drank portable water
iii. She drank impure water
iv. All of the above

(a). Only i
(b) Only iii
(c). Both ii and iii
(d). Both iii and iv

_____

7. You are on your way to school and you always come across a busy intersection. You wait at the Zebra Crossing. What will you witness?

i Contaminated air
ii A lot of Greenery
iii. People covering their faces
iv. People enjoying the queue of vehicles

(a). Only i
(b). Only iv
(c). Both i and iii
(d). Both iii and iv

APPENDIX 6

ACHIEVEMENT TEST SCORING KEY AFTER ITEM ANALYSIS (PRE-TEST AND POST-TEST)

"A STUDY OF EFFECTIVENESS OF BLENDED LEARNING ON THE ACADEMIC ACHIEVEMENT OF GRADE VIII STUDENTS IN SCIENCE".

Name of the researcher: Udesh Ramakant Natekar

Name of the Guide: - Dr. Anna Neena George

I A. Select and write the most appropriate alternative (a, b, c, d) from those given below each statement. (6 marks)

1. (a) a good conductor
2. (d) All of the above
3. (d) Both the statements are true and Statement II is the correct explanation of Statement I
4. (d) All of the above
5. (d) The seismic waves originate from a focus
6. (a) B, D and E

B. State whether the given statements are true or false. (5 marks).

1.(F)
2.(T)
3. (T)
5. (T)

C. Match each item from Column A with its most appropriate function from Column B and rewrite the pairs (4 Marks)

Ans: -

a) vi)
b) iii)
c) ii)
d) v)

D. Draw a neat diagram of a simple Electroscope and label a) Aluminum foil b) cardboard (2 marks for correct drawing 2 marks for correct labeling)(4 Marks)

E. Select and write the most appropriate alternative (a, b, c, d) from those given below each statement. (6 marks)

1. (d) Both statements are true, but Statement II is not a correct explanation for Statement I
2. (b) thunderstorm
3. (c) high-speed wind
4. (c) Both (a) and (b)
5. (a) Remaining in the car
6. (c) A glass rod when rubbed with silk acquires a negative charge.

II A. Select and write the most appropriate alternative (a, b, c, d) from those given below each statement. (6 marks)

1. (a) 30˚
2. c) 10cm
3. (b) 6
4. (b). Virtual, behind the mirror and of the same size as the object
5. (a) lateral inversion
6. (c) 65°

B. State whether the given statements are true or false. (4 Marks)

1.(F)
2.(F)
3.(T)
4.(F)

C. Match Each Phenomenon from Column A with its most appropriate meaning or process from Column B and rewrite the pairs (4 Marks)

Ans: -

a) iii)
b) ii)
c) iv)
d) vi)

D. Draw a neat diagram to show the formation of the image of an object in a plane mirror. Label the object and the image. (2 Marks for correct drawing 2 marks for correct Labeling) (4 Marks)

E. Select and write the most appropriate alternative (a, b, c, d) from those given below each statement. (7 marks)

1. (c) 8
2. (c) 20 to 25 cm
3. (d) Concave mirror
4. (b) Blindspot
5. (c) Kaleidoscope
6. (a) A
7. (d)) Cataract

F. Draw a neat diagram of the human eye and label a) Cornea b) Iris (4 Marks)
(2 marks for Correct drawing and 2 marks for correct labeling)

III A. Select and write the most appropriate alternative (a, b, c, d) from those given below each statement. (7 marks)

1. (c) 15 days
2. (b) What it existed 1000 years ago
3. (c)8
4. (b) The moon is between the Earth and the Sun

5. (b) The sun's light falling on earth in a year
6. (a) Both statements 1 and 2 are true and statement 2 is the correct explanation of statement 1.
7. (d) Saturn and Jupiter

B. State whether the given statements are true or false. (5 Marks)

1. (F)
2. (T)
3 (T)
4 (T)
5 (F)

C. Match each celestial object from column A with its most appropriate type from Column B and rewrite the pairs (4 Marks)

Ans: -

a) vi)
b) v)
c) iii)
d) iv)

D. Draw Sketches to show the relative positions of prominent stars in a) Ursa Major b) Orion (2marks for correct Drawing 2 marks for correct labeling) (4 Marks)

E. Select and write the most appropriate alternative (a, b, c, d) from those given below each statement. (6 marks)

1. (c) The sunlight is bright during day time
2. (d) Shooting star
3. (a)Nita, as there is no medium on the moon. Hence no sound.
4. (a) less than that of Neptune
5. (a) 1 - Full Moon, 2 - Waning gibbous Moon, 3 - Waning crescent Moon, 4 - New Moon, 5 - Waxing crescent Moon
6. (b) Only ii

IV A. Select and write the most appropriate alternative (a, b, c, d) from those given below each statement. (7 marks)

1. (c) Sulphur dioxide and nitrogen dioxide
2. (b) Carbon dioxide
3. (c) Chlorofluorocarbons
4. (b) 1985
5. (b). Respiratory problems
6. (a) Replace
7. (c). Both i and iii

B. State whether the given statements are true or false. (4 marks)

1. (T)

2. (F)
3. (T)
4. (T)

D. Match Each gas from Column A with its most appropriate effect from column B and rewrite the pairs **(4 Marks)**

Ans: -

a) v)
b) iv)
c) vi)
d) i)

E. Select and write the most appropriate alternative (a, b, c, d) from those given below each statement. (7 Marks)

1. (a) To clean the Ganga waters
2. (a) Carbon monoxide in the atmosphere
3. (b). Clean fuel
4. (d). Both i and iv
5. (c). Both ii and iii
6. (b) Only iii
7. (c) Both i and iii

APPENDIX 7

PERCEPTION SCALE

"A STUDY OF EFFECTIVENESS OF BLENDED LEARNING ON THE ACADEMIC ACHIEVEMENT OF GRADE VIII STUDENTS IN SCIENCE"

Name of the Researcher: Udesh Ramakant Natekar

Name of the Guide: - Dr. Anna Neena George

Name of the Student: - _____

Name of the School: - _____

Class: - VIII

Kindly read the statement carefully and mark the correct response with a tick mark
(Strongly disagree – 1, Disagree – 2, Neutral- 3, Agree – 4, Strongly agree – 5)

	Strongly Agree	Agree	Neutral	Strongly Disagree	Disagree
1. The organization of each lesson was easy to follow					
2. The structure of the environment helped me to focus on learning					
3 What is expected through assignments was clearly stated					
4. Activities were planned carefully					
5. The presentation of the content through videos and discussion forums was clear					
6.. The online content provided through MOODLE was very easy to understand					
7. I learned a great deal from this course					
8. The Activities given in the course helped me to develop skills					
9. The course provided through lessons increased the quantity of the content I learned					
10. The Teaching was designed at an appropriate level					
11.I look forward to learn using the same method in the					

future					
12. The entire course was difficult to follow					
13. The entire course was a waste of time					
14. I was able to chat with other students in this subject through MOODLE					
15. I could ask my teacher what I do not understand					
16. I could ask other students what I did not understand					
17. Other students responded promptly to my request for help					
18. The teacher gave me quick comments on my work					
19. My classmates and I could regularly evaluate each other's work					
20. I learned a great deal through discussions with my classmates					
21. My social skills improved during the course					
22. Using the MOODLE app was easy					
23. The Videos provided were easily Available					
24. The online material provided to me was available to me all the time					
25. I was able to learn at my speed					
26. I decided when to learn					
27. I was able to learn how to use the MOODLE App quickly					
28. My skills in Use Mobile improved					
29. I felt that I cannot use mobile phone as my classmate use					

Source:-

1) Farmer, Robert G. (2009) The effectiveness of a wiki as an online collaborative learning tool within a face-to-face course in higher education
2) Maria Josephine (2015) Effectiveness of a blended learning program on Academic Achievement in the teaching of Physical Science among Student Teachers of Ponduchery

APPENDIX 8

ATTITUDE SCALE

"A STUDY OF EFFECTIVENESS OF BLENDED LEARNING ON THE ACADEMIC ACHIEVEMENT OF GRADE VIII STUDENTS IN SCIENCE".

Name of the researcher: Udesh Ramakant Natekar

Name of the Guide: - Dr. Anna Neena George

Name of the Student: _____

Name of The School: _____

Class: - VIII

Kindly read the statement carefully and mark the correct response with a tick mark

(Strongly disagree – 1, Disagree – 2, Neutral- 3, Agree – 4, Strongly agree – 5)

Statement	**Strongly Agree**	**Agree**	**Neutral**	**Strongly Disagree**	**Disagree**
1. I like online learning through MOODLE as it provides more information.					
2. I use my time better when studying online through MOODLE					
3. Online learning through MOODLE encourages me in my studies					
4. Online learning through MOODLE makes me more responsible for my studies					
5. I believe Classroom learning is more effective than online learning.					
6. I like to learn in a group, but I can learn on my own as well.					
7. I find learning through discussion with others is more effective.					
8. I learn better through demonstrated activities.					
9. I was able to communicate effectively with others using online technologies (e.g. chat, discussion forum.)					
10. I was able to contact my teacher easily online					

11. I was able to express myself clearly online through my writing					
12. I am comfortable using my mobile.					
13. I believe the MOODLE is a useful platform for learning.					
14. I am comfortable using the MOODLE app.					
15. I think we should use the MOODLE app for learning.					
16. I am comfortable using the MOODLE app to exchange knowledge with others.					
17. I can have unlimited access to online material					
18. I would like to decide where I want to study.					
19. I like to study at my speed.					
20. I would like to decide when I want to study.					
21. I get bored when studying online.					
22. I find it very difficult to study online.					
23. I am more likely to miss assignment due dates in an online environment.					
24. I feel alone in an online environment					

Source:

Dr. Roland Birbal, Dr. Mala Ramdass & Mr. Cyril Harripaul (2018) Student Teachers Attitudes Towards Blended Learning

APPENDIX 9

"A STUDY OF EFFECTIVENESS OF BLENDED LEARNING ON THE ACADEMIC ACHIEVEMENT OF VIII GRADE STUDENTS IN SCIENCE".

Mr. Udesh Ramakant Natekar **Dr. Anna Neena George**

Researcher **Guide**

Identification of suitable technology to design and develop Blended Learning Strategies.

Sr. No	Research Study	LMS as Technology used
1.	Reza Rachmadtullah (2020), Use of Blended Learning with Moodle: Study Effectiveness in Elementary School Teacher Education Students during the COVID-19 Pandemic	MOODLE
2	Ressa Novinta Sari, Andin Vita Amalia (2021) The Effectiveness of Blended Learning Using Moodle on Student Independence and Learning Outcomes	MOODLE
3	Al-Ani, Wajeha Thabit (2013), Blended Learning Approach Using Moodle and Student's Achievement at Sultan Qaboos University in Oman	MOODLE
4	Wahyu Setyaningrum (2018) Blended learning: Does it help students in understanding mathematical concepts?	MOODLE
5	Lyubov Alekseevna Krasnova and Viktor Yurjevich Shurygin (2019), Blended learning of physics in the context of the professional development of teachers	MOODLE
6	Andromahi Filippidi, Nikolaos Tselios, and Vassilis Komis (2010), Impact of Moodle usage practices on students' performance in the context of a blended learning environment	MOODLE
7	Nick Z. Zacharis (2016) Predicting Student Academic Performance in Blended Learning Using Artificial Neural Networks	MOODLE
8	Tatiana Krasnova (2016) Blended learning in teaching Foreign Languages	MOODLE
9	Z.Sun, R.Liu (2017)Exploring cooperative learning effect in Blended Learning environment	WeChat, MOODLE
10	Noermanzah Noermanzah *(*2020) Improving students' ability to analyze discourse through the Moodle-based blended learning method	MOODLE

APPENDIX 10

"A STUDY OF EFFECTIVENESS OF BLENDED LEARNING ON THE ACADEMIC ACHIEVEMENT OF GRADE VIII STUDENTS IN SCIENCE ".

Mr. Udesh Ramakant Natekar **Dr. Anna Neena George**

Researcher **Guide**

Identification of suitable technology for teaching Science to design a Blended Learning Strategy.

Technology LMS	Advantages	Disadvantages	Deployment	Type	Who is it for?	Pricing	Selected/ Rejected
EduMe	1)Compatible with SCORM. 2)Provides real-time data on the users' progress and performance. 3)Offers a range of useful resources including case studies, guides,	1)Has limited gamification options. 2) Doesn't have 24/7 support. 3) Doesn't offer eCommerce or video-conferencing capabilities.	Desktop Application, Mobile Application, Cloud-based/SaaS	Academic LMS, Corporate LMS	It is ideal for educational institutions and organizations of types and sizes.	Licensed	Rejected

	webinars, and a blog. 4)Has a content creation tool that uses a microlearning format and creates engaging learning materials.						
CoreAchieve	1)Offers detailed reporting. 2)Has rich customization capabilities. 3)Compatible with SCORM and Section 508. 4)Comes with a range of integrations including eCommerce. 5)Offers blended and	1)Doesn't offer 24/7 support. 2)Doesn't provide a gradebook. 3)More expensive compared to others.	Cloud-based/SaaS, Mobile Application, Self-Hosted Cloud-based, Self-Hosted System	Academic LMS, Corporate LMS	It's suitable for educational institutions, public administrations, and organizations of all types and sizes.	Licensed	Rejected

	mobile learning.						
Top Hat	1)Offers the ability to customize learning content – textbooks. 2)Has plenty of teaching resources including a blog, guides, and webinars. 3)Has digital classroom tools. 4)Has a mobile app (iOS and Android) 5)Comes with a marketplace of ready-made textbooks.	1)Not SCORM compliant. 2)Doesn't offer progress reporting or video conferencing options. 3)Doesn't have any eCommerce capabilities.	Mobile Application, Cloud-based/SaaS	Academic LMS	It is intended for use by higher education instructors, professors, and educational institutions.	Free for Professor, Licensed for Students	Rejected
TalentCards	1)Comes with API integrations.	1)Not compatible with SCORM.	Desktop Application, Mobile Application,	Academic LMS, Corporate LMS	It's ideal for freelancers, educators, trainers, academic staff,	Licensed	Rejected

	2)Offers the ability to create fun and interactive learning content. 3)Supports mobile learning through an app (iOS and Android). 4)Simple in its use for new or inexperienced users. 5)Provides the ability to train multiple groups or staff at once.	2)Lacks ILT and grading options. 3)Doesn't support eCommerce. 4)Doesn't offer 24/7 support.	Cloud-based/SaaS		SMEs, large organizations and public administrations		
Blackboard	1)Comes with a mobile app (iOS and Android). 2)Compatible with SCORM, AICC, IMS	1)Has limited reporting capabilities. 2)Has limited gamification options. 3)Doesn't have any	Desktop Application, Mobile Application, Self-Hosted System, Cloud-based/SaaS	Academic LMS, Corporate LMS	It fits well with the requirements of educational institutes, public administrations, educators, trainers, instructional designers, as well	Licensed	Rejected

	LTI, and xAPI/Tin Can API. 3)Offers the ability to categorize users by different metrics e.g. skills and department. 4)Integrates with social channels and video conferencing tools.	security-enhancing features.			as SMEs and enterprises.		
EssentialSkillz	1)Compatible with SCORM. 2)Offers the ability to create courses fast. 3)Provides ongoing setup and training support. 4)Allows automation of key learning tasks	1)Can be expensive compared to others. 2)Has very limited customization features. 3)Doesn’t offer any gamification capabilities. 4)Doesn’t have any integrations or	Cloud-based/SaaS	Academic LMS, Corporate LMS	It can be used by educators, teachers, trainers, and businesses of any type and size.	Licensed	Rejected

	and activities. 5)Offers the ability to issue policies and ensure that users understand them	eCommerce options.					
Moodle	1)Has a desktop and mobile app (iOS and Android). 2)Compatible with SCORM, AICC, IMS LTI, and xAPI/Tin Can API. 3)Offers a variety of customization options and integrations to plugins and add-ons. 4)Gives you access to a community of	1)Doesn't offer an email or 24/7 support. Has limited gamification options. 2)Can be expensive if you are hosting the solution but don't have an in-house IT team. 3)Its setup can be tricky and time-consuming with the help of a certified Moodle partner. 4)Its consultation services may come with an	Mobile Application, Self-Hosted Cloud-based, Self-Hosted System	Academic LMS, Corporate LMS	It's suitable for educators, freelancers, businesses, and public administrations.	Free for 45 days	Accepted

	developers, users, and certified partners that share best practices on the use of the platform. 5)user-friendly interface that is easy to navigate for both instructors and students, supporting multimedia content, discussion forums, assignment submissions, and grading, with clear instructions and organization that supports various types of content, including text, images, videos, audio	additional fee.					

	files, presentations, and interactive multimedia. supporting diverse assessment methods, including quizzes, surveys, assignments, discussions, and peer reviews, and 6) facilitating communication and collaboration among instructors and students through discussion forums, chat, messaging, announcements, and group workspaces						

Google Classroom	1)It's Google so it's free and it seamlessly integrates with its suite of applications. 2)It's also very intuitive. 3)It is a great alternative to others that may be more costly for institutions.	1)Google Classroom is now and then certain users will have problems accessing the classrooms. 2). The only issue of have experienced is trouble logging in.	Cloud, SaaS, Web-Based Desktop - Mac Desktop - Windows Mobile - Android Mobile - iPhone Mobile - iPad	Academic LMS	It is suitable for Educators	Licensed/Free	Rejected
Canvas	1)Great to connect with lecturers and have a unified platform for all course material. 2)Allows multimedia file transfers and integration with third-party applications like Turnedin. 3)It is easy to use and it is easily available on the internet. 4)You can download it free of	1)There was always the possibility of losing your work if you timed out or hit the wrong key, especially on a laptop. 2)Is not an autosave feature, specially when building quizzes..	Cloud, SaaS, Web-Based Desktop - Mac Desktop - Windows Mobile - Android Mobile - iPhone Mobile - iPad	Academic LMS	It is suitable for Educators	Licensed/free	Rejected

	cost.						

APPENDIX 11

"A STUDY OF EFFECTIVENESS OF BLENDED LEARNING ON THE ACADEMIC ACHIEVEMENT OF VIII GRADE STUDENTS IN SCIENCE ".

Mr. Udesh Ramakant Natekar — **Researcher**

Dr. Anna Neena George — **Guide**

Identification of suitable pedagogical practices for teaching of Science to design a Blended Learning Strategy

Sr.no.	Name of the Chapter	Units	Learning By doing	Discussion Method	Case Study Method	Survey Method	Methods Can be Used
1	Crop Production And Management	1.1 Agricultural Practices		✓			Discussion Method
		1.2 Basic Practices of Crop Production		✓			Discussion Method
		1.3 Preparation of Soil		✓			Discussion Method
		Agricultural Implements					
		1.4 Sowing		✓			Discussion Method
		1.5 Adding Manure and Fertilisers		✓			Discussion Method
		1.6 Irrigation		✓			Discussion Method
		Traditional methods of Irrigation					
		Modern Methods of Irrigation					
		1.7 Protection from Weeds		✓			Discussion Method
		1.8 Harvesting		✓			Discussion Method
		1.9 Storage		✓			Discussion Method
		1.10 Food from Animals		✓			Discussion Method
2	Microoraganisms: Friends and Foe	2.1 Microorganisms		✓			
		2.2 Where do Microorganisms Live?		✓			
		2.3 Microorganisms and Us	✓	✓			Disscussion Method
							Learning by doing
		Friendly Microorganisms		✓			
		Making of Curd and Bread		✓			
		Commercial Use of Microorganisms		✓			
		Medicinal Use of Microorganisms		✓			
		Increasing Soil Fertility		✓			
		Cleaning the Environment		✓			
		2.4Harmful Microorganisms		✓			Discussion Method
		Disease causing Microorganisms in Humans		✓			
		Disease causing Microorganisms in Animals		✓			

		Disease causing Microorganisms in Plants		✓			
		Foods Poisoning		✓			
		2.5 Food Preservation		✓			Discussion Method
		Chemical Method					
		Preservation by Common Salt					
		Preservation by Sugar					
		Preservation by Oil and Vinegar					
		Heat and Cold Treatments					
		Storage and Packing					
		2.6 Nitrogen Fixation		✓			Discussion Method
		2.7 Nitrogen Cycle		✓			Discussion Method
3	Synthetics Fibres And Plastics	3.1 What are Synthetic Fibres?		✓			
		3.2 Types of Synthetic Fibres	✓	✓			Discussion Method
							Learning by doing
		Rayon					
		Nylon					
		Polyester and Acrylic					
		3.3 Characteristics of Synthetic Fibres	✓	✓			Discussion Method
							Learning By doing
		3.4 Plastics		✓			Discussion Method
		3.5 Plastics as Materials of Choice		✓			Discussion Method
		Plastic in Non-reactive					
		Plastis is Light, Strong and Durable					
		Plastics are Poor Conductors					
		3.6 Plastics and the Environment		✓			Discussion Method
4	Materials: Metals and Non Metals	4.1 Physical Properties of Metals and Non - metals	✓	✓			Discussion Method
							Learning By doing
		4.2 Chemicals Properties of Metals and Non - Metals	✓	✓			Discussion Method
							Learning By doing
		Reaction with Oxygen					

		Reaction with water					
		Reaction with Acids					
		Reactions with Bases					
		Displacement Reactions					
		Uses of Metals amd Non- metals					
5	Coals and Petroleum	5.1 Coal		✓			Discussion Method
		Story of coal					
		Coke					
		Coal Tar					
		Coal Gas					
		5.2 Petroleum		✓			Discussion Method
		Refining of Petroleum					
		5.3 Natural Gas					
		5.4 Some Natural Resources are Limited		✓			Discussion Method
6	Combustion And Flame	6.1 What is Combustion?	✓	✓			Discussion Method
							Learning by doing
		6.2 How do we control Fire?		✓			Discussion Method
		6.3 Types of Combustion		✓			Discussion Method
		6.4 Flame		✓			Discussion Method
		6.5 Structure of a Flame		✓			Discussion Method
		6.6 What is a Fuel		✓			Discussion Method
		6.7 Fuel Efficiency		✓			Discussion Method
		Burning of Fuels Lead to Harmful Products					
7	Conservation of Plants and Animals	7.1 Deforestation and Its causes		✓			Discussion Method
		7.2 Consequences of Deforestation		✓			Discussion Method
		7.3 Conservation of Forest and Wildlife		✓			Discussion Method
		7.4 Biosphere Reserve		✓			Discussion Method
		7.5 Flora and Fauna		✓			Discussion Method
		7.6 Endemic Species		✓			Discussion Method
		7.7 Wildlife Sanctuary		✓			Discussion Method
		7.8 National Park		✓			Discussion Method

		7.9 Red Data Book		✓			Discussion Method
		7.10 Migration		✓			Discussion Method
		7.11 Recycling of Paper		✓			Discussion Method
		7.12 Reforestation		✓			Discussion Method
8	Cell - Structure And Fuction	8.1 Discovery of the Cell		✓			Discussion Method
		8.2 The Cell		✓			Discussion Method
		8.3 Organisms show Variety in Cell Number, Shape and Size		✓			Discussion Method
		Number of Cells					
		Shape of Cells					
		Size of Cells					
		8.4 Cell Structure And Function		✓			Discussion Method
		8.5 Parts of the Cell		✓			Discussion Method
		Cell Membrane					
		Cytoplasm					
		Nucleus					
		8.6 Comparison of Plant and Animal Cells		✓			Discussion Method
9	Reproduction in Animals	9.1 Modes of Repoduction		✓			Discussion Method
		9.2 Sexual Reproduction		✓			Discussion Method
		Male Reproduction Organ					
		Female Reproductive Organs					
		Fertilisation					
		Development of Embryo					
		ViviParous and Oviparous Animals					
		Young Ones to Adults					
		9.3 Asexual Reproduction		✓			Discussion Method
		10.1 Adolescence and Puberty		✓			Discussion Method
		10.2 Changes at Puberty		✓			Discussion Method
		Increase in Height					
		Changes in Body Shape					
		Voice Change					

10	Reaching The Age of Adolescence	Increased Activity of Seat and Sebaceous Glands					
		Development of Sex Organs					
		Reaching Mental, Intellectual and Emotional Maturity					
		10.3 Secondary Sexual Characters		✓			Discussion Method
		10.4 Role of Hormones in Initiating Reproductive Function		✓			Discussion Method
		10.5 Reproductive phase of Life in Humans		✓			Discussion Method
		10.6 How is the sex of the Baby Determined		✓			Discussion Method
		Boy or Girl?					
		10.7 Hormones other than Sex Hormones		✓			Discussion Method
		10.8 Role of Hormones in Completing the Life History of Insects and Frogs		✓			Discussion Method
		10.9 Reproductive Health		✓			Discussion Method
		Nurtritional Needs of the Adolescents					
		Personal Hygiene					
		Physical exercise					
		Say "No" to Drugs					
		PART II					
11	Force and Pressure	11.1 Force n A Push or a Pull	✓	✓			Discussion Method
							Learning by doing
		11.2 Forces are due to an Interaction					Discussion Method
		11.3 Exploring Forces	✓	✓			Learning by doing
							Discussion Method
		11.4 A Force can change the State of Motion	✓	✓			Learning by doing
							Discussion Method
		11.5 Force can change the Shape of an object	✓	✓			Discussion Method
							Learning by doing
		11.6 Contact Forces	✓	✓			Discussion Method
							Learning by doing
		Muscular Force					
		Friction					
		11.7 Non - ContactForces	✓	✓			Discussion Method

							Learning by doing
		Magnetic Force					
		Electrostatic Force					
		Gravitationla Force					
		11.8 Pressure					
		11.9 Pressure Exerted by Liquids and Gases	✓	✓			Discussion Method
							Learning by doing
		11.10 Atmospheric Pressure	✓	✓			Discussion Method
							Learning by doing
12	Friction	12.1 Force of Friction	✓	✓			Discussion Method
							Learning by doing
		12.2 Factors affecting Friction	✓	✓			Discussion Method
							Learning by doing
		12.3 Friction: A Necessary Evil		✓			Discussion Method
		12.4 Increasing and Reducing Friction		✓			Discussion Method
		12.5 Wheels Reduce friction	✓	✓			Discussion Method
							Learning by doing
		12.6 Fluid Friction		✓			Discussion Method
13	Sound	13.1 Sound is Produced by a Vibrating Body	✓	✓			Discussion Method
							Learning by doing
		13.2 Sound Produced by Humans	✓	✓			Discussion Method
							Learning by doing
		13.3 Sound Needs a Medium for Propagation	✓	✓			Discussion Method
							Learning by doing
		13.4 We hear sound through our Ears	✓	✓			Discussion Method
							Learning by doing
		13.5 Amplitude, time Period and Frequency of a Vibration	✓	✓			Discussion Method
							Learning by doing
		Loudness and Pitch					
		13.6 Audible and Inaudible Sounds		✓			Discussion Method
		13.7 Noise and Music		✓			Discussion Method
		13.8 Noise Pollution		✓			Discussion Method

		what are the Harms of Noise Pollution					
		Measures to limit Noise Pollution					
14	Chemical effects of Electric Current	14.1 Do Liquid Conduct Electricity	✓	✓			Discussion Method
							Learning by doing
		14.2 Chemical Effects of Electric current	✓	✓			Discussion Method
							Learning by doing
		14.3 Electroplating		✓			Discussion Method
15	Some Natural Phenomena	15.1 Lighting		✓			
		The Sparks that the Greeks Knew About					
		15.2 Charging by Rubbing	✓	✓			Discussion Method
							Learning by doing
		15.3 Types of Charges and their Interaction	✓	✓			Discussion Method
							Learning by doing
		15.4 Transfer of Charge	✓	✓			Discussion Method
							Learning by doing
		15.5 The Story of Lightning		✓			Discussion Method
		15.6 Lightning Safety		✓			Discussion Method
		Finding a Safe Place					
		Dois and Donits during a therstorm					
		15.7 Earthquakes		✓			Discussion Method
		what is an earthquake?					
		what causes an earthquake?					
		Protection against Earthquakes					
16	Light	16.1 What makes Things Visible		✓			Discussion Method
		16.2 Laws of Reflection	✓	✓			Discussion Method
							Learning by doing
		16.3 Regular and Diffused Reflection	✓	✓			Discussion Method
							Learning by doing
		16.4 Reflected Light can be Reflected again	✓	✓			Discussion Method
							Learning by doing
		16.5 Multiple Images	✓	✓			Discussion Method

16	Light	Kaleidoscope					Learning by doing
		16.6 Sunlight & White or coloured	✓	✓			Discussion Method
							Learning by doing
		16.7 What is inside Our Eyes?	✓	✓			Discussion Method
							Learning by doing
		16.8 Care of the Eyes		✓			Discussion Method
		16.9 Visually Challenged Persons can Read and Write		✓			Discussion Method
		16.10 What is the Braille System		✓			Discussion Method
17	Stars and the Solar System	17.1 The Moon	✓	✓			Discussion Method
		The Moonis Surface					Learning by doing
		17.2 The Stars		✓			Discussion Method
		17.3 Constellations		✓			Discussion Method
		17.4 The Solar System		✓			Discussion Method
		The Sun					
		The Planets					
		Mercury (Budh)					
		Venus (Shukra)					
		The Earth (Prithvi)					
		Mars (Mangal)					
		Jupiter (Brihaspatil)					
		Saturn (Shani)					
		Uranus and Neptune					
		17.5 Some other Members of the Solar System		✓			
		Asteroids					
		Comets					
		Meteors and Metorites					
		Artifical Satellites					
		18.1 Air Pollution		✓		✓	Discussion Method
							Survey Method
		18.2 How does Air get polluted?		✓		✓	Discussion Method
							Survey Method
		18.3 Case Study - The Taj Mahal		✓	✓		Discussion Method

18	Pollution of Air and Water						Case Study method
		18.4 Greenhouse Effect		✓			Discussion Method
		18.5 What can be Done?		✓			Discussion Method
		18.6 Water Pollution	✓	✓			Discussion Method
							Learning by doing
		18.7 How does water get polluted?		✓	✓		Discussion Method
							Case Study method
		18.8 What is potable water and how is water Purified?	✓	✓			Discussion Method
							Learning by doing
		18.9 What can be done?		✓		✓	Discussion Method
							Survey Method

APPENDIX 12

BLENDED LEARNING STRATEGY 1: - LEARN AT HOME, DISCUSS AT SCHOOL

FLIPPED CLASSROOM LESSON PLAN TEMPLATE

"A STUDY OF EFFECTIVENESS OF BLENDED LEARNING ON THE ACADEMIC ACHIEVEMENT OF GRADE VIII STUDENTS IN SCIENCE".

Name Of the Researcher: - Udesh Ramakant Natekar
Name of the Guide: Dr. Anna Neena George

Class	VIII
Subject	Science
Lesson Title	Lightning Safety, Finding a Safe Place Do's and Don'ts during a Thunderstorm, Lightning Conductors
Chapter	Some natural Phenomena
Teacher	Udesh Ramakant Natekar
Timeline	60 mins (Online) 60 mins (Offline)
Materials	Access to Smartphones, Access to the MOODLE app
Date	

Learning Objectives

Students will be able to
List the safety measures to protect ourselves from lightning
List do's and don'ts during thunderstorms when inside the house
List do's and don'ts during thunderstorms when outside the house
(Remembering)
Explains the safety measures during lightning
Explains do's and don'ts during thunderstorms when inside the house
Explains do's and don'ts during thunderstorms when outside the house
(Understanding)

Student Learning Resources at Home

Students view the video Presentation at: https://udeshnatekar.com

Student Learning Activities at Home

Students Submit answers to the questions found at the discussion forum at https://udeshnatekar.com

STUDENT ACCESS TO FORUM and CHAT

FORUM:

Students:-

- Clicks on the Forum topic
- Reads the content of the forum published by the teacher
- Clicks on Reply
- Writes reply and Post to forum

CHAT:

Students: -

- Clicks on the Chat Topic
- Reads the content of the chat
- To enter into Chat room, click on “click here to enter chat now”
- Types views in the given textbox and sends.

Classroom Activities

Discussion

Discussion Method

1. Orientation

Teacher:-

- Place the students into groups (not more than 6 members in the Group)
- Randomly assigns students in a group
- Chooses one student from each group as Leader
- Allots time for discussion
- Explain how the discussion will be conducted.

2. Engagement

Teacher: -

- Develop an environment.
- Provides students with the discussion topic based on the URL provided through the MOODLE Application
- Encourages students to think.
- At the end of the allotted time ask the leader to reflect on behalf of the group.
- Keeps progressive record
- Closes discussion by summarising or evaluating.

3. Debrief

Teacher: -

- Allows time for students to make their notes
- Asks students to upload their notes on the MOODLE platform (Online)
- Facilitates students' reflection on what they learned (Through MOODLE, Through Discussion Forum, Online)

Assessment

Diagnostic assessment:
Before class, the teacher logs in to check if students have viewed the video/presentation found in the Forum http://udeshnatekar.com. Review student responses to the questions assigned and provide feedback if necessary.

Formative assessment:
The teacher walks around the classroom to answer individual student questions during break-out activity from 0-10 min and worksheet activity from 30-50 min. Ask students to volunteer to write answers to worksheet questions on the board. Briefly goes over each question with the class and addresses any further questions.

Summative assessment:
Provides online quiz at http://udeshnatekar.com

Reference:-

1) Flipped Classroom Lesson Plan Template: Beginners Guide: https://lecturetalks.com
2) Flipped Classroom Lesson Plan Template: http://harper-academy.net
3) Jonathan Bergmann, Aaron Sams(2012): Flip your classroom, Reach Every student every class every day. *International Society for Technology in Education*
4) Mayada Zaki (2015): Flipped Classrooms: Lesson Plan Strategies and activities: *research gate*
5) Patras, Greece (2019) How to Design and Implement a Flipped Classroom Lesson: A Bottom-up Procedure for More Effective Lessons, *Open Journal for Educational Research, 2019,*
6) Shane Cronin, Darragh Coakley (2018) Flipped Classroom In Practice*: Erasmus*

APPENDIX 13

BLENDED LEARNING STRATEGY 2: - LEARN AT HOME, DO IT AT SCHOOL

FLIPPED CLASSROOM LESSON PLAN TEMPLATE

"A STUDY OF EFFECTIVENESS OF BLENDED LEARNING ON THE ACADEMIC ACHIEVEMENT OF GRADE VIII STUDENTS IN SCIENCE".

Name Of the Researcher: - Udesh Ramakant Natekar
Name of the Guide: Dr. Anna Neena George

Class	VIII
Subject	Science
Lesson Title	Lightning, Charging by Rubbing
Chapter	Some natural Phenomena
Teacher	Udesh Ramakant Natekar
Timeline	60 mins (Online) 60 mins (Offline)
Materials	Access to Smartphones, Access to the MOODLE app
Date	

Learning Objectives

Students will be able to
Define Lightning
Define Charging
List the items which attract and which does not attract (Remembering)
Explains the spark the Greeks knew about
Distinguish between the objects which can be charged and which cannot be charged(Understanding)

Student Learning Resources at Home

Students view the video Presentation at: https://udeshnatekar.com

Student Learning Activities at Home

Students submit answers to the questions found at the discussion forum at https://udeshnatekar.com

STUDENT ACCESS TO FORUM and CHAT

FORUM:

Students: -

- Clicks on the Forum topic
- Reads the content of the forum published by the teacher
- Clicks on Reply
- Writes reply and Post to forum

CHAT:

Students: -

- Clicks on the Chat Topic
- Reads the content of the chat
- To enter into Chat room, click on "click here to enter chat now"
- Type views in the given textbox and send.

Classroom Activities

Learning by doing

Teacher: -

- Place the students into groups (not more than 6 members in the Group)
- Randomly assigns students in a group
- Chooses one member from each group as leader
- Allows students to perform the activity in the group
- Provide the students with a worksheet
- Ask students to reflect on their personal experience with the activity
- Students reflect on other groups' observations.
- Students form the concept and the principles.
- Students apply the concepts and principles in new situations.

Assessment

Diagnostic assessment:
Before class, the teacher logs in to check if students have viewed the video/presentation found in the Forum https://udeshnatekar.com. Review student responses to the questions assigned and provide feedback if necessary.

Formative assessment:
The teacher walks around the classroom to answer individual students' questions during break-out activity from 0-10 min and worksheet activity from 30-50 min. Ask students to volunteer to write answers to worksheet questions on the board. Briefly goes over each question with the class and addresses any further questions.

Summative assessment:
Provides online quiz at https://udeshnatekar.com

Reference: -

1) Flipped Classroom Lesson Plan Template: Beginners Guide: https://lecturetalks.com
2) Flipped Classroom Lesson Plan Template: http://harper-academy.net
3) Jonathan Bergmann, Aaron Sams(2012): Flip your classroom, Reach Every student every class every day. *International Society for Technology in Education*
4) Mayada Zaki (2015): Flipped Classrooms: Lesson Plan Strategies and activities: *research gate*
5) Patras, Greece (2019) How to Design and Implement a Flipped Classroom Lesson: A Bottom-up Procedure for More Effective Lessons, *Open Journal for Educational Research, 2019,*
6) Shane Cronin, Darragh Coakley (2018) Flipped Classroom In Practice*: Erasmus*

APPENDIX 14

BLENDED LEARNING STRATEGY 3: - LEARN AND SURVEY AT HOME, DISCUSS AT SCHOOL

FLIPPED CLASSROOM LESSON PLAN TEMPLATE

"A STUDY OF EFFECTIVENESS OF BLENDED LEARNING ON THE ACADEMIC ACHIEVEMENT OF GRADE VIII STUDENTS IN SCIENCE".

Name Of the Researcher: - Udesh Ramakant Natekar
Name of the Guide: Dr. Anna Neena George

Class	VIII
Subject	Science
Lesson Title	Air Pollution Activity 4.1 How does Air Get Polluted? Activity 4.2 Activity 4.3
Chapter	Pollution of Air and Water
Teacher	Udesh Ramakant Natekar
Timeline	60 mins (Online) 60 mins(Offline)
Materials	Access to Smartphones, Access to Moodle app
Date	

Learning Objectives

Students will be able to
Define Pollution
Define Air pollution
List the air pollutants
(Remembering)
Explain how air gets polluted (Understanding)

Student Learning Resources at Home

Students view the video Presentation at: https://udeshnatekar.com

Student Learning Activities at Home

Students conducts a survey at home and submit answers to the questions found at the discussion forum at https://udeshnatekar.com

STUDENT ACCESS TO FORUM and CHAT

FORUM:

Students: -

- Clicks on the Forum topic
- Reads the content of the forum published by the teacher
- Clicks on Reply
- Writes replies and posts to the forum

CHAT:

Students: -

- Clicks on the Chat Topic
- Reads the content of the chat

- To enter into Chat room, click on “click here to enter chat now”
- Types views in the given textbox and sends.

Classroom Activities

Survey Integrated with Discussion Method

Teacher:-

- Observe the things properly before the student’s observation.
- Make a list of the same.
- Place the students into groups (not more than 6 members in the Group)
- Randomly assigns students in a group
- Chooses one member from each group as leader
- Provide students with a worksheet to note their observations.
- Asks students to reflect.
- Closes observation by Summarising and evaluation.
- Allows time for students to make their own notes

Assessment

Diagnostic assessment:
Before class, the teacher logs in to check if students have viewed the video/presentation found in the Forum http://udeshnatekar.com. Review student responses to the questions assigned and provide feedback if necessary.

Formative assessment:
The teacher walks around the classroom to answer individual student questions during break-out activity from 0-10 min and worksheet activity from 30-50 min. Ask students to volunteer to write answers to worksheet questions on the board. Briefly goes over each question with the class and addresses any further questions.

Summative assessment:
Provides online quiz at http://udeshnatekar.com

Reference: -

1) Flipped Classroom Lesson Plan Template: Beginners Guide: https://lecturetalks.com
2) Flipped Classroom Lesson Plan Template: http://harper-academy.net
3) Jonathan Bergmann, Aaron Sams (2012): Flip your classroom, Reach Every student every class every day. *International Society for Technology in Education*
4) Mayada Zaki (2015): Flipped Classrooms: Lesson Plan Strategies and activities: *research gate*
5) Patras, Greece (2019) How to Design and Implement a Flipped Classroom Lesson: A Bottom-up Procedure for More Effective Lessons, *Open Journal for Educational Research, 2019,*
6) Shane Cronin, Darragh Coakley (2018) Flipped Classroom in Practice*: Erasmus*

APPENDIX 15

BLENDED LEARNING STRATEGY 4: - LEARN AT HOME, DISCUSS CASE AT SCHOOL

FLIPPED CLASSROOM LESSON PLAN TEMPLATE

"A STUDY OF EFFECTIVENESS OF BLENDED LEARNING ON THE ACADEMIC ACHIEVEMENT OF GRADE VIII STUDENTS IN SCIENCE".

Name Of the Researcher: - Udesh Ramakant Natekar
Name of the Guide: Dr. Anna Neena George

Class	VIII
Subject	Science
Lesson Title	Case Study – The Taj Mahal 4.4 Greenhouse Effect 4.5 What can be done?
Chapter	Pollution of Air and Water
Teacher	Udesh Ramakant Natekar
Timeline	60 mins (Online) 60 mins (Offline)
Materials	Access to Smartphones, Access to the MOODLE app
Date	

Learning Objectives

Students will be able to
Define Acid rain
Define the Greenhouse effect. (Remembering)
Explains how monuments get affected by pollution
Explain Greenhouse effect (Understanding)

Student Learning Resources at Home

Students view the video Presentation at: https://udeshnatekar.com

Student Learning Activities at Home

Students submit answers to the questions found at the discussion forum at https://udeshnatekar.com

STUDENT ACCESS TO FORUM and CHAT

FORUM:

Students:

- Clicks on the Forum topic
- Reads the content of the forum published by the teacher
- Clicks on Reply
- Writes replies and posts to the forum

CHAT:

Students: -

- Clicks on the Chat Topic
- Reads the content of the chat
- To enter into Chat room, clicks on "click here to enter chat now"
- Types views in the given textbox and sends.

Classroom Activities

Case study

Case Study Method

Teacher: -

- Places students into groups (not more than 6 members in the Group)
- Randomly assigns students in a group
- Choose one student from each group as Leader
- Provide students with the worksheet
- Asks students to analyze the case
- Ask students to identify the problem and the solution.
- Asks students to make an alternative decision
- Asks students to arrive at conclusion
- Asks students to reflect.
- Closes case method by Summarising and evaluation.
- Allows time for students to make their own notes

Assessment

Diagnostic assessment:
Before class, the teacher logs in to check if students have viewed the video/presentation found in the Forum http://udeshnatekar.com. Review student responses to the questions assigned and provide feedback if necessary.

Formative assessment:
The teacher walks around the classroom to answer individual student questions during break-out activity from 0-10 min and worksheet activity from 30-50 min. Ask students to volunteer to write answers to worksheet questions on the board. Briefly goes over each question with the class and addresses any further questions.

Summative assessment:
Provides online quiz at http://udeshnatekar.com

Reference: -

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4) Mayada Zaki (2015): Flipped Classrooms: Lesson Plan Strategies and activities: *research gate*
5) Patras, Greece (2019) How to Design and Implement a Flipped Classroom Lesson: A Bottom-up Procedure for More Effective Lessons, *Open Journal for Educational Research, 2019,*
6) Shane Cronin, Darragh Coakley (2018) Flipped Classroom in Practice*: Erasmus*

ANNEXURE 16

LIST OF EXPERTS

1) **Prof. Narendra Deshmukh**
   Scientific Officer-E at the Homi Bhabha Centre for Science Education, Tata Institute of Fundamental Research. Mumbai, India.

2) **Prof. Veena Deshmukh**
   Professor-cum-Director,
   Centre for Distance Education, SNDT Women's University
   Approved Ph. D. Guide of Mumbai University, SNDT Women's University and YCMOU

3) **Prof. K.L Bindu**
   Professor,
   Dept. of Education, University of Kerala, Thycaud. P O, Thiruvananthapuram – 14

4) **Dr. Shashikala Gaikwad**
   Retired Principal, P.E.S College of Education, Farmagudi, Ponda , Goa

5) **Prof. Kavita Salunke**
   Director, School of Online Learning, YCMOU digiuniversity,. Nashik.

6) **Dr Lesan Azadi**
   Director, Bahai Academy, Panchgani, Maharashtra

7) **Dr. M.D. Pawar,**
   Associate Professor, RTMNUS Bar.S.K.Wankhede College of Education, Nagpur

8) **Dr. S.P Yelekar**
   Associate Professor, RTMNUS Bar.S.K.Wankhede College of Education, Nagpur

9) **Dr Sudhir Kaware**
   Assistant Professor, Department of Education, School of Education,
   Guru Ghasidas Vishwavidyalaya (A Central University)
   Koni, Bilaspur, Chhatisgraha – 495009

10) **Dr. Avinash Bhandarkar**
   Associate Professor,
   Vidya Pratishthan (Maharashtra)'s College of Education, Ahmednagar. 414005

11) **Dr. Rajiv Pancham**
   Assistant Professor, Ganpat Parsekar College of Education, Harmal, Pernem, Goa