EFFECTIVENESS OF E-CONTENT IN LEARNING CHEMISTRY AND ACADEMIC ACHIEVEMENT AT THE HIGHER SECONDARY LEVEL

Thesis submitted to Bharathidasan University
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IN
EDUCATION

By
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This is to certify that the thesis entitled, **"EFFECTIVENESS OF E-CONTENT IN LEARNING CHEMISTRY AND ACADEMIC ACHIEVEMENT AT THE HIGHER SECONDARY LEVEL"**, submitted by **R. SELVAGANAPATHY,** for the award of Doctor of Philosophy is a record of research work done under my guidance and supervision during the period 2019-2022 and the thesis has not formed basis for the award to the scholar of any degree, Diploma, Associateship, Fellowship or any other similar title.

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DECLARATION

I hereby declare that the thesis entitled “**EFFECTIVENESS OF E-CONTENT IN LEARNING CHEMISTRY AND ACADEMIC ACHIEVEMENT AT THE HIGHER SECONDARY LEVEL**”, submitted to **Bharathidasan University** for the award of the degree of Doctor of Philosophy in Education is my original work and that it has not previously formed the basis of the award of any Degree, Diploma, Associateship, Fellowship or any other similar title of the University or Institution.

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R.SELVAGANAPATHY
(Research Scholar)

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CHAPTER-I

INTRODUCTION AND CONCEPTUAL FRAMEWORK

"Most People tire of a lecture in ten minutes;
Clever people can do it in five.
Sensible people never go to lectures at all."

-Stephen Leacock (1922)

1.1 INTRODUCTION

The new millennium has witnessed a phenomenal explosion of knowledge and application of communication cum information technologies and acceleration in the access to knowledge and skills. Since the past, education systems all over the world have been under the continuous process of experiments, these experiments are becoming inevitable to meet the challenges of the ages. Education attempts to prepare a man for the modern world. This fitness differs from age to age. The 3rd millennium is characterized not only by population explosion but also by galloping advancement of science and technologies. These two together have brought a good many problems to mankind. Hence technology in education has become a new cause of concern for educators, teachers, and students as a result of recent developments and advancements. Former US President Bill Clinton (1995) says, "Technological literacy must become the standard in our society; educating youngsters for a lifetime of computer use is just as essential today as teaching them the basics of reading, writing and arithmetic". Many difficulties have been successfully solved using technology, and this success has been extended to teaching-learning circumstances. In the sphere of education, Educational Technology has arisen as a new discipline. According to Sharma (1982), "Educational Technology implies the use of all modern media, methods, materials, practices, and theories, principles for maximizing the learning by control of the environment, media and method”. The methods of a learner-centered approach are aimed to give pupils a highly flexible system of learning that is tailored to an individual's life and learning styles.

Since time immemorial, learning styles have been varying in a variety of ways. One of those styles of learning is from E-Content. This type of learning brings innovative technology, removes the barrier of distance, time, and provides greater flexibility. This enables the learner to study at his or her own speed and own learning environment. This also results in the transformation of ideas and information into innovation, flexible delivery, and significant development. It also contains text, video, music, animation, a virtual environment, self-paced, hands-on material, and so on.

This study focuses its area on eleventh standard Chemistry prescribed under Tamil Nadu Textbook Corporation of State board syllabus. Quite a time students may struggle to construct the forms of mental conceptual representations needed to understand chemical structures. Contemporary research suggests that this is a common problem among both secondary and tertiary students and represents a significant impediment to their cognitive development. (eg. Garnett, Garnett & Hackling, 1995; Nekleh 1992). Much of the explanation and description of the processes involved in chemical compounds is given in terms of the interactions of the numerous submicroscopic particles that represent atoms and molecules. Students often have difficulty in visualizing this submicroscopic world and its components, a factor that creates a barrier to their development of a scientifically valid understanding of many chemistry concepts. Chemistry students often exhibit a wide range of alternative conceptions about Quantum mechanics. A meaningful understanding of chemistry-declarative and procedural knowledge has been difficult for many students. Students appear to memorize algorithms and lower-level content in order to pass examinations without developing a meaningful understanding of the higher-level concepts and unifying principles. Furthermore, misunderstanding chemical ideas and alternative conceptions hinder students' further learning (Niaz 1995). Enhancing students' understanding of chemistry concepts and processing skills, rather than learning Lower-level chemical understanding has emerged as a primary objective for chemistry education (Ardac & Sezen,2002; Nakhleh, 1993). Also, each unit prescribed in the textbook consists of more than 50 pages with a minimum of nearly 100 concepts in it. This is not given in chunks to be digested by the young learners except the high Intelligent Quotient pupils. By reviewing all areas of the average level learners, the investigator divides the content into meaningful segments and uses the innovative technology in the form of E-Content for learning chemistry. The main intention of this package is to produce a meaningful E-Content for learning chemistry at the higher secondary level with firsthand experience.

In order to make the computer as an assistor, the investigator used and modified the operating system as user-friendly. And at the same time, the investigator used texts, video, audio, animation, virtual environment, etc to make the learning of chemistry enjoyable. This study attempts to explore students' conceptual understanding of chemistry and attitude towards E-Content in learning chemistry at the higher secondary level. By reviewing all the relevant factors, the investigator aims to study the "Effectiveness of E-Content in learning chemistry and academic achievement at the higher secondary level" in this study.

1.2 EDUCATION - A BROAD VIEW

Education is a process by which a society transmits its accumulated knowledge, skills, and values from one generation to another. Education must give the skills and chances for children to develop their creative expression and aesthetic appreciation. Education teaches us about the world around us. It equips children with the ability to interpret situations correctly. Education is the sum of all procedures that enable a person to develop the capacity, actions, and other forms of positive attitude in the society in which he lives. Education may be defined as a systematic process of determining the extent to which instructional objectives are achieved by the learners.

According to **Richard Shaull (**1968**)** in his book Pedagogy of the Oppressed, "Education either functions as an investment which is used to facilitate the integration of the younger generation into the logic of the present system and bring about conformity to it, or it becomes the "practice of freedom", means by which men and women deal critically with reality of discovering how to participate in the transformation of their world".

To educate means "to lead forth" or "to extract out" the best in each individual. Some explanations about education are as follows:

- Education is an attempt to develop a man.
- Education modifies behavior.
- Education is the art of training.
- Education is a continuous reorganization and integration of activities and experiences.
- Education is emancipation.
- Education is an influence.

When find ourselves in non-optimal states, education is a process of cognitive topography, describing our experiences and finding a range of dependable routes to ideal states. Education is an important tool to shape human beings in the process of civilization. Humanity grows through education. This means that education is more than just a process of teaching and learning; it is also a process of social emancipation. Swami Vivekananda said, "Education is the manifestation of perfection already exists in man." This goes to say that, the learner has some hidden potentiality that can be enhanced with the help of the technology module. In order to enhance the potentiality of the learner, the researcher has prepared a small piece of E-Content for learning Chemistry to improve the quality of education.

Education has been regarded as the path to growth and wealth since time immemorial. Different educationists' from the eastern to western have explained the term education. According to the need for the hour, various persons have given their views on education. Some important concepts are here below:

According to Rig Veda, 'Education is something which makes a man self-radiant and selfless'.

Mahatma Gandhi, 'Education I mean 'an all-round drawing out of the best in man-body, mind, and spirit'.

The Indian Philosopher Shankaracharya considered education as 'the realization of the self'.

Aristotle "Educating the mind without educating the heart is no education at all."

Nelson Mandela, "Education is the most powerful weapon which you can use to change the world."

1.3 CONCEPT OF EDUCATION

Education is a lifelong continuous process of learning and adjustment, of interaction between the individual and his environment, and education may be defined as the changes brought about in the individual as a result of that interaction in a broader context, all life is education, and the individual learns throughout his or her life.

Education is to facilitate, ease and to further this process. Education is growth and development. It is a process in which, and by which, the knowledge, character, and behavior of the young are shaped and molded. Education provides an individual with social, moral, cultural, and spiritual skills, allowing them to live a more advanced, cultured, and civilised life. It is the process of obtaining or imparting systematic instruction, particularly in a school or university.

K. Smith examines the meaning of education and proposes it as a process of encouraging truth and potential. It is defined as the intelligent, hopeful, and respectful nurturing of learning performed with the notion that everyone should have the opportunity to participate in life.

It is, as John Dewey (1916) put it, a social process – "a process of living and not a preparation for future living". In this view, educators look at acting with people rather than on them.

According to P. O.Benneriji, it is the development of the power of adaption to an ever-changing social environment.

1.4 AIMS OF EDUCATION

There are different types of Education. They are General Education, Technical Education, Medical Education, Commercial Education, etc. Each and every type has its own prescribed aims. Aims that cover all aspects of life are called General aims, and the aims that meet the needs of the definite aspects of life are called Specific aims.

General aims can be classified into two main streams, they are:

- Individual aims
- Socialistic aims

Specific aims can be classified as follows:

- Moral aims
- Vocational aims
- Cultural aims
- Spiritual aims

According to Kothari Commission (1964–66), the following are the aims of education:

(a) To increase productivity

The first goal of education in our democratic system is to raise output by leaps and bounds. This enhanced output should keep pace with the growing population.

(b) To develop social and national unity

National unity is critical for national reconstruction. The only way to foster a sense of national unity is through education. As a result, the goals of education should be to foster social and national unity.

(c) To consolidate democracy

Education is required for democracy to succeed. To consolidate democracy, education should be well-organized in order to offer youngsters with more and more effective experiences in order to instill in them the attributes of democratic living. Only then would national consciousness foster a feeling of national identity, character, and duty.

(d) To modernize the country

Education's fourth goal is to modernise the country. This could be accomplished by learning various types of scientific knowledge as well as effective industrial strategies. It must be used wisely in order to improve our output and effect the needed shift in our old notions.

(e) To develop social, moral and spiritual values

As far as this goal is concerned, human values should be instilled in youngsters in order for them to become human beings.

1.5 FIVE MODERN LEARNING THEORIES

Learning theories deconstruct complicated cognitive processes and give educators with valuable mental models for structuring and designing courses, as well as insights into best practices during and after learning experiences. Even for the most experienced educator, navigating through the vast array of learning approaches available can be a daunting task. The following modern learning theories cuts through some of the complexity to focus on the key elements of several educational learning theories and how they could be applied in the classroom.

(a) Behaviorism

Learning is defined as a process of knowledge acquisition that takes place through observation in behaviourism, a pedagogical theory (i.e., based on objectively quantifiable events rather than introspective psychology). Pavlovian conditioning is when a specific stimulus is used to elicit a predictable response. It is named after Russian physiologist Ivan Pavlov. After associating a bell with food, Pavlov learned that he could cause salivation in dogs by using a bell. B.F. Skinner, an educational theorist, refined Pavlov's idea of 'learning by association' by proposing the operant conditioning theory, which demonstrated that learners' behaviours may be altered by positive or negative reinforcements.

According to behaviourism, Learning is reinforced by repeated action, therefore having a structured routine where knowledge is addressed repeatedly will surely increase learning. Feedback, especially when utilised as a form of positive reinforcement, is an important part of behaviourism. It's worth noting, though, that the behaviourist school of thought relies almost solely on teacher input and views the student as a passive receiver of knowledge.

(b) Cognitivism

Cognitivism, as the name implies, is concerned with mental processes such as thinking, memory, recall, and problem-solving. Similar to behaviourism, cognitivism focuses on internal processing rather than the external environment when it comes to learning by association.

Associations, in contrast to behaviourism, are built on the creation of connections between new understandings and existing knowledge. Cognitivism differs from behaviourism in that it recognises that people receive and encode information differently. The Social Cognitive Theory (SCT) is a core tenet of cognitivism that claims that observing others, particularly one's peers, is the most effective way of gaining knowledge. Collaborative problem-solving, discussion-based activities, and peer-to-peer instruction are all excellent activity styles for fostering social interactions that help students learn more effectively.

(c) Constructivism

Constructivism is a student-centered learning theory based on students' prior experiences and knowledge being combined to form understandings. In other words, learning becomes a process of building new knowledge on top of what is already known, to continue the construction analogy. It seeks to transform abstract theories into approachable concepts by placing learning in a familiar environment. By enabling student experiences to decide the path of learning, constructivism offers an alternative to teacher-directed curriculum design. Constructivist learning is fundamentally a dynamic and ever-changing process because it focuses around the students' understandings and experiences.

(d) Humanism

Humanism takes a growth minded approach to learning and education. Humanism, like constructivism, is an educational philosophy that is fundamentally student-centered. Many of the ideas of humanistic education are derived from the seventeenth-century intellectual movement, in which philosophers such as Voltaire (1642-1778) believed that persons were born with innate potential.

It's worth noting that humanism gives the cognitive (knowledge) and affective (feeling) domains equal weight, which affects not just what and how content is communicated, but also how outcomes are measured. A humanistic education tries to reimagine what academic success looks like in the traditional sense. Humanistic educators use a more holistic approach to measuring student achievements, considering emotions, moral understandings, and knowledge as equally significant objectives in a learning experience, and hence avoid traditional grading.

(e) Connectivism

Connectivism is a future-oriented learning theory. It's a new pedagogical perspective that considers the changing nature of knowledge acquisition in the digital age. In contrast to constructivism, which focuses on what a learner already knows, connectivism focuses on what a learner needs to know and delivers the information at the right moment.

1.6 TECHNOLOGY

Technology comes from the Greek word 'tekhnologia,' which means "systematic treatment of an art, craft, or talent." Technology is the application and understanding of tools, techniques, crafts, systems, and organisational procedures to solve a problem or fulfil a goal. It is a science of procedures, or methods of doing/getting things done in connection with any art, science, or profession. In a nutshell, it is a method of developing and using scientific approaches in a methodical manner.

Technology makes a significant contribution to education. This gift of technology helps modern educators to bestow enriched teaching and learning; helps to raise levels of attainment; and closes the attainment gap. Technology plays the role of taking the classroom and the students into the emerging trend (Kumari & Jose, 2014). Technology has expanded from use primarily as an instructional delivery medium to an integral part of the learning environment (Kumari & Jose, 2015). Learners will gain a wide range of digital abilities if digital technology is used effectively in schools and early learning settings.

Academic, commercial, government and private sectors have all been infiltrated by technology. It has transformed the way people do business, communicate, work and manage their personal lives. Technology provides abundant teaching aids that teachers can use in and out of the classroom to enhance student learning. The changes and innovations in information and communication technologies due to globalization and advancements in technology have driven changes in the economic and social lives of the societies to a greater degree (Kumari & Jose, 2014).

1.7 EDUCATIONAL TECHNOLOGY

Brynmor Jones Robert coined the term Educational Technology in the United Kingdom in 1967.

The systematic application of scientific knowledge to teaching is known as educational technology. Educational Technology involves input, output and process aspects of education. Educational technology emphasises the creation of effective learning methods and procedures. Educational technology aids in the objective, easy, unambiguous, exciting, and scientific teaching process.

Educational technology helps students learn by allowing them to control their surroundings, material, and methodologies. It emphasises the effective implementation of educational goals through the arrangement of learning circumstances.

Any subject that fits these two criteria – systematic application of scientific knowledge to practical activities and the organisation of practical tasks into sections and subsections – is considered educational technology.

Teaching objectives are defined in behavioural terms by educational technology. It is the science that underpins the development and construction of diverse methods and procedures for achieving predetermined instructional objectives.

1.7.1. Definitions of Educational Technology

The National Council of Educational Technology (1971) defined "Educational Technology as development, application and evaluation of systems, techniques, skills and aids to improve the process of human learning."

G.O.M. Leith (1969): "Educational technology is the systematic application of scientific knowledge about teaching-learning and conditions of learning to improve the effectiveness of teaching and training."

1.8 ROLE OF EDUCATIONAL TECHNOLOGY IN THE TEACHING-LEARNING PROCESS

Educational technology has completely transformed the educational system. Until recently, teachers were the sole interpreters of knowledge for students, and textbooks were the only source of information. Educational technology has changed traditional duties and opened up new areas of teacher function, such as resource management and learning management. Today's teachers have access to a variety of media to aid and augment their classroom work.

Teachers can also set learning objectives, choose a topic, identify the stimulus situation, choose media, manage teaching, and lastly perform evaluations and make changes to the instructions based on the outcomes of the evaluations.

Without the assistance of educational technology, the educational process cannot be carried out in a systematic way. Educational technology has totally illuminated every facet of the educational system.

1 Educational technology has given educational theory and practise a scientific foundation. With audio-visuals, charts and models, smart classrooms, and e-learning rooms, it has changed a passive classroom into

an active and participatory classroom, radically motivating and increasing the attention level of the pupils.

2 The introduction of educational technology has modernised the educational institution's teaching-learning climate. Learners will be exposed to professionally developed video or computer programmes.

3 Through planned lessons for remedial, enrichment, or drill reasons, educational technology has aided and supported teachers in their instructional programmes. Learners receive self-education training, and teachers are relieved of the pressure of routine repetition for the purposes of exercise and review.

4 Educational technology has given well-integrated structured materials for teachers through a systematic organisation of content and instructional materials, allowing them to spend more time on creative work and quality improvement.

5 Teachers' professional development is aided by training and the use of educational technologies. It prepares them to solve educational and administrative challenges using scientific methods. It improves teachers' teaching abilities and instills a scientific outlook and attitude in both teachers and pupils.

6 Educational technology has made the teaching-learning process more efficient and process-oriented. Television, radio, VCR, computers, and LCD projectors, among other things, have enriched and facilitated effective knowledge communication.

7 By providing Teaching Aids and Programmed Instructional Material, educational technology has not only maintained but significantly increased educational standards.

8 In teacher-training institutes, mechanisms of feedback devices for adjustment of teaching-learning behaviour have produced effective teachers.

9 Educational programmes on television, radio, and the internet have benefited students taking higher or competitive tests.

10 Educational technology has spawned new fields of study in the areas of examinations, evaluation, and classroom instruction.

11 Educational technology has equipped teachers with techniques and tactics that allow them to teach students based on their particular peculiarities.

12 Educational technology has given education a scientific foundation through learning and intelligence theories.

As a result, educational technology is necessary in all aspects of the teaching and learning process. Educational technology is useful for all aspects of modern education. Today's education would be impossible to achieve without the aid of educational technology. Technology advancements in the realm of education have had a significant impact on the educational process. It has not only preserved the framework of the educational process, but has also improved the nature of it.

1.9 NEED FOR EDUCATIONAL TECHNOLOGY

Technology associated with learning does not seek to replace traditional teaching and learning, but is expected to supplement them. The students are in a digital era. It is difficult to think of any event in one’s daily life that is not using Information and Communication Technology. Indian schools and classrooms are no exceptions. This is meant for introducing these technologies with the intention that one can meaningfully integrate technology in his/her practices related to teaching and learning.

The learning process has been influenced by the expansion and evolution of computer, network, and multimedia technologies (Alemany & Majós, 2000). Those technologies allow the learners to participate in an active and self-paced learning environment. Technologies were not necessarily changing the way of teaching subjects. What has changed in fact is the discipline of teaching resources at the teachers' and learners' behavior. They have added interest to the course content and delivery (Thompson, Lamshed & Framework, 2006). Most web-based contents have been developed using text, image, sound, and video, but failed to induce interactivity contents (Nagy, 2005). Therefore, (Zerfab & Hartmann, 2005) the ability to construct effective, useful, useable, and satisfying electronic contents remains one of the major obstacles in e-learning because the educational design is complex, and the main aim of developing E-Content is to achieve specified goals in education, and place the learner needs at the centre of the learning process (Bate, Robertson & Smart, 2003).

Dexter points out that: "Educational technology does not possess inherent instructional value: a teacher designs into the instruction any value that technology adds to the teaching and learning processes" (Dexter, 2002, p. 57). Teachers begin with "technologies' affordances and constraints and the skills needed to operate them and then later attempt to discern how they can be integrated successfully into content- based learning…" (Harris, Mishra, & Koehler, 2009, p. 395). Curriculum planners should have knowledge on selecting the technology based on its suitability for the context and curriculum for a successful technology integration, (Brookfield, 1995). The technology in education contributes a lot in the pedagogical aspects in which the application of ICT will lead to effective learning with the help and support from ICT elements and components (Jamieson-Procter *et al.,* 2013). To summarise, Educational Technology is not limited to the use of audio-visual aids, software resources, and hardware equipment, nor is it restricted to the use of psychological concepts and instructional theories to improve and evaluate the teaching-learning process. However, a clever and reasonable use of existing human and nonhuman resources to improve the teaching-learning process and provide acceptable answers to educational difficulties.

1.10 LEARNERS AND TECHNOLOGY

In today's world, many students are intertwined with technology. This enables them to have a 24ù7 mobile access to information and sources, develop multimedia content and share them with the world (Kumari & Jose, 2016). It is a known fact that learners are exposed to the now-a-days social media such as, YouTube, MySpace, Facebook, Digg, ToGo, Computer games, Twitter, email, and text messaging, as part of using technologies in their social life (Zhang & Olfman, 2010). Teachers need to learn more about combining technology resources like podcasting, simulation, blogging, Wikipedia, online instruction, Twitter, Digg, and mobile learning with digital age learners, as their environment is hard due to their social connection with technologies. Learning how to integrate and use technology in the classroom will help students fit in with their peers' backgrounds. Furthermore, instruction will become more organised, with less time wasted, and will be more effective and efficient. Learners will be motivated to learn and understand through the use of familiar technology at the end.

1.11 TEACHERS AND TECHNOLOGY

The teacher of today is now expected not only to inculcate knowledge but alsobecome more of an advisor rather than a giver of hand out readymade truths (Kumari& Jose, 2013). In this era of global technological transformation, efficient use of technology in the classroom is becoming an increasingly crucial aspect in students' success. Teachers are more likely to stick to their pedagogical attitudes about teaching with technology as the necessity for technology in the classroom grows. Teachers, on the other hand, with their limited training and very shallow curricula, would have found technology deployment to be extremely difficult. In-service training is needed to help them develop a positive attitude toward technology. When teachers practice and test new strategies for mediating technology- based learning, which will in-turn revolutionize pedagogical development (Hennessy *et al*., 2007).

1.12 TEACHING AND LEARNING VIA ICT

Students have access to advanced Information and Communication Technology (ICT) skills when they are at school or at home. As a result, teachers must be literate and have solid skills and expertise in using ICT to improve their teaching methods and approaches, as well as a willingness to promote effective learning and satisfy the demand for 21st-century teaching skills. Teachers and school administrations have traditionally dealt with this in a partial and sporadic manner.

Teaching is a social phenomenon, involving a series of actions (Dahiya, 2004). It is a cluster of actions incorporated to uplift an individual by enabling him/her to acquire knowledge, skills, attitudes etc. It is a profession or service to a community or group of individuals. Researchers emphasized various professional elements like competence, professional motivation, work stress, accessibility, dedication, and enthusiasm, professional conduct, and so on, greatly influencing the teaching profession (OS, 2013; Maphalala, 2014, & Nzulwa, 2014). ICT provides an enjoyable environment for both the teacher as well as learner. This shift develops a creative and interactive environment for both (Khan, 2012). ICT policy and integration could greatly improve the status of knowledge based economy, and can develop an effective and robust Education System (Shaikh & Khoja, 2011).

According to Leask & Pachler (2014), it is evident when ICT is integrated appropriately into curriculum it not only enhances learning of students but also improves the existing teaching practices. They further emphasized that teachers should work in collaboration, so that they can establish up to date and superior professional practices like; teaching methodologies, assessment techniques, learning enhancement and so on. Only through ICT, the process of teaching and learning has emerged into a new dimension known as e-learning. When teaching is done through E-Content, the retaining power of the learners will be escalated.

In general from 100 % of the e-learning material (facts) pupils can remember:

- 10 % through reading,
- 20 % through hearing,
- 30 % through seeing,
- 40 % through hearing and seeing,
- 80 % through hearing, seeing and doing (interacting)

1.13 ELECTRONIC CONTENT – A GENERAL VIEW

On the internet, students can find a wide range of digital items with instructional value. Teachers and students can use, re-use, and modify some of the high-quality materials that are available for free or with little limitations for their teaching and learning. Students are migrating from textbooks to digital course materials because textbooks are too large. These products increase interactivity and social participation for both teachers and students. E-Content is one of the materials that may be produced, developed, utilised, re-used, and distributed.

Students can access a variety of digital objects with educational value on the internet. For learning, students can use, re-use, and alter some of the high-quality materials that are available for free or with little restrictions. Because textbooks are excessively bulky, students are switching to digital course materials. students benefit from these items since they improve interactivity and social participation. E-Content is one of the many types of resources that can be created, developed, used, repurposed, and distributed.

Meaning and Definitions

Electronic content (E-Content) which is also known as digital content refers to the content or information delivered over network based electronic devices or that is made available using computer networks such as the internet. According to Oxford dictionary ‘E-Content is the digital text and images designed to display on web pages’. According to Saxena Anurag (2011) ‘E-Content is basically a package that satisfies the conditions like minimization of distance, cost effectiveness, user friendliness and adaptability to local conditions’.

Well-developed E-Content can be provided to a variety of learners multiple times. Individual course components, such as units, lessons, and media elements like images and animations, can be reused in different contexts.

1.14 DESIGNING AND DEVELOPMENT OF E-CONTENT

The goal of E-Content development is to create a class that is rich in information. Everyone in the class has the ability to generate, receive, exchange, and use information for their own advancement. E-Content that is well-designed, generated, and validated will enable access to high-quality, useful digital content while also acting as a virtual teacher.

The nature of the content and the learners will determine the design, development, and approach to E-Content. It will also be determined by the learning's quality and intricacy. Depending on our needs, we can choose from a variety of instructional design models. The majority of models include steps such as analysing learner needs and goals, developing a distribution method and content, conducting a pilot study of the material generated, implementing, evaluating, and refining the materials, and so on. We must use one of the instructional design models based on our requirements while planning and developing E-Content.

"Instructional Design is the systematic process of translating general principles of learning and instruction into plans for instructional materials and learning" (Alessi & Trollip, 1991). The process entails identifying the current state of learner comprehension, specifying the educational materials and objective, devising some sort of 'intervention' to aid the transition. This methodical approach lays out a step-by-step methodology for analysing the needs of the learners, as well as designing and developing the material.' The ADDIE paradigm is the most prevalent and widely utilised model for developing instructional materials. The five phases of the model are represented by this abbreviation. Analyze, design, develop, implement, and evaluate are the steps. Florida State University created this model to demonstrate the steps needed in developing an instructional systems development (ISD) programme for military inter-service training. ISD was designed to prepare people for specific jobs. This can also be applied to any action involving inter-service curriculum development. Under the five original phases of the model, there were several steps (analyze, design, develop, implement and evaluate). The steps were updated over time, and the model eventually grew more dynamic and interactive.

A) Analysis: It is the first phase of this model meant for examining the suitability of the E-Content to be developed. It is related to analyzing the learning needs, context, learner, task and content. Analyzing the learning needs is identifying the needs from the perspective of different learners. Every single step included in the analysis phase is illustrated in details below.

a) Set Learning Objectives

Learning objectives that are clearly defined can help E-Content creators select teaching and learning activities and empower learners to be accountable for their own learning in a way that satisfies the expectations of E-Content developers. When students know exactly what they need to know from the start of the learning process, they can take charge of their own education and are more likely to succeed.

The objectives of a course should be complete, appropriate, sound, feasible, relevant, open-ended, and be shared with students (Gronlund & Brookhart, 2009).

b) Define Learner’s Need

It is critical that teachers respect and acknowledge the viewpoints of their students. As discussed in McCombs (2001) quality learning is that engages learners, and encourages discovery, creativity, and imagination. In addition, the course material needs to be shaped by what adults know and by students’ interestsand their learning preferences. As a result, the course content should be presented in a way that allows for knowledge construction rather than response strengthening or information acquisition, provides instructional support and guidance to allow learners to create meaningful representations of knowledge, moderately increases learner motivation by using game-like exercises, and allows creativity, allows learners to participate as thinkers, provides interaction, and provides activity and assessment.

c) Define the Specifications of Educational Material

The definition of educational material standards, such as content and teaching methodology, is the third step in the analysis phase of the content development lifecycle. Identifying 'content' entails choosing the best graphics for each sort of content. Identifying 'teaching methodology' entails choosing the most effective methods for achieving learning objectives.

d) Identifying ‘Content’

To explain the offered material in e-learning, a combination of text, audio, still and motion visuals can be used. In any presentation, combining words and pictures is preferable to utilising only words. However, not all pictures are created equal when it comes to learning. Decorative graphics, representational graphics, relational graphics, organizational graphics, transformational graphics, and interpretive graphics are some possible graphics that can be selected to present the material (Clark & Mayer, 2011). Fact, Concept, Process, Procedure, and Principle are the five forms of material identified by Clark. The visual types indicated above can be used to present each content category. Representational Organizational Graphics, for example, could be used to teach 'Fact' which is a content category. To teach 'Fact' and 'Concept' subject kinds, representational and organisational visuals could be employed. Transformational graphics could be utilized to teach topic kinds such as 'Process,' 'Procedure,' and 'Principle.' Interpretive visuals could be used to teach topic kinds such as 'Concept,' 'Process,' and 'Principle.' The topic type 'Process' could be taught using Relational Graphics. In addition to the content kinds outlined above, interactive and animated content may be used in the development of electronic content to allow learners to participate in an active learning environment. Fadel and Dyson (2007) represented that the use of animation while presenting a series of steps helps the learners achieve the specified goals in learning. They also claim that delivering text that is relevant to the animation in a synchronous manner is more successful than simply displaying animation.

Interactivity in content is a powerful tool for helping students grasp abstract concepts. It allows students to take control of a virtual situation in order to see the outcomes and develop a better knowledge of a concept. It also allows students to control and validate outcomes on the screen right away.

e) Identifying Teaching Methodology

In education, a variety of teaching approaches can be utilised. The approach chosen is mostly determined by the learning objectives, followed by the technology tools available. Students should become active participants and involved in their own learning to make learning relevant (Steinbronn & Merideth, 2008). To ensure active engagement, student-centered techniques should be adopted, which could be accomplished using inductive teaching methods. Students are given several instances and are expected to notice how a concept works in inductive teaching approaches. This strategy is known as 'noticing.' The following are some examples of active involvement teaching approaches (Prince & Felder, 2006)

Inquiry Learning: The learning process begins with the learners being given some questions, problems, and observations. As a result, students must respond to inquiries, solve problems, and explain their observations.

Problem-Based Learning: This is the most complicated and toughest instructional strategy to implement. Complex, open-ended, and real-world problems are used in problem-based learning, and they demand knowledge and abilities that are described in the learning objectives.

Project-Based Learning: The learning process begins with learners being given an assignment to complete various tasks in order to create a product. A design, a model, a device, or a computer simulation could be the final product.

Case-Based Teaching: When learning objectives require making decisions under complex contexts and situations, this method might be applied.

Discovery Learning: Inquiry-based learning is used in discovery learning, in which students answer questions, solve problems, and explain observations before working independently to obtain the needed knowledge. The learners are then given feedback on their efforts without any instructions on how to come to conclusions. Because learners can be meaningfully involved in learning activities through interaction with learning tasks, the teaching approaches outlined above allow active participation.

B) Design: It deals with creating learning objectives, logically structuring content, developing instructional and evaluation methodologies, and preparing visual and technical design.

Learning objectives must be defined in language that are unambiguous, realistic, and measurable. The assertions that explain what the learner will be able to perform at the end of the course or programme are known as learning objectives. Learning objectives should describe how students will perform and why they are doing so. Prepare a precise content outline that includes a thorough analysis and logical organisation of the content. Simple to complex, known to unknown, concrete to abstract, general to specific, and so on are all examples of logical content structure.

Instructional strategies must be provided in a clear and concise manner. The proper instructional method must be determined based on the learner's learning style and the nature of the topic. It is necessary to choose an appropriate media mix, which includes a combination of audio, video, images, animation, simulation, and other elements.

Learner evaluation strategies such as practice, computer marked or tutor marked assessments, pretest, post-test, remedial tests etc are to be specified. We must choose between formative and summative evaluations. Examine the proposed learning objectives before producing content for the chosen course. Make sure that the material, assessment tests, and activities all align with the stated goals. To accomplish the learning objectives, provide the necessary information and knowledge.

C) Development: It has something to do with the building of a storey board. The entire course content is scripted using a storyboard. The term 'board' comes from the film industry. It denotes the visual portrayal of distinct scenes in a film. In E-Content development, a storyboard depicts the step-by-step screenplay of the e-final content's conclusion, i.e A storyboard is constructed to offer a blueprint of the course, complete with all of the course's details and content notes. The objectives and instructional tactics are used to develop the story board. The content assets and learning items are created and assembled here by the developers. This phase includes the programming and integration of all media elements into a cohesive multimedia presentation.

D) **Implement:** Materials are delivered to learners during the implementation phase. A detailed implementation strategy document is being created. The course content, learning outcomes, method of delivery in terms of hard and software needs, and testing processes should all be covered in this document. If the material is on the web site, make sure it is functional.

E) **Evaluation:** The evaluation step is divided into two parts: There are two types of evaluations: formative and summative. Each level of the ADDIE process includes formative evaluation. The adequacy of the supplied materials in accomplishing the course objectives is determined through summative evaluation. Based on the input collected, the material will be changed at each stage.

1.15 UNDERSTANDING OF E-CONTENT

Any single or multi-media application, whether commercial or not, is built around E-Content. Almost every website, CD, movie, or mobile application is designed to deliver material to the user or to assist the user in creating their own content. Today, E-Content is mostly used to preserve and transmit cultural or historical legacy, to communicate lifestyle, scientific, educational, and corporate information in a digitalized manner, or to provide users with interactive services.

E-Content is digital information sent across a network of electronic devices, i.e. symbols that can be used and interpreted by human actors during communication processes, allowing them to share visions and influence one another's knowledge, attitudes, and behaviour. E-Content enables for user participation and can alter dynamically based on the user's actions. It is a subclass of both digital and electronic content that is distinguished by the presence of a network, which results in the content's ongoing renewal (contrary to the fixed set of content stored on a carrier such as a CD-ROM, or the content broadcast via TV and Radio). This ongoing regeneration of content, coupled with its dynamic development, results in a qualitative distinction, hence defining E-Content.

The creation and dissemination of E-Content in several vital categories completes the spread of E-Content. One important category for E-Content interventions and delivery is e-learning. In the field of e-learning, a variety of information distribution systems and advances have emerged.

1.16 E-CONTENT ACROSS THE WORLD

The use of ICT in education, or more specifically, the creation and development of E-Content for e-learning, is in various phases of development and implementation. Countries and cultures are always working to provide a viable platform for e-learning by constructing and delivering information that is both effective and useful. Gradually, social structures and organisations are being shaped to recognise the value and usefulness of e-learning modules and practises for a variety of purposes. There is a constant quest for value-based content throughout communities and institutions to achieve this.

The goal is to improve on the current knowledge-based society. Universities in Brazil are investing in digital media to improve teaching and learning tools. E-learning is the most advanced kind of electronic content.

1.17 FORMS OF E-CONTENT

There are two forms of E-Content, SLO and Module.

a) SLO

SLOs (Short Learning Objects) are a new method of thinking about content for learning. They are much shorter learning units, usually spanning from two to three minutes in length. It could be a description of a product, piece of equipment, concept, procedure, or activity, etc.

b) Modules

E-Learning modules are larger, self-contained structured experiences that include goals, learning activities, and assessments. To put it another way, it's a whole bundle that includes a lesson. It includes lecture modules with built-in visuals, as well as text, quizzes, FAQs, assignments, a dictionary, case studies, references, discussion, and downloads. The output can be used on the web or on CDs.

1.18 PEDAGOGICAL ISSUES IN E-CONTENT DEVELOPMENT

Pedagogy is the study of teaching and learning techniques, processes, tactics, procedures, and approaches. It also includes understanding of the goals of instruction, evaluation, and student learning. The challenges of pedagogical concerns in E-Content include i) making knowledge visible to learners, (ii) making teachers' thinking apparent to learners, and (iii) making learners' thinking visible to themselves, their peers, and the teacher. The pedagogy has primarily evolved as a result of practical restrictions (e.g. time, class size, linear text books). Many of these limits, such as dictionaries, references, and connections, have been addressed by planned E-Content packages.

A digital text and images designed for display on web pages which is suitable for particular audience is called as "e-content". It means, any content product available in a digital form and it typically refers to music, information and images that are available for distribution on electronic media. (Anurag Saxena, 2011)

Several components are required in the E-Content development process. In order to ensure that the learning objectives and expected outcomes are satisfied, the content should follow appropriate instructional design techniques. The time and effort put into creating electronic content should be reusable across different learning management systems. All the E-Content materials are focused on

a. ***Cognitive perspective:*** it focuses on the cognitive processes involved in the learning as well as how the brain works;
b. ***Emotional perspective:*** it focuses on the emotional aspects of learning, like motivation, engagement, fun, etc.;
c. ***Behavioural perspective:*** it focuses on the skills and behavioural outcomes of the learning process, role-playing, settings of job and
d. *Contextual perspective:* it focuses on the environmental and social aspects which can stimulate learning.

1.19 INSTRUCTOR'S ROLE IN THE DEVELOPMENT OF E-CONTENT

A competent E-Content educator is one who effectively and efficiently completes a task in a specific digital context, utilising suitable knowledge, skills, attitudes, and abilities that have evolved over time to meet their needs. In addition, the International Board of Standards for Training, Performance, and Instruction established standard competencies for teachers in the areas of E-Content generation in the following domains:

a. Professional foundations,
b. Planning and preparation,
c. Instructional methods and strategies,
d. Assessment and evaluation, and
e. Management.

1.20 CHARACTERISTICS OF E-CONTENT DEVELOPMENT

According to Anurag Saxena (2011) he explained the possible methods of educational E-Contents conversions are viz., (i) learning by doing and learning by investigation; (ii) learning by using themes; (iii) learning by testing/evaluation; (iv) learning by simulation and (v) learning by role-playing. As per the UGC (University Grants Commission, India) guidelines of E-Content development needs the following categories viz., (i) home; (ii) objectives; (iii) subject mapping; (iv) summary; (v) text with pictures & animations; (vi) video and audio; (vii) assignments, quiz & tutorial; (viii) references, glossary & links; (ix) case studies; (x) FAQs; (xi) download; (xii) blog and (xiii) contact. These categories are arranged sequentially by the subject experts along with technical supporters so as to develop the E-Content materials.

E-Content is a product, but e-learning is a process. E-Content is typically created to assist students through a large amount of material in order to complete a certain goal. In virtual classroom scenarios, an E-Content package can act as a teacher.

The quality of learning is determined not only by the manner in which the process is carried out, but also by the content taught and presented. This kind of instruction has become a solution to complex difficulties and unidentified places.

In a classroom, technology motivates students and engages them in the learning process. Books are an extension of the brain, video is an extension of the eye, audio is an extension of the ear, audio conferencing is an extension of the mind and vocal chord, computer is an extension of mind, hands, and eyes, satellite technology is an extension of human reach, and computer networks are an extension of human cooperation. As a result, we would expect E-Contents to be able to stimulate the student in a way that allows them to maximise their learning capacity.

For all individual teaching systems, E-Content is important to the student and also helpful to the teachers; E-Content is the newest way of instruction that has attracted more attention to gather diverse notions. The ultimate goal of E-Content is to eliminate learning disparities through effective education. E-Content makes it easier for teachers to be more effective. It improves the learner's knowledge level, which leads to creative thinking, and it provides future ideas based on the links and references provided.

1.21 CHALLENGES IN E-CONTENT

As previously said, e-learning and content are inextricably linked, and the former is dependent on the latter. In developing successful modules for an information-rich society and institutions, content and e-learning encounter a variety of obstacles. In reality, most of the problems with E-Content in developing countries are also problems with e-learning. These include:

- a lack of basic ICT infrastructure such as telephones, power supplies, and Internet connectivity;
- a lack of computer knowledge and training among the general public;
- high costs of ICT equipment, such as computers, which prevents access to ICT due to financial constraints; and a lack of knowledge of ICT and its applications.
- Absence of sound ICT policy efforts such as tax incentives, tariff abolition, or exemptions from certain taxes on IT equipment.
- Low levels of investment in the production of learning and educational programmes and materials as a constraint for the development of media-rich E-Content
- There is a decrease in the production of user-friendly applications.
- Many cultures have a risk-averse cultural and commercial ethos when it comes to technological advancements and uses.
- In many nations, there is insufficient political and administrative backing.
- A strategic vision for the growth of the information society is lacking.
- Inadequate legal foundation for the deployment of the information society

- In the field of content framework and general information society, there is a lack of cooperation between the state and public institutions.

1.22 ADVANTAGES OF E-CONTENT IN HIGHER SECONDARY EDUCATION

For academic purposes, many higher secondary educational institutions and governing bodies produce books, research reports, lecture modules, theses, and other materials. All of these publications are typically in print and kept in the library for use by other teachers, stakeholders, and students.

Are there compelling reasons to convert these print periodicals to electronic format? To answer this, you must first determine the benefits and drawbacks of printed content (p-content) and electronic content (E-Content). According to Bonime and Pohlmann, (1998) E-Contents benefit from:

- hyperlinking - contents can be linked to other pages inside and outside the book;
- non-linearity - the order of access can be set by the users
- multimedia enhancement - content presentation is improved by combining different types of information (e.g., sound, video, and so on);
- data density - storage capacity is reduced while portability increases;
- searching - the ability of users to locate any piece of information or access any area instantaneously improves the utility of the content.

When analysing the feasibility of transforming printed information to E-Content, Bonime and Pohlmann and Rawlins give a comparison of paper book and electronic book features (see Table1.1).

Table 1.1

Features comparison of p-content and E-Content

Features	***p-content***	***E-Content***
Tactile	Yes	No
Portable	Yes	Yes & No
Access without devices	Yes	No
Easy random access	No	Yes
Multiple access at one time	Yes	Yes
Customisable (font size, annotations etc.)	No	Yes
Hyperlinks	No	Yes
Text	Yes	Yes
Pictures	Yes	Yes
Audio	No	Yes
Animation/video	No	Yes
Instant search facility	No	Yes
Easily and conveniently read	Yes	No
Easily damaged (i.e. tear)	Yes	No
Content updated easily	No	Yes
Go out of print	Yes	No
Highly interactive	No	Yes
Good legibility	Yes	No
Easily reproduced with the same quality	No	Yes

It is a well-known truth that the e-learning process offers a number of benefits that are not available in the traditional human-assisted teaching and learning process. People describe a slew of e-learning advantages and benefits. Some of the major benefits of e-learning include: it is not just learning but also sharing; the content in E-Content is not static but dynamic; it is anywhere and anytime learning; it has a global audience; the content to be delivered through the process of e-learning has certification; it is indeed dam cheap; the instructional design in E-Content will be learner centric; it invites structured feedback; it is self-paced; it can be used in real time and multiple times; It can provide content in a multimedia format, it will use a scientific evaluation approach, the content will be legitimate, and it may include features such as interactivity, book marking, whiteboard, hot spot, hypertext, and hyperlinks, among others.

Aside from that, the E-Content offers the content in a variety of formats; entire technical content is explained using appropriate images and animations. The E-Content is typically delivered in a self-directed, self-paced instructional manner, with fluid teaching tactics designed to keep learners engaged. It offers the information in a straightforward text format with clear images and important supporting headings. It may have its own reference resources, which are normally not burdensome to students and may be accessed on demand with optional frames. Some E-Content has unique capabilities, such as automatic retaking of classes. Wherever learners are unable to perform satisfactorily, an automatic learning path may be implemented some advanced level E-Content offers synchronous and asynchronous 3D virtual reality interactivity — chat, conference, and so on.

According to the above information, e-learning is a combination of multiple learning approaches that are supplied to learners via information technology and are accompanied by educational instructional design and appropriate content. The world of e-learning is made up of three essential elements: 1. content, 2. services, and 3. technology. The content is the foundation of e-learning, while services and technology are the carriage on which the material travels

1.23 NEED FOR A VIABLE CONTENT STRUCTURE

The growth and dissemination of e-learning networks across communities, particularly in undeveloped and emerging countries, necessitates immediate attention to a number of critical challenges. The following factors are important in defining a society's e-learning status as well as the general structure of E-Content:

- A clear ICT policy from the government.
- A proactive policy for bridging the digital divide.
- Allow financial incentives in ICT interventions including in e- learning ventures.
- Enhance ICT awareness and spread in communities and people.
- Incentive academic courses on ICT across the countries and societies.
- Environment for developing e-learning solutions that is feasible, accessible and utility based.
- Effective public-private partnerships in the promotion of e-learning content ventures in schools and institutions.
- Ease of access of content online and through other communications technology.
- Development of proper and effective e-learning software through effective course delivery and content.
- Continual advances in value addition through the use of latest applications such as educational animation to be made available to support online learning.
- Open source e-learning systems such as Blackboard, Model, A Tutor, ILIAS, need to be used effectively towards a student-centred learning solution.

1.24 LEARNING OF SCIENCE

The word "science" has its origin from a Latin word "scientia" meaning "to know'. To understand the meaning of science it is essential to know the definitions of science. According to the APEID (1983) document, "Science is an organised and ordered way of investigating and understanding the world which is essentially practical in nature". Einstein says, "Science is an attempt to make the chaotic diversity of our sense experience correspond to logically uniform systems of thought. "Science education programmes will be designed to enable the learner to acquire problem solving and decision making skills", National Policy on Education (1968).

“If science is poorly taught and badly learnt, it is little more than burdening the mind with dead information and it could degenerate even into a new superstition” - Kothari commission.

On the basis of these and many other definitions we can conclude that,

a) Science is a study of natural Phenomena.

b) It is an organized and systematized learning.

c) It is a body of cumulative and ordered observations.

d) Science is a process as well as the product of that process.

The major goal of teaching science is to modify students' socially desirable behaviour, which can only be accomplished if the education is effective and based on teaching principles. The method of teaching is the process of interpreting the world of knowledge and transferring it to the mind of a child. The method refers to how content is presented in the classroom. Science is a vital subject in the school curriculum because man's future is heavily reliant on scientific advancements and the expansion of productive activities.

1.25 LEARNING CHEMISTRY

"Chemistry is a scientific discipline. It is defined as "the comprehensive study of the preparation, characteristics, structure, and reactivity of chemical elements and their compounds, as well as the systems that they form."

The following are the goals of chemistry education.

1. It promotes critical thinking among kids.
2. It improves students' problem-solving skills.
3. It assists students in developing an understanding of the scientific process.
4. It instilled a sense of professionalism.

1.26 OBJECTIVES OF LEARNING CHEMISTRY AT VARIOUS LEVELS

Table-1.2

Level	Cognitive	Affective	Psychomotor
Primary	Knowledge	Interest, attitude Appreciation	Observation, Manipulation
Secondary	Knowledge Comprehension Application	Interest, Appreciation, habit formation	Observation, Drawing Experimental skill
Higher Secondary	Knowledge comprehension Application, Analysis synthesis, Evaluation	Interest, Appreciation, Habit formation, attitude	Observation, Drawing, Problem solving

The main goals of teaching chemistry at the secondary level are as follows:

1. To acquire the real scientific knowledge
2. To develop in the student the capacity to solve problems.
3. To develop interest in a sense of appreciation.
5. To develop the students interest in learning chemistry.

6. To make them realize the impact of chemistry on society.
7. To develop the economic efficiency
8. To develop in students the thirst for knowledge and higher education.
9. To develop practical skills.

1.27 CURRICULUM IN LEARNING CHEMISTRY

"Curriculum is the tool in the hands of the artist (the teacher) to mold his material (the pupils) in his studio (the school) according to his ideals (aims and objectives)."- **Cunningham**. Curriculum comes from the Latin term currere, which means "to run." As a result, curriculum refers to "a course to be followed in order to achieve a specific goal." It is the lifeblood of the educational process. It serves as a fulcrum for coordinating instructional efforts on a reasonable scale, and it is unquestionably the beating heart of the school and everything that it entails. As a result, chemistry curriculum should aid in attaining the goals and objectives of teaching chemistry.

Recognizing the importance of chemistry, several efforts were undertaken after independence to strengthen the chemistry curriculum in India. The following organisations have aided in the curriculum enhancement programme:

(i) Chem Study

(ii) UNESCO Planning (1964)

(iii) National Policy on Education (1986)

Chem Study

CHEM study is chemical Educational material study. CHEM study is an experiment-based chemistry course. Each succeeding step has 'Discovery' based on Laboratory work. In CHEM study, practical work proceeds theory and employs the inductive approach. The following are the recommendations of CHEM- study with regard to chemistry subject.

1. Experiments must permit students to make their own discoveries of the principles which unify chemistry and make it easier to understand.
2. Its emphasis is on the making of careful observations and quantitative measurement under controlled experimental conditions.
3. Its stress is on the preparation of tables for recording data which help in making deductions.
4. It involves challenging discussions and questions which help in the application of principles observed in the experiments to new situations.

UNESCO Planning Commission

The following are the few recommendations given by the UNESCO Planning Commission (1964)

(i) Learning of chemistry be made compulsory

(ii) More emphasis be put on the practical applications of chemistry.

Indian Education Commission

A few recommendations of the Indian Education commission (1964-66) are followed here:

(i) Chemistry should be taught as a separate school subject in middle classes.

(ii) Chemistry should be made an elective subject at the senior secondary stage and be offered only to those students who are interested in taking it up as an elective subject.

National Policy on Education (1986)

In the light of NPE (1986) Document, chemistry is to be taught as a part of the integrated science course up to class X and as a separate in classes XI and XII.

1.28 `AIMS OF LEARNING CHEMISTRY AT HIGHER SECONDARY LEVEL

The important aims of learning chemistry are as follows:

1. Knowledge aim

Teaching chemistry should increase the knowledge of an individual. This knowledge should aid him in gaining a better awareness of himself and his surroundings. This knowledge should assist him in his day-to-day activities.

2. Practical aim

The Knowledge gained should be of practical use to an individual. The knowledge should be related to the material with which the pupil is familiar and should not be based on obsolete devices and ideas.

3. Development of scientific attitude

It should be helpful in removing superstitions, false beliefs; wrong notions spread in the society and cultivate the habits of proper reasoning, observation and experimental action.

4. Cultural aim

The following should be taught in school in such a way as (i) to grasp the progress in the field of chemistry, (ii) to apply it for enhancement of our cultural heritage and development of civilization (iii) appreciate the study of chemistry in the progress and development of culture and civilization.

5. Utilization of leisure time

It should be useful to an individual to learn ways and means of utilizing his leisure hours more fruitfully.

6. Skill aim

Teaching of chemistry should aim at developing useful skills pertaining to scientific observation, experimentation and practical use of scientific facts and principles.

The following are the general aims of teaching of chemistry:

- **(i) Usefulness:** The knowledge gained should be useful to the students in their lives.
- **(ii) Timeliness:** It should be concerned with materials / objects with which the student is familiar.
- **(iii) Fitness:** It should fit into sequence that leads him to broad objectives.
- **(iv) Appropriateness:** The learning should be appropriate for the maturity and background of the students.
- **(v) Practicability:** It means that experience required for development of learning should be possible.

1.29 CHEMISTRY FOR HIGHER SECONDARY STUDENTS

At the higher secondary level of education, chemistry is provided as an elective Subject. At this point, students choose Chemistry as a discipline with the goal of pursuing jobs in basic sciences or professional fields such as medicine, engineering, or technology in the future. There is a need to offer learners with an adequate conceptual basis in Chemistry so that they are prepared to handle the difficulties of academic and professional courses once they complete high school. Process skills, problem-solving ability, and applications of Chemistry concepts/content, as well as usefulness in real-life settings, are all important aspects of the higher secondary curriculum.

At the higher secondary level, the curriculum is divided into two-year units. The units are organised in such a way that they present distinct perspectives on chemistry as a science. Each unit is organised with a topic, content-related practical examples, and theory-related questions. Continuous and Comprehensive Evaluation of numerous ideas covered in a unit is an absolute must for evaluating the learners. With this in mind, Tamilnadu's Chemistry curriculum at the higher secondary level aims to:

- Strengthen the concepts developed at the secondary stage to provide firm ground work and foundation for further learning chemistry at the tertiary level more effectively and learning the relationship with daily-life situations;
- Develop conceptual competence in the learners and make them realize and appreciate the interface of Chemistry with other disciplines;
- Expose the learners to different processes used in Chemistry-related industrial and technological applications;
- Develop process-skills and experimental, observational, manipulative, decision-making and investigatory skills in the learners;
- Promote problem-solving abilities and creative thinking to develop interest in the learners in the study of Chemistry as a discipline;
- Understand the relationship between nature and matter on scientific basis, develop positive scientific attitude, and appreciate the contribution of Chemistry towards the improvement of quality of life and human welfare;

Chemistry learning in the upper secondary school allows students to comprehend current knowledge, develop aesthetic sensitivities, and build processing abilities. Learners' experimental and process abilities, together with their conceptual chemistry knowledge, equip them for more meaningful learning experiences and contribute to a considerable improvement in their quality of life. The students would also understand the importance of chemistry and technology, as well as its connections to overall national growth.

1.30 NEED FOR MODERN METHODS AND APPROACHES FOR LEARNING CHEMISTRY

Indian Education Commission (1966) observes that, if science is poorly taught and learned, it is little more than lifeless information burdening the mind, and it may even devolve into a new religion. It also stressed the importance of significantly improving the quality of science education in order to fulfill its intended goals. Today's science is the foundation for tomorrow's technology. Albert Einstein, himself a brilliant specialist, scientist, and technologist, advocated for creative educational practices that would broaden pupils' intellectual experiences and mental flexibility.

In practice, teachers in the classroom focus on finishing the curriculum within the allotted time and forcing students to memorise the content without any intellectual or cognitive thinking. This kind of science instruction fails to instill a scientific mindset in students, as well as to promote academic achievement and competency, as well as to meet educational goals. This issue could be addressed by increasing the use of instructional technologies.

1.31 THE PRESENT STATUS OF LEARNING CHEMISTRY AT THE HIGHER SECONDARY LEVEL

In today’s world where knowledge is exploding and science is progressing at breakneck speed. Education, which is regarded as the people's third eye, must be relevant, meaningful, and pleasurable in order to keep up with technical and scientific growth. In reality, today's educational system is bookish, academic, and disconnected from the real world. Many vital sciences, such as physics and chemistry, are challenging, but the essence of each concept is abstract in nature. Students are unable to grasp the abstract nature of the chemistry idea on their own. Chemistry is a topic that deals with element symbols, structures, composition, and preparation. Because suitable explanations and diagrammatic representations are not provided in the textbook, students have difficulty understanding the topics. Students come from both rural and urban locations to attend school. Even the foundations of chemistry are not taught or explained in rural schools. When these pupils attend urban area schools, they find it difficult to keep up with the other students.

Organic, inorganic, and physical chemistry are the three branches of chemistry. The Periodic Table, which lists 119 elements that occur naturally and are manufactured intentionally, is at the heart of the study. However, students do not have a comprehensive knowledge of the 119 elements. Another significant development is the government's implementation of the Smart Class programme. The majority of the items are accessible on CD. However, some teachers do not use technology to teach in the classroom and are unaware of how to use computers. Teachers nowadays are under-motivated, despite the fact that they are forming the pillars that will support the future society. Teachers provide insufficient explanations, causing students to hunger for information even more. They do not receive adequate in-service training on how to use the computer in class. Because of the aforementioned factors, the researcher decided to create chemical concepts in the form of E-Content for use in higher secondary chemistry classes. The researcher created E-Content for teaching chemistry by combining two units from +1 chemistry and determining the efficacy of the E-Content in chemistry learning.

Students enter the classroom with trepidation, hoping that the teachers will be able to clear up their uncertainties. However, ill-equipped teachers have a tough time providing appropriate responses to the queries. As a result, the pupils are dissatisfied with their education. Furthermore, professors do not introduce students to new concepts, knowledge, practical exposure, practical implications, or information. Taking into account the aforementioned facts, the researcher has created E-Content for learning chemistry at the higher secondary level.

1.32 STATEMENT OF THE PROBLEM

The introduction of improved communication technology is one of the major forces driving educational reform in the twenty-first century. These technology reforms are constantly influencing the education system, which is an innovation in and of it. Some wealthy countries' educational systems have become overly reliant on technical advancements. In some countries, E-Content has practically become an indispensable component of the entire educational system. Knowledge of contemporary technological breakthroughs will aid critical awareness of new prospects for enhancing educational accessibility while retaining educational quality. Developing countries like India are now unable to profit from technology advancements due to a variety of restrictions. However, by being more aware of the possibilities, Indian educators may be more sure that there are technologies that can help them improve the quality of education and make it more accessible to the general public.

Chemistry is considered generally as a tough subject by students and they find it difficult to understand the abstract concepts involved in it. In schools, the majority of the students feel that they need more clarity to comprehend the subject. Specifically the higher secondary first year students find difficulty in understanding many abstract concepts covered in the units Quantum mechanical model of atom and chemical bonding. The investigator felt that this impression can be reversed with the help of integrating technology in teaching and learning and by including interesting multimedia elements for learning the subject. Hence by reviewing all needs, the investigator wants to study the "**EFFECTIVENESS OF E-CONTENT IN LEARNING CHEMISTRY AND ACADEMIC ACHIEVEMENT AT THE HIGHER SECONDARY LEVEL**".

1.33 NEED FOR THE STUDY

Computers are having an increasingly large and powerful impact on research and development processes in numerous domains of science and technology. One must consider the consequences for the student society if the elders remain adamant about not introducing computer technology at all costs. Education's main goal is to improve students' ability and skills so that they can adapt to life's constant and rapid changes. It is noted that computers are not fully integrated into the teaching-learning process in Indian classrooms, whereas pupils in developed countries have been exposed to computer dynamics. Because of the usefulness of computers in instruction, it is critical to expose Indian learners at the school and college levels to computer assisted instructional activities in order to keep up with their western counterparts' educational attainment. As a result of student unhappiness, Indian schools suffer issues of student indiscipline and unrest. Indian students were equally disappointed with the classroom teaching methods. The most important component of the uprising isn't whether or whether the topic matter and content are proper. Instead, it is their growing disdain for traditional teaching methods.

"In our educational institutions now, instructions still conform to a mechanical pattern, occasionally to be dominated by the old besetting sin of verbalism, and therefore remains as monotonous and uninspired as before," the Indian Education Commission (1964) stated. Our educational institutions' teaching methods are insufficient and do not meet the needs of students or education.

Educational technology can help solve challenges in today's educational systems. The lack of challenging instructional material that does not limit the learner's creativity is better met by E-Content. While this strategy can help slow learners enhance their learning, it can also help high achievers build expertise. While educational waste can be reduced, the productivity and accountability of the educational system can be improved via the use of technology.

E-Content for learning chemistry is a useful educational tool in the hands of qualified teachers who can improve the teaching-learning process. The classroom is loaded with a mountain of syllabi, and students are expected to obtain knowledge in order to better their understanding.

An alternate teaching method must be used to stimulate students' interest, enrich meaningful development of independent study habits, and foster purposeful development of self-confidence in learning. Furthermore, in today's fast-paced world, when knowledge is exploding in many areas, it is unrealistic to believe that spoken (or written) words alone can transmit the volume of essential information to learners. In this regard, E-Content for chemistry learning is a particular and unique medium, with features such as high-quality audio-visual recording and immediate feedback. It's a simple way to deliver well-designed information with a variety of interesting effects.

This is a teaching method in which teachers can progress at their own pace through learning activities. They will be encouraged to have a more active and accountable part in their own education.

Keeping all of these factors in mind, the researcher conducts an experiment to examine E-Content for studying chemistry at the higher secondary level in order to allow higher secondary students to master the subject at their own pace.

1.34 SIGNIFICANCE OF THE STUDY

E-Content allows students to extend their learning beyond the classroom's four walls. This can be seen from any accessible location in a room. Even the most complex subjects, such as Quantum mechanical model of atom and chemical bonding, can be taught to students in an engaging manner thanks to the animation visuals. It can be utilized to improve the learning environment in the classroom. As a result, material might stick around in the minds of students for a long time. More deeply than any other medium, E-Content for learning chemistry can penetrate the growth of the human cognitive system with immediate excitement. In the hands of pupils, E-Content is more important. The student has the option of learning at his or her own pace.

The present investigation is based on two major units from the Tamil Nadu State Board of Education's 11th grade chemistry textbook, Quantum mechanical model of atom and chemical bonding. The reactions and illustrations in the book are static, while the E-Content for learning chemistry includes texts, pictures, music, animation, and video. This E-Content for learning chemistry also includes laboratory preparation, which draws the learner's attention. This E-Content for learning chemistry can be beneficial because it defines each difficult word in each presentation. As a result, the learner's degree of achievement will be higher. As a result, E-Content for studying chemistry will be more engaging and relevant for all students, resulting in more intentional learning.

E-Content for learning chemistry proves to be better than all other aids in several aspects.

i) Highly individualized teaching instruction can be provided.

ii) E-Content for learning chemistry is effectively used for achieving cognitive objectives.

iii) Large amount of information stored in the computers is made available to the learners more rapidly than by any other media.

iv) It is possible to provide immediate reinforcement to each correct response.

v) E-Content for learning chemistry gives proper cues, as a result, average, and below average students were able to compete with the gifted children to the same extent.

vi) The improvement in learning of the student can be supervised by the teacher as the system stores his progress.

vii) E-Content for learning chemistry helps students to save time.

viii) This type of learning doesn’t suffer due to subjectivity.

1.35 SCOPE OF THE STUDY

1. E-Content for learning chemistry has a wider scope in the instructional process bringing the real situations and characters.
2. The learners will be able to understand the concepts very easily
3. E-Content for learning chemistry will reduce monotony, because it brings real life situations.
4. E-Content for learning chemistry has got wider applications in the area of technological sciences in particular.
5. The present study aims at developing E-Content for learning chemistry at higher secondary level.
6. The study provides scope for the development of innumerable software, which can suit different categories of learners and subjects.
7. The study aims at motivating the students to learn the chemistry concepts clearly.
8. It saves a lot of time and energy.

1.36 TITLE OF THE STUDY

The title of the study is precisely stated below;

"**EFFECTIVENESS OF E-CONTENT IN LEARNING CHEMISTRY AND ACADEMIC ACHIEVEMENT AT THE HIGHER SECONDARY LEVEL"**

1.37 OBJECTIVES OF THE STUDY

The following are the objectives of the study:

1. To find out the effectiveness of the E-Content in learning chemistry and academic achievement at the higher secondary level.

2. To find out the attitude of the students toward E-Content in learning chemistry at the higher secondary level.

1.38 CONTRIBUTIONS OF THE STUDY

The E-Content in chemistry learning has made a significant contribution to making chemistry learning simple. "A curriculum should be dynamic in character, to meet with the current demands of the society," as the phrase goes, "and self-learning through science based and technology oriented means would always be beneficial to the young children and ultimately to the nation." The following are some of the most significant contributions of electronic content for learning chemistry.

1. Mastery over the subject
2. Clear understanding
3. In-depth knowledge
4. Relation of the subject matter
5. Immediate reinforcement
6. Easy access to information
7. Visual image aids learning easy and so on.

1.39 ORGANIZATION OF THE STUDY

This study is divided into five chapters as given below:

- The first chapter introduces the study and provides the theoretical framework of the study. It gives details about the subject chemistry, aims of teaching and learning chemistry, education, and technology in general, specific notes on E-Content in learning Chemistry, etc., This chapter also discusses the statement of the problem, scope of the study and the objectives of the present study.

- The second chapter presents a review of conceptual and research studies which have been done abroad and India in the area taken up for the study.
- The third chapter deals with the procedures and methods of research adopted by the investigator for this present study.
- The fourth chapter presents the analysis and interpretation of the data.
- The fifth chapter summarizes the findings of the study and suggestions for further study.

1.40 CONCLUSION

If technology is meant to empower people, then it is the ideal medium for education and learning in all communities. It is beneficial to build ICT abilities that allow students to create new learning experiences. Students in the XI standard who follow the State Board Syllabus can benefit from using an E-Content in learning chemistry at the higher secondary school level. Students are motivated by E-Content because it actively involves them in the learning process, allows them to interact, promotes higher-order thinking, and helps them study without boredom or tiredness.

CHAPTER – II

REVIEW OF RELATED LITERATURE

CHAPTER - II

REVIEW OF RELATED LITERATURE

"Since effective research is based on past knowledge, a review of related literature helps to eliminate the duplication of what has been done and provides useful hypotheses and helpful suggestions for significant investigation. A summary of the writing of recognized authorities and of previous research provides evidence that the researcher is familiar with what is already known and what is still unknown and untested".

- *Bett John. S.*

2.1 INTRODUCTION

A study of the related literature allows the researcher to acquaint himself withcurrent knowledge in the area where he proposes to do research. It warns the researcher not to select unworthy, unfruitful and used problem areas. In the words of Lokash (1984) the review of related literature gives the researcher an understanding of the research methodology which refers to the way of the study to be conducted. It helps the researcher to know about tools and instruments which was proved to be useful and promising in the previous study, that is, the advantage of the related literature is to provide insight into the statistical method through which validity of results is to be established.

According to W. R. Brog, "The literature in any field forms the foundation upon which all future work will be built. If we fear to build the foundation of knowledge provided by the review of literature, our work is likely to be shallow and native and will often duplicate work that has already been done better by someone else."

Best (1971) says, "The search for related literature is one of the first steps in the research process". It is a valuable guide in defining the problem, recognizing the significance of suggesting data-gathering devices and sources of data. A summary of recognized authorities or previous research clearly tells the researches what is alreadyknown and what is still unknown and untested.

This chapter brings out the needs and aims of reviewing the related literature besides a comprehensive analysis of the various studies conducted by foreign and Indian researchers in the areas of CAI, electronic packages and attitudes of the learners regarding computer based learning.

2.2 AIMS OF REVIEW OF RELATED LITERATURE

The aims of review of related literature in education research are:

1. To make the investigator familiar with the accumulated facts in the chosen field.
2. To guide the investigator not to select problems that have already beeninvestigated.
3. To sensitize the investigator to new possibilities in research.
4. To explore techniques and procedures for adoption in other areas as well.
5. To assimilate ideas that can be worked out into a new research project.
6. To give a theoretical grounding to a research study apart from providingproblems requiring a solution.
7. To discover major issues and research methodologies related to a desirablearea and to the selection of a research problem.
8. To provide evidence suggesting the need for change in the existing practice.

2.3 NEED OF REVIEW OF RELATED LITERATURE

The literature review is the basis of most research projects or work. It implies locating, reading and evaluating reports of research as well as reports of casual observation and opinion that are related to the individual's planned a research project or work. A careful review of research thesis books, journal books, and other resources is one of the important steps in any research activities. It helps the researcher to avoid unintentional duplication of well-established theories. The review of literature provides us with an opportunity of gaining insight into the measures, objects, samples, tools, and approaches employed by other research workers. Walter R. Borg said, "Theliterature in any field forms the foundation upon which all future work will be built".

2.4 SOURCES AND TYPES OF RESEARCH LITERATURE

The investigator has studied Books, Journals, reports, popular media, memos, minutes, internal reports, published and unpublished papers, introductory and overviewtexts, methodological and confessional writing, edited collections and literature reviews.The above mentioned are the primary sources and the secondary sources of research literature.

The research studies reviewed here include closely related investigations which have been carried out in abroad and India on various dimensions of the researchproblem selected by the investigator. Many similar results which are described in technical reports of various journals and papers delivered of conferences are also reviewed. However, since the problem of the study is a new trend the closely related investigation or very less. Even then the investigator has reviewed some similar studies which have been carried out abroad and India.

2.5 CLASSIFICATION OF RELATED LITERATURE

The investigator has gone through the related researches to the present problem. Hence an attempt was made by the investigator to put forth the reviews related to the present investigation. The investigator identified 135 studies which are conducted in abroad and India. These studies concentrate on instructions provided with the help of computers, CAI, Electronic Packages, ICT and CD-based courseware and the attitude of the learners towards computers. Of these studies, 73 were conducted abroad and the remaining 62 studies were done in India which were related to the topic chosen for the present study. The details of the above studies are given below.

2.6 STUDIES RELATED TO CAI, ELECTRONIC PACKAGES IN OTHERSUBJECTS- ABROAD

Amory, Alan; Naicker, Kevin (2001) evaluated two Biology online software packages used by the students in constructivist environments. Students' interviews, as well as studies of student performance, were used to conduct evaluations using paper and electronic-based tools (pre-and post-testing, examination results). Students loved using the software, considered the constructive learning settings challenging, valued the constant availability of online material, and found the software products' user interfaces straightforward to use and navigate, according to the findings. Exam results analysis revealed that the pupils did better than the previous year (traditional lectures). The carbohydrate course produced better results than the other courses. In online learning settings, interactive components that encourage constructivist-based learning skills tend to be more significant than information display.

Chun-Yen Chang (2002) studied the impact of different forms of electronic computer-assisted instruction on students' science achievement. On the science accomplishment of tenth-grade pupils, he compared the teacher-centered traditional technique with students-centered electronic computer-assisted instruction. The pre-test post-test comparison group experience included 244 tenth grade high school students from six science classrooms. During a one-week period, one group of students (n = 122) was taught using a traditional teacher-centered technique, while the other group (n = 122) was taught using a student-centered electronic computer-assisted method. On the Earth Science - Achievement test, post-test scores were compared to students' pre-test scores to determine correlation. He discovered that a teacher-centered teaching style was more effective in boosting students' science achievement in the cognitive domain of knowledge and application.

Kekkonen-Monetam et al. (2002) evaluated the effectiveness of web-based, interactive, electronic learning materials by comparing the students' learning outcomes in the lecture and online versions of an introductory computing course at Hong Kong University of Science and Technology. They suggest that the use of carefully designed interactive electronic learning modules fosters higher-order learning outcomes.

Moreno, Roxana and Mayer, Richard (2002) conducted a study on "Emerging student in active learning: the case for personalized electronic messages". The college students learned about botany through an agent-based electronic game in their research. Students were given either oral or written explanations on a computer screen. In the narration circumstances, students scored higher on retention, transfer, and programme ratings than in the in-text conditions.

Jha et al. (2002) made an attempt to study the development and evaluation of an interactive computer-assisted learning program - a novel approach to teaching gynecological surgery. The goal of this study was to create an interactive computer-assisted learning (CAL) application on CD-ROM that included video, graphics, and three-dimensional visuals to help people understand the anatomy and processes of a vaginal hysterectomy. To better appreciate the complicated interaction between the uterus, bladder, and rectum, a three-dimensional graphic was included. There was also an anatomy self-test and an interactive self-assessment portion with multiple choice questions. The CD-ROM was evaluated as an educational tool by twelve undergraduate students and sixteen gynaecological trainees. The majority of them were happy with the programme. It has been determined that more such educational software is required. The CD-ROM has discovered a novel and practical technique to teaching operative surgery. The results from the evaluation were positive in terms of the need for similar programs in the future.

Bobby (2004) experimented on Computer Supported Collaborative Learning (CSCL) in Learning Zoology among the IX Std Students. The researcher employed a single group design for the investigation. For the current investigation, 27 students from standard IX were chosen. CSCL was used to teach the Zoology unit 'Organisms and Environment.' Based on their performance on the last achievement test, selected students were divided into nine groups. Teacher Presentation (Electronic), Student Presentation

(Electronic), Assignment, and Brain Storming are all tasks included in CSCL. Each challenge corresponds to one of the lesson's subunits. The investigator assessed their performance after each task was completed, and so a continuous assessment was made. The pupils took part in the activity with vigour and zeal. Computer-Supported Collaborative Learning (CSCL) had a substantial impact on learning Zoology, according to his findings, and learning was expedited by it.

Teabo, Sharon, L. (2004) made a study on the usage of instructional electronicto enhance interactivity through web-based learning in P-12 settings. The goal of this study was to look at electronic as an instructional teaching tool for enhancing interactivity in a web-based environment and to show how interactive electronics can help students learn better. To confirm results acquired by quantitative approaches, add validity to this, and analyse the participant's impression of instructional media and their use, an in-depth analysis of an intensity sampling that indicated high use of instructional media was done. The study found a link between the types and use of specific instructional media, with some taxonomies incorporating it more frequently than others at a low level. In-depth research backed up the findings, and an examination of emergent themes revealed new information on the types and ways in which instructional media were used.

Norhayati, A.M. & Siew, P.H. (2004) in their study on "Malaysian Perspective: Designing interactive Electronic Learning Environment for Moral Values Education" developed an interactive electronic courseware package for moral values education using traditional Malay oral narratives called CITRA. The study's main goal was to develop a pedagogical tool that combines on-screen text, graphics, animation, music, and video in a visually appealing environment. CITRA, a didactic tool, disseminated information via CD-ROM and computer. The Storytelling World module, Enjoyable Reading World module, Word Enrichment Corner module, and Mind Test Land module were among the four learning modules available. The most crucial element of the tool was its capacity to communicate with users. According to the study's findings, CITRA promoted positive values among pupils through projecting visuals of stories.

Angeli, Charoula (2005) did a study on transforming a Teacher Education Method Course through Technology. In this study, an instructional design model was employed for restructuring a teacher education course with technology. The concept was used in a science education method course that was taught across two semesters with a total enrollment of 111 students in the fall semester and 116 students in the spring semester. Teacher-educators created high-quality technology-infused science lessons and then modelled them in the classroom for pre-service teachers using technologies such as electronic authoring tools in the autumn semester and modelling software in the spring semester. Pre-service teachers' technology competency was assessed using an assessment instrument that measured four aspects: (a) selecting appropriate science topics to be taught with technology, (b) using appropriate technology-supported representations and transformations for science content, (c) using technology to support teaching strategies, and (d) integrating computer activities with appropriate inquiry-based pedagogy in the science classroom. A MANOVA revealed that pre-service teachers in the modelling group outperformed pre-service teachers in the Electronic group in terms of overall performance, F = 21.524, , p = 0.000. Only two of the four characteristics of technology competency, namely the use of technology to enhance teaching strategies and the integration of computer activities with proper pedagogy in the classroom, outperformed the Electronic group, F=59.892, p=0.000 and F=10.942, p=0.001, respectively. The findings show that preparing pre-service teachers to be technology competent is a demanding endeavour that demands numerous efforts to provide them with adequate opportunities to build the competencies needed to teach with technology during their education.

Glkang. A. Noell, J. & Swartz, L. (2005) carried out a study using interactive electronic to teach "Pedestrian safety: An Exploratory Study". The study's primary goal was to assess an interactive electronic (IMM) programme for teaching young children safe pedestrian skills. IMM (animation and video) is used in the curriculum to teach youngsters critical skills for crossing streets safely. The effectiveness of the software in teaching safe street-crossing skills was assessed using a compute-delivered video assessment and a real-life street simulation. The computer-delivered and behavioural measurements were found to have substantial effects in this investigation. It was also discovered that by using the IMM programme, children may learn to distinguish between risky demands in traffic circumstances and transfer that information to real-life situations.

Yuen, S.T.S. Naidu, S. & Kodikara, J.K. (2005) in their paper reported a collaborative courseware development project in geotechnical engineering, conducted by the University of Melbourne and Monash University in Australia. The project's goal was to create electronic learning modules for professors and students to use. Videos on DVD and self-learning programmes on CD or the internet were among the modules developed. Deep excavation (building of a multi-level basement in Melbourne) and a laboratory direct shear test were among the subjects discussed. In a context when student field trips are becoming more difficult due to high class sizes and strict occupational health and safety rules, the former allows students to obtain a deep understanding of a complicated construction activity that takes place in an urban area. The laboratory module, on the other hand, supports the students' restricted hands-on laboratory experiments. The modules have been integrated into geotechnical engineering electives and offered as supplemental material in a variety of other subjects. The foundation, project execution, and lessons learned from the joint effort are described in this document. Finally, it summarises the results of a deep excavation module evaluation based on comments from a group of students. It is clear that students value the modules' availability and, as a result, perform better in their respective subjects.

Mohd Hafiz Zakaria, Umawathy Techanamurthy and Anusuriya Devaraju (2006) developed electronic courseware as a teaching aid for the children with dyslexia focuses on the planning, analysis, and design of e-learning courseware to teach dyslexics to read using the ‘picture thinking’ model. The creation of this e-learning courseware entails converting traditional printed book content from passive printing and graphics to interactive electronic content. The study's subjects were dyslexic youngsters and pre-school children aged 5 to 7. In comparison to the identical teaching methodologies used to teach their non-dyslexic counterparts, the study concluded that the electronic courseware was beneficial to dyslexic learners because it was a picture thinking model and multimodal approach to the best of their ability.

Tas et al. (2006) made a study on the effects of computer-assisted instruction material on understanding photosynthesis. The study's goal was to see how computer-assisted training material affected students' understanding of photosynthesis. The study's sample consisted of two classes of 52 students in a lycee in central Trabzon, Turkey. The study used an experimental design, with one class (the control group) receiving traditional training and the other class (the experimental group) receiving computer-assisted instruction material. As a pre-test and post-test, the two groups were given the Photosynthesis Achievement Test and the Biology Attitude Scale. When compared to the traditionally designed science instruction group, the computer-assisted instruction group had a higher success rate in photosynthesis. Furthermore, as compared to the control group, the experiment group children showed a significantly positive difference in their attitude toward science as a school subject.

Lau, HYK. Mak and KL. Ma, H. (2006) have written an article on the Interactive Electronic E-learning System (IMELS) that was developed to provide a comprehensive problem-based learning environment for the discipline of industrial engineering. It provides an overview of the design of an interactive electronic E-learning System, which enables interactive, web-based teaching and learning of industrial engineering using a problem-based learning paradigm. One of the case issues contained in the system, the conduct of system analysis of a production operation of a "virtual company," is offered to demonstrate the system's capabilities. The article uses this example to demonstrate the system's properties as well as offer and explore the significance of the features provided by the IMELS.

Zajaczck, J. Gots et al. (2006) have created and utilized a web-based, electronic teaching and learning application “Schoolbook” for neuron radiology. Schoolbook is technically based on a content management system and is realized in a LAMP environment. The material is generated and saved in a database using the established technology. A PHP programme defines the layout, and the web pages are generated by the system. Schoolbook is realised as a writing tool, allowing it to be integrated into daily practise, according to the findings. This allows the teacher to process the knowledge into the web-based application for lectures, seminars, and self-study on their own. The primary building block of Schoolbook for Neuron Radiology is an electronic case library, which provides the learner with original diagnostic and therapy data from multiple individual patients. Because there are several ways to engage with case histories, the user can place specific focus on essential learning areas. A methodical structured manner of dealing with the topic is accessible in addition to the case-based method of teaching and learning. It is determined that e-learning provides a variety of teaching and learning opportunities in academic, scientific, and economic settings. Schoolbook and other web-based apps may be useful not only for basic university education but also for the implementation of international educational programmes like as the European Master of Medical Science with a major in neuron-radiology.

Leuenberger, H., Menshutina, N. and Betz, G. Puchkov, M.N. (2006) have written an article on “E-learning and Development of New Courses and Scientific work in the field of Pharmaceutical Technology”. The

Swiss National Science Foundation (SNF) has supported an institutional partnership (IP) between the University of Basel's Institute of Pharmaceutical Technology (IPT) and Russia's Mendeleyev University of Chemical Technology (MUCTR) since 2001, as part of the SCOPES (Scientific Cooperation between Eastern Europe and Switzerland) project. The innovative teaching technologies that were presented at the MUCTR and the IPT are the product of this collaboration. Electronic pharmaceutical technology courses were presented simultaneously at the University of Basel and MUCTR, and the educational web-portal 'Pharmacy online' was awarded a medal at the 4th Moscow International Salon of Innovations. Electronic lectures have been shown to be popular with and beneficial to MUCTR students since they can somewhat compensate for the MUCTR's lack of equipment.

Kanellopoulos, D., Sakkopoulos, E., Lytras, M.T., and Sakalidis, A. (2007) in their article titled “Using Web-Based Teaching Interventions in Computer Science Courses” discussed that an open-source management system for Web-based teaching interventions can be utilised in science curriculum courses in general, and in computer science courses in particular. The System of Teaching Intelligent Interventions (STII) is a proposed solution that simplifies the creation, deployment, and evaluation of Web-based metaphors. They examine the use of metaphors to help students understand the substance of cognitive ideas and their foundational context in this study. The STII was used in a specific educational setting to aid the learning of 228 students enrolled in the "computer applications" course. The system's utility is demonstrated by the presentation of the results of a pilot study of two metaphors. The focus of the evaluation is on the influence of the two metaphors on student learning and the detection of potential correlations between metaphors and student groups. The findings of the STII evaluation clearly support the use of electronic metaphors as an alternative instructional tool to help students overcome cognitive restrictions and build a functional knowledge of curriculum courses.

Lanyi, CS., Kosztyan, Z., Kranicz, B., Schanda, J. and Navvab, M. (2007) in their article "Using Electronic Interactive e-teaching in Science", discussed that colour is becoming a key issue in many e-commerce products. This necessitated the creation of a colour course that could be accessed through the Internet or provided on CD-ROM. It was stated that electronic approaches were proven to be more advantageous than classroom demonstrations in teaching students the foundations of colorimetry through demonstrations.

Walker, David A. et al. (2008) studied the E-learning module for Teacher Development: Project REAL. First-rate professional development is required to produce highly qualified instructors and to sustain the development of their classroom techniques. E-learning modules were developed to provide in-service teachers with high-quality professional development, improve instruction without sacrificing time, and provide a common knowledge base of instructional strategies for in-service and pre-service teachers to improve teacher preparation and provide additional resources for continued development. In-service and pre-service instructors take e-learning modules to build a common understanding of optimal teaching practises in specified, essential areas. In-service and pre-service teachers can use the same tactics and expectations to teach lessons. E-learning modules can also enable access to materials from other universities' colleges. These modules are available 24 hours a day, seven days a week, from any place, via the internet or on a CD-ROM. Project REAL (Rockford Education Alliance) is a comprehensive cooperation between Northern Illinois University (NIU), Rock Valley College, and Rockford, Illinois Public School (RPS) District 205 with the goal of improving student performance and teacher educator quality. E-learning modules were chosen as an alternative technique of providing professional development by Project REAL.

Abdallah Arman (2009) investigated the effect of the E-learning approach on the students' achievement in the Biomedical Instrumentation Course at Palestine Polytechnic University. E-learning is widely used at universities and other organisations around the world, either to supplement classroom learning or to replace it entirely. The possibilities for education are endless because to newly developed electronic technologies that combine narration, visuals, and text in real time. After studying a course using the E-learning approach, an experimental group of fourteen students was studied in this study. In the construction of E-Content, the El Gazzar Instructional Design Model (2002) instructional design technique was applied. MOODLE-LMS was used to implement the course. Before and after the experiment, the students' performance was assessed. The findings of the study revealed that there has been a significant improvement in accomplishment gains. E-learning has an efficiency of more than (80%) in terms of achievement.

Suraez, ADA., Artal, CG and Herandez, FMT (2009) in their paper "E-learning electronic applications: Towards an engineering of content production" provided the gained expertise in the development and usage of electronic content for E-learning applications produced for some of the disciplines of the computer science engineering degree programme. The Internet and video streaming technology are used to provide these contents. The work's outcome demonstrates the satisfaction of the students, as well as their comments.

Kenneth, H. Smith (2009) made a study on the effect of computer-assisted instruction and field independence on the development of rhythm sight- reading skills of middle school instrumental music students. The study's goal was to see how the efficiency of computer-assisted instruction (GAI) for teaching rhythm reading skills was influenced by the extent of field dependency or independence of the'subjects.' The study included 120 middle school instrumental music students who were placed into four groups based on their Group Embedded Figures Test scores. Each was divided in half at random. The experimental group received CAI utilising Music Ace 2 software, while the control group did not get any CAI treatment. For eight weeks, the CAI was administered for half an hour each week. The Rhythm Performance Scale was used to assess the subjects' ability to read and perform rhythms before and after the study. The study's findings revealed that there was a substantial difference between the experimental and control groups' test score improvements. However, significant data revealed that the field-independent subjects outperformed the field-dependent subjects on the rhythm performance test.

Yusuf, Mudasiru and Afolabi, Adedeji (2010) studied the effects of Computer Assisted Instruction (CAI) on secondary school students' performance in Biology. The study's findings revealed that students who were exposed to CAI, either individually or jointly, performed better than their counterparts who were given traditional classroom teachings. It was suggested that relevant CAI packages for teaching biology in Nigerian secondary schools be developed.

Elizabeth A. Fisher and Vivian H. Wright (2010) have done a qualitative study investigating the effectiveness of implementing usability testing into online course development for improved course design. Usability testing refers to iterations of testing that guide cyclic modifications in course design for the purposes of this study. The information was gathered during the spring semester of 2009 at a prominent research university in the Southeast. The study enlisted the participation of fourteen freshmen. As they completed predetermined activities, the participants were observed. Video recordings, surveys, observer logs, and journaling were used to collect data. Usability testing may give a model for better online course design, according to the findings.

Michele Biasutti, (2011) did a study on the student experience of a collaborative E-learning university module. The purpose of this study was to offer a picture of a student's experience in an asynchronous E-learning environment while participating in a collaborative E-learning module. A self-evaluation questionnaire was used to acquire quantitative and qualitative data about student satisfaction with the collaborative E-learning activity in a distance learning module on music education worth five credit points for a bachelor online degree for primary school teaching teachers. The quantitative section of the questionnaire consisted of 27 closed items on a 10-point Likert scale that provided information on module satisfaction. The qualitative section of the survey revealed the participants' perspectives on the online collaborative experience. An inductive examination of general open questions on satisfaction and displeasure revealed the rating criteria employed by 92 students. The analysis revealed five themes in the participants' viewpoints, which the researcher characterised as good elements of teamwork, cognitive, operating, organising, and emotive/ethic, and negative aspects of teamwork, operating, organising, and emotive/ethic. Collaboration, comparing ideas, sharing information and skills to help one other, peer learning, assessing and integrating multiple points of view, platform usability, group planning, and task management were all factors that were linked to pleasure. More collaboration between students, because some students engage differently; more coordination and organisation, workload management in group activities, and some technical problems, such as updating modifications, are all aspects of the student learning experience that should inform E-learning improvements. The module's outcomes boosted the participants' didactic potential as primary school instructors. The findings are explored in light of their possible impact on the development of collaborative activities aimed at distant learning teacher education. Future research implications are also considered.

Campbell, Kristin R., Wilson, Sandra B., Wilson, P., and Christopher He, Zhenli (2011) in their paper titled, “Interactive Online Tools for Teaching Plant Identification”, described the interactive review exercises that were developed as the online learning component of an existing native plant landscaping course. The instruments were created with specific objectives in mind: 1) to assess students' plant identification skills, 2) to practise leaf terminology with specific plant examples, and 3) to link landscape performance to native ecosystem traits. The plant identification tool was created using formulas made up of logic statements in a spreadsheet application. Students' ability to identify plants and spell scientific and common names connected with high-resolution plant photos was tested using this technology. An electronic platform was used to create the leaf terminology tool. Students were instructed to associate a specific leaf phrase (i.e., margin, apex, base, texture, arrangement) with a scanned image that best matched the taxonomy description using a drag-and-drop interface. Digital photos were captured for each of Florida's primary ecosystems, together with sets of plant combinations and site features, for the ecosystem tool, which was also constructed on an electronic platform. Students chose the relevant options and submitted their responses online, where they received immediate feedback. After having access to these identification tools, the students reported an improvement in plant recognition. These interactive learning tools can be extended to a number of online courses around the country, not just for students enrolled in this specific course.

Koehler, N.A., Thompson, A.D. and Phye, G.D. (2011) attempted a design study on “A design study of an electronic instructional grammar program with embedded tracking”. The goal of the study was to show that it was possible to combine three quite different theoretical viewpoints for future efforts in electronic instructional design. An electronic instructional grammar application was created and assessed within the framework of teaching English as a Second Language (ESL). Mayer's Electronic Learning Theory (2001), Sweller's Cognitive Load Theory (CLT, 2005), and cognitive training theory employing an inductive reasoning paradigm (Klauer and Phye, Rev Educ Res 78(1): 85-124, 2008) served as the foundation for the programme design. In a

Midwest community college, two studies involving ten and four adult ESL students were done. The history and geography of the United States were used to teach grammar. The approach was most beneficial to pupils who had little prior knowledge of passive voice grammatical ideas, a moderate level of general vocabulary, and good basic content knowledge (basic geography and history). The preliminary findings are promising in terms of the previously indicated integrative efforts.

Ketut Budiastra, A.A. (2011) conducted a study on inquiry teaching-learning using video recorded modeling as a way to teach science in distance education. The study's main goal was to create an educational programme that combined a video-based teaching paradigm with inquiry learning in an in-service teaching programme. In the process of designing and validating the model, 63 in-service teachers enrolled in the Bachelor's programme at the University of Indonesia and 454 elementary schools were participated. Data from the pre- and post-tests revealed a considerable increase in student-teacher achievement. It improved the attitude and performance of students and teachers, which was, of course, linked to student achievement.

Anderson, Janice and Barnett, Michael (2011) conducted a study Using Video Games to Support Pre-Service Elementary Teachers Learning of Basic Physics Principles. The goal of this project is to share our results on how to use video gaming technology to help pre-service elementary teachers comprehend basic electromagnetism. To that goal, we compared the influence of playing the game "supercharged!" on pre-service teachers' grasp of electromagnetic principles to students who did a more typical inquiry-based exploration of the same ideas. The control group learned using a succession of guided inquiry approaches, while the experimental group played "Supercharged!" throughout the laboratory sections of the science course as part of a wider design experiment assessing the pedagogical potential of "Supercharged!". On the gains from the pre-to-post assessment, there was a significant difference F (2,124) = 4.8, p less than 0.05, eta [superscript 2] = 0.59 between the control and experimental groups, with an effect size of d = 0.72. While the experimental students outperformed their control group classmates, they assessed their knowledge of the issue lower than the control group (M[subscript post-control] = 2.0, M[subscript post-experiment] = 2.7), prompting a review of their laboratory journals. As seen by the increase in test scores from the pre-to-post assessment, the findings of this study reveal that video games can lead to good learning effects. Furthermore, this research implies that combining video games with hands-on activities, with each activity informing the other, could be a very effective way for enhancing students' scientific comprehension. Furthermore, our findings imply that educational video game designers should include meta-cognitive tasks like reflecting opportunities in their games to provide scaffolding for students and to emphasise that they are participating in a learning experience.

Hsu, Pi-Sui (2012) Examining the Impact of Educational Technology Courses on Pre-Service Teachers was the subject of a research. Teachers' Development of Technological Pedagogical Content Knowledge, the goal of this qualitative study was to see how an educational technology course affected pre-service teachers' development of technological integration knowledge in a teacher training programme in the United States. The current study had eight pre-service teachers enrolled in a prominent university's elementary teacher education programme in the Midwest. Interviews, documents, and observations were used as data sources. The findings revealed that pre-service teachers have knowledge of technology integration. The current study made several recommendations for activities that could be included in an educational technology course to better educate pre-service teachers to teach with technology.

Hui-Yi Liang and Chih-Chien Yang (2013) The effects of using computer-assisted instruction (CAI) in this case, LIVE ABC, on the development of English vocabulary in college freshman were investigated. The study included two groups of college freshman from Chienkuo Technology University (high-proficiency and low-proficiency). Each group has 50 students in it (a totally of 52 male and 48 female). This study lasted 18 weeks and took place in the fall semester of 2012-2012. A pre-test was given at the start of the study, and a post-test was given immediately after it was completed. The results of each semester assessments were used to assess student performance in the study (pre-test and post-test). In addition, a questionnaire was created to aid the investigation. To analyse the gathered data and determine an effectiveness grade, the research approach used the Grey Relational Model. The following were the study's principal findings: The exam results were generally better when pupils employed computer-assisted learning to improve their vocabulary. CAI benefited low-proficiency pupils more than high-proficiency students. All of the pupils improved their fluency, pronunciation, and understanding of words. When it comes to gender, female students fared better than male students. In addition, the study made some recommendations for future research.

Wolter et al. (2013) - In collegiate level biology classrooms, researchers investigated whether an online, electronic case study may influence students' performance, motivation, and attitudes of science. Data was collected from 138 students in five classes from four schools in the United States and Puerto Rico (performance tests, surveys and focus group interviews). After participating in the learning environment, the students' pre- and post-test performance improved (F(1,80) = 17.256, p less than or equal to 0.01, eta [superscript 2] = 0.177). Students' belief in their own abilities grew as well. During focus group interviews, students said the project was an excellent learning experience (95 percent), that it would help them with future classes or occupations (87 percent), and that it piqued their interest by illustrating the application of theoretical information in real-life settings (64 percent). Students were motivated by the learning environment, which made material more relevant, resulting in improved performance. This adaptive instructional tool is not dependent on the instructor.

Ana Cecilia B. Fajardo (2014) conducted a study on "Electronic-Assisted Instruction in Developing the English Language Skills". This study examined the amount to which respondents used electronic-assisted instruction in teaching English and the extent to which they used it in improving relevant language skills. This study was based on the idea that electronic-assisted English instruction had been used in the development of college students' English language skills, with the teacher manipulating print media, audio, and audiovisual aids, as well as online materials. The study was place in the Central Bicol State University of Agriculture's Main Campus in Pili, as well as its campuses in Pasacao, Sipocot, and Calabanga, all in Camarines Sur.

Respondents included college professors, deans, and language educators, as well as English experts from the university. The descriptive research method was used. The weighted mean and the Likert's validation scale were employed as statistical tools. The data was analysed and interpreted in depth to determine the specific electronic-assisted instruction in English used by college teachers, the extent to which it was used in teaching, and the extent to which it was used to build language skills. According to the findings, college professors were making extensive use of the electronic resources available on their campuses, with electronic-assisted education being used regularly in the development of associated English language skills.

Doer H.M. and Thompson (2014) explored how the teacher-educators understand their pre-service secondary teachers through the electronic case studies of practice. The findings suggested that electronic case studies of practise can be used to expose teacher educators' knowledge and practise as they assist the professional development of pre-service teachers.

Rommel L. Verecio (2014) conducted a study on Students' Evaluation of an Interactive Electronic Courseware. Students' performance is typically studied by educational researchers in order to better understand whether their test scores would increase if they were exposed to certain learning technology. The importance of students in such research cannot be overstated, particularly because they can be an invaluable resource in evaluating courseware for their own classes. The goal of this project was to create and test interactive electronic courseware for teaching and learning Fundamentals of Problem Solving and Programming. Questionnaires, interviews, and observations were employed as part of a descriptive survey method. Respondents were eighty students registered in the course. They were asked to rate the courseware based on its substance, presenting style, and usefulness. The study's findings revealed that the developed courseware facilitates and enhances classroom learning; arouses and maintains a positive attitude among students toward learning the subject due to the novelty of the materials' use; and contributes to consistent improvement in the ability to define and measure students' attainment of educational goals. These findings may motivate teachers and academics to create their own courseware.

Jifeng Cao (2014) conducted a Study on Designing and Evaluating Electronic Courseware in EST Teaching English for science and technology (EST) teaching is different from normal English teaching mainly due to students’ lack of contact with the discussed topics in real life. And the feasibility of making use of the electronic technology in EST class has been mentioned by many scholars. However, there are a few papers referring to the way to design electronic courseware for EST class and how to assess the effect of the designed courseware. This paper aims at sharing the author’s opinion and experience on principles and steps of designing and assessing electronic courseware for EST class

Fui-Theng and Mai Cao (2014) conducted a Study on Interactive Electronic Learning: Innovating Classroom Education in a Malaysian University. The goal of this research study at INTI International University was to improve the quality of classroom learning for university students by focusing on three key areas: Gagne's instructional model, electronic learning, and student-centered learning. To increase the quality of student learning, an Interactive Learning Module (ILM) was created as the fundamental component of the electronic-mediated student-centered learning environment (MMSLE). Pre- and post-tests, questionnaires, open-ended questions, and interviews were used to assess the effects on student learning. The test results showed a considerable improvement, indicating that this learning environment has improved the pupils' learning achievement. Students' attitudes have also improved as they have become more engaged and driven in the learning process. MMSLE was offered as a framework for educators at Malaysian universities to use as a guideline for fostering education innovations as alternatives to traditional classroom teaching and learning methodologies.

Li MA, Zhenmei SHI (2014) conducted a Study on Factors Interfering Students' Learning Effect in Electronic-Based ESL Classes in China. With its distinct properties of richness in texts, visuals, animation, music, and other areas, electronic technology has become a popular and necessary aspect of ESL instruction. However, an increasing number of experts are recognising and studying its downsides. In this research, the author examines three important difficulties that obstruct students' learning in China's electronic-based ESL classrooms, namely, information overload, aural and visual interference, and a lack of efficient communication, and suggests some solutions. It is advised that instructors, as facilitators of students' learning activities, understand basic electronic learning theories and put them into practise when creating teaching content and courseware for learners-oriented ESL classes aided by technology.

Myhill, Debra; Watson, Annabel (2014) reviewed the Role of Grammar in the Writing Curriculum in this article. Grammar education has been a source of contention, controversy, and disagreement in most

Anglophone countries for the past 50 years. We're still no closer to reaching an agreement on the importance of grammar in the English/Language Arts curriculum. The discussion has been compared to battles and grammatical wars (Kamler, 1995; Locke, 2005), with educational professionals typically pitted against politicians, but also one professional against another. Different viewpoints on the value of grammar for language learners and different views on what educational benefits learning grammar may or may not gain are at the centre of the dispute. Several nations, including England and Australia, are currently enacting new grammatical mandates in their curricula. The literature on grammar education and its function in the curriculum is reviewed in this article, and a developing consensus on a fully-theorized understanding of grammar in the curriculum is noted.

Tutku Basoz, Feryal Cubuckcu (2014) studied "The effectiveness of computer-assisted instruction on vocabulary achievement". The goal of this study is to see how successful computer-assisted training is at improving students' vocabulary. The participants in this study were 52 freshmen from Balikesir University's ELT Department during the spring semester of the 2012-2013 academic year. With two groups, this study used a quasi-experimental pre-post test control group approach (experimental and control groups). Despite the fact that the experimental (CAVI) group was handled differently than the control (CLT) group, both groups got the same pre-, post-, and delayed post-test. Students were randomly assigned to one of two groups before the intervention: Computer Assisted Instruction or Communicative Language Teaching, and they were given a pre-test. Following the pre-test, the CAVI group used a Module in a computer lab to study 20 target words, whereas the

CLT group was taught the same terms by their teacher in a communicative classroom setting. The post-test was given to both groups immediately after the intervention. The freshmen were given a delayed post-test five weeks following the intervention to see if they had retained the information. Both the CAVI and CLT groups gained some vocabulary as a result of the therapies, according to the findings. However, there was no significant difference in vocabulary growth between the groups.

Fazzlijan Mohamed Adnan Khan and Mona Masood' (2015) conducted a study on the Effectiveness of an Interactive Electronic Courseware with Cooperative Mastery Approach in Enhancing Higher Order Thinking Skills in Learning Cellular Respiration. The major goal of this research is to combine mastery and cooperative learning methodologies with an interactive electronic to improve students' high-order thinking skills in Cellular Respiration learning. Electronic interactive courseware was created and implemented in three different strategies: Electronic-assisted Mastery Learning (MML), Electronic-assisted Cooperative Learning (MCL), and Electronic-assisted Cooperative Mastery Learning (ECML) (MCML). The MML had a self-study approach, but the MCL and MCML require group learning. The domain scores of analysing, assessing, and synthesising were the three dependent variables in this study, which used a quasi-experimental approach. The interactive electronic courseware with the three techniques was the independent variable. The MML, MCL, and MCML were completed by 84, 88, and 90 pre-university students, respectively. Based on the three methodologies and the deployed courseware, the MANCOVA was used to examine the performance scores of each of the three higher-order thinking skills. When compared to MCL students, MML and

MCML students did much better in establishing domain scores. Overall, the results of this study imply that electronic interactive courseware that combines mastery and cooperative learning methodologies has a favourable impact on Cellular Respiration learning.

Mohd Nor Hajar Hasrol Jono et al. (2016) conducted a study on “Effectiveness of Courseware Presentation Using Learning Theory for a Programming Subject”. At all stages of school, the necessity to integrate technology into the teaching and learning process is growing increasingly pressing. E-learning, which is based on electronic technology, is seen as a viable option in the teaching and learning process. This strategy encourages students to be independent and study at their own pace and in their own space, resulting in student-centered learning. Nonetheless, in today's world, the rapid growth of information and communication technologies (ICT) has forced a new trend in the presentation of information in the form of flash video, which is more understandable and available to consumers quickly. The study is carried out by integrating electronic courseware while preserving the Gagne Theory of Nine Events paradigm. The effectiveness of courseware presentation using learning theory that may allow users to interact simultaneously with the information was examined in a new courseware entitled "Introduction to Computer Programming C++" that was built using learning theory. The courseware is designed to be a useful teaching tool for students interested in programming. The research was carried out at the University Technology Mara Shah Alam's Faculty of Applied Science. A total of thirty students were chosen as responses. . A series of questionnaires on a 5-point Likert scale were utilised to evaluate the courseware. The respondents were given this questionnaire during their first semester. The outcomes were really excellent and promising. Students considered the electronic-mediated web-based learning environment to be entertaining and engaging, and they were also able to exhibit their subject-area learning and skills.

Salasiyas Mat Kila and Mai Shihah Abdullah (2016) conducted a study on "Immunization sub-topic and interactive electronic courseware for Malaysian students: An impact study". Any views held by students that are inconsistent or in contradiction with the basic idea acknowledged by scientists are referred to as alternative frameworks or misunderstandings. Teachers must first unearth students' prior knowledge, then determine their alternative framework, and then develop successful tactics and learning styles for students to solve difficulties. This action research intends to investigate the effects of interactive electronic courseware in resolving the challenges of students' alternative frameworks in the Immunization topic, as well as determine students' and lecturers' impressions of the software's appropriateness and quality. The study involved one lecturer and 20 students enrolled in two Malaysian institutions' Bachelor of Education in Biology and Bachelor of Science in Biology programmes. PowerPoint 2010 was used to create interactive electronic courseware named "Immunization." The instruments used in this study were questionnaires on the effectiveness of the courseware, a pre-test, and a post-test. The results of the data analysis revealed that the means of the post-test and pre-test scores differed statistically significantly. After using the interactive electronic courseware, students in the Bachelor of Science in Biology programme demonstrated higher and better success results than their counterparts in the Bachelor of Education in Biology programme. The majority of students and lecturers believed that using this courseware improved students' grasp of the issue of immunisation.

Thorp, Robert (2017) has made a study on “Experiencing, Using, and Teaching History: Two History Teachers' Relations to History and Educational Media”. How can two Swedish secondary school teachers use their experiences and instructional material to relate to and make sense of history? This article aims to learn more about history instruction by examining two instructors' personal accounts of their experiences during the Cold War, as well as classroom observations of the teachers in action. The teachers' personal experiences and observed teaching match the prevalent Cold War historical culture in Swedish education, according to the report. On this foundation, the author addresses the significance of critical historical culture awareness in order to advance a more comprehensive knowledge of history.

Mansfield, Andrew (2019) has made a study on “Confusion, Contradiction, and Exclusion: The Promotion of British Values in the Teaching of History in Schools”. His paper highlights the difficulties that trainee instructors experience when teaching the promotion of "British values." The Department of Education's promotion of these 'British values' is perplexing, contradictory, and appears to exclude a significant number of students from minority backgrounds from the current historical narrative of Britain as defined by the National Curriculum (2012). Furthermore, despite being part of the criteria required to obtain QTS, there is no guidance for new teachers on what these 'values' really mean or how they should be taught in schools. The author not only investigates this ambiguity, but also offers the viewpoint of a former professor who has transitioned into secondary education, as well as their reactions to history instruction in schools and worries about the History Curriculum.

Allia, M. Y., & Souyeh, M. E. (2021) conducted a study on “Probing the Effectiveness of E-Learning/Teaching during Covid-19 The Case of EFL Tutors and Students at the English Language Department of M’sila University, Algeria”. The study used an explanatory research design to investigate the efficiency of e-teaching and e-learning in the process of EFL learning in the context of the COVID-19 pandemic, in the case of master one English language students at Mohamed Boudiaf University in M'sila. The study's goal is to learn more about teachers' and students' attitudes regarding e-learning and e-teaching, as well as to assess the effectiveness of adopting e-learning as a substitute for face-to-face instruction. At addition, in the department of English at Mohamed Boudiaf University -M'sila-, to research the usage of e-learning and to investigate the current condition of e-learning method. Two questionnaires, administered to 57 master one English language students and 12 teachers, were used to collect data. Furthermore, teachers support the use of e-teaching and regard it as a valuable learning/teaching tool in all aspects of language learning. Pedagogical recommendations are made for teachers, students, and policymakers based on the findings.

2.7 STUDIES RELATED TO CAI, ELECTRONIC PACKAGES IN OTHERSUBJECTS - INDIA

Sharma and Sansarwal (2002) studied on “Comparison among video-based instructional Strategies for teaching Science at class IX level in terms of Achievement.”One of the main objectives was to find out whether there is any significant difference in teaching Science to class IX through video-based instruction. The main findings were that (a) the treatment had a substantial impact on scientific achievement of students who participated in various video-based science instructional methodologies. (b) The significance of video viewing followed by discussion was much higher than video viewing alone.

Shanthi and Amalraj (2003) studied the effectiveness of Computer Assisted Learning on the achievement of students studying through CAL and traditional methods of instruction and they studied the effectiveness of CAL on achievement in Bio-Zoology among the experimental and control group students with reference to different mental abilities such as Gifted, Average and Slow learners. When the pre-test scores were compared to the post-test scores of the control and experimental groups independently, the results showed a significant difference. It was discovered that both the Lecture Method and the CAL had a considerable impact on the students' achievement. At the same time, when the achievement scores of the control and experimental groups were compared, the experimental group's achievement score was significantly higher. This demonstrates that CAL has had a major positive impact on Bio-Zoology achievement.

Annaraja and Felcia Persis Rani (2003) developed a computer-animated package in biology and found out the effectiveness of computer-animated packages in teaching biology to the VII standard students. They utilised PowerPoint to create the computer-animated biology package. Each slide was created for a specific topic, and the investigators created a computer-animated package using various animation effects such as appear, fly, swivel, spiral, and so on, with the slides being shown using an electronic computer. The experimental group surpassed the control group in Biology, according to the results of the 't' test. This could be because the experimental treatment was successful in teaching Biology. Furthermore, it was demonstrated that the animation included in the powerpoint slides caught the students' attention. Furthermore, the computer-animated technique encouraged students to study Biology.

Beena Y. Desai (2004) made a comparative study of the efficacy of teaching through the traditional method and the electronic approach in the subject of home science. The study's goals included: (1) developing an electronic package for teaching the subject of nutrition (Protein) to undergraduate level Home Science students, (2) determining the effectiveness of the electronic package in terms of student achievement, and (3) comparing the achievements of students learning through the electronic approach to those learning through the traditional approach. It was a controlled experiment with an experimental group and a control group. The study included 98 students from Smt. J.P. Shroff Arts College, Val inda, who were in their first year of B.A. home science (2001-2002). The electronic package, which included transparencies, pie graphs, charts, diagrams, photos, tapes, audiotape, and a slide set, was created by the investigator. The investigator carefully developed all of the tests, including the pre-test, retention test, and opinion. The Desai intelligence test was used in the research. T-test and F-test were used suitably in this study for data analysis. One of the most important discoveries was that the experimental group's mean achievement was much higher than the control group’s mean achievement. In both groups, there was a nearly identical reduction in performance from the post-test to the retention test. The pupils were reported to be enthusiastic about the technological method. In the field of

Home Science, specifically the issue of "Proteins," the study discovered relative usefulness of teaching using the traditional technique and the electronic approach.

Mirdula D. Ramade (2004) researched on the "Effectiveness of CAI Study and Critical Evaluation of a Computer-Assisted Instruction package developed for teacher educations". One of the main objectives of her study was to find the effectiveness of computer-assisted Instruction. The major findings were (a) The findings which were both qualitative and quantitative revealed that the presentation was effective in bringing about learning (b) It was also effective in evoking positive- reactions assisted instruction in teaching-learning.

Arulsamy, S. (2005) compared the effectiveness of interactive electronic CD-based learning with the conventional teaching method with science group students. The study included 50 students from Sri N. Krishanrajulu Chettiar Government Girls High School, Kurusukuppam, Pondicherry, who were in the XI standard. A pre-test and post-test revealed that the experimental group performed significantly better than the control group. The study clearly demonstrated that interactive electronic CD-based learning courseware is better.

Subbaiah. S (2005) developed a user-friendly prototype electronic courseware package as a communication technology in teacher education (i.e. learning to learn with information technology) and produced it in a CD-ROM. The research is a good mix of positivist descriptive methods, normative survey techniques, and experimental research methods. Using a chance sampling method, the sample was drawn from 29 District Institutes of Education and Training in Tamil Nadu, 71 English teacher- educators, and 200 teacher trainees. For data collection, the following instruments were used: (1) questionnaire, (2) attitude scale, (3) interviews, and (4) diary analysis. (1) Sixty-six percent of teacher educators did not understand basic computer principles, according to the study's findings. (2) It was unfortunate that ICT approaches in teacher education had not been widely adopted. (3) The teacher-educators' attitudes toward ICT were generally favourable. (4) It was discovered that the focus on computer equipment issues had both number (insufficient computers) and quality issues.

Johnson (2006) studied the effectiveness of an interactive electronic approachover the conventional method in teaching physics for the XII Standard students. The experimental method was used. A total of 80 people were included in the study. The students were from Pondicherry's Blessed Mother Teresa Model High School's XII class. He calculated the difference between the pre- and post-test findings using the 't' test score. In the post-test, he discovered that there was a substantial difference in achievement between the experimental and control groups. It also indicated that the electronic approach improved the effectiveness of the teaching-learning process and increased mastery of the subject.

Anil Tanaji Patil (2006) developed an electronic instructional system on computer education for B.Ed., pupil teachers. The study's objectives included evaluating the developed electronic educational system's effectiveness and comparing the constructed electronic instructional system's effectiveness to that of the traditional system of instruction. The electronic instructional system was carefully conceived and created after determining the needs in the context of computer education. Alpha testing was carried out in order to further develop the system using the available skills. The prototype was pilot tested in two groups (20(12+8) and 20(12+8), using a pre-test post-test design. Using the Solomon Four Groups Experimental design, the electronic instructional system was finally implemented on a sample of 64 pupil-teachers (22(20+12), 22(20+12). The investigation came up with a few interesting results: (1) A computer-based electronic instruction system for computer education was found to be possible to design, develop, and implement; (2) On the pre-test, there was no significant difference in the performance of the pupil teachers in the control and experimental groups. (3) On the post-test, there was a significant difference in the performance of the pupil teachers in the control and experimental groups.

Nirmala Sundara Raj (2006) made an attempt to develop visual basic-based computer-assisted instruction and computer-animated packages in zoology and their effectiveness on the achievement of the plus one students. The study's objectives were I) create a visual basic-based CAI package for plus one students in zoology, ii) create a computer-animated package for teaching zoology to plus one students, and iii) determine the effectiveness of the visual basic-based CAI package and the computer-animated package in teaching zoology to plus one students. The CAI group was the group that was taught with the help of the CAI package. The electronic group was the one that was taught with the help of a computer-animated package. Only the students' science marks in the SSLC public examination were used to construct the experimental and control groups. One hundred and five girls were chosen at random as the study's sample. In this study, a parallel and equivalent group design was used. Three control groups (Child Jesus Girls' High School, Palayamkottai) and two experimental groups (each with 35 pupils) were chosen (St. Ignatius Convent High school, Palayamkottai). I Visual Basic-based CAI package in zoology, (ii) computer-animated package in zoology, (iii) accomplishment exam in zoology, (iv) attitude toward computer education, (v) Aaron's socioeconomic status scale (1976), and (vi) Cattell's Culture Fair Intelligence Test (1961). Mean and standard deviation, T-scores, t-test F-test (ANOVA), Chi-square test, correlation, and multiple correlations were all employed in the study. The study's findings included: I the t-test result showed that the CAI group students had higher gain scores than the control group students. This could be because the CAI package developed was successful in teaching zoology to XI standard pupils. (ii) The results of the t-test demonstrated that the electronic group outperformed the control group in terms of gain scores and achievement of the zoology knowledge, understanding, and skill objectives. This could be attributed to the fact that the computer-animated package proved effective in teaching zoology to students.

Patil A.T. (2006) developed an electronic instructional system on computer education for the B.Ed., pupil-teachers and studied its effectiveness. The Electronic, instructional System was finally implemented on a sample of 64 pupil-teachers (22 (20+12) and 22(20+12) using the Solomon four group Experimental design. On the post-test, the study discovered a significant difference between the performance of the pupil teachers in the control and experimental groups. In the retention test, there is a significant difference in achievement gains between the control and experimental groups in terms of pre-test and post-test scores of pupil-teachers.

William, B. Edward (2007) developed an Interactive Electronic CD-based learning Courseware for teaching physics at the High school level. The study's sample includes 15 pupils in each of the control and experimental groups. The research was carried out in a Pondicherry school. This study employed a pre-test post-test control group design. The Interactive Electronic CD-based Learning Courseware was determined to be beneficial. The experimental group's mean post-test scores were greater than the control group's mean post test scores, showing a significant difference at the 0.05 level. In addition, the experimental group was positive about the Interactive Electronic CD-based learning courseware.

Vishnu Panddurang Shikhare (2007) carried out a study on the Development ofmultimedia Instructional System on Educational Technology for the B.Ed., student teachers. Using the Soloman 4 Groups Experimental Design, the experimental implementation was carried out on a sample of 120 pupil teachers from the Barshi and Solapur Colleges of Education. All of the study's tools, such as the Questionnaire, Evaluation Forms, and Achievement Tests, have well-established characteristics. The information was examined using appropriate statistical and nonstatistical methodologies. The data was analysed using the F-test and the t-test. The study concluded that there was a substantial difference in achievement increases between the Control and Experimental Group student-teachers in terms of mean scores in the pre-test over the post-test. It was discovered that the Electronic Instructional System outperformed the Traditional Instructional System.

Jebaraj, G. and Mohanasundaram, K. (2008) developed web-enabled E-Content on teaching of physics at the Tertiary Level which included the following objectives: (1) to develop and validate an E-Content on the "Solar System" (ii) to find the effectiveness of E-Content on the "Solar System" in teaching beyond cognition at the tertiary level, and (iii) to find out the differences in achievement between the teacher trainees learning the "Solar System" through E-Content with respect to gender and subject of study. The experimental method, using the pre-test post-test method, was adopted. The data were converted into percentages and subjected to the 't' test. The study indicated that the experimental group and the control groups differ in their achievement.

Kannan, K. & Ahrar Husain (2008) conducted a study on the effectiveness of the use of computer technology in teaching the concepts of physics at the senior secondary level. The study's main goals were to I compare computer-using children to their non-computer-using peers, and (ii) investigate how computers aid children's intellectual development, such as critical thinking and problem solving, as well as to determine to what extent computer technology aids students in understanding difficult physical concepts. A questionnaire was sent to 50 physics PGTs who teach physics at senior secondary schools in both government-aided and public schools, and their responses were analysed. Furthermore, for Standards XI and XII, the investigator produced software materials for physics principles. The accomplishment test was suggested for NPSC (National Progressive Schools Conference) students. The students were divided into two experimental groups and one control group for the research project. Experimental Group-I received computer-assisted instruction, Experimental Group-2 received computer access without the assistance of teachers, and Control Group-3 received traditional instruction. The study found that computer-assisted teaching was the most effective approach for teaching physics concepts at the senior secondary level. Utilizing computer technology to study physics ideas without the help of professors or using the traditional technique of teaching physics did not provide much benefit to the students.

Mohanasundaram, K. and Soosairaj, J. (2008) developed a web-based classroom instruction in learning mathematics with reference to attitude, interaction and web skills of high school students to find out the effectiveness of the web-based classroom instruction method in learning mathematics over the conventional method. This study used a two-group experimental design with a pre-test, treatment, and post-test. Pupils in the experimental group who learnt through web-based classroom education outperformed students in the control group who learned through traditional methods in mathematics. In terms of improving students' math achievement, the web-based classroom instruction method outperforms than the traditional method.

Babu R. and Vimala T.S. (2008) constructed and validated electronic instructional materials for developing learning skills in accountancy learning and compared the error level of the students in pre-test and post-test. A total of 240 students studying accountancy at the high school level participated in the research. There were 120 boys and 120 girls in high school, all of them came from aided and corporation schools in Chennai. (1) There were substantial changes in the pre-test and post-test errors of the experimental group aided school students in terms of remediation in an electronic technique in primary, omission, recording, casting, and other sorts of errors, according to the research findings. However, there were no significant differences between the experimental group assisted school students pre-test and post-test errors in terms of remediation in the multi-media method in the error of posting. (2) there was asignificant difference between the pre-test and post-test errors of the experimental group of the corporation school students with respect to the remediation in the electronic method in the error of principal, omission, recording, costing and other types of errors.

Golda Grena Rajathi. P (2008) studied the "Effectiveness of Electronic Instructional Strategies in Teaching Science among the District Institute of Education and Training students." The study's sample includes 20 students in each of the control and experimental groups. The suitable statistical and non-statistical approaches F-test and t-test were used in the investigation. The study found that adopting Electronic Instructional Strategies yielded favourable results (MIS). In other words, MIS was proven to be successful in terms of student achievement. In Science, students who were taught using MIS performed much better than students who were taught using the traditional method.

Patel J.A. (2009) Development and Implementation of CAI to teach English grammar to the standard VIII students in different modes viz., only CAI, CAI with repetition, CAI with discussion. The current study's sample included 26 students in each of the control and experimental groups. The relevant data was obtained using the researcher's Pre-test, Post-test, and Reaction Scale. Between the pre-test and post-test, the researcher used a CAI package to administer the intervention programme for ten days. According to the findings of the study, among the three means of presenting this CAI, the mode of teaching through 'CAI with discussion' was shown to be considerably superior to the other two modes. Furthermore, students who were only taught using CAI had much higher English Grammar achievement than students who were taught using the traditional method.

Anita Rastogi and Babita Parashar (2009) developed an E-Content package following Gagne’s instructional design model based on the concept of micro-teaching. In this study, it was tested on student instructors in an experimental setting. It was discovered that in an E-learning environment, students become retroactive, participating in the learning process rather than being passive in a traditional teaching environment, and their attitude toward learning becomes positive and encouraging. The E-Content proven to be beneficial in raising their level of achievement and teaching ability.

Nimavathi, Gnanadevan. G. (2009) made an effort to develop study habits through an electronic program. The objective of this study was to determine the impact of electronic devices on the development of secondary school students' study habits. The sample comprised of ninth-grade secondary school pupils. For this study, the pre-test and post-test equivalent group design was used. The data was analysed using descriptive and differential statistics. The investigator's electronic software was utilised to teach biology themes covered in the IX Standard science syllabus, and the Study Habit Inventory standardised by B.V Patel was used to measure secondary students' study habits. The results of the study revealed that there was a significant difference between the experimental group's mean study habits scores on the pre-test and post-test. The study found that students who learned using electronic devices had better study habits than students who learned using traditional methods.

Anbucarassy, B. (2010) conducted a study on the effectiveness of electronic in teaching biological science to the IX standard students. The goal of the study was to see how effective the electronic technique was in teaching biology to IX standard students compared to the traditional method. This study used an experimental approach using a parallel-group design as the research method. Two or more groups were chosen and their mean and standard deviation of some selected variables were equal in the parallel-group design. One group was assigned to be the control group, while the other was assigned to be the experimental group. At the same time, experimental elements were applied to the experimental group and traditional instruction was delivered to the control group. Both the control and experimental groups were given a pre- and post-test. A random sampling approach was used to choose 80 pupils from Jeevanandham Govt. Hr. Sec. School, all of whom were in the ninth grade. The experimental group's students received one-month electronic training in the specified lessons. The standard method was used to teach the same lessons to the control group. The pre-test on the selected topic prepared by the investigator, the electronic package to teach the experimental group, and achievement on the selected topic developed by the investigator were all employed as tools. The main finding demonstrated that the experimental group outperformed the control group of ninth-grade biology students by a significant margin due to the experimental group's exposure to electronic-based learning.

Aravindan, S. and Ramaganesh, E. (2010) investigated the effectiveness of E-Content in concretizing the concepts of physics among the heterogeneous teacher educators. The study investigated the usefulness of E-

Content in concretizing physics concepts among a diverse sample of potential teacher educators from Bharadhidasan University, Trichy's Department of Education. The E-Content was created around the subject of "Semiconductors." With a sample of 22 students from the Department of Educational Technology, the study used a single group experimental design. The findings demonstrated that the E-Content was helpful in concretizing physics concepts, even for pupils with little prior knowledge of the subject at the collegiate level.

Ramasamy, R. and Hariharakrishnan, V. (2010) developed an E-Content on "laser" in physics at the college level. The experiment was carried out on the laser with a group of 20 undergraduate physics students using the produced modules of subject-content material. On the laser, the E-Content is a 10-minute programme. On the laser, the students were taught the developed E-Content. On the topic of laser, a 15-item achievement test with objective type items was given. The purpose of the experiment was to determine the validity of the created e-material with content specialists as well as user satisfaction with learning. After statistical analysis of the obtained data, it was discovered that E-Content is quite successful in teaching this subject. Digital convergence of texts, graphics, animation, music, video, audio, and other media determines the quality of subject content material. The achievement test result is higher than the national average by more than 80%. As a result, this study demonstrates the usefulness of the E-Content programme offered to college students, as well as the fact that it aids them in achieving their academic goals.

Angadi, G.R. (2010) developed an electronic package in biology. Electronic presentation development and validation is a viable teaching approach. The investigator constructed and validated the topic 'The Living

World' in Bio-science, IX Standard, in the DSERT of Karnataka State's approved syllabus. The equivalent group experimental designs for pre-test and post-test were used. When compared to the traditional technique of teaching, electronic training was proven to be more effective in terms of comprehension and retention of information for a longer period of time.

Nisha Raninga (2010) has studied the effectiveness of CAI for the Teaching of Mathematics of Standard VII. The effectiveness of the CAI method and the standard way of teaching the "Mean, Median, and Mode" unit of mathematics for class VII were compared in this study. A total of 66 Gujarati medium high school students from class VII. The L.B.S. schools in Rajkot were chosen as a representative sample. An accomplishment exam was performed after each experiment, and the findings were reviewed and analysed using relevant statistical methods such as mean, standard deviation (SD), and t-value. In the case of the experimental group, the t-value was significant, according to the study. As a result, the researcher rejected the null hypothesis and concluded that the CAI technique was more effective than the traditional method in teaching mathematics to class VII students.

Tharvin Sumi, I. & Edward William Benjamin A. (2011) found the effectiveness of electronic in the teaching of physics for XI Standard students in the Pondicherry region. The study's major goals were to see how effective an electronic approach was in teaching physics to XI standard pupils compared to the traditional technique. A sample of fifty students from XI Standard were chosen for the study. The experimental group was taught using an electronic package, a pre-test on the selected topic generated by the study, and an achievement test on the selected topic. Differential analysis, mean, S.D., and the 't' test were used as statistics. The study's findings revealed that there was a significant difference in physics achievement between the experimental and control groups of XI Standard students. As a result, electronic learning aided pupils in maintaining their interest as well as their ability to retain information better than traditional teaching method.

Amutha, S. (2011) investigated the effectiveness of designing E-Content with a meta-cognitive instructional design (model) on the science teaching competence of the student-teachers in teacher education institutions. E-learning modules teach scientific students-teachers how to write a script and storyboard for the creation of their own E-Content. The modules do indeed assist students in learning the what, why, and how of E-Content. This E-Content was the first of its type, designed to offer scientific students and teachers a new teaching technique for teaching science concepts through meta-cognitive instructional design.

Rajula Shanthy. T (2011) conducted a study on Interactive Electronic Instruction Versus Traditional Training Programmes: Analysis of their Effectiveness and Perception. Using a pre-test and post-test control group experimental design, the feasibility of introducing computer technology as an instructional tool was compared to the traditional way for training sugarcane growers in ratoon management practises in three villages in Tamil Nadu, India. Using Macromedia Flash as the authoring software, a CD-ROM was created as an electronic resource to aid in the training process. Three ways of message transmission were evaluated for their effectiveness in terms of information gain, learning index, and adoption extent: traditional lecture alone, lecture followed by electronic, and electronic alone. The group that received a lecture followed by an electronic component gained more knowledge and had a higher learning index. Farmers thought the usage of various electronic construction blocks made it a fun and educational tool. When delivered solely by lecture, the message was seen as boring and monotonous by those with a short attention span. The amount to which ratoon management methods were adopted was about equal; however, the group who got training by lecture followed by computer application had a higher adoption rate. Such a comparison allows for a better understanding of the function that electronic technology can play in technology transfer to farmers.

Rossafri Mohamad (2012) conducted a study on the design, development, and evaluation of an adaptive electronic learning environment courseware among the history teachers. In contrast to "Ready to Use" courseware, which does not allow for the amendment or alteration of prescript content, teachers were given complete control over the content of the courseware in terms of data input, audio-video, graphics, photos, quizzes, and so on. The mean values for characteristics such as I technical aspects; ii) interface design; iii) electronic features; and iv) instructional design were calculated using gender, age, computing competence, teaching experience, and graduate and non-graduate teachers' perspectives. Despite the fact that it was still in the prototype stage, the overall mean calculated for this courseware was quite high. The study's data was gathered from 85 teachers who were chosen at randomDescriptive statistical analysis was performed to derive the mean values of the courseware's strengths and deficiencies, which were scored using a Likert-style instrument. Gender, age group, level of computer abilities, teaching experience, and teacher category were used to determine the findings (graduate or non-graduate). The findings revealed that male and female teachers had similar perceptions of three characteristics, namely interface, technology, and instructional design. However, when it came to technical features, male teachers had a higher mean value than female professors.

Sujit Pal, Sibananda Sana and Asis Kumar Ghosh (2012) studied the influence of interactive Electronic Courseware: a Case Study among the Students of Physical Science of Class VIII. For this goal, computer-assisted electronic courseware was created using Adobe Flash and Bangla Word on a single unit of the WBBSE Physical Science Curriculum for class VIII (Bengali medium). Then, two groups of class VIII students (experimental and control) were chosen. To get a comparable result, the sample size was set at 50 students for each group. One group received electronic courseware whereas the other did not. After administering the self-prepared standardised achievement test, the performance of both groups was statistically compared (using a t-test and ANOVA). The observed 't' value is 16.068, which exceeds the critical threshold at a 1% level of significance (df = 49). The ANOVA test also revealed a statistically significant difference between the experimental and control groups. Thus, statistically, computer-assisted electronic courseware improves students' learning in physical science more than the traditional chalk and talk method.

Jeya Shanmugaraja, Karthikeyan K. and Jayaraman. K (2012) conducted a study of the effectiveness of E-Content on teaching zoology at the high school level. The researcher created and validated E-Content in Zoology. The investigator determined whether there is a significant difference in teaching Zoology to XI standard students in Virudhunagar District using the lecture technique versus teaching using E-Content. The mean, standard deviation, and t-test were used to examine the data acquired from XI Standard pupils. The current study's findings demonstrated that the performance of teaching using E-Content is superior than the Lecture method in terms of achievement.

Sadaghiani, Homeyra R. (2012) studied the impact of using electronic learning modules (MLM) on the learning of the students enrolled in introductory physics courses at California State Polytechnic University, Pomona. One hundred fifty-nine students were assigned at random to one of two sections of an introductory mechanics course, one of which included the MLM. Both portions had the same lecturer, took part in the same class discussions, and used the same problem-solving examples. In a final course examination and across identical discussion questions, students in the electronic group outperformed students who did not encounter the MLM.

Pratibha Sharma (2012) conducted an experimental study to examine the efficiency of an interactive electronic and traditional direct way of teaching English with 50 students in each group (control and experimental). The study revealed that both techniques used for the study were highly efficient for teaching the English language to class VII students; however, the interactive electronic method was determined to be more suited in terms of the marks they achieved in English. It was discovered that when students were taught using both direct conventional techniques and interactive electronic methods, the gained retention was superior in the case of interactive electronic methods.

Diskshit, Jyotsna; Garg, Suresh and Panda, Santhosh (2012) made a comparative study on the pedagogic effectiveness of printed self-learning text with face-to-face tutorial support, interactive electronic CD-ROM and online learning in an introductory computing module at the certificate level offered at

Indira Gandhi National Open University (IGNOU), India. The study was analysed on the basis of existing instructional practises in open universities in India in terms of difficulties encountered, student preferences, quality of support structure and services, method of interaction, instructional and technology components for learning success. Both descriptive and experimental research methodologies were employed. A web server was set up for use in the students' experiment. The three groups of students were given an achievement test and the Response to Learning Activity Scale. According to the study, the use of interactive electronic CD-ROM was found to be pedagogically more effective with a variety of learning activities than print with face-to-face support and web with online learner support.

Upasana Singh (2013) attempted to find out the state of technology integration inthe teacher education institutions and schools of Patna in the State of Bihar, India thathas the state of the art technology status. A purposive cum accidental selection strategy was used to choose a sample of 150 pre-service and 64 in-service teachers for this study. The researcher investigated the availability and accessibility of technology in the selected schools and teacher education institutions, as well as the relationship between pre-service and in-service teachers' technology proficiency and their attitude toward integrating technology in education, as well as the relationship between the frequency of faculty use of technology in classroom instruction and the attitude of pre-service teachers toward technology integration. According to the findings of the study, teacher education institutes are attempting to incorporate technology in the teaching-learning process, whereas schools continue to employ the traditional way. However, technology integration in educational processes is still a long way off. There is a significant relationship between in-service teachers' proficiency and their attitude toward technology integration, as well as between the frequency of faculty use of technology in classroom instruction and pre-service teachers' attitude toward technology integration.

Suman Chhabra and Neelam Dhamija (2013) studied Computer Assisted Instruction Technique (CAI) in comparison to Conventional Teaching (CT) on the achievement of pupil teachers in the methods of teaching the English language. In this study, the researcher created and verified teaching materials for both CAI and Conventional Teaching styles of training (CT). The experiment was carried out with the participation of 70 B.Ed. students from a college of education in Panipat. The Control Group design was employed for the pre-test and post-test. In this study, two types of tools were used: instructional resources (software packages for CAI, traditional lesson plans) and measuring tools (criterion reference tests (CRTS) and Raven's Standard Progressive Matrices). The experiment's findings revealed that CAI was beneficial in terms of pupil teachers' achievement in English language teaching methods in the post-test stage. At the pre-test stage, however, no significant difference was identified between the experimental and control groups.

Harsha Patadia, Pramila Ramani (2014) studied, "Computer Assisted Instruction and Teaching of Arithmetic". This True Experimental study compared the academic performance of students in class VIII in an initial tryout in one of the English Medium Schools of Vadodara, India, among three methods of teaching arithmetic subject, namely I conventional method (in control group – C), (ii) computer aided instruction (CAI) only (in Experimental Group A – Exp A), and (iii) computer aided instruction with simultaneous discussion (in Experimental Group B - Exp B). CAI was adjusted after the initial tryout based on comments from the students in the groups (Exp A and Exp B), the mathematics teacher, and the investigators' observations. The modified version of CAI utilised at another school's final tryout. The following is the methodology employed in both tryouts. This study employed a post-test only control group design. Three sections of class VIII students were chosen and groups were assigned at random. ANOVA and the Turkey HSD Test were used to analyse the data. There was a substantial difference in posttest scores between students who received the usual approach, CAI just, and CAI plus simultaneous discussion in both tryouts. The Turkey HSD test was used to assess additional data. The degree of relevance for tryouts was set at.05. The findings of the Initial Tryout revealed that (1) there was a substantial difference between the mean achievement score of Exp B and Exp A. (2) There was a statistically significant difference in the mean achievement score of the Exp B and Control Groups. (3) There was no statistically significant difference between the Exp A and Control Groups. The results of the final tryout revealed that (1) there was no significant difference between the mean achievement score of Exp A and that of the Control Group, and (2) there was no significant difference between the mean achievement score of Exp A and that of Exp B. (3) There was a statistically significant difference in the mean achievement score of the Control Group and Exp B.

Kamalika Chaudhuri (2015) made a study on "Development of an Effective Method of Teaching History in the Secondary Classes. History is a veritable treasure trove of life experiences. The contents of History must be explicitly described, and the subject matter must be presented in a scientific, logical, and psychological manner. In this regard, the investigator undertook a study to determine the most successful technique of teaching History among three methods, namely the lecture method, the programmed learning method, and the biographical method. There are three objectives and three hypotheses in this study. Class IX was chosen for an experiment involving three types of schools (co-ed, boys' and girls') located in rural and urban locations. The Latin Square Design was used in the research. After careful matching, three groups of students (A, B, and C) were formed. Three themes were chosen from the class IX history syllabus. As research instruments, the researcher used self-created 'Achievement Tests of History,' and she also created learning modules for her study. A stratified random sampling strategy was employed to collect 600 homogenous samples from rural and urban areas of 24 paraganas in Kolkata's South district. The researcher divided the total samples into six strata, with each stratum divided into two homogeneous groups - controlled and experimental groups, each being treated separately. The controlled group was treated using the formal classroom teaching method (i.e. lecture method), while the experimental group was treated using the programmed learning method and biographical method. In the study, descriptive statistics such as Mean and S.D. were used, as well as inferential statistics such as ANOVA. The significance was determined at the 0.01 level. Percentage, chart, graph, and table were used to represent data. The investigator concludes that the programmed learning approach is more effective than the lecture method and the biographical method after examining the obtained data. Students are more engaged in history when they are taught using a programmed learning strategy. The thesis also includes some pedagogical recommendations and proposals for further research.

Pio Albina, A (2018) studied the "Effectiveness of E-Content in Teaching of Mathematics Education among B. Ed. Student-teachers". The purpose of this study is to determine the efficiency of E-Content in the teaching of mathematics education among B.Ed. student-teachers. The pre-test-post-test control group design was employed by the investigator. In the current investigation, a stratified random selection procedure was used to choose a sample of 60 student-teachers to form the study's control and experimental groups. The control group served as the standard against which the experimental group was measured. The control group was taught conventionally, whereas the experimental group was exposed to E-Content. Data was collected using two study tools: E-Content in Teaching of Mathematics Education and Achievement Test. According to the research findings, E-Content in the Teaching of Mathematics Education has resulted in higher achievement among B.Ed. student-teachers.

Saravanakumar, A. R. (2020) conducted a study on "Effectiveness of interactive E-Content module in enhancing students' achievement in mathematics". The study's aims are to determine the efficiency of the interactive E-Content module of teaching vs the chalk and talk way of teaching in learning mathematics among high school pupils. In this study, the investigator utilised a pre-and-post-test design with two equivalent groups. The traditional and modern methods of instruction were allocated to the purposive sampling methodology, which was used by selecting a sample of 20 Ninth standard pupils from each group. Under the supervision of the research supervisor, the researcher created an E-Content module and a teacher-created achievement test based on the Mathematics subject section as set theory, incorporating drawing skills of Venn diagrams. For statistical analysis and interpretation of achievement scores (data), the Fmax test, independent t-test, ANCOVA test, p2 test, R2 test, 2 test, r2 test, Effect Size, and Gain Ratio test are used, and the results are explained E-Content module in enhance students' achievement in mathematics effectively.

Nachimuthu, K., & Sasi, P. (2021) conducted a experimental study entitled on "Effect of Multimedia on Learning History among Secondary Students". The investigator's multimedia package was titled Cultural Traditions of Tamil Nadu. India have seen an early development of cultures and civilizations, according to the content. Technology serves to bridge the gap between teaching and learning. Past events in Indian history must be taught through new techniques. Text, video, music, and animations are encased in multimedia components to help students learn more. The researchers chose 50 students from the ninth standard of Government high schools in the Attur District of Tamil Nadu State to participate in the experiment. Both genders were divided into control and experimental groups. The control group was given the traditional classroom method, whereas the experimental group was given the multimedia method. According to the findings, multimedia history instruction was more effective than traditional methods. According to the findings, the multimedia package has a favourable impact on history education.

2.8 ICT AND STUDIES RELATED TO CHEMISTRY - ABROAD

Jennings, Kathrine, T., Erik, M. Weaver and Gabriela, C. (2007) preferredto make use of an electronic DVD for physical Chemistry analysis of its effectivenessfor teaching the content and applications to the current research and its impact on student views of physical chemistry. The study's aims were to adopt a modern electronic learning tool for physical chemistry in a classroom setting and to analyse students' attitudes and learning gains. The Physical Chemistry in Practice (PCIP) DVD contains electronic modules that describe the research of eight different scientists in detail. Each module includes a documentary-style video presentation of the researcher and the laboratory, HTML-based background material about the topic, puzzles for students to solve, and links to relevant information. The DVD was used in a physical chemistry laboratory course where students worked through a surface-enhanced Raman spectroscopy module (SERS). Data was gathered through pre- and post-tests of content knowledge, as well as surveys of attitudes and academic career choices. The findings demonstrated that students showed statistically significant learning gains ager using the DVD, as well as an increase in their recognition of physical chemistry applicability to real-world problems. The students also expressed an increased interest in furthering their studies in physical chemistry.

Kamith Osman and Tien Tien Lee (2012) carried out a study on the Impact of the interactive electronic module with pedagogical agents (IMMPA) on students understanding and motivation in the learning of Electrochemistry (EC). The study used a non-equivalent pre-test-post-test control group design. The instruments used included a pre- and post-test, a motivation questionnaire, and the IMMPA EC Lab. The findings demonstrated a significant difference in concept understanding between the control and experimental groups when learning electrochemistry.

Plass, J. L., Milne, C., Homer, B. D., Schwartz, R. N., Hayward, E. O., Jordan, T., & Barrientos, J. (2012) conducted a study on "Investigating the effectiveness of computer simulations for chemistry learning". When well-designed computer simulations are introduced into high school science classrooms, researchers found that they are a useful tool for supporting student learning of complicated topics in chemistry. Chemistry teachers adopted two alternate versions of a curricular unit in the two effectiveness studies reported, one in a rural context and the other in an urban context an experimental version integrating simulations and a control version using text-based materials covering the same topic. In total, 718 high school students (357 rural and 361 urban) took part in 25 classrooms. The simulations' implementation was investigated utilising criteria linked with implementation fidelity (FOI). Each situation shed light on the significance of FOI in influencing the efficacy of treatments when working with groups of instructors. The findings verified the efficiency of this sequence of simulations as a teaching tool in the classroom, as well as the importance of FOI elements like adherence and exposure in identifying the exact circumstances in which these materials were most effective.

Hibbard, L., Sung, S., & Wells, B. (2016) In a collegiate general chemistry curriculum, the usefulness of a semi-self-paced flipped learning approach is being investigated. Flipped learning has risen to prominence in education. It maximises learning by relocating content delivery online, where students may learn at their own pace, freeing up class time for student-centered active learning. This five-year cross-sectional study compared the flipped learning style to a more traditional lecture format in a college general chemistry for majors sequence taught by a single instructor. Students' conceptual understanding was assessed using standardised exam scores from the American Chemical Society (ACS) and evaluated using one-way ANCOVA. The Chemistry Motivation Questionnaire (CMQ-II) and an in-house Blended (Flipped) Learning Survey were used to measure student motivation and learning perspectives. Statistical study revealed that students taught utilising the flipped learning platform outperformed those taught using traditional teaching. The majority of student opinions of flipped learning were favourable and demonstrated motivation to succeed.

Sparck, E. M., & Levis-Fitzgerald, M. Ramachandran, R., (2019) conducted a study on “Investigating the effectiveness of using application-based science education videos in a general chemistry lecture course”. The authors used peer-reviewed scientific education videos from the Journal of Visualized Experiments (JoVE) as homework assignments to augment lectures on enthalpy, entropy, rate laws, and Le Châtelier's principle in a second-term general chemistry course. Student learning was tested using pre- and post-video conceptual quizzes, and value surveys were also used to collect student comment on the videos. Using these movies in the course greatly boosted student learning and reinforced conceptual knowledge for crucial basic concepts, according to the research, and these findings remain true even for students who did not like the videos. .

Hamid, S. N. M., Lee, T. T., Taha, H., Rahim, N. A., & Sharif, A. M. (2021) conducted a study on "Development and student views of an E-Content module for a Chemistry Massive Open Online Course (MOOC)." It investigated the module's validity, reliability, and student perceptions of its content, usability, design, and efficacy. This is a research and development project, and the E-Content module was created using the ADDIE instructional design approach. The pillars for module building are collaborative learning, Connectivism theory, and the Interaction Equivalency Theorem. Three experts used a content validity evaluation form to estimate the module's content validity. Questionnaires were provided to students to measure the module's dependability (n = 23) and students' views of the module (n = 129). According to the findings, the E-Content module has high content validity (CVI = 1.00) and a good dependability index (= 0.94). Students' perceptions of module content (M = 3.66, SD = 0.55), usability (M = 3.43, SD = 0.56), design (M = 3.41, SD = 0.59), and effectiveness (M = 3.47, SD = 0.56) were all high. This E-Content module of the Chemistry MOOC is intended to be an excellent and useful online resource for both lecturers and students involved in the teaching and learning of Chemistry in higher education institutions.

Putri, R. A., Munzil, M., & Sumari, S. (2021) conducted a study on “Developing multiple representation’s teaching materials assisted by blended learning to enhance students’ scientific argumentation skills”. Electrolyte-nonelectrolyte and colligative features of solutions are materials orientated by different chemistry representations. The teaching materials for this study were created as both online and offline tools. The creation of teaching materials is guided by Lee and Owen's five-step development model: 1) analysis/assessment, 2) design, 3) development, 4) implementation, 5) evaluation Based on the findings of the validity and readability tests, the creation of this research is valid and legible to be used in the learning process. The validity and legibility scores from the validators are 79 percent, while the students' scores are 79 percent. Based on the effectiveness test findings, it appears that the generated instructional materials are effective in improving students' scientific reasoning skills, as evidenced by the pre-test, post-test, and n-gain scores. According to n-gain scores, 13 students' scientific argumentation skills have improved at the low level, while 19 students' have improved at the medium level.

2.9 ICT AND STUDIES RELATED TO CHEMISTRY- INDIA

Vasanthi and Hema (2003) studied the effectiveness of teaching chemistry through Computer Assisted Instruction over the Traditional Teaching Method. The investigation's respondents in this study were first-year B.E.

students. In the first year of B.E., there were 220 students. Sixty pupils were chosen based on their achievement in a class test. Based on their performance in the class test, the 60 students were separated into two equal groups of 20. The control group consisted of 20 students, whereas the experimental group consisted of the remaining 20 pupils. Both groups were given the same pre-test. The pre-test consisted of multiple-choice questions. The 't' test was used to determine the significance of the difference in mean scores between the control and experimental groups in the pre-test. The results of the research revealed that there was no statistically significant difference between the two groups. It showed that the two groups were homogeneous. Visual Basic Version.6 was used to create the app. It provided an electronic platform to entice the learner's senses for easy and enjoyable learning. The findings revealed that: 1) There was no significant difference in the mean score of the control group and the experimental group in the pre-test. 2) There was a significant difference in the mean post-test scores between the control and experimental groups. 3) In all units, there was a significant difference between the mean gain score of the control group taught through TIM and the experimental group-administered CAI (Electro Chemistry and Banding). Based on the data, it is possible to conclude that studying history using CAI is more effective than standard teaching methods.

Jothi, K.B.S. (2007) made an experimental study to find out the impact of computer-based learning of chemistry. The study's aims were to create a self-instructional module on the topic of 'Chemical Bond' for IX Standard chemistry classrooms and to evaluate the effectiveness of the self-instructional module to the traditional teaching technique. The researchers used the matched pairs technique to recruit students for the control and experimental groups. The sample for the study consisted of 40 students from the IX standard at Little Star High School in Madannapet. Furthermore, the investigator's test from the lessons 'Properties of Gases' and 'Chemical Bond' was used in the pre-test and post-test, respectively. The study clearly demonstrated that the researcher's self-instructional module, which consisted of a simple powerpoint presentation, had a significant impact on chemistry learning.

Subramanian, P., & Ramakrishnan, N. (2017) made an experimental study to find out the "Effectiveness of E-Content on Achievement in Chemistry among XI Standard Boys". E-Content is an innovative use of computers in the teaching and learning process. Text, video, music, animation, and images are all included. The advancement of technology to design, deliver, select, administrate, and extend learning is referred to as E-Content. E-Content in education is a powerful instrument that can be used successfully and efficiently in the classroom to create a more interesting learning environment and provide students with a higher degree of educational knowledge. The experiment provides a clear picture of the impact of teaching Chemistry using E-Content on the accomplishment of XI Standard boys in Chemistry. The results show that XI Standard boys in experimental groups of both PPT design and PT design outperformed control groups in E-Content on Chemistry (atomic structure) than control groups in both PPT design and PT design.

R. Jayakumar (2016) conducted a study on "Effectiveness of E-Learning in Teaching Chemistry with Reference to Quality of Picture and Video". This study demonstrates that the quality of the picture and video 'learning output' is the most important aspect in determining the success of e-learning in teaching chemistry.

The authors emphasised the importance of reflecting on and clarifying how these concepts are employed in research and practise. This study provides entirely quantitative measures for achieving established e-learning objectives. This study explains elements that promote the success of e-Learning, which makes understanding solutions more effective. The context in which the e-Learning solution was utilised, the artefact, and the individuals who used the artefact were used to categorise these factors. As a result of additional categorization into important components, a model to assist e-learning design was developed. One of the numerous issues brought up throughout the conversation was whether e-Learning and traditional face-to-face learning should be measured using the same definitions and methodologies to effectiveness. To discover acceptable solutions to this question, the authors recommend that future researchers and designers critically analyse how high-quality images and videos can improve the effectiveness of e-Learning in chemistry teaching.

Devendiran, G., & Vakkil, M. (2017) made a study on "Effectiveness of E-Content Package on Teaching IUPAC Nomenclature of Organic Chemistry at Undergraduate Level". The purpose of this study is to determine the efficacy of an E-Content package in teaching IUPAC nomenclature of organic chemistry at the undergraduate level. The study used a Pre-test-Post-test Non Equivalent Groups Design, and the sample size was 71(n=71) students from two colleges. The total study was divided into two groups, one experimental and one control, with (n=36) students in the experimental group and (n=35) students in the control group. Students in the experimental group were taught using an E-Content package, whilst students in the control group were taught using current traditional methods of instruction. The study's preliminary findings suggested that students in the experimental group outperformed those in the control group when it came to mastering organic chemistry. . The final results of the study's estimated t–values suggested a higher level of significance. And the research hypothesis, which was based on the control groups and experimental group's pre-test and post-test scores in teaching IUPAC nomenclature of organic chemistry, was approved. The findings of this study revealed a substantial difference in mean scores between the control and experimental groups when teaching IUPAC nomenclature of organic chemistry.

2.10 STUDIES RELATED TO ATTITUDE TOWARDS THE USE OFCOMPUTERS-ABROAD

Mazanah Muhamad, Ahmad Zamri Mansor, On Lily (2002) studied Learners' Attitude towards Learning through CD-ROM Courseware: A Case Study of An Organization. The purpose of this study is to investigate two elements related to learners' attitudes toward learning via CD-ROM courseware: (1) student characteristics and (2) CD-ROM courseware characteristics. Data were collected utilizing a specially constructed device for the investigation. The respondents were 150 selected organization employees who had used any CD-ROM courseware in any of the organization's learning facilities throughout a one-month period. . The findings show that: (1) the majority of those polled had a favorable attitude toward the most recent CD-ROM courseware they had used; (2) learners' attitude toward computers was found to be highly correlated with learners' attitude toward CD-ROM courseware; and (3) courseware technology characteristics and immediate feedback were identified as two of the most highly correlated factors. Learner attributes such as attitudes toward computers, work experience, and educational performance must be considered while studying with CD-ROM courseware.

Textology and fast feedback are crucial factors in CD-ROM courseware production because they promote a positive attitude toward learning. This research will help CD-ROM courseware creators and training managers create more appropriate training for learners.

Paul G. Paris (2004) carried out a research study to examine the affective, behavioural, and cognitive attitudes of 52, Year 10 students from an Adelaide Public Secondary School towards a specific type of online E-learning, that of Online Web-Assisted Learning (OWAL). The data were gathered to investigate differences in attitudes toward OWAL and paper-assisted learning, differences in attitudes toward OWAL between males and females, the correlation between Internet use and positive OWAL attitudes, and the "publishing elements" that students find most appealing in OWAL.

Balarabe Yushau (2006) carried out a study that examines the influence of blended E-learning on students' attitudes towards mathematics and computers. The sample for this study was a random sample of 70 students from King Fahd University of Petroleum & Minerals (KFUPM), Dhahran's preparatory year programme. The Aiken Mathematics Attitude Scale, Andreessen and Loyd Computer Attitude Scale, and the Loyd Computer Attitude Scale were used to collect data at the beginning (pre-program) and end (post-program) of the semester. The findings suggest that the subjects have a favourable attitude toward mathematics and computers.

Alev Ates, Ugur Altunay, Eralp Altun (2006) studied "The effects of Computer Assisted English Instruction on High school preparatory students' attitudes towards computers and English". The purpose of this study was to examine the effects of computer-assisted English instruction on the attitudes of

English language preparation students toward computers and English in a Turkish-medium high school with an intense English curriculum. In this study, a quasi-experimental time-series research design, also known as a "before-after" or "repeated measures" approach, was utilised. One group of students (20 females and 10 males) was chosen at random as a sample. The study was divided into two parts: traditional English instruction and computer-assisted English instruction (CAEI). The data collection instruments were a Scale for Attitudes Towards English and a Scale for Attitudes Towards Computers, which were administered three times at two-week intervals. According to the data, students' attitudes toward computers and English improved dramatically following CAEI. The associations between increases in students' attitude ratings, gender, and monthly income, on the other hand, were determined to be insignificant.

Belinda Soo-Phing TEOH and Tse-Kian NEO (2007) conducted a Study on Interactive Multimedia Learning: Students' Attitudes and Learning Impact in an Animation Course. Malaysian classrooms are increasingly incorporating interactive multimedia as teaching and learning tools. Though, until now, interactive multimedia in a Malaysian classroom has been limited to a hybrid use of a chalk-and-talk technique with multimedia-assisted materials, where learning is still primarily teacher-centered. Such advancement falls short of realising the full potential of multimedia learning, undermining the legitimacy of student-centered learning methodologies. The Internet offers a vast network of knowledge and interactive simulations that are required for active and independent learning. As a result, this article presents the development and implementation of student-centered learning on students in a

Film & Animation course using a Web-based domain. Malaysian classrooms are increasingly incorporating interactive multimedia as teaching and learning tools. Though, until now, interactive multimedia in a Malaysian classroom has been limited to a hybrid use of a chalk-and-talk technique with multimedia-assisted materials, where learning is still primarily teacher-centered. Such advancement falls short of realising the full potential of multimedia learning, undermining the legitimacy of student-centered learning methodologies. The Internet offers a vast network of knowledge and interactive simulations that are required for active and independent learning. As a result, this article presents the development and implementation of student-centered learning on students in a Film & Animation course using a Web-based domain.

Barbhuiya Mamun, A. (2008) studied, “Students’ Attitude towards Using Computer for Language learning- A Survey”. The study's aims were to discover students' attitudes on the importance of developing communicative abilities, particularly writing skills, and to discover students' attitudes toward using computers in teaching and learning English in and out of the classroom. The researcher delivered 247 survey questionnaires to students at random in order to evaluate their attitudes. The study's findings are as follows: (1). According to the report, 98 percent of students believe that English language instruction is necessary in their technical degrees. (2). 86 percent of them would like to spend some extra time learning English. (3). 71 percent believe that a lack of English language is a disadvantage in technical education. (4). 88 percent of pupils choose to learn English on a computer. (5). 92 percent of students agree or strongly agree that the computer provides them with more opportunities to practise English. (6). 47 percent of pupils believe that utilising computers will help them learn English faster.

Erlich, Zippy; Gadot, Rivkar; Shahak, Daphna (2008) studied the use of technologies as teaching aids and tools for self-study influenced by student's attitudes towards computers and their applications. The focus of this research is to see if taking a Computer Literacy and Applications (CLA) course affects students' attitudes toward computer applications across diverse undergraduate disciplines. A Computer Application Attitude (CAA) questionnaire was given to social science students participating in a CLA course at the beginning and conclusion of the semester. The study population was separated into two groups based on the students' fields of study: quantitative and qualitative. Only in the quantitative group was there a significant difference in opinions before and after the CLA training. Based on the findings of this study, it is suggested that different computer literacy courses be offered to different categories of students in order to enhance their attitudes regarding the use of these programmes.

Padilla, B. and Rodrguez, M.C. (2008) conducted a research "Relationships between Affective Style, Attitude towards E-learning, and Effectiveness of an Online Training System". The research concentrated on an online training system utilised by a Mexican corporation. We used a convenience sample of about 20 pupils. An electronic version of PANAS and an adoption of Mishra and Panda's E-learning Attitude Scale were used to assess students' affective style and attitude toward E-learning, respectively.

These were tied to the program's effectiveness, which was measured by satisfaction and performance using Kirkpatrick's methodology. The outcome was positive, strong correlations between the variables.

Teo Timothy (2010) studied the effect of gender on pre-service teachers' computer attitudes. Design/methodology/approach: A total of 157 pre-service teachers completed a survey questionnaire that assessed their responses on four computer attitude variables. These were given out during the teaching term when the participants were taking a technical course in structural equation modelling, including confirmatory factor analysis and multiple indicators. For data analysis, multiple causes (MIMIC) modelling was applied. Gender has no statistical significance in the four constructs of computer attitude. The mean scores for males, however, are higher for three of the constructions. Overall, the results in this study supports the idea that computer attitude is a multifaceted construct with original value. This study adds to the researchers' ongoing interest in studying the effect of gender on computers. This study's findings contradicted previous research that indicated significant differences in computer attitudes based on gender. This could be owing to the significant reliance on computers for teaching and learning in many educational institutions, which has resulted in equal access for male and female users.

Tamer Kutluca (2011) conducted a study on Computer Usage and Attitudes toward Computers of Prospective Preschool Teacher. The goal of this study is to establish the status of computer usage and prospective preschool teachers' attitudes regarding computers, as well as to analyse many elements that influence their opinions. A "Computer Usage Information Form" and a "Computer Attitude Scale" were administered to 126 potential preschool instructors for this aim. This research is being carried out using survey methodologies. The data is examined using standard deviation, mean value, t-test, and one way ANOVA for group comparison, as well as a PostHoc Tukey HSD test to determine which group causes the difference in the group comparison. At the conclusion of the study, it is established that the potential preschool teacher utilises computers more at home and in internet cafes, and that their levels of proficiency with computer applications are intermediate or upper. It is also found that there is a significant difference based on the variables of taking a computer course, computer ownership, level of utilising a computer programme, frequency of computer usage, computer experience, and a class of computer attitudes. However, there is no significant difference based on the gender variables. It is suggested that future research look into academicians' use of computer programmes and attitudes about computer technologies.

Akin Efendioglu (2012) studied the effects of the Courseware Development model (CDM) on the primary school pre-service teachers' achievement in the field of geography and attitudes toward computer-based education (ATCBE). The CDM was made up of three parts: content (C), learning theory, specifically meaningful learning (ML), and multimedia (M). The CDM is intended to demonstrate the ML-based synthesis of the C and M components. An experimental design with pre-test and post-test groups is employed in this study to determine the efficiency of the CDM. There are 31 pre-service teachers in the control group, 28 in the meaningful learning theory-ML group, and 30 in the GTC group that employs geography teaching courseware-GTC based on the CDM. The analytical results show that the courseware is extremely beneficial in terms of increasing pre-service teachers' academic achievement as well as their ATCBE scores.

Adalier, Ahmed (2012) studied the relation between the Turkish and English language teacher candidates’ social demographic characteristics and their perceived computer self-efficacy and attitudes toward the computer. The study's population consists of teacher candidates from Cyprus's universities' Turkish and English language departments. The sample comprises of 126 teacher candidates from Cyprus International University's Faculty of Education who were chosen via convenience sampling. The "perceived computer Self-Efficacy" scale produced by Askar and Umay, as well as the "Attitude Toward Computer" scale developed by Askar and Orcan, were utilised to collect data in this study. Data analysis methods that were appropriate for the study's aim included the percentage documentation average, t-test, ANOVA, Mann-Whitney U, Kruskal Wallis, Scheffe, and Pearson Product –Moment Correlation test. In the study, the statistical significance level was set at 0.05. According to the findings of this study, there is a significant difference in the department, age, English proficiency level, and socioeconomic level of teacher candidates in terms of perceived computer self-efficacy based on attitudes toward the computer. There is only a statistically significant difference in English Proficiency. It was also shown that there is a moderately favourable statistical difference between perceived computer self-efficacy and attitudes toward computers.

Sadia Mahmood (2012) has studied the 'Influence of Personal and Institutional Factors on Attitude of Secondary School Students towards Computers'. He discovered that, like in previous studies, the majority of secondary school pupils (91.82 percent) have a favourable attitude toward computers, with female students (92.14 percent) having a more favourable attitude toward computers than male peers (91.54 percent). A positive association (r= 0.29) is established between computer attitude and math achievement, indicating that as computer attitude scores rise, so does math achievement. Furthermore, the results show that academic drop off leads to a less favourable attitude towards the computer, whereas academic increase leads to a more favourable attitude towards the computer. Furthermore, gender basis analysis in four sub-groups of Maths achievement reveals that students in the medium and low groups have a more favourable attitude toward the computer than their counterparts, but no gender difference is identified in the excellent and good achievement groups.

Celik, Vehbi, Yesilyurt, Etem (2013) studied the effect levels among the latent variables of attitude to technology, perceived computer self-efficacy computer anxiety and the attitude toward doing computer supported education and these latent variables related to each other. These eight assumptions were generated in light of theoretical information gleaned from a review of the literature. The technological Attitude Scale, Perceived Computer Self-Efficacy Scale, Computer Anxiety Scale, and Attitude Scale toward Using Computer Supported Education are used in this study. The research includes 471 pre-service teachers as participants. SPSS 16.0 software was used to conduct exploratory factor analysis on scales. AMOS 17.0 software was utilised for scale confirmatory factor analyses and structural equation modelling. The most noteworthy finding of this study is that attitude toward technology, perceived computer self-efficacy, and computer anxiety are important predictors of teacher candidates' attitudes toward computer-assisted education.

Orhan Ercan (2014) conducted a Study on The effects of multimedia learning material on students’ academic achievement and attitudes towards science courses. This study assessed the impact of multimedia learning material generated for the 5th grade science course topic "Food and Healthy Nutrition" on students' academic achievement and science attitudes. A control group, a pre-test-post-test quasi-experimental research design, and a convenience sample of 62 5th grade students were employed in the study. An accomplishment exam and a science attitude scale were used as research equipment. During the implementation phase, the experiment group learned through multimedia learning materials, while the control group learned through traditional techniques. An independent's amplest test, a paired-samples t-test, and ANCOVA statistics were used to examine the data. According to the data, there is a statistically significant difference between the experimental and control groups' post-test achievement scores, with the experimental group scoring better. Furthermore, there is a statistically significant difference in post-test scores by gender, with females outperforming males. In terms of science attitude, there is also a substantial difference between the experimental and control groups' post-test results. It has been concluded that multimedia learning facilitates more effective learning in science education.

Orachorn Kitchakarn (2015) conducted a study on EFL Learners ‘Attitudes towards Using Computers as a Learning Tool in Language Learning.

The survey was designed to look into undergraduate students' perceptions toward using computers as a learning aid at a private university. In this regard, various characteristics that could be potential antecedents of computer attitudes, such as gender, computer experience, and perceived competence in utilising programmes, were investigated. The information was gathered from 192 undergraduate students enrolled in two basic English classes (EN012 & EN 013). A questionnaire was used as the study's tool. According to the data, pupils showed positive opinions toward using computers as a learning aid. Gender and computer experience were found to have no effect on students' attitudes, however perceived ability in using programmes had an effect on their attitudes.

Ahmet Sami Konca et al. (2016) conducted a study on “Attitudes of Preschool Teachers towards Using Information and Communication Technologies (ICT)”. The study's goal is to assess preschool instructors' attitudes regarding adopting technology tools and to analyse them in terms of various characteristics. The research was carried out using a descriptive study design. Data was collected using a personal information form designed by the researchers and "The Scale of Attitudes Towards Using Technological Tools in Preschool Education" developed by Kol. T-test for independent samples and one-way variance analysis were used to evaluate the data T-test for independent samples and one-way variance analysis were used to establish the relationships between variables. The survey found that teachers had a very positive attitude toward adopting technological tools. When compared to distant education graduate preschool instructors, preschool education graduate teachers demonstrated a more positive attitude regarding adopting technological tools.

Scherer, R., Tondeur, J., Siddiq, F., & Baran, E. (2018) conducted a study on “The importance of attitudes toward technology for pre-service teachers' technological, pedagogical, and content knowledge: Comparing structural equation modeling approaches”. According to a wide body of literature, attitudes toward technology and its instructional usage are major drivers of technology acceptability and integration in classrooms. At the same time, teachers' Technological, Pedagogical, and Content Knowledge (TPACK) enables the effective use of technology in the classroom. The study advances this understanding by examining the relationships between three core technology attitudes (general attitudes toward ICT, attitudes toward ICT in education, and ease of use) and TPACK self-efficacy beliefs in a sample of 688 Flemish pre-service teachers from 18 teacher-training institutions. We describe the TPACK-attitudes relations from many viewpoints using a range of structural equation modelling methodologies and show a substantive-methodological synergism. The results demonstrated that attitudes toward technology and TPACK self-beliefs were positively connected; however, disparities between attitudes and TPACK dimensions occurred, indicating the separation of general and educational viewpoints on ICT use.

Allia, M. Y., & Souyeh, M. E. (2021) conducted a study on “Probing the Effectiveness of E-Learning/Teaching during Covid-19 The Case of EFL Tutors and Students at the English Language Department of M’sila University, Algeria”. The study used an explanatory research design because it is interested in the effectiveness of e-teaching and e-learning in the process of EFL learning in the midst of the COVID-19 epidemic, in the instance of master one English language students at Mohamed Boudiaf University, M'sila. The study's goal is to investigate teachers' and students' attitudes toward e-learning and e-teaching, as well as to assess the effectiveness of adopting e-learning as an alternative to face-to-face classrooms. Furthermore, to research the usage of e-learning and to investigate the current state of the e-learning approach in the department of English at Mohamed Boudiaf University - M'sila-. Two questionnaires were distributed to 57 master one English language students and 12 teachers to collect data. The key findings revealed that students who have mastered one English language have positive opinions toward the usage of e-learning during the COVID-19 epidemic and are willing to use it once the pandemic is finished. Furthermore, teachers support the use of e-teaching as a successful learning/teaching tool in all aspects of language learning. Based on the findings, pedagogical recommendations for teachers, students, and policymakers are made.

2.11 STUDIES RELATED TO ATTITUDE TOWARDS THE USE OFCOMPUTERS-INDIA

Kalia, Ashoka, Levine, Tamar and Viji, Sanjana (2000) identified 1) computer self-confidence and computer-related attitude among students; 2) found out the relationship between computer self-confidence computer-related attitudes and commitment to learning among the computer students and 3) found out the relationship between computer experience, computer-related attitudes and commitment to learning among the computer students. The sample included 50 students (male and female) from the NIIT computer centre in Rohtak (Haryana). A computer-based attitude and self-confidence questionnaire was used. The data was analysed using a Correlation. The findings revealed that 1) pupils who were more confident in their abilities to master new computer skills had more favourable opinions regarding computers. 2) It was discovered that the smaller the dedication to learning computer applications, the more unfavourable the effect of the computer. There was no statistically significant link between computer experience and computer attitude.

Kumaran and Selvaraju (2000) studied the computer attitude of teachers. The data revealed that 1) generally, teachers had a more favorable computer attitude. 2) The Age of the teachers had little influence on computer attitude. 3) Young teachers had a more favorable cognitive computer attitude subscale. 4) Teachers with post-graduation qualifications had a more favorable computer attitude. 5) The subjectof specialization faculty of the teachers had little influence on computer attitude. 6) The teachers belonging to the Commerce and Science faculties had a more favorable cognitive and effective computer attitude. 7) Different types of management of schools had no significant influence on teachers' computer attitudes. 8) The types of schools (Boys, Girls, and Co-education) had little influence on computer attitude. 9) The schools belonging to different boards of education had no significant influenceon the teacher's computer attitude.

Narayanasamy (2000) studied to what extent the teacher in DIET's and TTI's possess attitudes towards computers. The findings revealed that respondents in both types of teacher training schools had very favourable opinions toward computers in education. The majority of respondents saw the computer as a valuable aid or tool for instructors. In several situations, the percentage of affirmative responses to these items was considerably over 80%. Approximately 75% of those polled agreed or strongly agreed with the statement "Computers are more vital in educational institutions than in other fields."

Anbazhagan (2001) who studied the attitude towards Information Technologyamong the teachers and students of Bharathidasan University found that learning computers and the practice of using computers in day to day work life may lead to theformation of a positive attitude towards IT.

Epzi Bai et al. (2002) investigated on "Teaching Attitude towards Computers". One of the main objectives was to find out what teachers think about computer-based teaching in schools to the students. The major findings were: (a) gender and locality of the teacher do not influence their attitude towards computer (b) age has an influence on attitude towards computers (c) 51.14 % of teachers have a relatively favorable attitude towards computers.

Helen Joy and Manickam (2002) assessed the knowledge in computers and attitude to computer-Assisted Instruction of the science teachers. The results of their study showed that the teachers' attitude towards the use of computers became more favorable with the increase in their knowledge in computer usage and knowledge of computer-Assisted Instruction. Even though the teachers have a positive attitude towards computer-Assisted Instruction their attitude towards the use of computers wasnot equally favorable.

Nirmala Sundara Raj (2005) attempted to find out the attitude towards computer education of the B.Ed trainees of Tamil Nadu Open University. The study's aims were to discover whether there was a substantial difference in attitudes about computer education between male and female B.Ed trainees, rural and urban B.Ed trainees, and art and science group B.Ed trainees. The problem was studied using a survey method by the investigator. The study's sample included 60 B.Ed Trainees. The researcher created a method to assess students' attitudes toward computer instruction. The data was examined using the mean, standard deviation, and 't' test. According to the findings, B.Ed students at Tamil Nadu Open University have a positive attitude toward computer education. Their attitudes changed according on their gender, place of residence, and study group.

Sree Rekha, R. (2008) studied “Teachers’ Attitude towards the Use of ICT in English Language Teaching”. The study's aims were as follows: 1) Determine the attitudes of secondary school English language teachers concerning the use of ICT in ELT. 2) To compare the attitudes of secondary school English language teachers by gender, location, management, and experience. The investigator created and validated the ICT Attitude Scale for Language Teachers, which was employed in the study. The tool was given to a random sample of 120 secondary level English language instructors in the Thiruvananthapuram district of Kerala. The obtained data was scored, collated, and statistically analysed. The acquired data was analysed using statistical techniques such as percentage analysis, t-tests, and ANOVA. The study's key conclusions are as follows: 1) 52 percent of instructors were extremely positive, and 27 percent of teachers were somewhat positive. Only 10% of those polled had an unfavourable opinion about the use of ICT in ELT. 2) There is no statistically significant variation in teacher attitudes based on gender, location, management, or experiece.

Enok Joel. T. & Thangarajathi. S. (2011) made an attempt to find the influence of electronic in enhancing attitude towards computer science at the high school level. The study's aims were (I) to create an electronic package for teaching computer science at the high school level, and (ii) to determine the impact of electronic on high school students' attitudes toward computer science.

The investigator chose XI grade students from Bishop Heber High School in Trichy as the study's sample. The randomised pre-test and post-test experimental design was used in this investigation. The electronic package and the investigator's attitude scale toward computer science were the tools employed in the investigation. The attitude scale had 50 items on a five-point scale. The study's findings were as follows: I the attitudes mean scores of the control and experimental groups do not differ significantly at the pre-test; additionally, these two groups have similar attitudes; and (ii) the attitudes mean scores of the control and experimental groups differ significantly at the post-test. It is found that students in the experimental group with higher mean scores had a better attitude than students in the control group.

Amrit Pal Kaur (2011) conducted a Study on Pre Service Science Teachers Attitudes towards the use of selected ICT tools in Teaching: An Exploratory Study. According to the findings of a study on the integration of Information and Communication Technology (ICT) in education, teachers' attitudes toward ICT play a critical role in their use of ICT. However, there is a severe paucity of qualitative research on the ICT attitudes of pre-service teachers, particularly science teachers. The purpose of this qualitative study was to investigate pre-service science teachers' views about ICT use at the University of Adelaide. The particular goals were to discover the facts that led to these opinions and to explore how these attitudes changed after educational techniques. The study was divided into two parts: pre-teaching practise and post-teaching practise. To collect data from self-chosen individuals, open-ended questionnaires were employed, followed by in-depth one-on-one semi-structured interviews with purposely selected people in the second phase. The conclusions of the data analysis, which used comparison and open-coding methodologies, suggested that student-teachers' overall opinions were favourable. However, challenges such as a shortage of ICT facilities in schools and a lack of ICT expertise and skills among student-teachers have surfaced. It is suggested that student teachers receive sufficient training and have the opportunity to use ICT in educational settings. More large-scale study is required before making policy recommendations.

Gunmala Suri and Sneha Sharma (2013) conducted a study on the Impact of Age on student's attitude towards e-learning: A study on Panjab University, India This research builds multiple approaches to examine individual attitudes toward the computer technology and e-learning. This study investigates university students' opinions regarding e-learning and computer technology based on their age and access to and use of the internet. The survey method was used in the study to investigate students' opinions toward e-learning. The students studying on the Panjab University campus were the intended audience. A total of 500 questionnaires were distributed across the university's faculties. It consisted of the faculties of arts, science, business management, engineering, and law. The departments covered by the five faculties totaled more than ten. The study's key findings provide us with useful information. For starters, it successfully employs a newly developed scale for gauging computer and e-learning attitudes. Second, this study found that age is not a relevant criterion influencing computer attitude and e-learning attitude. Third, the findings demonstrated that there is no significant relationship between student age and their response to the department's offer of online access to classroom lectures and e-learning tools. These findings can then be utilised to guide the implementation of the e-learning process in any educational context.

Gopal B.V. and Anandan K. (2013) conducted a Study on Attitude towards e-Learning in Classroom Instruction among the B.Ed., Students at Colleges of Education. The grey revolution has prompted a paradigm shift in the field of education, which is matched by real-life teaching-learning scenarios. The entire educational game shifts from learner-centric to learning-centric. To be a part of the paradigm shift that the world of education witnessed, any teacher of any level with learners, switching from soloist to accompanist and shifting the emphasis from dispensing information to helping learners seek organised and manage knowledge, guiding them rather than moulding them. One of the most important objectives of education in modern society is to stay up with technological advancements by getting relevant information from trusted e-Resources. People's mindsets must be changed by educating them on the power of e-learning. Online learning has the potential to bridge the gap between distance learning and formal education. The attitude of B.Ed. students toward e-Learning in Classroom Instruction is a key aspect in implementing its use in a constructive way. As a result, the current study aims to examine the level of "Attitude One Learning in Classroom Instruction" among B.Ed. students at educational colleges. The Survey Research Method was used for this investigation. The investigators used a random sampling technique to select 360 B.Ed. students from two self-aided colleges and two government colleges in the Bharathidasan University catchment area as a sample. The researchers created the 'Attitude on e-Learning in Classroom Instruction (AECI)' tool, which is made up of four components: multimedia, web, video conferencing, and closed circuit television (CCTV). The Tool is made up of fifty items on a four-point scale. The Correlation Coefficient of ATP Reliability was found to be 0.87, indicating that it is extremely dependable. The tool was given to all 360 B.Ed. students. According to the findings of this study, the Total Mean value for attitude toward e-learning in classroom instruction is 53.03 out of a maximum value of 100, which is considered to be average among B.Ed. students at colleges of education. There is a considerable difference in the scores of B.Ed. students' attitudes about e-learning for classroom instruction based on their subject discipline. The study concludes that B.Ed. students should be encouraged to use e-learning components in their classrooms. In-service training on e-learning may be provided to teacher-educators so that they can include e-learning aspects into their teaching methods. As a result, teacher-educators can hold their students' attention and help them understand the principles of their subject matter more readily, which will improve their learning process.

Meenatchi. B and Edward William Benjamin, A. (2014) studied the attitude of the teacher educators towards professional excellence. The purpose of this study was to determine the relationship between teacher educators' attitudes and their professional excellence. The current study attempted to investigate the level of Professional excellence of Teacher Educators based on the type of institution they work in. In this study, the survey method was used. A sample of 60 Teacher Educators from Pondicherry's education colleges was used for this study. The data was gathered using a professional excellence questionnaire. This study is only for Teacher Educators in the Pondicherry region. The findings indicate that there is a favourable association between teacher educators' attitudes and their professional excellence.

Krishna Reddy. B. and Srilatha. G. (2015) conducted a Study on the Attitude of Students of Education towards E-Learning. E-learning is considered to be a more effective way of learning and teaching in a larger group of students, thereby providing consistency in the educational quality. Any individual's learning would be influenced by their attitude toward e-Learning. As a result, education students are no different from consumers of e-gadgets who will enter the teaching profession and use e-Learning technology during their teaching-learning process. As a result, the current challenge is being addressed to investigate the attitudes of education (M.Ed) students toward e-Learning and to comprehend the impact of numerous variables. According to the study, 77 percent of M.Ed students had a favourable attitude toward e-Learning. The trend implies that they are eager to participate in e-Learning sessions. As a result, education must be done utilising e-Learning materials, which allows students to achieve higher achievements in their academic areas. With the use of the eLearning system, the educational system creates a complete and collaborative learning environment, and every classroom requires LCD projectors with laptops, and students may be encouraged to master the application of computers for solving various educational difficulties.

Arumugam Raman et al. (2015) conducted a study on Teachers' Attitude toward Computer Use in Classroom Practice Innovation of computer technology as a learning tool that dramatically changes the traditional concept of teaching. Nowadays, the computer is viewed as a tool for achieving educational goals, with teachers serving as facilitators. However, the attitude of teachers is a critical factor in integrating computers into the current classroom teaching-learning process. The purpose of this study was to look into potential teachers' perspectives toward computer use in the classroom. Following the current investigation, a survey research design was used. Data was collected using a 5-point Likert type scale on selected items from several Computer Attitude Scales (CAS) and Technology Acceptance Models (TAM). The population consisted of students enrolled in Information Technology under the Educational Studies discipline [B.Ed. (Hons.)] at UUM, CAS, and the sample consisted of students in their last semester of the same department. The sample size for this investigation was kept to a bare minimum. The aggregate findings show that aspiring instructors expect to use a computer in classroom practise. However, males and girls had different attitudes toward computer ruse. The findings also indicate that prior computer experience is an important factor in computer use in education. It can also be inferred that perceived utility, perceived ease of use, and effective component are essential elements in computer acceptance in classroom practise. It could serve as a resource for legislators, curriculum developers, and administrators. As a result, the study's findings have a substantial impact on computer integration into curriculum instruction, as well as being effective in achieving the goal of national education policy, which is focused at Malaysian Vision 2020. The purpose of this study is to learn about the attitudes of diploma engineering students concerning e-learning adaptation.

Thakkar, Samir & Joshi, Hiren. (2017) studied “Students Attitude Towards E-Learning”. The study's primary goal was to assess students' attitudes toward the adoption of E-learning systems. The survey method is used in the investigation. Fifty-six students from the information technology branch of the diploma engineering programme were chosen as a population sample. The data was gathered using an attitude scale. Gender, locality (rural / urban), and cast category (General / Reserved) disparities in students' attitudes regarding the utilisation of E-learning were investigated. The findings suggest that diploma engineering students have a strong preference for using E-learning. This attitude is also unaffected by changes in gender, location, or social class of students.

Radha, R., Mahalakshmi, K., Kumar, V. S., & Saravanakumar, A. R. (2020) conducted a study on "E-Learning during lockdown of Covid-19 pandemic: A global perspective". Purpose of the study is to determine students' attitudes regarding e-learning, primary data was collected on a national and worldwide scale using Google forms, which included the student community from various schools, colleges, and institutions. The another objective of this research is to investigate the E-learning process among students who are familiar with web-based technology. It also helps to find out solutions to improve the self-study skills of students. The stratified sampling method adopted in this study and the sample size is 175 across the world. The findings of the study reflect the impact of E-learning, students' interest in using E-learning resources, and their performance. In conclusion, this study shows that students' positive attitudes regarding e-learning and e -learning has become quite popular among the students all over the world.

2.12 SUMMARY OF REVIEW OF LITERATURE

The investigator has reviewed the studies that have been undertaken on instructions provided with the help of computers, ICT, CD-based courseware and an electronic content in abroad and India. Many researchers are interested in using computers as a medium for learning various subjects like English grammar and English as a language, Chemistry, Physics, Maths, and Social Science. Therefore, many studies were conductedon using computers, CD-based E-Content and ICT for learning English and other subjects too. To the researchers' best knowledge, studies were hardly conducted on using E-Content in learning various subjects at high school, higher secondary school and college level in Abroad and India. However, this section contains studies conducted on learning other subjects and chemistry and learner's attitudes towards E-Content.

So many researches have been conducted abroad to enhance the achievement level of learners in English, Maths, Science and Social studies with the assistance of computers. The investigator has reviewed 46 such studies deal with other subjects. They are Amroy, Alan, Naicker, Kevin (2001), Kekkonen-Monetum et.al (2002), Norhayati, A.M. & Siew, P.H (2004), Angeli, Charoula (2005), Tas, et. Al (2006), Jennings, Kathrineet al. (2007), Walker, David A. et al. (2008), Kenneth H. Smith (2009), Elizabeth A. Fisher and Viviam H. Wright (2010), Anderson, Janice and Barnaett, Michael (2011), Hsu, Pi-Sui (2012), Kamith Osman and Tien Tien Lee (2012), Wolter, et al. (2013), Rommel L. Verecio (2014), Fazzlijan Mohamed Adnan Khan and Mona Masood (2015), Mohd Nor Hajar Hasrol Jono, et al. (2016), Salasiya Mat Kila and Mai ShihahAbdullah (2016),Thorp, Robert (2017), Mansfield, Andrew (2019), Allia, M.Y & Souyeh.M.E (2021)

So many researches have been conducted in India to improve the achievement level of learners in English language and grammar and other subjects with the help of computers and electronic packages. The investigator has reviewed 42 studies from Indian researches. They are Sharma and

Sansarwal (2002), Shanthi and Amalraj (2003), Mirdula D. Ramade (2004), Subbaiah.S (2005), Johnson (2006), William B. Edward (2007), Golda Grena Rajathi P. (2008), Patel J. A. (2009), Anbucarassy B. (2010), Amutha S.(2011), Sadaghiani, Homeyra R. (2012), Upasana Singh (2013), Myhill, Debora, Watson, Annabel (2014), Harsha Patadia and Pramila Ramani (2014), Pio Albina A (2018), Saravaakumar. A.R (2020), Nachimuthu.K & Sasi P (2021).

So many researches have been conducted abroad to enhance the achievement level of learners in chemistry with the assistance of computers and ICT. The investigatorhas reviewed 7 such studies deal with chemistry subjects. They are:.Jennings, Kathrine, T., Erik, M. Weaver and Gabriela, C. (2007) Kamith Osman and Tien Tien Lee (2012)Plass, J. L., Milne, C., Homer, B. D., Schwartz, R. N., Hayward, E. O., Jordan, T., ... & Barrientos, J. (2012) Ramachandran, R., Sparck, E. M., & Levis-Fitzgerald, M. (2019) Hibbard, L., Sung, S., & Wells, B. (2016) Hamid, S. N. M., Lee, T. T., Taha, H., Rahim, N. A., & Sharif, A. M. Putri, R. A., Munzil, M., & Sumari, S. (2021).

The investigator has reviewed 5 studies conducted in India to improve the achievement level of learners in chemistry with the assistance of ICT and computers. There are Vasanthi and Hema (2003) Jothi, K.B.S. (2007) Subramanian, P., & Ramakrishnan, N. (2017) R. Jayakumar (2016) Devendiran, G., & Vakkil, M. (2017).

`So many researches have also been taken up in abroad and India to assess the attitude of the learners towards the usage of the computers and computer-assisted instruction. The investigator has reviewed 19 such studies conducted abroad towards the attitude of the learners. They are: Mazanah Muhamad, Ahmad Zamri Mansor, On Lily (2002), Paul G. Paris (2004), Alev

Ates, Ugur Altunay, Eralp Altun, (2006), Belinda Soo-Phing and Tse-Kian (2007), Barbhuiya Mamun, A. (2008), Erlich, Zippy; Gadot, Rivkar; Shahak, Daphna (2008), Teo, Timothy (2010), Adalier, Ahmed(2012), Sadia Mahmood (2012), Celik, Vehbi, Yesilyurt, Etem (2013), Orhan Ercan (2014), Orachorn Kitchakarn (2015), Ahmet Sami Konca, Erdogan Ozel et al. (2016), Scherer, R-2018, Allia. M.Y (2021).

So many researches have also been taken up in India to assess the attitude of the learners towards the usage of computers and computer-assisted instruction. The investigator has reviewed 17 such studies. They are Kalia, Ashoka, Levine, Tamar and Viji, Sanjana (2000), Kumaran and Selvaraju (2000), Narayanasamy (2000), Anbazhagan (2001), Epzi Bai et al. (2002), Helen Joy and Manickam (2002), Nirmala Sundara Raj (2005), Sree Rekha, R. (2008), Enok Joel. T.& Thangarajathi (2011), Gunmala Suri and Sneha Sharma (2013), Gopal B.V. Anandan K. (2013), Meenatchi B. and Edward William Benjamin, A. (2014), Krishna Reddy B. and Srilatha G. (2015), Arumugam Raman, et al. (2015), Thakkar (2017), Radha.R (2020).

Having reviewed 136 studies altogether, it is found that many researchers have asserted the importance of computer-assisted instructions in learning. It is clear from the reviews that computer-assisted learning is more beneficial and effective than traditional methods. The present study is different from the previously mentioned studies, particularly; the unavailability of many kinds of researches in the use of CD-based E-Content for the enhancement of the achievement level in chemistry. Hence the investigator has resolved to develop an E-Content for learning chemistry at the higher secondary school level keeping in mind the welfare of the poor learners studying Class XI in the rural area of Nallur region Government Higher Secondary School run by Government of Tamil Nadu.

2.13 DISTINGUISHING FEATURES OF THE PRESENT STUDY

After reviewing the existing researches, the following distinguishing features were contemplated and incorporated in the present research. Almost all the previous researchers compared various forms of computer-delivered instruction with the traditional method of instruction. In the present study, the researcher has infused E-Content learning and traditional methods of learning. A comparison between these two methods has been done. The content of the present research is the chemistry lessons prescribed for Class XI students under the Uniform System of School Education, Government of Tamil Nadu. In the existing research, Chemistry is given much importance for research with a focus on higher secondary school. Generally, a few kinds of research have been done in learning chemistry that too for middle classes and secondary classes under Secondary education or High school education. Many kinds of research have been undertaken as far as English, Maths, and Science subjects are concerned whereas researches done in chemistry are very few. Computer Assisted Chemistry learningusing an electronic content is a fresh attempt in the field of higher secondary school education.Beautiful pictures along with colour discrimination, audio, and video with animation make the content to be liked by the learners. Learning activities and enrichment activities are provided in each lesson so as to strengthen the learning experiences. Correction and feedback are given to the learners at every stage of the learning process. At the end of each lesson, evaluation is given to assess the achievement level of the learners. Varieties of tests are utilized to evaluate the learner's performance. Each test item is provided with checking answer options, immediate feedback, review options and retry options. Probably, this study might be a maiden attempt made for learners of rural schools for learning chemistry at the higher secondary level.

2.14 RATIONALE OF THE PRESENT STUDY

It is inferred from the review of related literature that all the studies except one (Parmar Pravinchandra, D. (2014) has proved that Computer Assisted Learning and computer-assisted instruction in other subjects established the supremacy of computers in the learning process, preferably the achievement area of the learners. The experimental groups of all the studies have proved to be more effective whereas the control groups proved to be less effective than the experimental groups.

Based on the reviews it is understood, various technologies such as CAI, CBI,CMI, CAL, CALL, e-learning, web-based learning, CD-based courseware, etc are said to be useful in the effective learning of any subject. Very few studies are undertaken to study the effectiveness of CD-based E-Content. Hence, the investigator has resolved to develop an electronic content for learning chemistry at the higher secondary school level. It is deduced through the reviews that rarely there are studies related to learning chemistry at the higher secondary school level. Few studies have been done under secondary and middle schools. It is necessary to have a system to learn chemistry easily and interestingly at the higher secondary school level.

The studies conducted to find out the attitude of the learners' towards computers established a constant stand that both boys and girls have a positive attitude towards computers. A positive correlation is found between the computer attitude and academic achievement. The result shows that the learners' favorable attitude towards computers increases their achievement level. (Sadia Mahmood (2012). As such, an intervention along with computers is unavoidable in schools. Hence, the investigator has chosen the present study to develop electronic courseware for learning chemistry at the higher secondary school level and to find out its effectiveness.

Most of the studies show that there is a good or excellent correlation between the computers assisted learning material and the achievement level of the learners. So also, a positive correlation exists between the learner's attitude and their achievement level. Hence, developing CD-based E-Content for the effective learning of chemistry at the higher secondary school level is accomplished by the investigator himself.

2.15 CONCLUSION

In this chapter, the investigator discussed about the need of review of related literature. Many studies are reviewed under different categories such as CAI, CD-based Courseware, ICT and learning English and Chemistry, ICT and learning other subjects, ICT and the attitude of the learners. Based on the reviews, a summary of the review of the literature and the rationale for the present study are given at the end of the chapter. The next chapter deals with the methodology of the study.

CHAPTER - III

METHODOLOGY

CHAPTER - III

METHODOLOGY

"Research designs are invented to enable the researcher to answer research questions as validly, objectively, accurately and economically as possible."

– Fred N. Kerlinger

3.1 INTRODUCTION

Research is a scientific, orderly and intensive process of fact-finding, experimentation, analysis of data and arriving at a valid conclusion (Best, 1963). Furthermore, research is logical and objective, making use of all available tests to verify the data gathered and processes performed. Patience in research, plodding without rushing, and scientific integrity are the co-ordinal foundations for research. These qualities demand a great deal of guts and vision. The procedures used to create the E-Content, the study's aims and hypotheses, research design, research tools, and study delimitations are all detailed in this chapter.

3.2 TITLE OF THE STUDY

The following is the precisely stated title of the study: **"EFFECTIVENESS OF E-CONTENT IN LEARNING CHEMISTRY AND ACADEMIC ACHIEVEMENT AT THE HIGHER SECONDARY LEVEL".**

3.3 OPERATIONAL DEFINITIONS OF THE KEY TERMS

The following variables are operationally defined meaningfully based on the study's title, "Effectiveness of E-Content in learning chemistry and academic achievement at the higher secondary level":

1. Effectiveness: According to the oxford advanced learners dictionary of current English by A.S. Hornby (OUP, 1984) "Effectiveness" means the power to bring about the desired result". In this study, it refers how well the E-Content in learning chemistry is obtained through E-Content learning courseware and in enhancing academic achievement at the higher secondary level.

2. E-Content: In this study, it refers to an electronic content which is the integration of multimedia components such as text, image, animation, video, audio etc., developed for individuals' self-learning in learning chemistry with the selected contents at the XI standard prescribed by the Tamil Nadu State Board syllabus.

3. Learning Chemistry: Here, it refers to how well a student achievers the task of learning chemistry in a classroom at the 11^{th} standard level with the help of E-Content in this study.

4. Academic achievement: In this study, it refers to the marks obtained by the XI standard students in the content taught before and after the treatment.

5. Higher secondary school: In this study, it refers to the students who are studying at XI standard students in Govt. Hr. Sec. school, Nallur, Cuddalore district, Tamil Nadu.

3.4 ASSUMPTIONS OF THE STUDY

The assumptions of the present study are;

i. It is possible to improve the achievement in Chemistry with the help of E-Content in learning chemistry at the higher secondary level.

ii. Learning Chemistry can be made easy and interesting through E-Content.

iii. It is possible that E-Content in learning chemistry will certainly enhance the achievement of higher secondary school students in Chemistry.

iv. E-Content will play a significant role to learn Chemistry interestingly.

v. It is possible to assess the attitude of higher secondary school students toward the E-Content in learning Chemistry.

3.5 STATEMENT OF THE PROBLEM

The introduction of improved communication technology is one of the major forces driving educational reform in the twenty-first century. These technology reforms are constantly influencing the education system, which is an innovation in and of it. Some wealthy countries' educational systems have become overly reliant on technical advancements. In some countries, E-Content has practically become an indispensible component of the entire educational system. Knowledge of contemporary technological breakthroughs will aid critical awareness of new prospects for enhancing educational accessibility while retaining educational quality. Developing countries like India are now unable to profit from technology advancements due to a variety of restrictions. However, by being more aware of the possibilities, Indian educators may be more sure that there are technologies that can help them improve the quality of education and make it more accessible to the general public.

Chemistry is considered generally as a tough subject by students and they find it difficult to understand the abstract concepts involved in it. In schools majority of the students feel that they need more clarity to comprehend the subject. Specifically the higher secondary first year students find difficulty in understanding many abstract concepts covered in the units Quantum mechanical model of atom and chemical bonding. The investigator felt that this impression can be reversed with the help of integrating technology in teaching and learning and by including interesting multimedia elements for learning the subject. Hence by reviewing all needs, the investigator wants to study the "**EFFECTIVENESS OF E-CONTENT IN LEARNING CHEMISTRY AND ACADEMIC ACHIEVEMENT AT THE HIGHER SECONDARY LEVEL**".

3.6 OBJECTIVES OF THE STUDY

Major Objectives

1. To find out the Effectiveness of E-Content in learning chemistry and academic achievement at the higher secondary level.
2. To find out the attitude of the students toward E-Content in learning Chemistry at the higher secondary level.

Specific Objectives

1. To find out the significant difference between pre-test and post-test meanachievement scores of the control group.
2. To find out the significant difference between pre-test and post-test meanachievement scores of the experimental group.

3 To find out the significant difference between pre-tests mean achievementscores of the control and experimental groups.

4 To find out the significant difference between post-tests mean achievementscores of the control and experimental groups.

5 To find out the significant difference between low achievers in pre-test andpost-test mean achievement scores of the control group.

6 To find out the significant difference between low achievers in pre-test andpost-test mean achievement scores of the experimental group.

7 To find out the significant difference between low achievers in pre-tests meanachievement scores of the control and experimental groups.

8 To find out the significant difference between low achievers in post-tests meanachievement scores of the control and experimental groups.

9 To find out the significant difference between moderate achievers in pre-test andpost-test mean achievement scores of the control group.

10 To find out the significant difference between moderate achievers in pre and post-test mean achievement scores of the experimental group.

11 To find out the significant difference between moderate achievers in the pre-tests mean achievement scores of the control and experimental groups.

12 To find out the significant difference between moderate achievers in the post-tests mean achievement scores of the control and experimental groups.

13 To identify the effect size between pre-test and post-test mean achievementscores in the control group.

14 To identify the effect size between pre-test and post-test mean achievementscores in the experimental group.

15 To find out the gain ratio between pre-test and post-test mean achievementscores in the control group.

16 To find out the gain ratio between pre-test and post-test mean achievementscores in the experimental group.

17 To find out the significant difference if any between the pre-test and post-testscores of attitude towards E-Content in learning chemistry at the higher secondary level in the control group.

18 To find out the significant difference if any between the pre-test and post-test attitude scores towards E-Content in learning chemistry at the higher secondary level in the experimental group.

19 To find out the significant difference if any between the pre-tests attitude scores towards E-Content in learning chemistry at the higher secondary level in the control and experimental groups.

20 To find out the significant difference if any between the post-tests attitude scores towards E-Content in learning chemistry at the higher secondary level in the control and experimental groups.

21 To find out the significant difference if any between the post-test and retention-test scores in learning chemistry at the higher secondary level in the control group.

22 To find out the significant difference if any between the post-test and retention-test scores in learning chemistry at the higher secondary level in the experimental group.

23 To find out the significant difference if any between the retention-tests scores in learning chemistry at the higher secondary level in the control and experimental groups.

3.7 HYPOTHESES

Major hypotheses

1. E-Content in learning the Chemistry and academic achievement at the higher secondary level is not effective.
2. The attitude of the students toward E-Content in learning Chemistry atthe higher secondary level is not effective.

Specific hypotheses

1. There is no significant difference between pre-test and post-test mean achievementscores of the control group.
2. There is no significant difference between pre-test and post-test meanachievement scores of the experimental group.
3. There is no significant difference between pre-tests mean achievement scoresof the control and experimental groups.
4. There is no significant difference between post-tests mean achievement scoresof the control and experimental groups.
5. There is no significant difference between low achievers in pre-test and post-test mean achievement scores of the control group.
6. There is no significant difference between low achievers in pre-test and post- test mean achievement scores of the experimental group.
7. There is no significant difference between low achievers in the pre-tests meanachievement scores of the control and experimental groups.

8 There is no significant difference between low achievers in the post-tests meanachievement scores of the control and experimental groups.

9 There is no significant difference between moderate achievers in pre-test and post- test mean achievement scores of the control group.

10 There is no significant difference between moderate achievers in pre-test and post- test mean achievement scores of the experimental group.

11 There is no significant difference between moderate achievers in the pre-tests mean achievement scores of the control and experimental groups.

12 There is no significant difference between moderate achievers in the post-tests mean achievement scores of the control and experimental groups.

13 There is no difference between the effect size of pre-test and post-test mean achievement scores of the control group.

14 There is no difference between the effect size of pre-test and post-test mean achievement scores of the experimental group.

15 There is no gain between the pre-test and post-test mean achievement scores of the control group.

16 There is no gain between the pre-test and post-test mean achievement scores of the experimental group.

17 There is no significant difference between the pre-test and post-test scores of attitude towards E-Content in learning chemistry at the higher secondary level in the control group.

18 There is no significant difference between the pre-test and post-test scores of attitude towards E-Content in learning chemistry at the higher secondary level in the experimental group.

19 There is no significant difference between pre-tests attitude scores towards E-Content in learning chemistry at the higher secondary level in the control and experimental groups.

20 There is no significant difference between post-tests attitude scores towards E-Content in learning chemistry at the higher secondary level in the control and experimental groups.

21 There is no significant difference between the post-test and retention-test scores in learning chemistry at the higher secondary level in the control group.

22 There is no significant difference between the post-test and retention-test scores in learning chemistry at the higher secondary level in the experimental group.

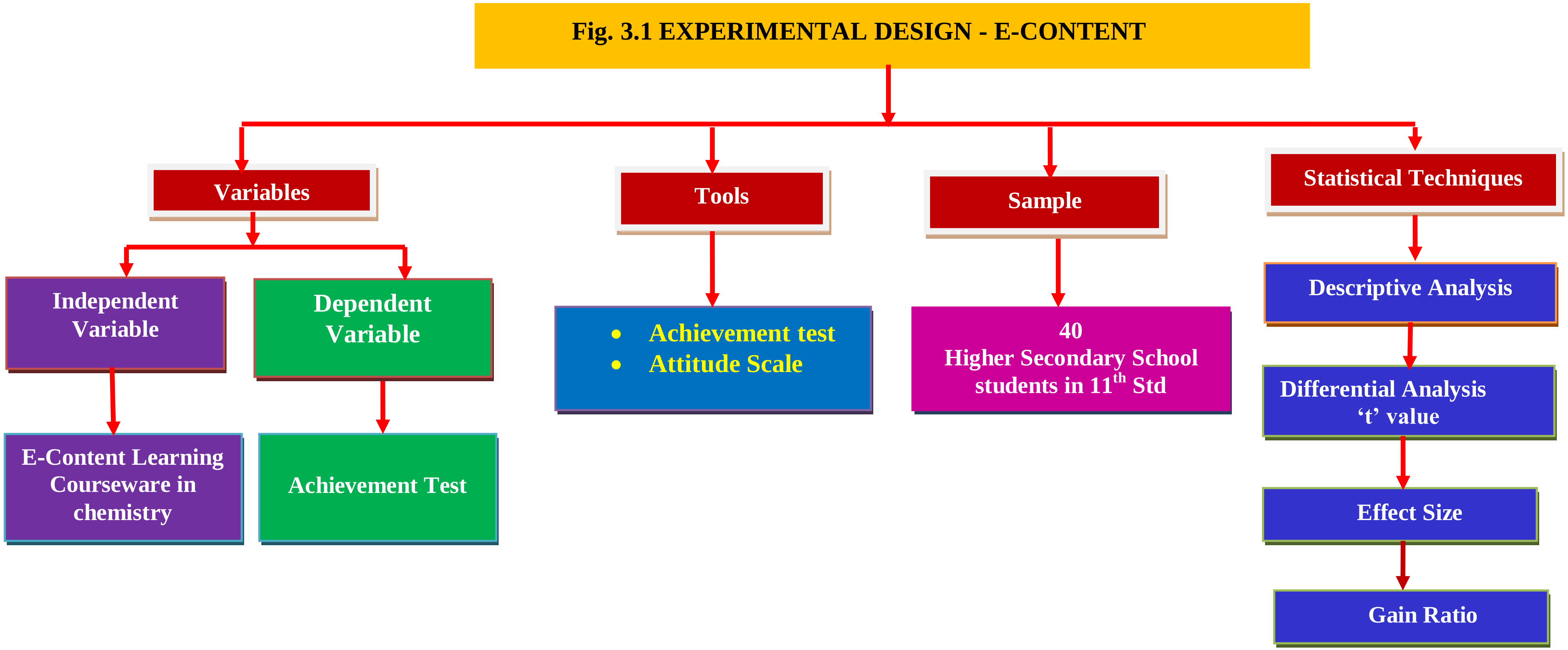
23 There is no significant difference between retention-tests scores in learning chemistry at the higher secondary level in the control and experimental groups.

Table – 3.1

Design of Experiment

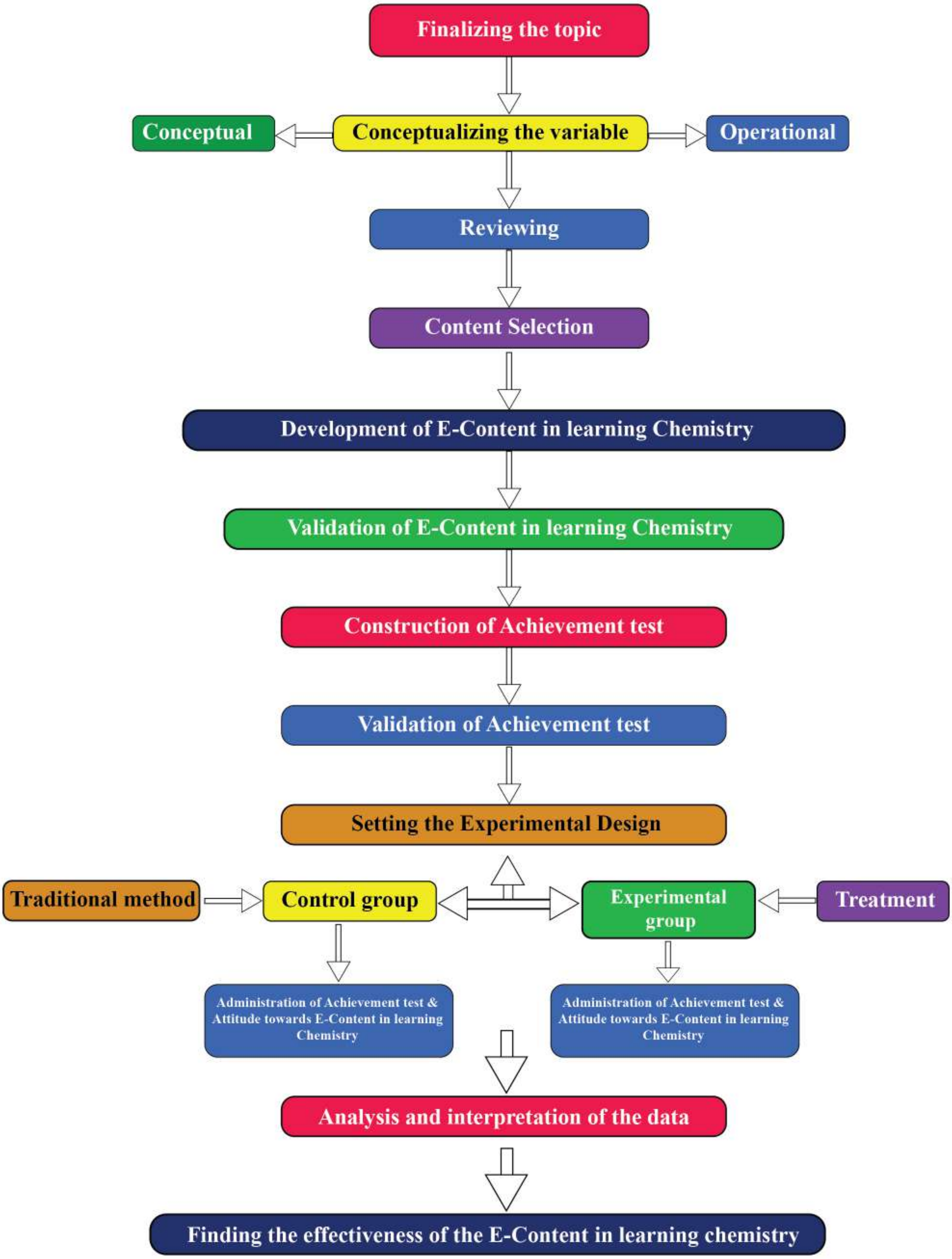
S.No	Control Group	Experimental Group
1	Pre-test	Pre-test
2	Learning through conventional method	Learning through E-Content
3	Post-test	Post-test
4	Retention test	Retention test

3.8 EXPERIMENTAL DESIGN



3.9 PHASES OF THE STUDY

Fig. 3.2 Phase of the study



3.10 EXPERIMENTAL METHOD

The experimental method of research does not involve activities such as describing a condition, determining the status of an object, or arranging past events, but rather the independent variables are systematically varied and manipulated to see what effects this variation has on the independent variables during the course of the experiment, which includes controlled observation as a major consideration. Experimentation's goal is to find causal links between various phenomena that must be uncovered in order to explain, predict, and regulate events.

3.10.1 RESEARCH DESIGNS

writes Kerlinger (1973) observes that "Research design is a plan, structure, and technique of study created so as to achieve control versions," The goal of research design is to make the various research activities run smoothly, resulting in research that is as efficient as feasible, giving the most knowledge with the least amount of effort, time, and money

William Zikmund (1988) has described, “Research design as a master plan specifying the methods and procedures for collecting and analyzing the needed information”.

As a result, the experimental design provides a blueprint for the techniques that allow a researcher to test hypotheses by drawing reliable conclusions about the relationships between independent and dependent variables. The objective of the experiment, the type of variables to be manipulated, and the settings or limiting factors under which it is conducted all influence the design. The design of experimental studies is inextricably linked to the controls utilised in the study.

3.11 EXPERIMENTAL DESIGN OF THE STUDY

In the present study Parallel group experimental design (Pretest-Posttest Equivalent-Groups design) is applied by the investigator. The pre test, progressive test, post test, Retention test control group design is used in this study. Experimental design provide different treatments on various groups and the responses to these treatments called as experimental conditions are observed by the investigator. In the parallel group experimental research, two parallel groups by name the control and experimental groups are exposed to treatment. Here, the control group is kept as the reference group by giving exposure in the traditional method of learning chemistry whereas the experimental group is exposed to E-Content for learning chemistry treatment so that comparisons can be made between the control group and the experimental groups.

E group	T_1	X	T_3	T_5
C group	T_2		T_4	T_6

E group - Experimental group, C group - Control group,

X – Treatment, T_1, T_2-Pretests T_3, T_4-Posttests

T_5, T_6-Retention tests

3.11.1 POPULATION OF THE STUDY

The population of the present study is eleventh standard students studying in the Govt. Hr Sec School, Nallur of Tamil Nadu with the Uniform Systemof School Education.

3.11.2 A SAMPLE OF THE STUDY

According to **W.G. Cochran,** "A sample as the name implies, is a smaller representation of a large whole. In other words, a section of the population selected from the latte in such a way that they are representative of the universe is called a sample".

Using a purposive selection technique, the investigator selected eleventh standard students from Govt. Hr. Sec. School, Nallur, which is located in the Virudhachalam educational district of Cuddalore revenue district as a sample. There are 73 students in this class. The investigator has randomly selected 40 students from the class based on their second term terminal examination, and a homogeneous group has been formed based on their achievements. Systematic error is reduced through randomization. When selecting samples from the population, the groups' equivalence is also taken into account. 20 students were assigned to the experimental group, while the other 20 were assigned to the control group.

3.12 E-CONTENT IN LEARNIG CHEMISTRY

The following E-Content is used in the present study:

a. E-Content (CD format) in learning chemistry at the higher secondary level developed and validated by R.Selvaganapathy & Dr.A.Edward William Benjamin (2021).

3.12.1 RESEARCH TOOLS

The following are the research tools used in this present study:

a) Academic Achievement test in Chemistry tool was constructed and validated by R.Selvaganapathy & Dr.A.Edward William Benjamin, 2021.

b) Attitude scale towards E-Content in learning Chemistry at the higher secondary level tool was constructed and validated by R.Selvaganapathy & Dr.A.Edward William Benjamin, 2021.

3.13 DEVELOPMENT OF E-CONTENT IN LEARNING CHEMISTRY

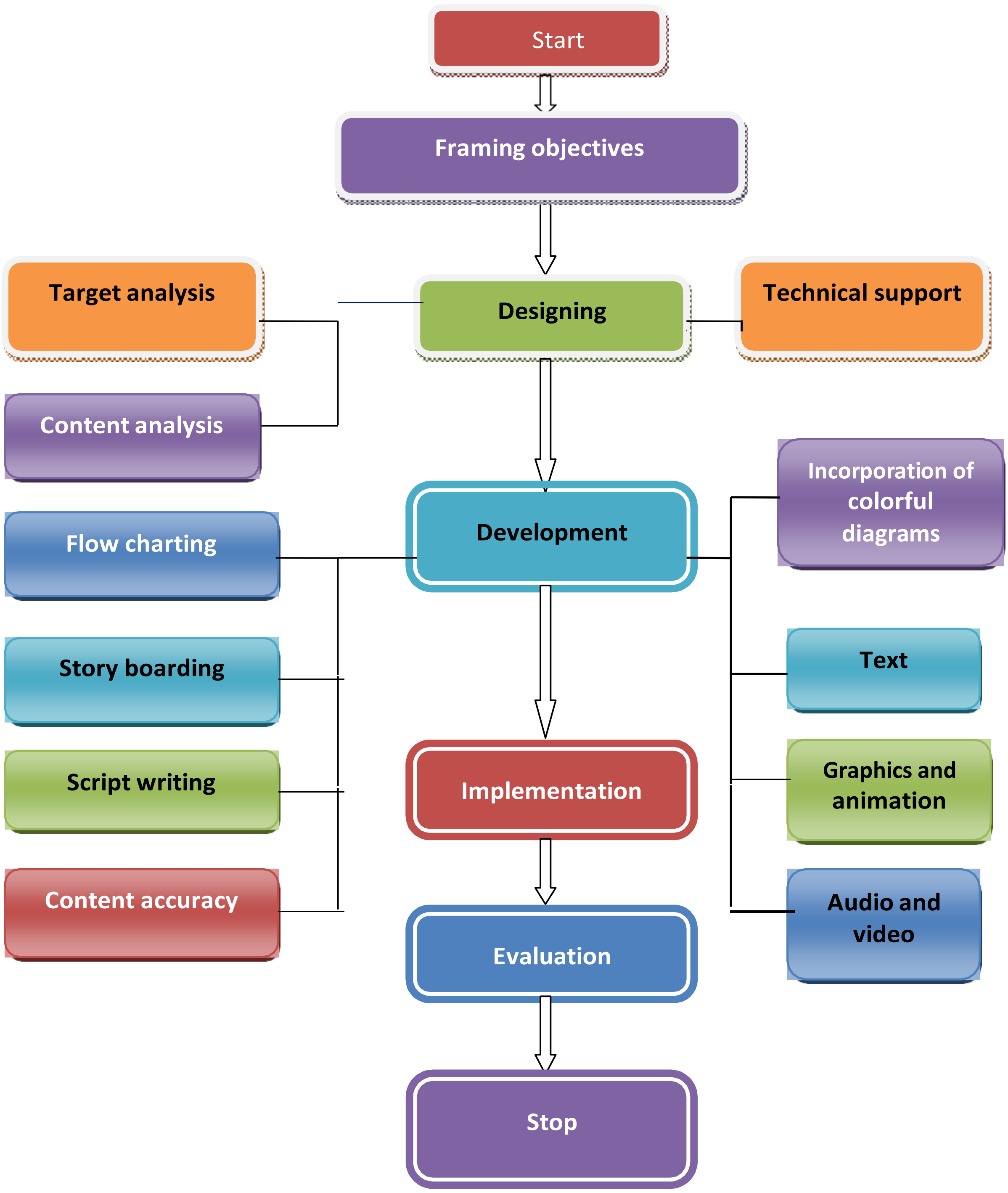
The primary objective of the present study is to develop an E-Content in learning chemistry at the higher secondary level. The investigator has chosen two chapters in the Class XI Chemistry textbook prescribed by the Government of Tamil Nadu under the Uniform of System of School Education. The **Quantum mechanical model of atom and chemical bonding** are taken for the preparation of the E-Content. This chapter has been converted into meaningful lessons with detailed illustrations along with pictures. The details of the lessons are presented here under in Table 3.2

Table - 3.2
Lessons in the E-Content

LESSON	CONTENT
Lesson- 1	Quantum Numbers
Lesson- 2	Shapes of Orbital
Lesson- 3	Aufbau Principle
Lesson- 4	Pauli Exclusion Principle
Lesson- 5	Hund’s Rule
Lesson- 6	Types of Chemical Bonding
Lesson- 7	Hybridisation
Lesson- 8	VSEPR Theory
Lesson- 9	VB Theory
Lesson- 10	MO Theory

The steps involved in the E-Content development is

Fig. 3.3. Development of E-Content



3.13.1 Analysis and Framing Objectives

The first task in this phase is to identify the target audience and determine their entry behavior, as well as to develop a set of learning objectives based on a selected set of competencies, a concept map that organizes the concepts that must be mastered in order to achieve the learning objectives, and course content organized as units/lessons. The identification of learning objectives for the selected list of competencies is the most important activity of the analytical phase. All of the goals must be behaviorally based and measurable.

3.13.2. Designing

The Design phase consists of tasks that help the learning designer to create a plan for the development of learning materials. Target analysis, content analysis, references, and technical support are all part of the planning process.

a) Target analysis

It is essential to evaluate the entry-level behaviour of the samples, who are all eleventh standard students, achievement scores, attitude toward computers, attitude toward E-Content in learning chemistry, and knowledge of using computer hardware such as CD-ROM.

b) Content analysis

The Chemistry textbook provided for Eleventh Standard students under the Uniform System of School Education in the State of Tamil Nadu was chosen as the subject of this study. For analysis and E-Content preparation, two chapters from the Class XI syllabus is chosen. The investigator has formed a team of professional experts (chemistry teachers at the secondary level – 3, chemistry teachers in colleges – 2, physical science teachers in colleges of education – 2, psychology teachers in colleges – 2, media instructors in colleges – 1). These specialists have been asked in analysing Chemistry topics, material quality, and providing suggestions to the investigator on how to prepare lesson plans in such a way that the learners can easily understand the concepts. While planning for the preparation of the lesson plans, the expert team considered pedagogical theories and methods of learning Chemistry. Each idea has been divided into simple units by the investigator with the help of the learners' interest and focus.

c) Technological support

An educational technologist's help is required to develop E-Content for learning chemistry. An education technologist is a specialist in the application of technology in the classroom. Furthermore, the techie must be familiar with articulate software in order to mould the information gathered from the subject expert. The computer-based teaching for the units was created by an education technologist, and the subject's contents are further divided into meaningful lessons based on the lessons presented. These lessons are organised in a logical order based on the content.

3.12.3 Development

The following are taken into account to the development of E-Content.

a) Flowcharting

To operate the E-Content, flowcharting is required. For the learner to proceed with the E-Content, a well-established flow chart is required. The software in this E-Content begins with a title screen and then continues on to a menu button. The learner can use the mouse to click the buttons on the menu board to select the lessons/units that they want to be learnt.

b) Content accuracy

The content used for developing the E-Content is extremely exact, leaving no opportunity for error or confusion. The accuracy of the material matched well with the electronic aspects such as scriptwriting, narration, graphics, and animation. The content analysis was carried out with the care by the expert group and the subject specialist.

c) Scriptwriting

The content for all lessons was scripted by the investigator and a team of teachers who are professionals in teaching Chemistry at the higher secondary school and college level. The scripts are written to display appropriate graphics, including animated and audio-effect pictures, while avoiding abstract terminology and words. All of the content is taken from the class XI textbook in order to keep the students engaged. The structures introduced are well-known, and they lead learners from a well-known source of knowledge to the unknown.

d) Storyboarding

A storyboard is a hand-drawn representation of each and every scene that will be shot. It creates a visible physical copy of the information from the script and flow charts. In order to ensure visual and narrative continuity between scenes, storyboards are essential. In order to generate the E-Content for this study, the investigator worked with a technical specialist to create a storyboard for all of the classes.

e) Text

When using the text, it is important to pay attention to the font and font size of the text, as well as the colour of the text and its background. Access to the meaning of text transmitted in another media, such as images, is likewise given due consideration and care. The wording is so precise that it may provide the student with the correct information and meaning. Wherever visuals are utilised to enhance the teaching experience, they are designed so that students can access the learning that the topic expert intended.

f) Diagrams and graphs

Diagrams and graphs can be an excellent substitute for verbal or numerical information that is difficult to comprehend. As a result, they are employed very carefully to ensure that the learners may access the material that the subject expert intended for the learners to acquire.

g) Audio and Video

Audio information is a valuable learning tool. Both audio and video, like audio and video, are a rich medium and effective accessibility solution. To overcome accessibility obstacles, audio information has been accompanied by a transcript.

h) Animations

Still diagrams, photos, and other visual information can be enhanced using animations, which add vibrancy and clarity to the content. The E-Content features a lot of animations so that it can access the content as well as gain knowledge and experience.

3.13.4 Implementation

The instructional materials and methods were adapted at this stage to allow the teacher to operate the E-Content. A small scale trial is evaluated with eleventh standard students of group "B" from Govt. Hr Sec School, Nallur, Cuddalore district, Tamil Nadu. Since the interface between the learners and the computers determines the efficiency of the programme. To achieve the goal achievement in chemistry through E-Content at the higher secondary level, improvements to the learning materials are worked out and included into the E-Content.

3.13.5 Evaluation

Evaluation of the E-Content in learning chemistry at the higher secondary level can be done at the content level and also at the applied technology level. Following the development of the E-Content, a test CD-ROM was developed and submitted to content specialists for input and evaluation using a sample of the target evidence. The CD-ROM was put through its paces in terms of content correctness, usability, and appeal. Corrections were made to the E-Content based on the content specialists' comments and feedback to ensure the correctness and relevancy of the information, style, and content interest.

The E-Content was again tested individually and in groups with students in the eleventh grade from Govt. Hr Sec School, Nallur, and comments on the content was gathered. The E-Content was fine-tuned in response to the learners' feedback. The E-Content was finally implemented to the experimental group after receiving expert feedback. The thesis includes a copy of the E-Content in learning chemistry at the higher secondary level. (Refer-Appendix)

3.14 SYSTEM REQUIREMENTS TO RUN THE E-CONTENT PACKAGE

The minimum hardware requirements to run the E-Content package in learning chemistry at the higher secondary level are

1. Microsoft Windows XP, 7 or later
2. Pentium 4 processor or higher
3. 2GB RAM
4. Minimum 15 GB available on the C Drive
5. CD-ROM, 2 X or higher
6. Windows Media Player ActiveX
7. PDF reader
8. Bomini Tamil Font.

The Software’s used to develop the E-Content in learning chemistry are

1. Articulate Storyline
2. Articulate Studio
3. Audacity 1.3
4. Photoshop CS 2
5. OBS Studio
6. Openshot
7. PowerPoint
8. Adobe Captivate
9. Hot Potatoes

3.15 INSTALLATION

The procedures to be followed to run the E-Content in learning chemistry at the higher secondary level is

- Insert the E-Content in the CD-ROM drive
- Just double click on 'selvaganapathy.exe' file.
- It is a portable version.
- Some antivirus may block this. If it is not running please stop your antivirus temporarily.
- It will take some time to load, please wait until loading.
- Set correct resolution for best appearance.

3.16 UNIQUE FEATURES OF E-CONTENT IN LEARNING CHEMISTRY AT THE HIGHER SECONDARY LEVEL

1. The E-Content is learner-centered and user-friendly in nature.
2. Learners can learn Chemistry concepts through E-Content.
3. The E-Content is motivating in nature and interesting that it keeps the attention of the learners.
4. Each lesson is introduced with the necessary objectives.
5. Each lesson has got five components namely, objectives of the lesson, introduction with motivation part, learning activities/experiences and presentation of the lesson,enrichment activities, and evaluation part.
6. Teachers can check their responses every now and then and get the feedback.
7. Lessons are composed of relevant attractive pictures, video clippings, animation, and audio effects.

8 Each lesson is developed with an added voice so as to draw the attention of the learners.

9 Navigation buttons are clearly displayed so that the learners can use them as per their requirements.

3.17 ACHIEVEMENT TEST

According to N.M.Downier (1961), “Any test that measures the attainment or accomplishments of an individual after a period of training of learning is called an achievement test”. Achievement test is designed to assess what a student has learnt and their current level of achievement. The majority of school assessments are achievement tests. They can be used to determine an individual's achievement. Achievement scores are used to assess the effects of study courses, teaching methods, and other aspects considered significant in educational practice.

The achievement test is developed as per the instructions of Stanley and Hopkins (1972). The instructions are as follows

- Achievement tests should evaluate all important outcomes of the instruction.
- The Organization of the test must reflect the purpose of the test.
- The nature of the test must reflect the conditions under which it should be administered.

3.18 DEVELOPMENT OF THE ACHIEVEMENT TEST

The Development of the achievement test was based on the selection and analysis of the items. Judgments cannot be made solely on the basis of intuition, haphazard guessing, or custom (Sax, 1989). It is critical to undertake item and test analysis when norm-referenced exams are produced for instructional purposes, assessing the effectiveness of educational programmes, or conducting educational research.

3.18.1 Item Selection

The following suggestions are followed scrupulously while developing the multiple-choice question items as suggested by Ebel (1963):

a) Write the items clearly, simply and correctly as much as possible.

b) The Select key statement that clearly defines the concepts and principles fromthe instructional materials.

c) Write the items so as to cater to the potential of the gifted learners too.

d) Make the item in such a way as to make revision and assembly convenient.

e) Avoid specific determiners so as to make the correct answers thoroughlycorrect.

3.18.2 Item Analysis

Test analysis examines how the test items perform as a set. Item analysis "investigates the performance of items considered individually either in relation to some external criterion or in relation to the remaining items on the test" (Thompson &Levitov, 1985, p. 163). These studies rate the items' and the test's overall quality. All 75 items were analysed in this study by administering a pilot study to a population of 35 students, and 50 things were chosen through item analysis. Such analyses can also be used to revise and improve both individual items and the entire test. These tools include item difficulty.

Item Difficulty

The percentage of students that answered the item correctly is referred to as item difficulty. The easier an item is, the higher the percentage of people who get it right. The easier the object is perceived to be, the higher the difficulty index (Wood, 1960). Divide the number of persons who properly answered the item by the total number of people who answered items to get the item difficulty. The proportion for the item is usually denoted as p and is called item difficulty (Crocker & Algina, 1986). The item difficulty, or p-value, of an item answered correctly by 85 percent of the examinees is.85, whereas the item difficulty, or p-value, of an item answered properly by 50 percent of the examinees is.50.

3.19 RELIABILITY OF THE ACHIEVEMENT TEST

'Reliability is a consistency with which a tool measures what it is supposed tomeasure' (Garret, 1979). A test is reliable to the extent it measures accurately and consistently from one time to another.

3.19.1 Internal Consistency Method

The researcher can use reliability test analysis to see how well a scale delivers consistent findings when measurements are repeated. As the inter-correlations among the items in the study increase, Cronbach's alpha rises. Alpha above 0.70 is regarded reliable in Cronbach's alpha statistics, according to a common norm. Alpha more than 0.60 is probably reliable, whereas alpha less than 0.59 is considered unreliable.

According to Cronbach's internal consistency method, the achievement test's reliability to test the chemistry achievement of eleventh standard students is 0.79, which is regarded reliable (alpha).

3.20 VALIDATION OF ACHIEVEMENT TEST

The validity of a test is defined as "the degree to which the test genuinely succeeds in measuring what it sets out to measure." As a result, validity refers to the test's accuracy. There are several types of validity, depending on the research tool's objective. Content validity, construct validity, predictive validity, and concurrent validity are the four types of validity. The content validity of the achievement test item has been given careful consideration by the investigator.

3.20.1 Content Validity

The degree to which the test genuinely measures or is precisely related to the attributes for which it was developed is referred to as content validity. The achievement test in this study is designed to assess the information and skills that a student should be able to master after completing the E-Content, and therefore content validity is established.

3.21 ADMINISTRATION OF THE ACHIEVEMENT TEST

The achievement tests were conducted in two aspects uch as pre-test, post test and retention-test for both the control and experimental groups.

3.21.1 Administration of Pre-Test

The accomplishment exam designed to collect data was used as a pre-test to assess the learners' entry-level behaviour in both the control and experimental groups. 75 minutes was allotted for the pre-test. Dececco and

Cramford (1977) rules were rigorously followed for optimal administration.

3.21.2 Administration of Post-Test

The post-test was given to both the control and experimental groups after the experimental group received treatment for two month. The duration of the test was 75 minutes. The post-test was used to determine the learners' final behaviour, which included both control and experimental groups.

3.21.3 Administration of Retention-Test

The retention-test was given to both the control and experimental groups after the twenty one days after the post tests. The duration of the test was 75 minutes. The retention-test was used to determine the learners' retention level, which included both control and experimental groups.

3.21.4 Scoring Procedure

The scoring procedure was carried out by awarding one mark to each objectivetype question for correct answers. Wrong answers were awarded zero marks. The totalscore of the achievement test is of 50 marks.

3.22 CONTROLLING THE THREATS TO VARIABLES

Variable control is a key aspect of experimental design. The experimenter attempting to demonstrate causal linkages should be able to change experimental conditions and observe the results. At their level of achievement, the samples chosen for experimentation should be similarly matched. Randomization and group equivalence have both been used to reduce systematic inaccuracy.

The experimental design is a roadmap for the processes that will be followed during the experiment. Any experiment must be genuine in order to be beneficial. Experimental validity can be divided into two categories. They are as follows:

- Internal validity.
- External validity.

The extent to which the experiment is actually effective, that is, the extent to which manipulations in the independent variables cause changes in the dependent variable, is referred to as internal validity. It is concerned with the genuine variance in the dependent variable that has been caused by the independent variable's induced variations (treatment). The generalisation of the experiment's outcomes/findings is connected to external validity.

3.22.1 Internal Validity

Internal validity refers to the control of extraneous variables. The factors that affect the internal validity of the experimental design are discussed below.

a) Subject characterization: The individuals in a comparison group may differ in age, gender, ability, socioeconomic level, and other factors. Subject characteristics threats are the names given to these variables. If not controlled, these variables may be used to explain any differences that arise across groups. To avoid subject categorization, the subjects in this study were chosen from the Government recognised high school in Nallur based on their performance in the second term end examinations.

b) Loss of subjects: Even if the subjects are carefully chosen, it is highly normal for some of them to drop out as the study progresses. This is known as a mortality threat, which occurs when some subjects drop out of the study or are missing during data collection. This will almost probably have an impact on the post-test result. There was no loss of individuals in this study till the experimentation was done within one month, therefore the hazard was controlled.

c) Location: The particular location in which data are collected or in which an intervention is carried out may create alternative explanations for results. This is called a location threat. The Location threat was controlled by choosing a Government recognized high school under the control of the investigator.

d) Instrumentation: The way in which instruments are used may cause a threat to internal validity. The factors which cause instrumentation threat are:

1) Instrument decay

The Instrument can create problems if the nature of the instrument is changed in some way or another. This is referred to as instrument decay. In this research, the researcher used objective type was administered by him alone. Thus, instrument decay is controlled to maintain internal validity.

2) Data collector's characteristics

The characteristics of the data collector can also affect the results. Gender, age, ethnicity and language pattern of the individual who collects the data in the studymay have an effect on the nature of the data he/she obtains. If these characteristics are related to the variables, being investigated, they may offer an alternative explanation for whatever findings appear. The researcher himself conducted the test instead of the class teacher to avoid any characterization on the part of the data collector.

3) Data collector's bias

There is also the possibility that the data collector or scorer may unconsciouslydistort the data in such a way to make the outcomes more likely. In this study, the researcher himself is the data collector; the question of characterization didn't arise.

e) Testing: Testing threat is the effect of taking one test on the results of subsequent tests. It is usual to test individuals at the start of an intervention study where data is collected over a long period of time. We use the term "testing" to refer to the usage of any type of instrumentation. If there is a significant improvement in the post-test score, the investigator may assume that it is due to the intervention; however, another possibility is that it is due to the usage of pre-test. To counteract this danger, the researcher ran the same test on all of the samples at the same time.

f) Chemistry: Some unexpected events that may occur during the progress of the experiment, affecting the dependent variable. Chemistry is a list of important events. Any external event that will occur in the course of the experiment and affect the influence of the independent variable upon the dependent variable is Chemistry. In the present study, unexpected events didn't occur and thus the threat of Chemistry is controlled.

g) Maturation: Changes that occur during an intervention are frequently due to factors related to the passing of time rather than the intervention itself. This is referred to as a maturation threat. The investigator has included well-selected reference groups in the present study to control the maturation threat.

h) Diffusion: If the study is done on the same premises, venue, or school, it is feasible that the experimental and control groups will share their thoughts and ideas during the investigation. When two groups are treated in the same school, there is always the possibility of inferiority and superiority complexes developing between them. Diffusion of treatment, according to McMillan and Schumacher (1984), can lead to resentment or rivalry among members of one group, particularly among those who believe they have received inferior treatment or activity. Diffusion was controlled in this study by treating both the control and experimental groups equally.

3.22.2 External Validity

The goal of conducting an experiment on a sample chosen according to sampling procedures is to ensure that the results or inferences gained from the experiment are generalizable or applicable to other samples of similar character. This feature of the experiment is called external validity. The factors which contribute to external validity are: 1. Location, 2. Representation, 3. Reactive effects of testing, 4. Reactive effect of experimental procedures, 5. multiple treatment interference, 6. Intersection of selection and the experimental variable.

a) Location

The specific place where data is collected may result in a different interpretation for the results. The term for this is 'location threat.' If the tests are delivered in noisy or poorly lit rooms, the students' performance may suffer. However, in this investigation, a well-known school was chosen to avoid any potential dangers.

b) Representation

The degree to which the sample is typical of the population to which the study's findings are to be applied is a significant criterion in establishing external validity. The population and sample for this study were purposefully selected from high school students enrolled in the XI standard. As a result, the chosen group was a population representative group.

c) Reactive effective of Pre-testing

In an experiment, there is a risk that the pre-test will influence the experimental group's response to the treatment. It has been discovered that giving subjects a pre-test to assess their knowledge of the study may sensitise them, causing them to be more receptive to the information delivered during the treatment period. To avoid sensitization, the test was administered to both the control and experimental groups as a routine class test.

d) Reactive effects of the experimental procedures

In experimental research, there's a chance that the therapy and the experimental procedures will interact and cause an effect. The 'Hawthorne effect' is a term used to describe this phenomenon. It got its name since it was discovered in Chicago's western electrified Hawthorne Plaint. Because people may react differently in such situations due to anxiety, the investigator did not inform the subjects that an experiment was being carried out. However, the groups were treated equally.

e) Multiple-Treatment Interferences

Many treatments were tested on the same patients in some tests. As a result, interactions between the various treatments are possible. When another therapy is scheduled, the residual effect of the previous treatment may still be present. However, in this study, the researcher took great care to avoid any type of interference throughout the treatment. The students were made interested to learn Chemistry through E-Content.

f) Interaction of selection and experimental variable

There is always a chance of affecting the results of the experiment due to selection and experimental variable for the study. But by taking remedial measures, ithas been controlled in the following ways:

- Since the learners are common in achievement, there is less chance of interactive variable.
- The syllabus was also the same.

3.23 CONSTRUCTION OF ATTITUDE SCALE TOWARDS E-CONTENT IN LEARNING CHEMISTRY AT THE HIGHER SECONDARY LEVEL

Attitude is a psychological state that influences behaviour. Attitude is not an inborn or instinctive trait; it is largely determined by a person's prior experiences and its impact in a new setting. As a result, attitudes are established via experience, and they can alter as a result of internal and external factors.

The investigator devised an attitude scale for E-Content in learning chemistry to assess learners' attitudes toward studying chemistry at the higher secondary level, which he administered to the samples before and after treatment. The Scale was created in 3 phases.

- Pre-Pilot phase
- Pilot phase and
- Finalization phase.

3.23.1 Pre-Pilot Study Phase

In this phase, item pooling is done. Item Pooling consists of a) item coverage b) source of items and c) criteria for item selection.

a) Item Coverage

Computer usage, Computer usage in teaching Chemistry, Confidence in handling computers, Computer anxiety, and Computer Utility are the items covered in constructing the learner's attitude scale toward E-Content in learning chemistry.

b) Item Sources

The item pool is initially made by drawing resources from the following sources.

- Review of thematic and research work.
- Discussion with experienced computer teachers.
- Discussion with experienced educational psychologists.
- Discussion with learners and their Chemistry teachers.

The statements were collected through discussions and tabulated. Thus a total of 45 statements were collected during this phase.

c) Criteria for Selection of Items

The criteria set to screen the statements collected through discussion with experts from various fields to delete, to add, to revise, to refine and to modify the statements are

- The language of the statements should be simple and concise.
- The language of the statements should be unambiguous.
- All statements must be as far as short.

- The direction should be clear for an honest rating.
- The rater should clearly know what is going to be rated.

3.23.2 Pilot Study Phase

In this phase, the refinement of the items was done through Judgment analysisand Item analysis.

In judgment analysis, all the selected statements were given to the subject andtechnological experts to determine the suitability and objectivity of the items pooled. On getting inputs from them, some of the items were dropped and some have been modifiedand restructured. Finally, 35 out of the 45 items were selected for item analysis.

In item analysis, the refined 35 items were put to pilot testing. 25 students from Government high school XI'B' group was administered with the attitude towards E-Content in learning chemistry. Scores obtained by them were tabulated and computed. Finally, 25 items were selected for the study using Croanback's Alpha.

3.23.3 Finalization Phase

In this phase, 25 items were retained in the Attitude towards E-Content scale using item analysis.

3.23.4 Scoring Procedure

The Attitude scale towards E-Content consists of 25 items. All items are presented as statements with 10 statements for the cognitive domain, 8 statements for the affective domain and the remaining 7 statements for the behavioral component. Each item is unique in nature and each item has five options, strongly disagree, disagree, undecided, agree and strongly agree. The scale consists of both positive and negative statements. There are 15 positive statements and 10 negative statements. Items 1-4, 7,9,11,15,16,18 and 19-23 are positive and items 5, 6, 8, 10, 12-14, 17, 24 and 25 are negative. The students have to choose any one of the five options as their choice. The scale is used for testing the learner's attitude towards E-Content. First reverse the scores for the following items: 5, 6, 8, 10, 12-14, 17, 24 and 25. For example, a score of "1" becomes a "5." Next, add up all twenty-five scores to obtain the total 'Attitude scale' score. This score must range from 25 to 125 with a neutral score of 75.

3.23.5 Reliability of Attitude Scale towards E-Content in Learning Chemistry

Reliability comes to the fore-front when variables developed from summated scales are used as predictor components in objective models. Since summated scales are an assembly of interrelated items designed to measure underlying constructs, it is very important to know whether the same set of items would elicit the same responsesif the same questions **are recast and re-administered** to the same respondents. Variables derived from test instruments are declared to be reliable only when they provide stable and reliable responses over a repeated administration of the test.

A general rule for measuring reliability is Cronbach's alpha above 0.70 is considered reliable. Alpha above 0.60 is probably reliable. Alpha below 0.60 is considered not reliable. The reliability of the attitude Scale is 0.81 which is high enough to establish reliability.

3.23.6 Validity of Attitude Scale towards E-Content

The validity of a test is defined as "the degree to which the test genuinely succeeds in measuring what it sets out to measure." As a result, validity refers to the test's accuracy. There are several types of validity, depending on the research tool's objective. Content validity, construct validity, predictive validity, and concurrent validity are the four types of validity. The content validity of the attitude test item was given appropriate consideration by the investigator.

a) Content Validity

The degree to which the test genuinely measures or is precisely related to the attributes for which it was developed is referred to as content validity. The attitude scale in this study is used to assess the learners' attitudes regarding E-Content. The attitude scale's statements measure what it's designed to measure, hence its validity is established.

b) Concurrent Validity

It refers to the usefulness of a test item in closely relating to scores on another test of known validity. In this study, the attitude scale test scores of Pre-test versus posttest scores and Pre-test versus posttest scores were correlated. The calculated coefficient was 0.86 to justify concurrent validity.

The format used to collect the attitudes of the learners through the ‘Attitude scale towards E-Content Scale’ is given below in table 3.3.

Table - 3.3

Attitude Scale towards E-Content in learning chemistryat the higher secondary level

1	2	3	4	5
Strongly Disagree	**Disagree**	**Undecided**	**Agree**	**Strongly Agree**

S. No.	Statements	Choice
1	Learning through computer is interesting.	
	கணினி மூலம் கற்றுக்கொள்வதுசுவாரஸ்யமாக உள்ளது.	
2	Animation does not scare me at all.	
	மின் பாடங்கள் என்னை அச்சுறுத்துவதாக இல்லை.	
3	Learning through E-Content is informative.	
	மின் பாடங்கள் மூலம் கற்றுக்கொள்வது தகவல் அளிப்பதாக உள்ளது.	
-	……………………………………………………………….	
25	………………………………………………………………… …	

3.23.7 ADMINISTRATION OF ATTITUDE SCALE TOWARDS E-CONTENT IN LEARNING CHEMISTRY AT THE HIGHER SECONDARY LEVEL

Attitude scale towards E-Content in learning Chemistry at the higher secondary level tool was constructed and validated by R.Selvaganapathy & Dr.A.Edward William Benjamin, 2021. During the pre and post achievement assessments, it was given to both the control and experimental groups to measure the learners' attitudes about E-Content in learning chemistry at the higher secondary level.

3.24 DELIMITATIONS OF THE STUDY

The delimitations of the study are:

1 The sample selected for experimentations are students of class XI only.

2 The investigation is restricted to rural school students belonging to the Nallur, Cuddalore district, Tamil Nadu.

3 This study lays the focus on students studying in Tamil medium schools run by Government of Tamil Nadu.

4 The content selected for developing the E-Content is meant for two chapters and the experimental period is for two months only.

5 The E-Content prepared in learning chemistry is based on the state board syllabi prescribed under the Uniform System of School Education in Tamil Nadu.

6 For studying the attitude of students, the concepts known as E-Content in learning chemistry will be selected. The other aspects of technology are not included within the purview of the present study.

7 Only a few concepts contained in the 11^{th} Chemistry textbook were selected for the development of E-Content in learning chemistry.

3.25 CONCLUSION

The investigator has discussed the assumptions, objectives and hypotheses in this chapter. Additionally, the experimental design, research methods, development of E-Content, development of the achievement test, development of the attitude scale, and their validation were discussed. Finally, delimitations of the study were also discussed. The following chapter throws light into the data analysis and interpretation.

CHAPTER – IV

ANALYSIS AND INTERPRETATION OF DATA

CHAPTER - IV

ANALYSIS AND INTERPRETATION OF DATA

"The goal is to transform data into information and information into insight''.

- Carly Fiorna

4.1 INTRODUCTION

This chapter is about analyzing and interpreting the data that the investigator gathered and documented throughout the experiment. The most crucial step in the entire research process is interpretation. It necessitates a careful analysis of the data's limitations as well as the subjective attitude. According to Fergusen, G.A (1981) "the process of interpretation is essentially one of stating is that what the result shows, what they mean, what their significance is, what is the answer to the original problem".

Data was obtained, collected, categorized, and statistically evaluated in accordance with the objectives of the study entitled, "Effectiveness of E-Content in learning chemistry and academic achievement at the higher secondary level." The research includes an independent variable, E-Content, and a dependent variable, achievement in chemistry. The sample of the study consisted of 40 students studying in class XI at Govt. Hr Sec School, Nallur Cuddalore district under the Uniform System of School Education, Government of Tamil Nadu. The 40 students were divided into two groups of 20 each, which were referred to as the control and experimental groups, respectively.

4.2 STATISTICAL TECHNIQUES USED

Statistical techniques serve the fundamental purpose of the descriptive and differential analysis. The following statistical techniques were used in this present study.

- Descriptive analysis (Mean and Standard Deviation)
- Differential analysis (‘t’ test)
- Effect Size
- Gain ratio

Descriptive analysis

Measures of central tendency and measures of variability are used in descriptive analysis. These two can be used to investigate the nature of any variable's distribution. The computed mean and standard deviation are used to explain the sample's properties, while descriptive statistics are used to compress the amount of data to a manageable level.

1) Mean

The mean is commonly known as an arithmetic average is computing by dividing the sum of all the scores by the number of scores.

The formula for mean is

$$M = \frac{\Sigma X}{N}$$

Where

M	=	Arithmetic Mean
$\sum X$	=	Sum of scores
X	=	Scores in distribution
N	=	Number of items

2) Standard Deviation

The standard deviation of the square root of the variance is most frequently used as a measure of the spread or distribution of scores in a distribution. The standard deviation formula is similar to the variance formula. It is given below:

$$\sigma = \sqrt{\frac{1}{N}\sum_{i=1}^{N}(x_i - \overline{x})^2}$$

Where

σ = standard deviation

xi = each value of dataset

x (with a bar over it) = the arithmetic mean of the data (This symbol will be indicatedas mean from now)

N = the total number of data points

∑ (xi - mean)^2 = The sum of (xi - mean) ^2 for all data points

Differential statistics

Apart from descriptive statistics, differential statistics were also employed for analyzing the data. The Differential analysis involves the most important by which the investigator is able to make inferences involving the determination of the statistical significance of differences between groups in the reference to the selected variable.

1) 't' Test

A 't' test is a numerical procedure that takes into account the difference between the mean of two tests (Pre-test versus Post-test or Post-test versus Retention-test). Thus the 't'-test is used to determine whether the mean scores of achievement between the two groups differ significantly or not. 't' test is used to find out the significant difference between the means of two variables.

The formula to find 't' value is

$$\boxed{t = \frac{M_1 - M_2}{\sqrt{\frac{\sigma_1^2}{N_1} + \frac{\sigma_2^2}{N_2}}}}$$

M1	=	Mean of the first group
M2	=	Mean of the second group
σ1	=	Standard deviation of the first group
σ2	=	Standard deviation of the second group
N1	=	Size of the first group
N2	=	Size of the second group

Effect Size

Effect size is the ratio of the difference in the Post assessment means between the control group and the experimental group to that of the Standard Deviation of the control group.

$$\text{Effect Size} = \frac{\text{(Post - mean of the Experimental group)} - \text{(Post - mean of the control group)}}{\text{Standard deviation of the control group}}$$

< 0.1	=	Trivial effect
0.1 to 0.3	=	small effect
0.3 to 0.5	=	moderate effect
> 0.5	=	large difference effect … (developed by Cohen)

Gain Ratio

Mc-Guin Peters (1965) suggested that the best criterion of program effectiveness is the gain ratio between the amount learned and the amount that could be learned.

$$\text{Gain ratio} = \frac{\text{Mean of (Post test scores} - \text{Pre test scores)}}{\text{Mean of (Full scores} - \text{Pre test scores)}}$$

4.3 LEVEL OF SIGNIFICANCE

A level of significance (alpha level) is used as a criterion for rejecting or accepting a null hypothesis. The hypothesis formulated in this study was tested, and the results were obtained through data analysis using statistical procedures, differential analysis, and the level of significance for rejection or acceptance of the hypothesis has indicated the actual probability level associated with the findings, allowing the investigator to make his own decision on whether the null hypothesis should be rejected or accepted.

In the present study, only a 1% level of significance is taken into account. It is a more rigorous test of significance in which the rejection of a hypothesis at (0.01 alpha) 1% alpha (α) level would suggest that a difference in means as large as that found between the experimental and control groups would have resulted from sampling error is less than 1 in 100 replications of the experiment.

4.4 DESCRIPTIVE ANALYSIS

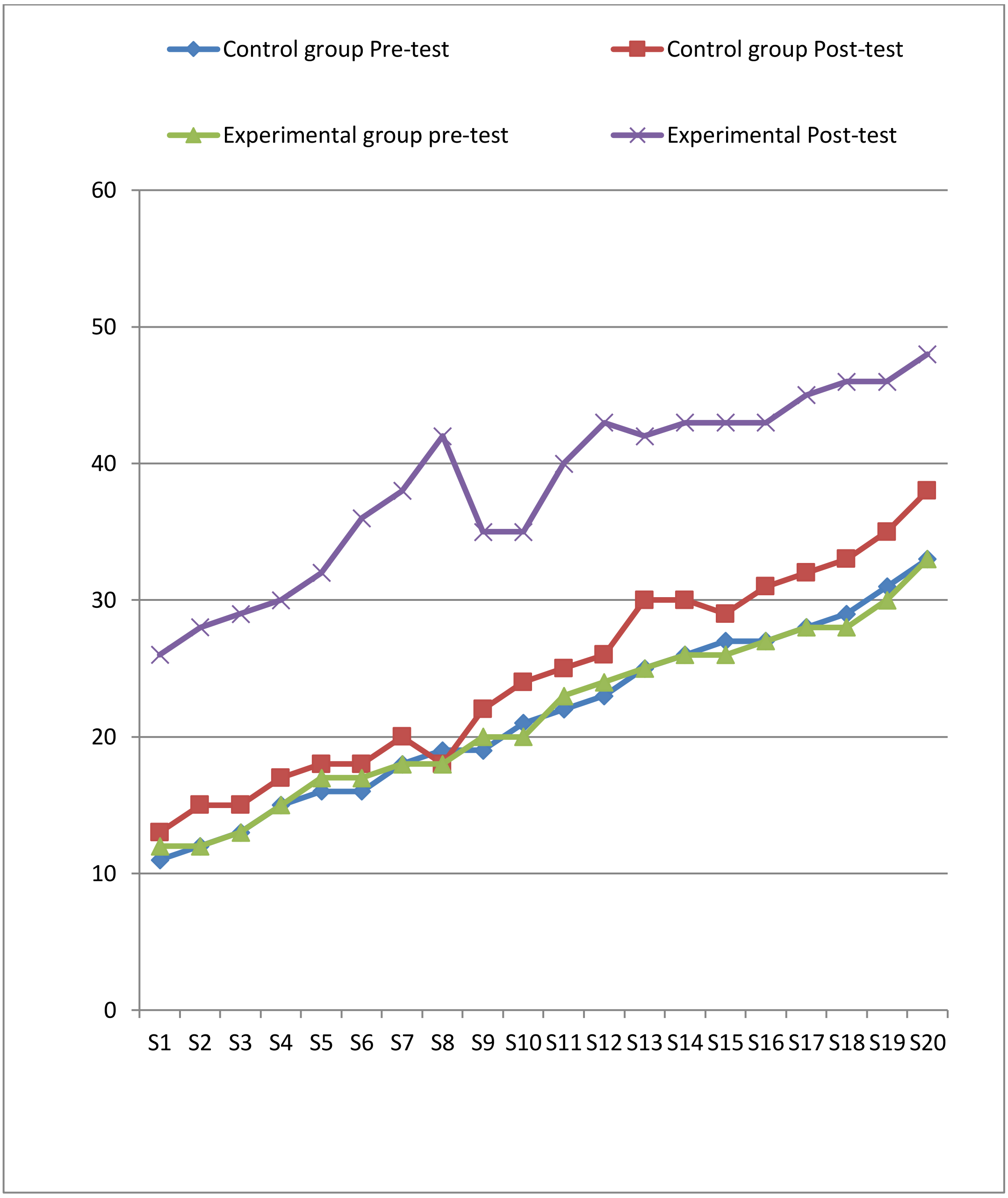
Comparison of individual Academic achievement scores of the Pre-test and Post-test of the experimental and the control groups.

Table - 4.1

Variables	Control Group		Experimental Group	
Tests	**Pre-test**	**Post-test**	**Pre-test**	**Post-test**
S1	11	13	12	26
S2	12	15	12	28
S3	13	15	13	29
S4	15	17	15	30
S5	16	18	17	32
S6	16	18	17	36
S7	18	20	18	38
S8	19	21	18	42
S9	19	22	20	35
S10	21	24	20	35
S11	22	25	23	40
S12	23	26	24	43
S13	25	28	25	42
S14	26	30	26	43
S15	27	29	26	43
S16	27	31	27	43
S17	28	32	28	45
S18	29	33	28	46
S19	31	35	30	46
S20	33	37	33	48

Table 4.1 shows the individual scores of the Pre-tests and Post-tests of theexperimental and the control groups.

Figure 4.1 Individual Scores of the Pre-test and the Post-test of thecontrol and experimental groups



The mean and standard deviation of the mean achievement scores secured by the higher secondary school students in the Post-tests are tabulated and presented in Table 4.2.

Table - 4.2

Mean and Standard Deviation of Post-test Mean achievement scores of higher secondary school students learning through E-Content and Conventional method

Variables	**Tests**	**N**	**Mean**	**SD**
E-Content (Experimental group)	E-Post	20	38.50	6.71
Conventional Method (Control group)	C-Post	20	24.45	7.24

It is obviously seen from table 4.2 that the mean achievement score of the post-test conducted to the experimental group through the E-Content is (38.50) higher than that of the control group (24.45) taught through the Conventional method to the higher secondary school students.

The mean and standard deviation of the scores secured by the higher secondary school students in the Pre-test, and Post-test through the E-Content and the Conventional method of the experimental and control groups are tabulated and presentedin Table 4.3

Table - 4.3

Mean and Standard Deviation of Pre-test and Post-test scores of higher secondary school students in learning chemistry through E-Content in the experimentalgroup and Conventional method in the control groups

Variables	Test	N	Mean	Mean Difference	SD
Experimental group (E-Content)	Pre-test	20	21.60	16.9	6.26
	Post-test	20	38.50		6.71
The Controlgroup (Conventional Method)	Pre-test	20	21.55	2.9	6.56
	Post-test	20	24.45		7.24

It is obviously seen from table 4.3 that the mean achievement score of the post-test conducted to the experimental group through the E-Content is (38.50) which is higher than that of the control group (24.45) through the Conventional method to the higher secondary school students. Besides, the mean difference between the pre-test and post-test of the experiment group is 16.9 whereas it is 2.9 only in the case of the control group.

4.5 DIFFERENTIAL ANALYSIS

Table 4.4 displays the details of results gathered by differential analysis.

Table - 4.4

S. No.	Groups compared	Test	Mean scores
1.	The Experimental group treated through E-Content	Pre-test	21.60
		Post-test	38.50
2.	Control group treated through the Conventional method	Pre-test	21.55
		Post-test	24.45

The mean differences between pre-test and post-test scores of the control group and experimental groups are given in the above table. A detailed evaluation of the data given above in the table is analyzed with the formulated hypotheses using differential analysis through calculating the ‘t’ value and the analyzed data are given in the following tables (Table 4.5 to Table 4.25) for inferring if any significant differences exist between the mean achievement scores of the pre-progressive-post tests.

Hypothesis: 1

There is no significant difference between pre-test and post-test mean achievement scores of the control group.

Table - 4.5

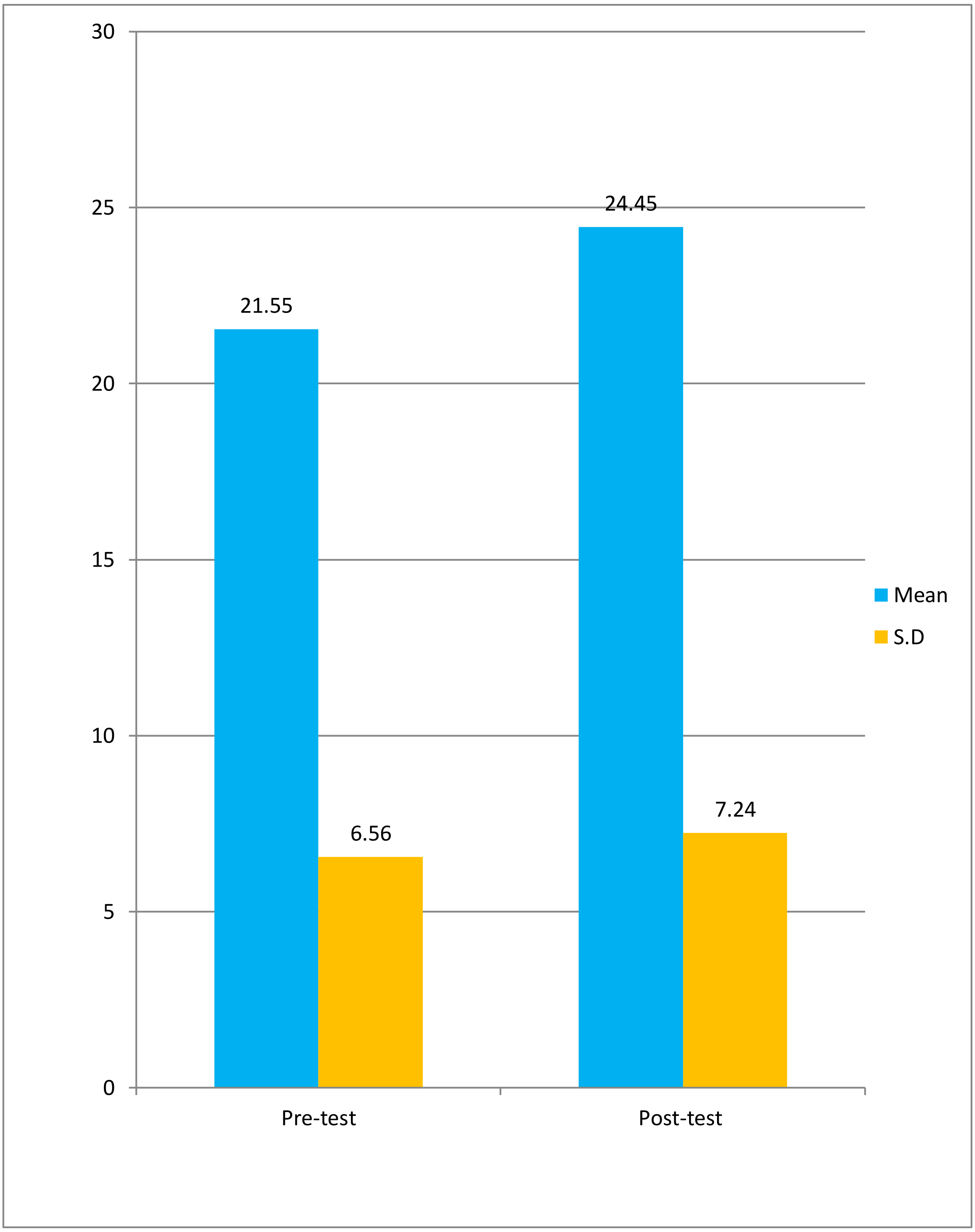
The pre-test and post-test mean achievement scores of the control group

Test	No. of students	Mean	S.D	Mean difference	't' value	Degrees of freedom	Level of significance (0.01 level)
C-group Pre-test	20	21.55	6.56	2.9	15.218	19	significant
C-group Post-test	20	24.45	7.24				

The mean of the pre-test scores of the control group through the Conventional method is found to be 21.55 with an SD 6.56. The mean of the post-test scores of the control group through the Conventional method is found to be 24.45 with an SD 7.24. The mean difference 2.9 is found to be low level of significance for the 't' value 15.218 for 19 degrees of freedom at a 1% level of significance. Therefore, the hypothesis is rejected.

It is concluded that there is a significant difference between pre-test and post- test mean achievement scores of the control group.

Figure 4.2 shows the pre-test and post-test mean achievement scores of the control group through the Conventional method



Hypothesis: 2

There is no significant difference between pre-test and post-test mean achievement scores of the experimental group.

Table - 4.6

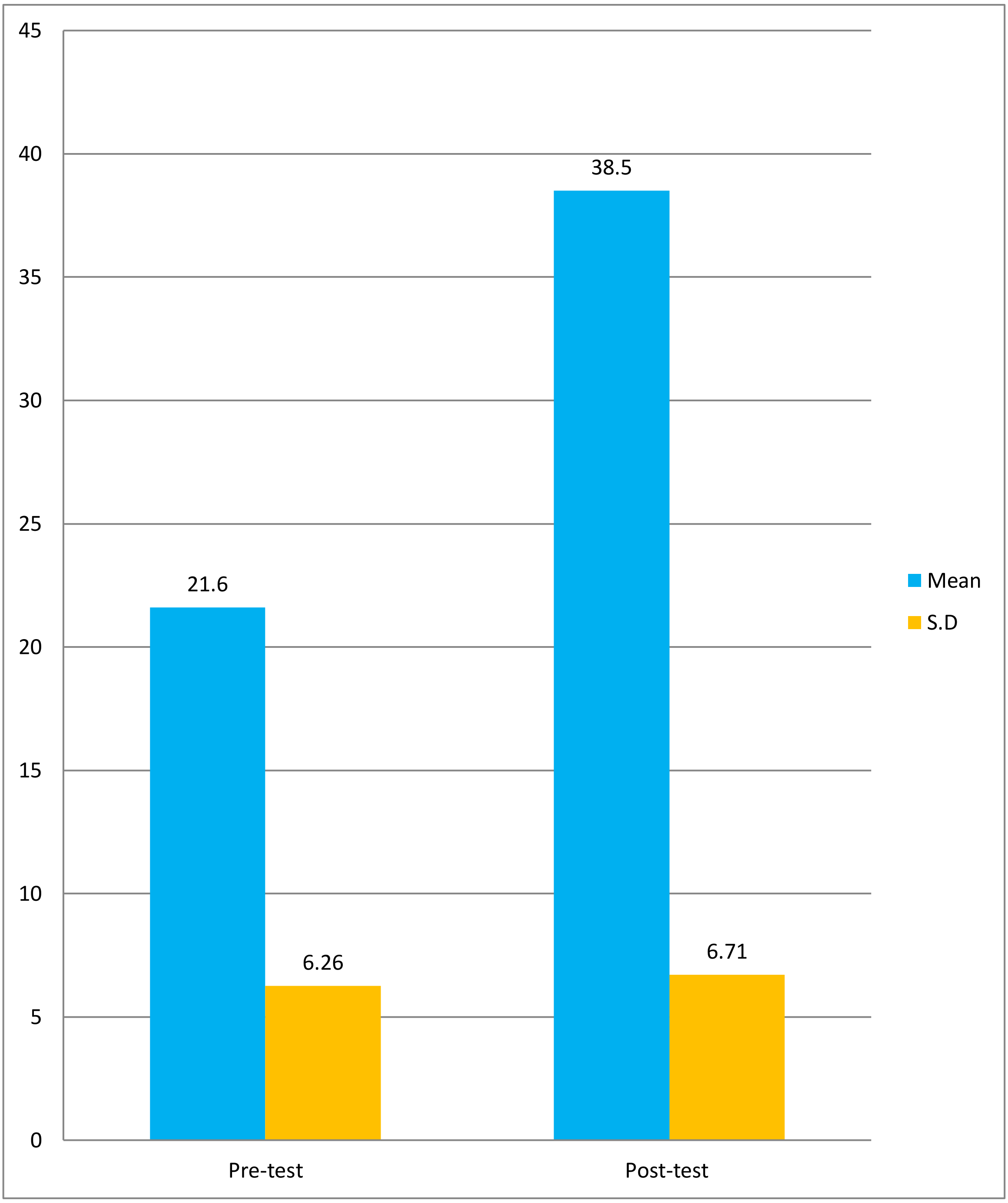
The pre-test and post-test mean achievement scores of the experimental group

Test	No. of students	Mean	S.D	Mean difference	't' value	Degrees of freedom	Level of significance (0.01 level)
E-group Pre-test	20	21.60	6.26	16.9	32.78	19	Significant
E-group Post-test	20	38.50	6.71				

The mean of the pre-test scores of the experimental group through the E-Content is found to be 21.60 with an SD 6.26. The mean of the post-test scores of the experimental group through the E-Content is found to be 38.50 with an SD 6.71. The mean difference 16.9 is found to be significant for the 't' value 32.78 for 19 degrees of freedom at a 1% level of significance. Therefore, the hypothesis is rejected.

It is concluded that there is a significant difference between pre-test and post- test mean achievement scores of the experimental group.

Figure 4.3 shows the pre-test and post-test mean achievement scores of the experimental group



Hypothesis: 3

There is no significant difference between pre-tests mean achievement scores of the control and experimental groups.

Table - 4.7

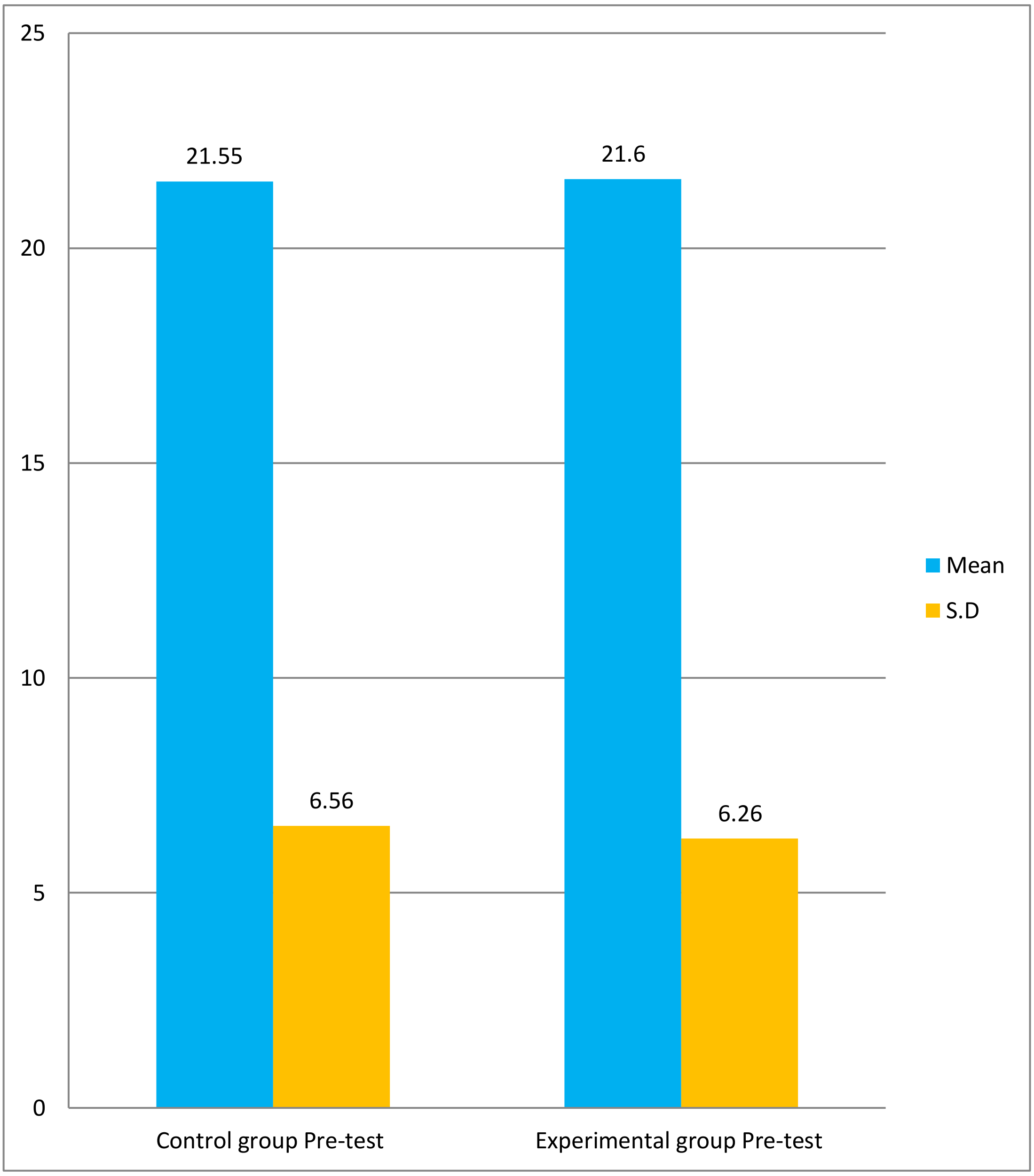
The pre-tests mean achievement scores of the control and experimental groups

Test	No. of students	Mean	S.D	Mean difference	't' value	Degrees of freedom	Level of significance (0.01 level)
Control group Pre-test	20	21.55	6.56	0.05	0.025	38	Not significant
Experimental group Pre-test	20	21.60	6.26				

The mean of the pre-test scores of the control group through the Conventional method is found to be 21.55 with an SD 6.56. The mean of the pre-test scores of the experimental group through the E-Content is found to be 21.60 with an SD 6.26. The mean difference 0.05 is found to be not significant for the 't' value 0.025 for 38 degrees of freedom at a 1% level of significance. Therefore, the hypothesis is accepted.

It is concluded that there is no significant difference between the pre-tests mean achievement scores of the control group and experimental groups.

Figure 4.4 shows the pre-tests mean achievement scores of the control group learning through the Conventional method and experimental group through E-Content



Hypothesis: 4

There is no significant difference between the post-test mean achievementscores of the control and experimental groups.

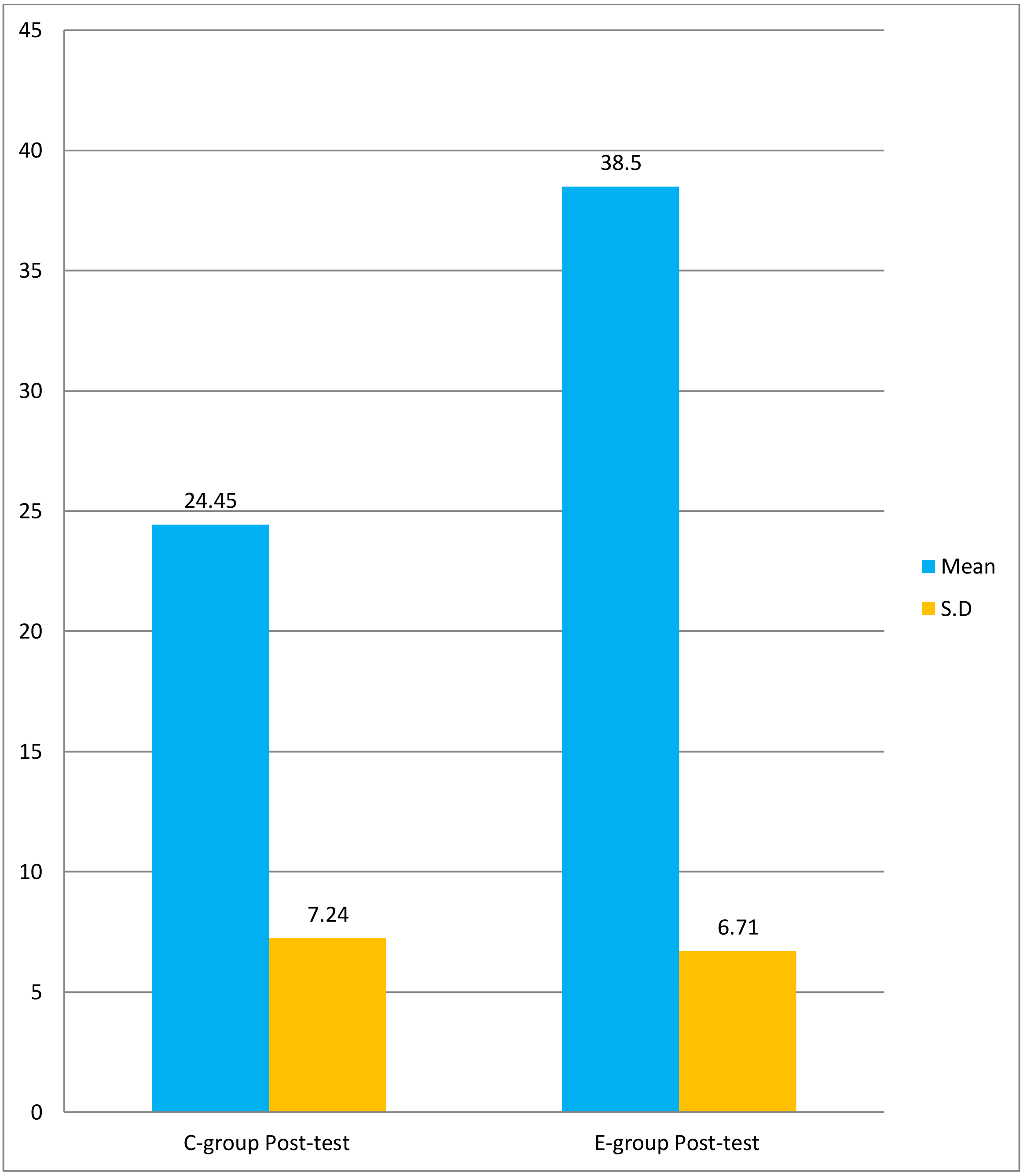
Table - 4.8
The post-tests mean achievement scores of the control and experimental groups

Test	No. of students	Mean	S.D	Mean difference	't' value	Degrees of freedom	Level of significance (0.01 level)
C-group Post-test	20	24.45	7.24	14.05	6.368	38	Significant
E-group Post-test	20	38.50	6.71				

The mean of the post-test scores of the control group through the Conventional method is found to be 24.45 with an SD 7.24. The mean of the post-test scores of the experimental group through the E-Content is found to be 38.50 with an SD 6.71. The mean difference 14.05 is found to be significant for the 't' value 6.368 for 38 degrees of freedom at a 1% level of significance. Therefore, the hypothesis is rejected.

It is concluded that there is a significant difference between the post-test meanachievement scores of the control group and the experimental groups.

Figure 4.5 shows the post-tests mean achievement scores of the control groupthrough the Conventional method and the experimental group through E-Content



Hypothesis: 5

There is no significant difference between low achievers in pre-test and post-test mean achievement scores of the control group.

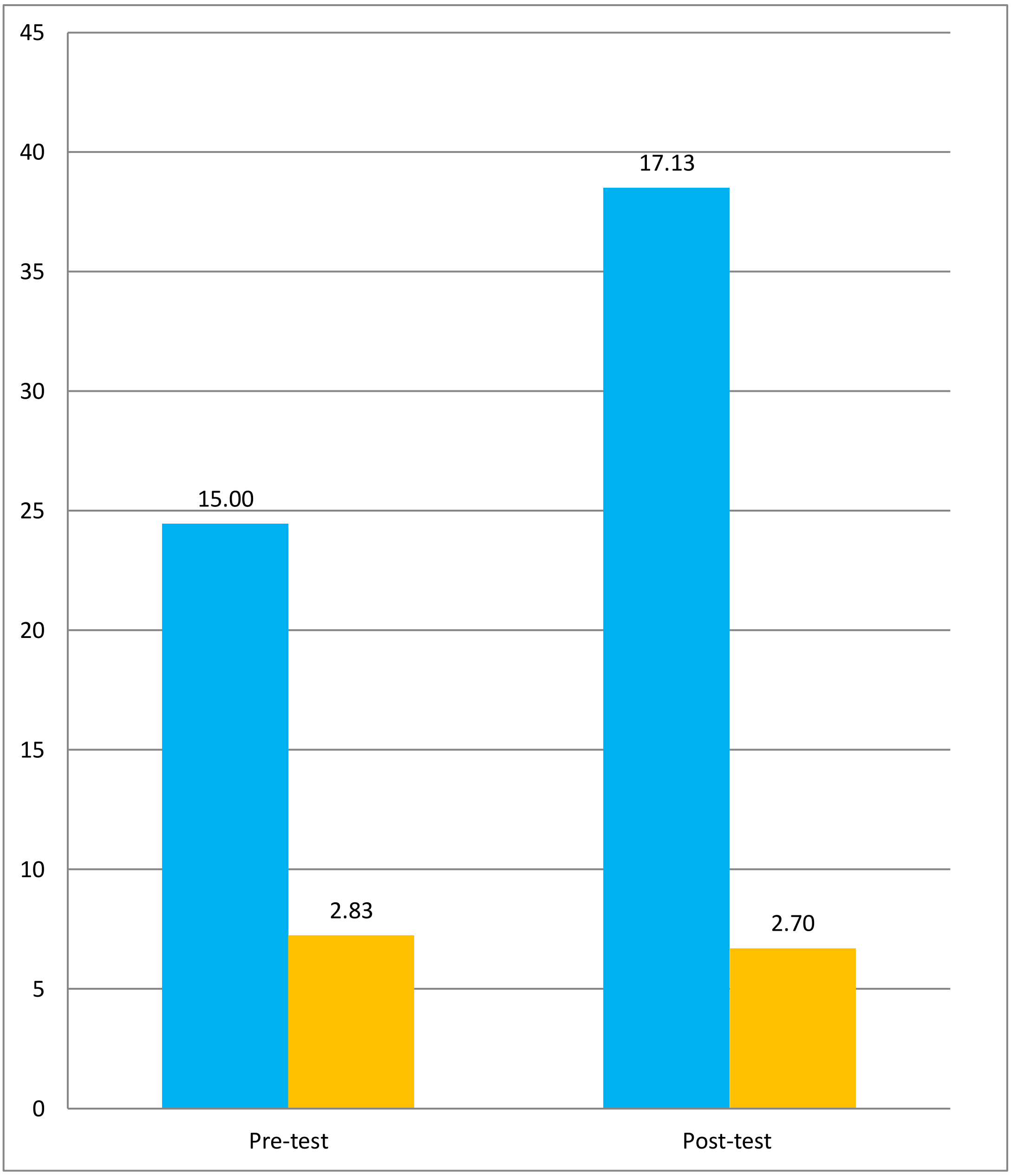
Table - 4.9
The pre-test and post-test mean achievement scores of low achievers in the control group

Test	No of students	Mean	S.D	Mean difference	't' value	Degrees of freedom	Level of significance (0.01 level)
C-group Pre-test	8	15.00	2.83	2.33	1.538	13	Not significant
C-group Post-test	8	17.13	2.70				

The mean of low achievers in the pre-test scores of the control group through the Conventional method is found to be 15.00 with an SD 2.83. The mean of low achievers in the post-test scores of the control group through the Conventional method is found to be 17.13 with an SD 2.70. The mean difference 2.33 is found to be not significant for the 't' value 1.538 for 13 degrees of freedom at a 1% level of significance. Therefore, the hypothesis is accepted.

It is concluded that there is no significant difference between low achievers in pre-test and post-test mean achievement scores of the control group.

Figure 4.6 shows the pre-test and post-test mean achievement scores of low achievers in the control group through the Conventional method



Hypothesis: 6

There is no significant difference between low achievers in pre-test and post-test mean achievement scores of the experimental group.

Table - 4.10

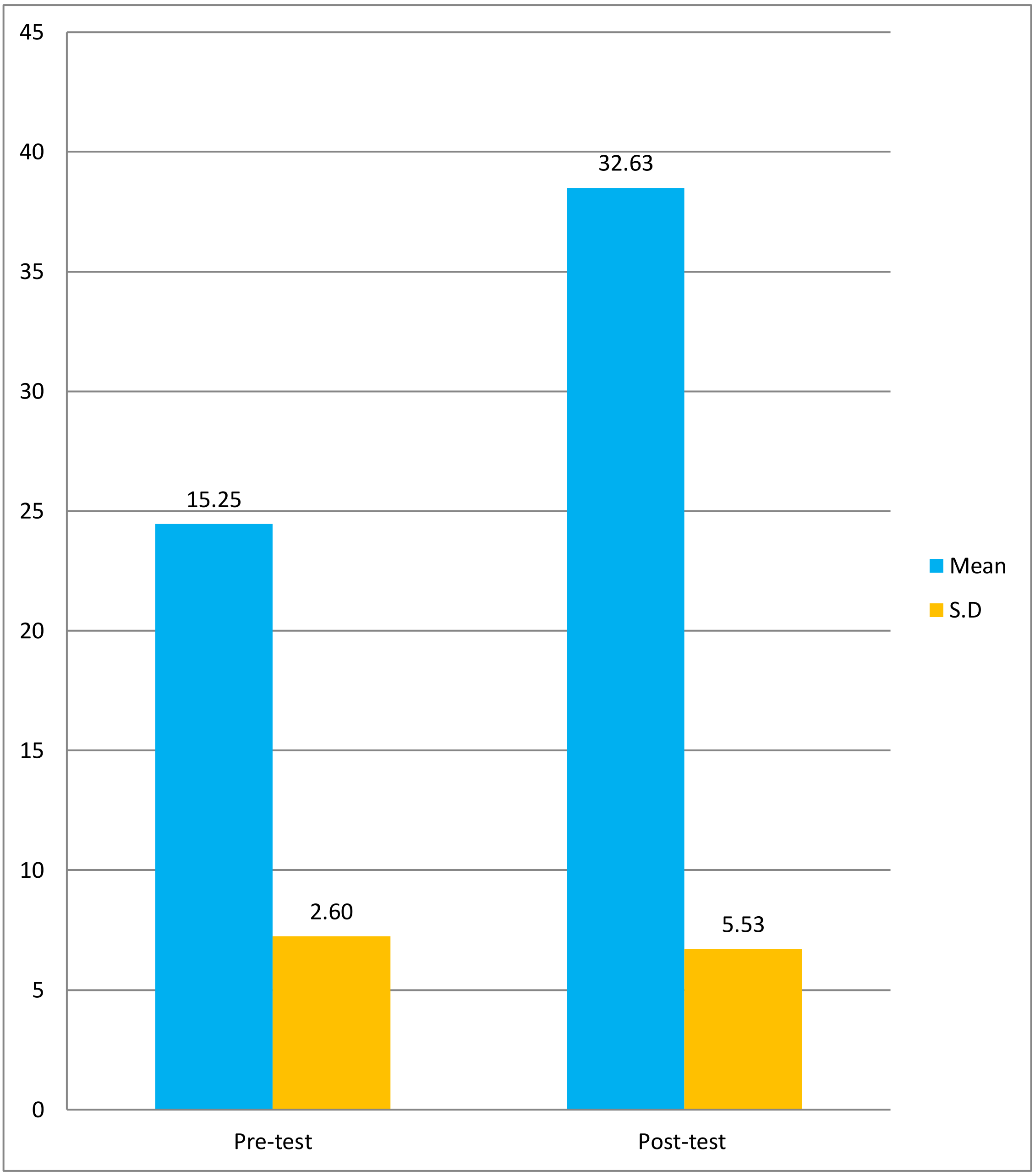
The pre-test and post-test mean achievement scores of low achievers in the experimental group

Test	No. of students	Mean	S.D	Mean difference	't' value	Degrees of freedom	Level of significance(0.01 level)
E-group Pre-test	8	15.25	2.60	17.38	8.042	9	Significant
E-group Post-test	8	32.63	5.53				

The mean of low achievers in the pre-test scores of the experimental group through the E-Content is found to be 15.25 with an SD 2.60. The mean of low achievers in the post-test scores of the experimental group through the E-Content is found to be 32.63 with an SD 5.53. The mean difference 17.38 is foundto be significant for the 't' value 8.042 for 9 degrees of freedom at a 1% level of significance. Therefore, the hypothesis is rejected.

It is concluded that there is a significant difference between low achievers in pre-test and post-test mean achievement scores of the experimental group.

Figure 4.7 shows the pre-test and post-test mean achievement scores of low achievers in the experimental group through E-Content



Hypothesis: 7

There is no significant difference between low achievers in the pre-tests achievement scores of the control and experimental groups.

Table - 4.11

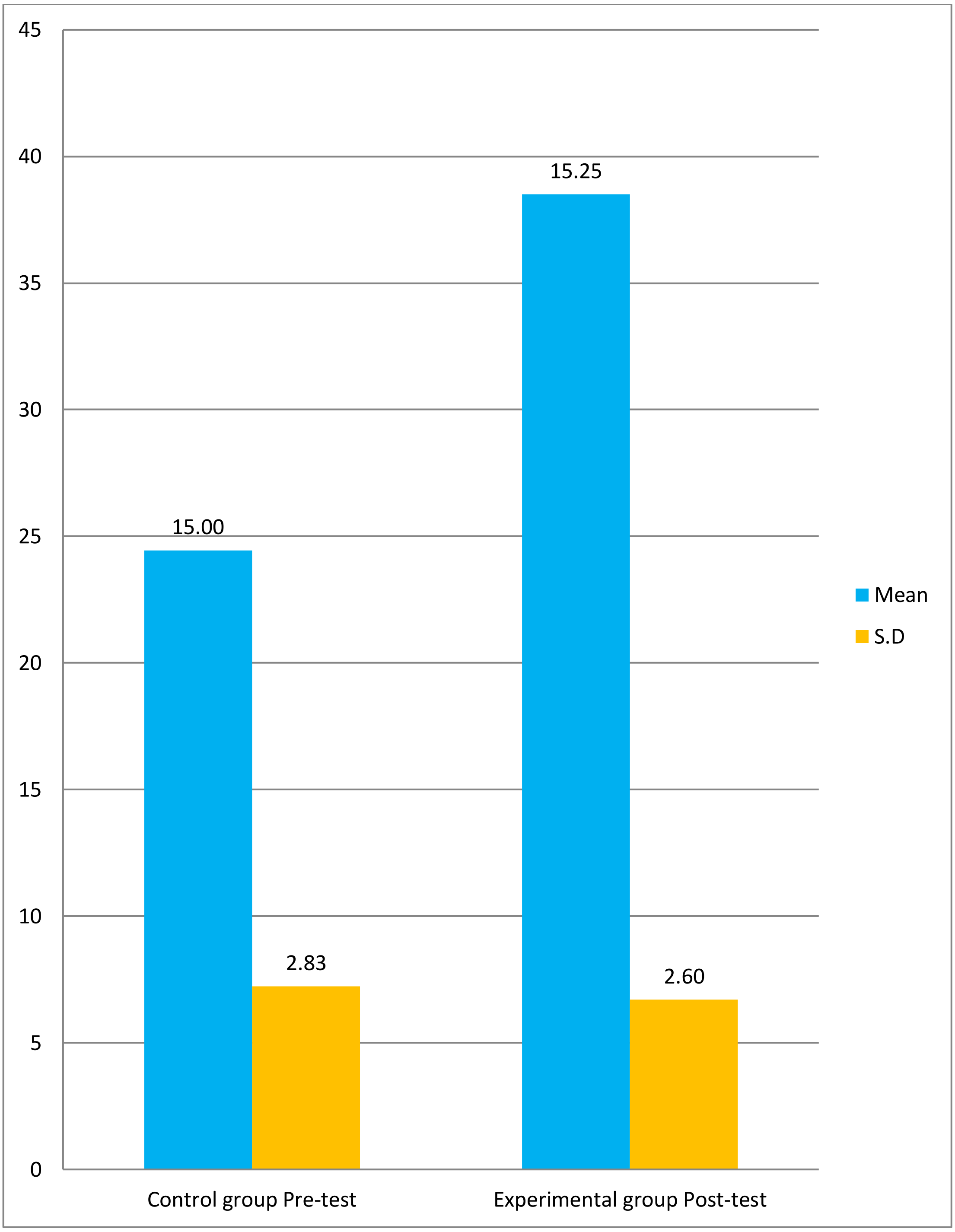
The pre-tests mean achievement scores of low achievers in the control and experimental groups

Test	No. of students	Mean	S.D	Mean difference	't' value	Degrees of freedom	Level of significance (0.01 level)
C-groupPre-test	8	15.00	2.83	0.25	0.184	13	Not significant
E-grouppre-test	8	15.25	2.60				

The mean of low achievers in the pre-test scores of the control group through the Conventional method is found to be 15.00 with an SD 2.83. The mean of low achievers in the pre-test scores of the experimental group through the E-Content is found to be 15.25 with an SD 2.60. The mean difference 0.25 is found to be not significant for the 't' value 0.184 for 13 degrees of freedom at a 1% level of significance. Therefore, the hypothesis is accepted.

It is concluded that there is no significant difference between low achievers in the pre-tests mean achievement scores of the control and experimental groups.

Figure 4.8 shows the pre-tests scores of low achievers in the control group through the Conventional method and the experimental group through E-Content



Hypothesis: 8

There is no significant difference between low achievers in the post-tests mean achievement scores of the control and experimental groups.

Table - 4.12

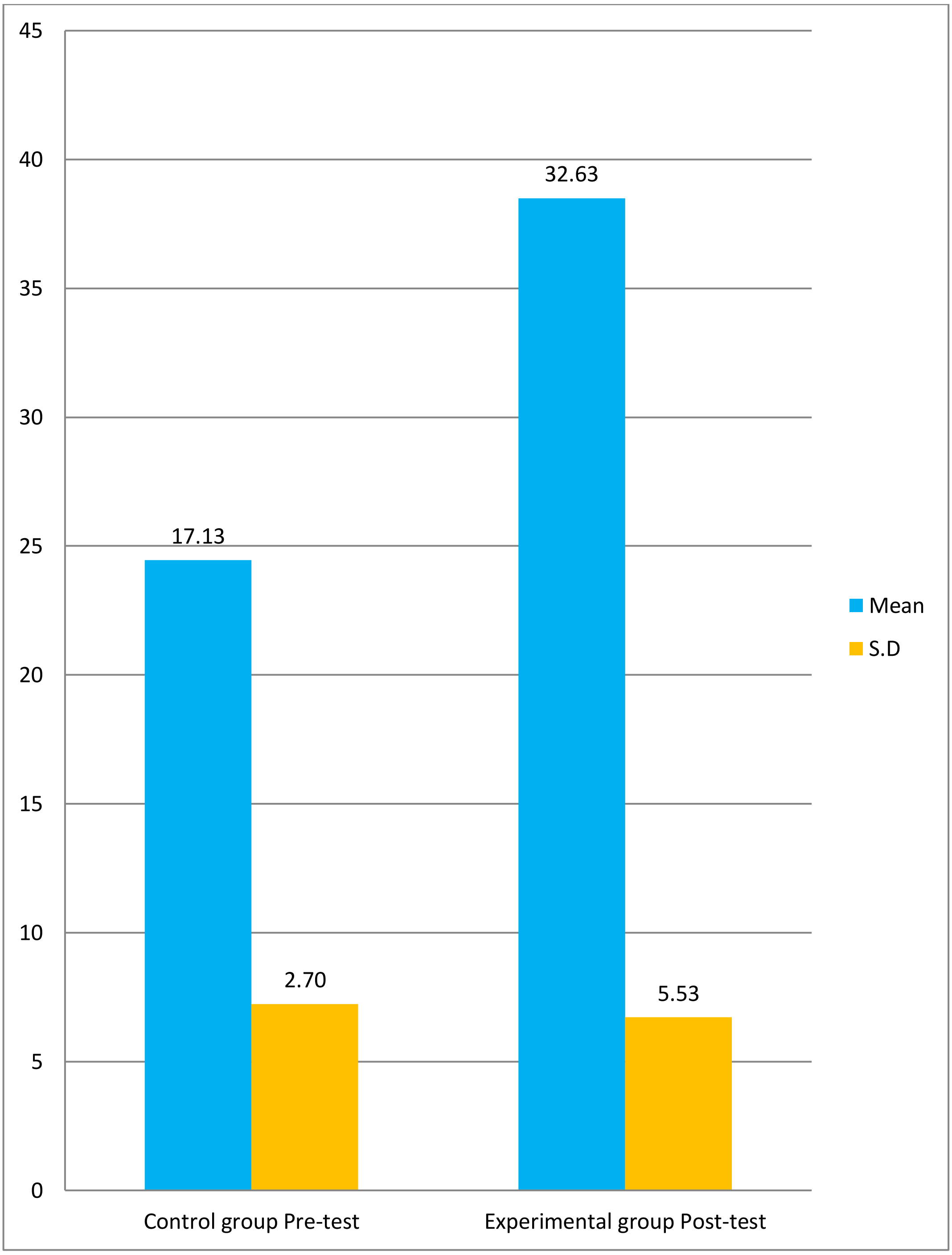
The post-tests mean achievement scores of low achievers in the control and experimental groups

Test	No. of students	Mean	S.D	Mean difference	't' value	Degrees of freedom	Level of significance (0.01 level)
C-group Post-test	8	17.13	2.70	15.5	7.127	10	Significant
E-group Post-test	8	32.63	5.53				

The mean of the post-test scores of low achievers in the control group through the Conventional method is found to be 17.13 with an SD 2.70. The mean of low achievers in the post-test scores of the experimental group through the E-Content is found to be 32.63 with an SD 5.53. The mean difference 15.5 is found to be significant for the 't' value 7.127 for 10 degrees of freedom at a 1% level of significance. Therefore, the hypothesis is rejected.

It is concluded that there is a significant difference between low achievers in the post-tests mean achievement scores of the control and experimental groups.

Figure 4.9 shows the post-tests mean achievement scores of low achievers in thecontrol group through the Conventional method and the experimental group through E-Content



Hypothesis: 9

There is no significant difference between moderate achievers in pre-test and post-test mean achievement scores of the control group.

Table - 4.13

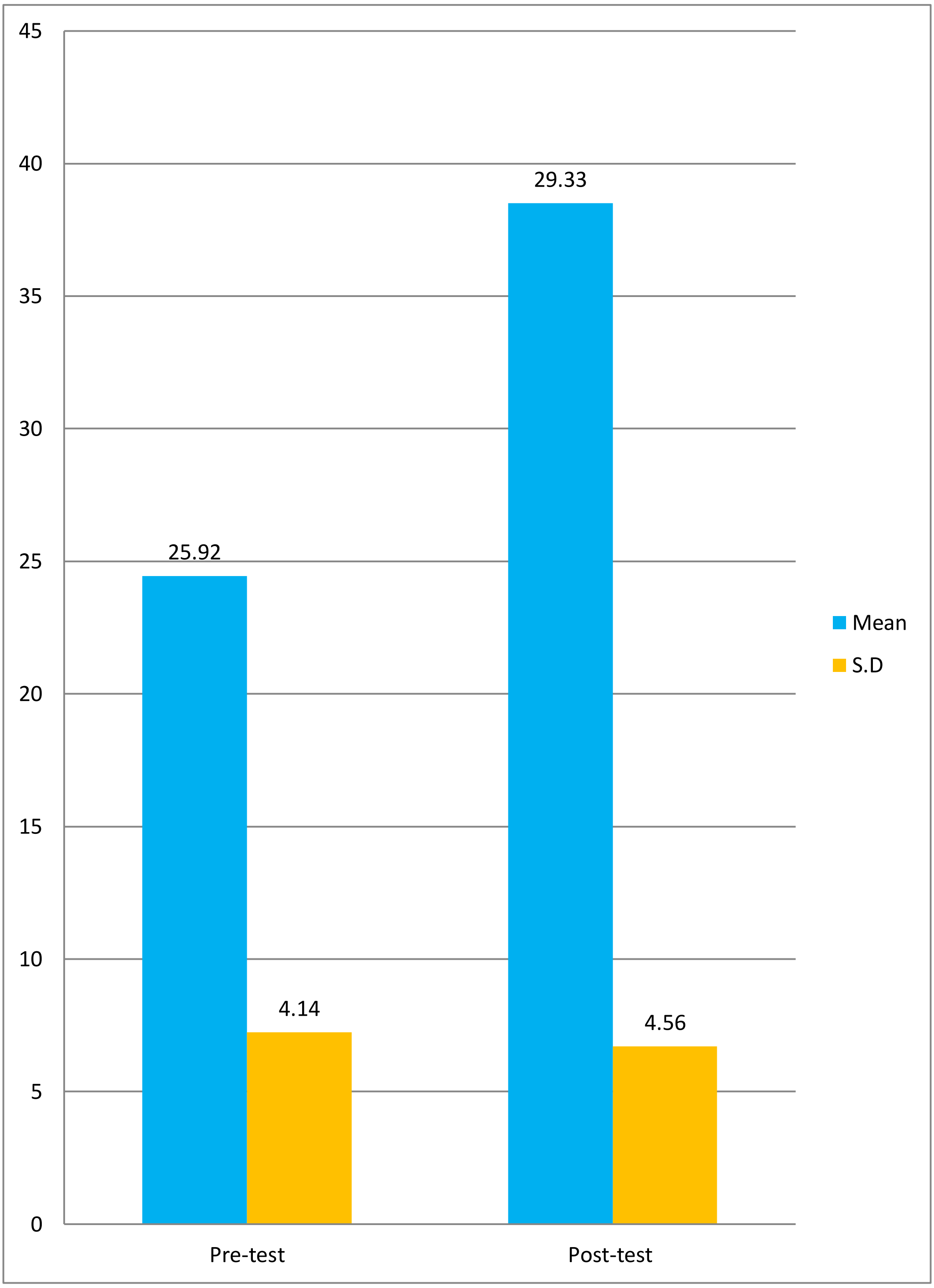
The pre-test and post-test mean achievement scores of moderate achievers in thecontrol group

Test	No. of students	Mean	S.D	Mean difference	't' value	Degrees of freedom	Level of significance (0.01 level)
C-group Pre-test	12	25.92	4.14	3.41	17.02	11	Significant
C-group Post-test	12	29.33	4.56				

The mean of moderate achievers in the pre-test scores of the control group throughthe Conventional method is found to be 25.92 with an SD 4.14. The mean of moderate achievers in the post-test scores of the control group through the Conventional method isfound to be 29.33 with an SD 4.56. The mean difference 3.41 is found to be significant for the 't' value 17.02 for 11 degrees of freedom at a 1% level of significance. Therefore, the hypothesis is rejected.

It is concluded that there is a significant difference between moderate achievers in pre-test and post-test mean achievement scores of the control group.

Figure 4.10 shows the pre-test and post-test mean achievement scores of moderate achievers in the control group through the Conventional method



Hypothesis: 10

There is no significant difference between moderate achievers in pre-test and post-test mean achievement scores of the experimental group.

Table - 4.14

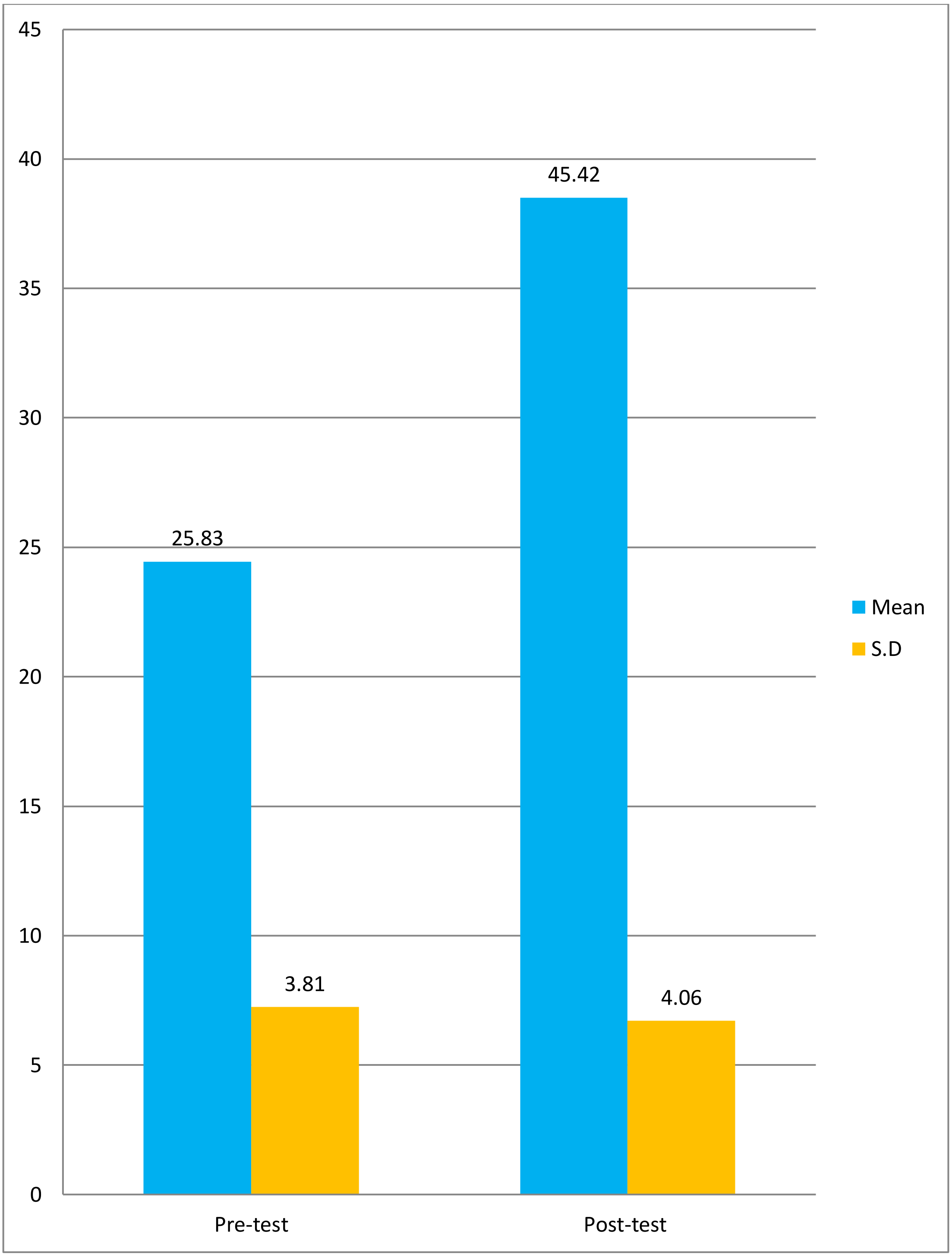
The pre-test and post-test mean achievement scores of moderate achievers in theexperimental group

Test	No. of students	Mean	S.D	Mean difference	't' value	Degrees of freedom	Level of significance (0.01 level)
E-group Pre-test	12	25.83	3.81	16.59	46.323	11	Significant
E-group Post-test	12	45.42	4.06				

The mean of moderate achievers in the pre-test scores of the experimental group through the E-Content is found to be 25.83 with an SD 3.81. The mean of moderate achievers in the post-test scores of the experimental group through the E-Content is found to be 45.42 with an SD 4.06. The mean difference 16.59 is found to be significant for the 't' value 46.323 for 11 degrees of freedom at a 1% level of significance. Therefore, the hypothesis is rejected.

It is concluded that there is a significant difference between moderate achievers in pre-test and post-test mean achievement scores of the experimental group.

Figure 4.11 shows the pre-test and post-test mean achievement scores of moderate achievers in the experimental group through E-Content



Hypothesis: 11

There is no significant difference between moderate achievers in the pre-tests achievement scores of the control and experimental groups.

Table - 4.15

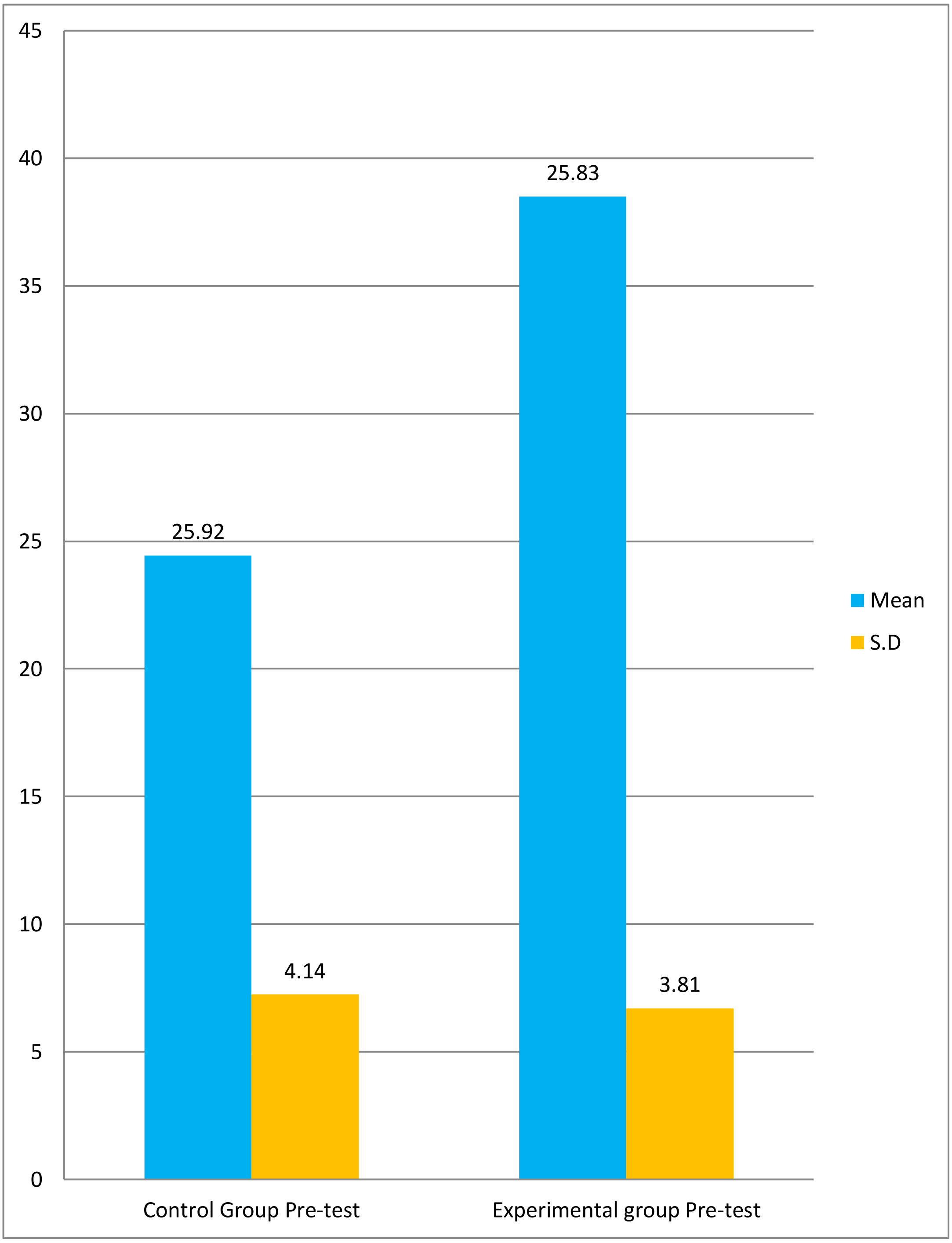
The pre-tests mean achievement scores of moderate achievers in the control andexperimental groups

Test	No. of students	Mean	S.D	Mean difference	't' value	Degrees of freedom	Level of significance (0.01 level)
C-group pre-test	12	25.92	4.14	0.09	0.057	22	Not significant
E-group pre-test	12	25.83	3.81				

The mean of moderate achievers in the pre-test scores of the control group throughthe Conventional method is found to be 25.92 with an SD 4.14. The mean of moderate achievers in the pre-test scores of the experimental group through the E-Content is found to be 25.83 with an SD 3.81. The mean difference 0.09 is found to be not significant for the 't' value 0.057 for 22 degrees of freedom at a 1% level of significance. Therefore, the hypothesis is accepted.

It is concluded that there is no significant difference between moderate achievers in the pre-tests mean achievement scores of the control and experimental groups.

Figure 4.12 shows the pre-tests mean achievement scores of moderate achievers in thecontrol group through the Conventional method and experimental group through E-Content



Hypothesis: 12

There is no significant difference between moderate achievers in the post-test mean achievement scores of the control and experimental groups.

Table - 4.16

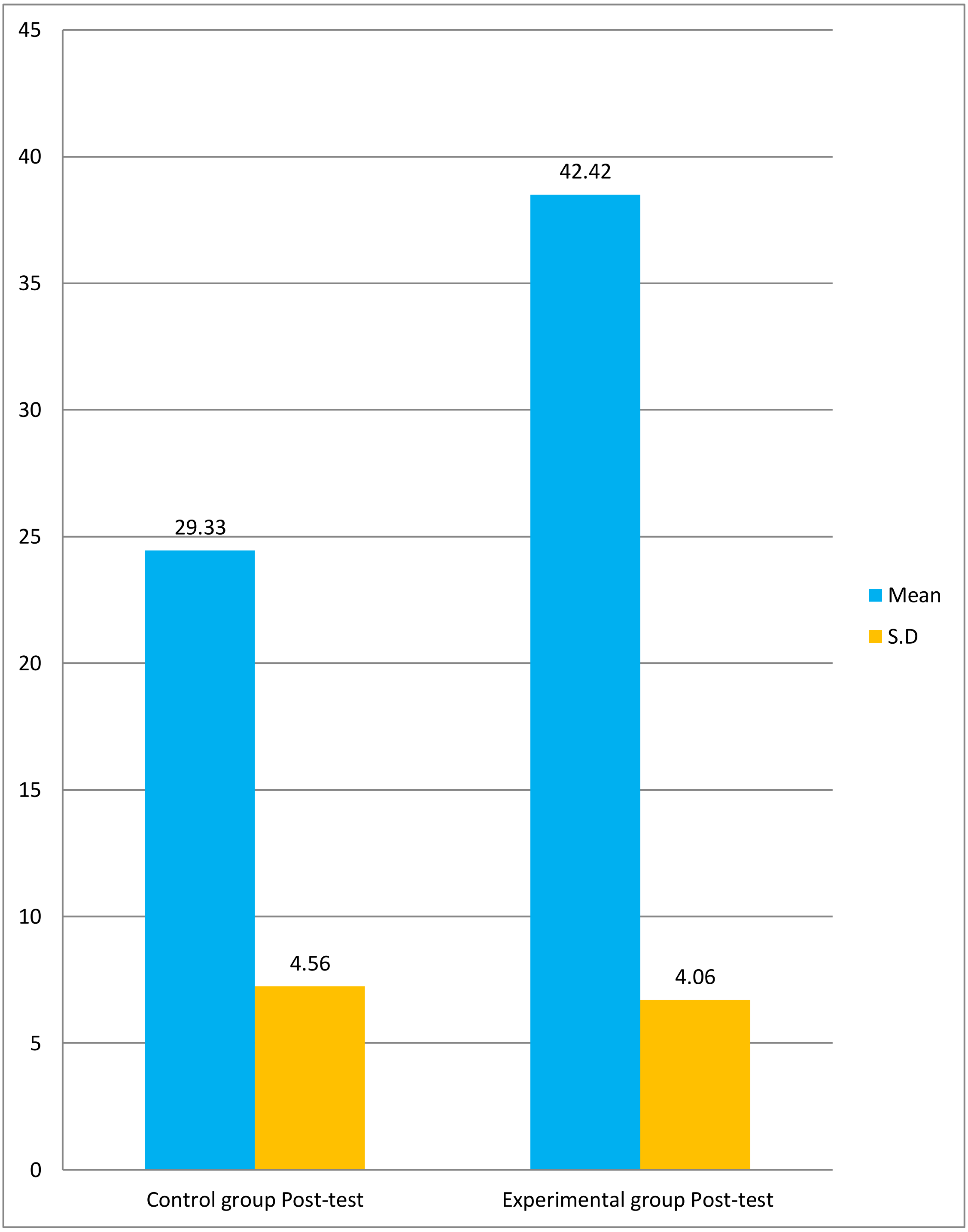
The post-test mean achievement scores of moderate achievers in the control andexperimental groups

Test	No. of students	Mean	S.D	Mean difference	't' value	Degrees of freedom	Level of significance (0.01 level)
C-group Post-test	12	29.33	4.56	13.09	7.426	22	Significant
E-group Post-test	12	42.42	4.06				

The mean of the post-test scores of moderate achievers in the control group throughthe Conventional method is found to be 29.33 with an SD 4.56. The mean of moderate achievers in the post-test scores of the experimental group through the E-Content is found to be 42.42 with an SD 4.06. The mean difference 13.09 is foundto be significant for the 't' value 7.426 for 22 degrees of freedom at a 1% level of significance. Therefore, the hypothesis is rejected.

It is concluded that there is a significant difference between moderate achievers in the post-tests mean achievement scores of the control and experimental groups.

Figure 4.13 shows the post-tests mean achievement scores of moderate achievers inthe control group through the Conventional method and the experimental groupthrough E-Content



Hypothesis: 13

There is no difference between the effect size of pre-test and post-test mean achievement scores of the control group.

Table - 4.17

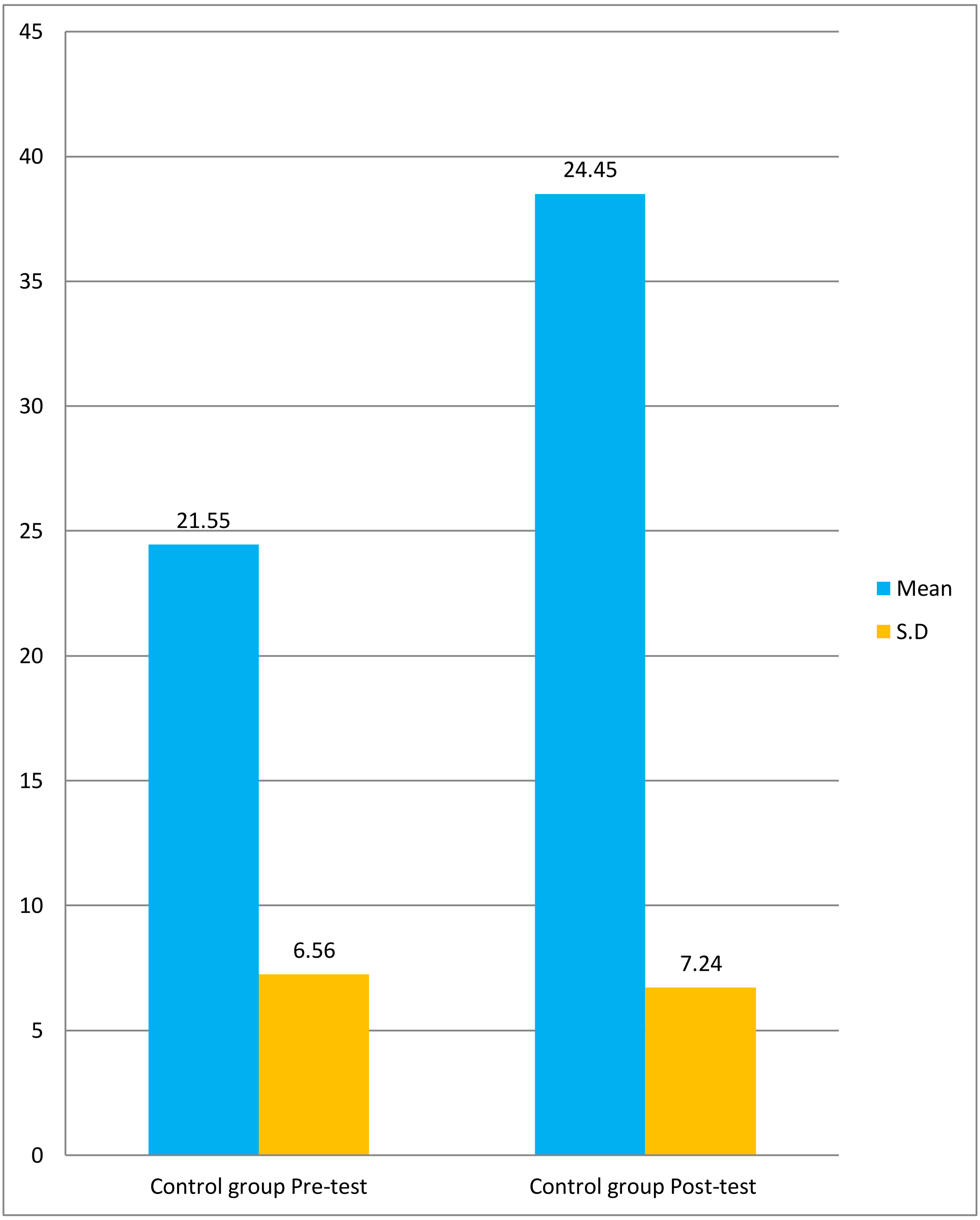
The Effect size of pre-test and post-test mean achievement scores of the control group

Group	Test	No. of students	Mean	SD	Effect size (E)
Controlgroup	Pre-test	20	21.55	6.56	0.419
	Post-test	20	24.45	7.24	

The effect size for the difference between the means of pre-test and post-test achievement scores of the control group through the Conventional method of learning chemistry at the higher secondary school level is found to be 0.419 which is considered as a moderate effect size by Cohen (1992). Therefore, the hypothesis is rejected.

Hence, it is concluded that there is a significant difference between the effect size of pre-test and post-test mean achievement scores of the control group and the degree of the effect size as estimated by Cohen (1992) is moderate effect size.

Figure 4.14 shows the effect size for the difference between pre-test and post-testachievement scores of the control group through the Conventional method



Hypothesis: 14

There is no difference between the effect size of pre-test and post-test mean achievement scores of the experimental group.

Table - 4.18

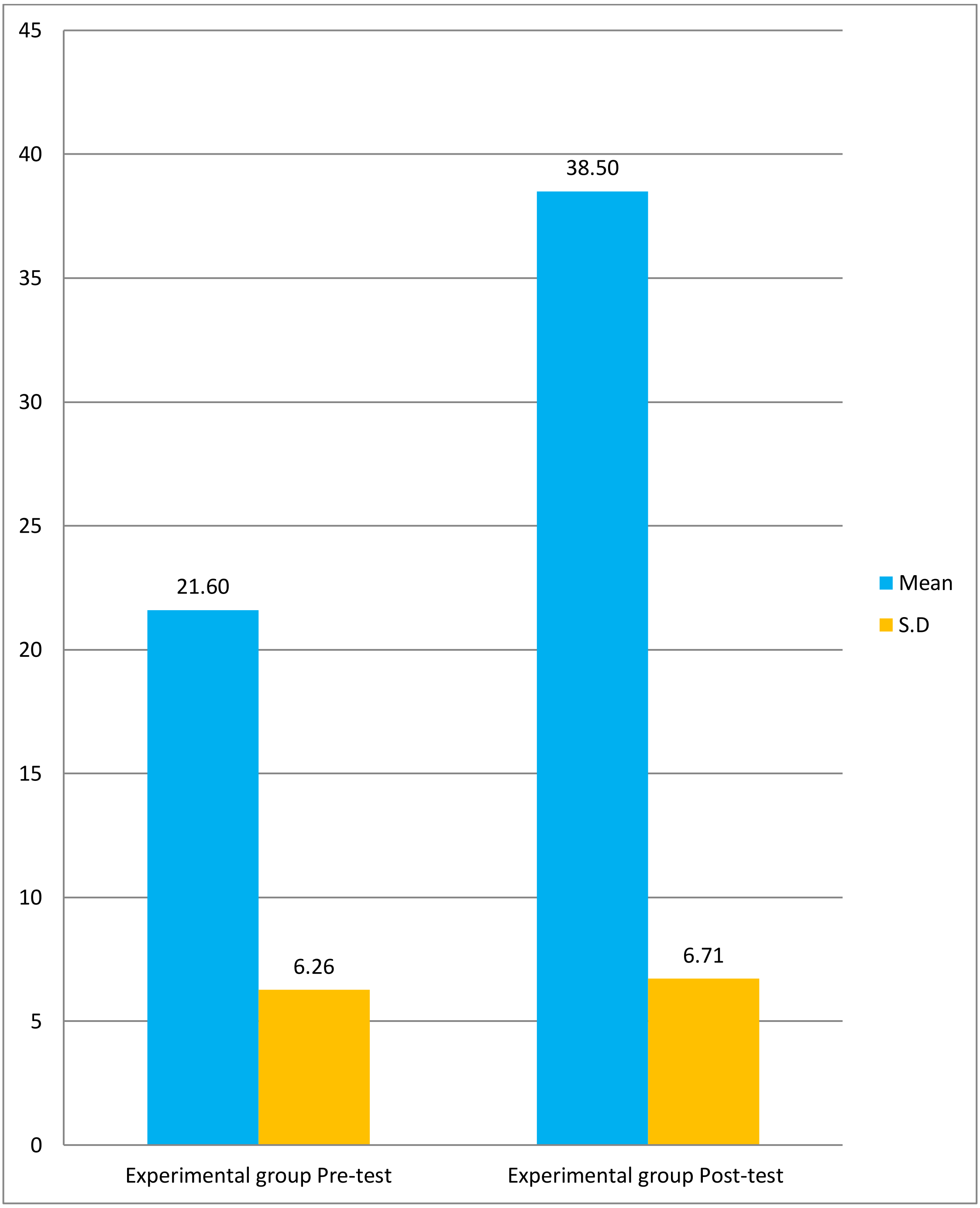
The Effect size of pre-test and post-test mean achievement scores of the Experimental group

Group	Test	No. of students	Mean	SD	Effect size (E)
Exp-group	Pre-test	20	21.60	6.26	2.60
Exp-group	Post-test	20	38.50	6.71	

The effect size for the difference between the means of pre-test and post-test achievement scores of the experimental group through the E-Content in learning chemistry at the higher secondary school level is found to be 2.60 which is considered as a large effect size by Cohen (1992). Therefore, the hypothesis is rejected.

Hence, it is concluded that there is a significant difference between the effect size of pre-test and post-test mean achievement scores of the experimental group and the degree of the effect size as estimated by Cohen (1992) is a large (≥ 0.80) effect size.

Figure 4.15 shows the effect size for the difference between pre-test and post-test mean achievement scores of the experimental group through E-Content



Hypothesis: 15

There is no gain between the mean scores of the pre-test and post-test of the control group learned chemistry through Conventional methods at the higher secondary schoollevel.

The gain ration for the Control group learned chemistry through the Conventional method at the higher secondary school level.

$$\text{Gain ratio} = \frac{\text{Mean of (Post test scores} - \text{Pre test scores)}}{\text{Mean of (Full scores} - \text{Pre test scores)}}$$

$$= \frac{24.45 - 21.55}{50 - 21.55} \times 100$$

$$= \frac{2.9}{28.45} \times 100$$

$$= 0.101933 \times 100$$

Gain ratio = 10.19 %

Thus, it is found that the gain ratio obtained by the control group through theConventional method in learning chemistry at the higher secondary school level is just 10.19%.

Hypothesis: 16

There is no gain between the mean scores of the pre-test and post-test of the experimental group learned chemistry through the E-Content at thehigher secondary school level.

The gain ratio for the experimental group learnt chemistry through E-Content.

$$\text{Gain ratio} = \frac{\text{Mean of (Post test scores} - \text{Pre test scores)}}{\text{Mean of (Full scores} - \text{Pre test scores)}}$$

$$= \frac{38.50 - 21.60}{50 - 21.60} \times 100$$

$$= \frac{16.9}{28.4} \times 100$$

$$= 0.595070 \times 100$$

Gain ratio= 59.50 %

Thus, it is found that the gain ratio obtained by the experimental group through the E-Content in learning chemistry at the higher secondary school level is 59.50 % whereas it is just 10.19 % in the case of the control group.

Hypothesis: 17

There is no significant difference between the pre-test and post-test mean scores of the attitude towards learning chemistry at the higher secondary school level through E-Content in the control group.

Table - 4.19

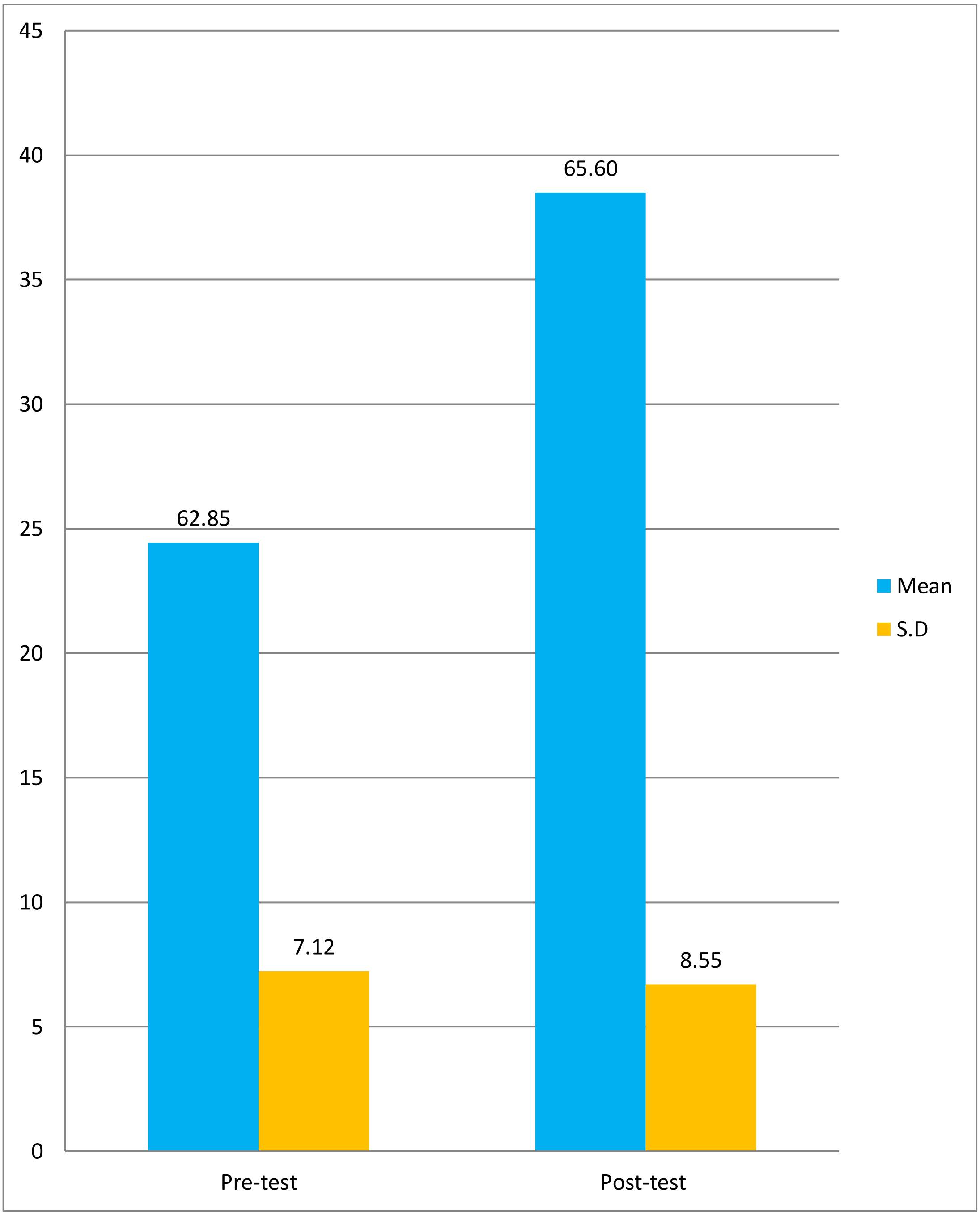
The pre-test and post-test mean scores of the attitude towards learning chemistrythrough E-Content in the control group

Test	No. of students	Mean	S.D	Mean difference	't' value	Degrees of freedom	Level of significance (0.01 level)
Pre-test	20	62.85	7.12	2.75	4.215	19	Not significant
Post-test	20	65.60	8.55				

The mean of the attitude scores in the pre-test of the control group towards learning chemistry at the higher secondary school level through E-Content is found to be 62.85 with an SD 7.12. The mean of the attitude scores in the post-test of the control group through the E-Content is found to be 65.60 with an SD 8.55. The mean difference 2.75 is found to be not significant for the 't' value 4.215 for 19 degrees of freedom at a 1% level of significance. Therefore, the hypothesis is accepted.

It is concluded that there is no significant difference between the pre-test and post-test mean scores of the attitude towards learning chemistry at the higher secondary school level through E-Content in the control group.

Figure 4.16 shows the pre-test and post-test mean of the attitude scores of thecontrol group towards E-Content in learning chemistry at the higher secondary school level



Hypothesis: 18

There is no significant difference between the pre-test and post-test mean scores of the attitude towards learning chemistry at the higher secondary school level through E-Content in the experimental group.

Table - 4.20

The pre-test and post-test mean scores of the attitude towards learning chemistry atthe higher secondary school level through E-Content in the experimental group

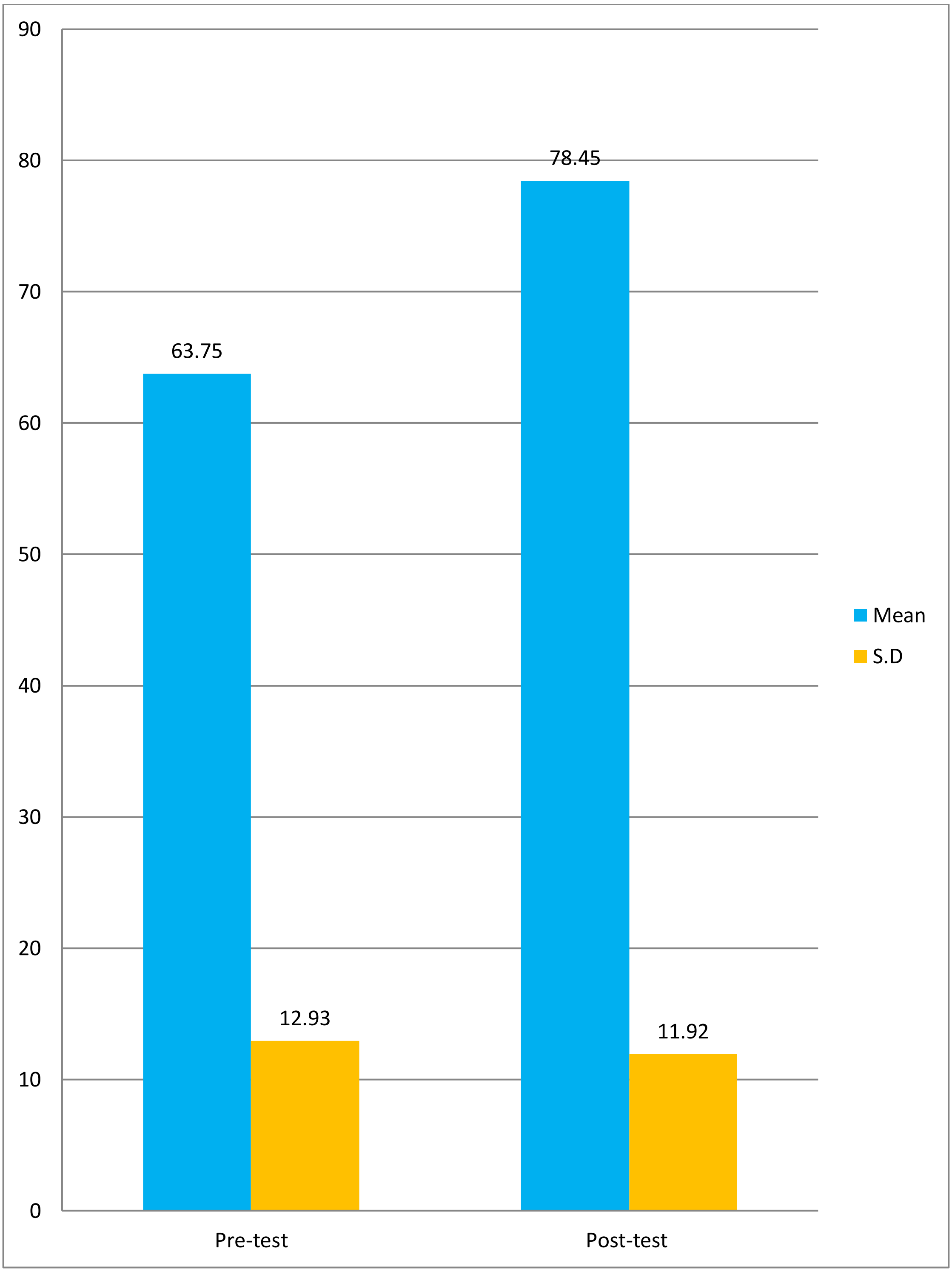
Test	No. of students	Mean	S.D	Mean difference	't' value	Degreesof freedom	Level of significance (0.01 level)
Pre-test	20	63.75	12.93	14.7	20.354	19	Significant
Post-test	20	78.45	11.92				

The mean of the attitude scores in the pre-test of the experimental group towards learning chemistry through E-Content is found to be 63.75 with an SD

12.93. The mean of the attitude scores in the post-test of the experimental group through the E-Content is found to be 78.45 with an SD 11.92. The mean difference 14.7 is found to be significant for the 't' value 20.354 for 19 degrees of freedom at a 1% level of significance. Therefore, the hypothesis is rejected.

It is concluded that there is a significant difference between the pre-test and post-test mean scores of the attitude towards learning chemistry at the higher secondary school level through E-Content in the experimental group.

Figure 4.17 shows the pre-test and post-test mean of the attitude scores of theexperimental group towards E-Content in learning chemistry at the higher secondary school level



Hypothesis: 19

There is no significant difference between pre-tests attitude scores towards E-Content in learning chemistry at the higher secondary level in the control and experimental groups.

Table - 4.21

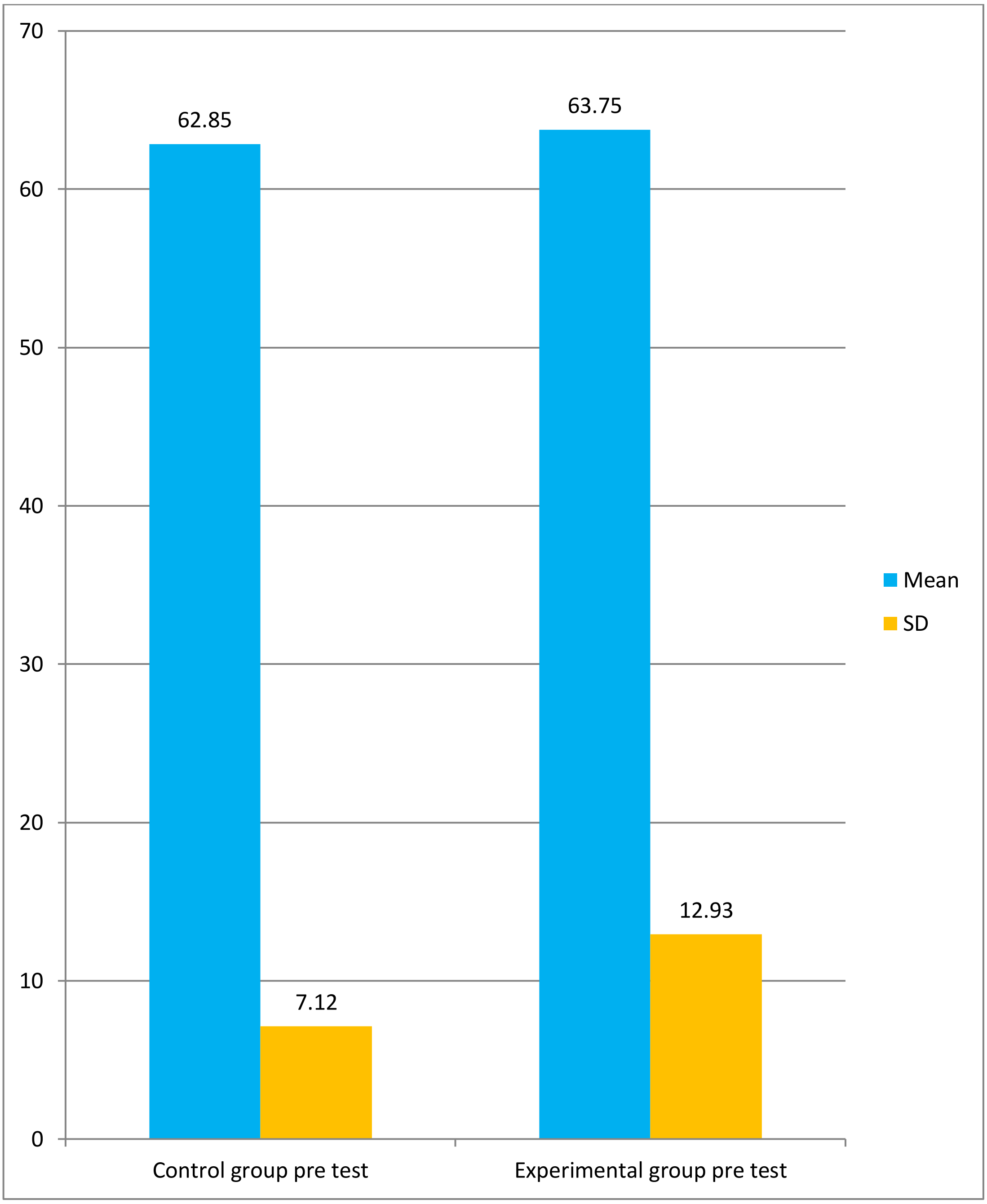
Pre-tests attitude scores towards E-Content in learning chemistry at the higher secondary level in the control and experimental groups.

Test	No. of students	Mean	S.D	Mean difference	't' value	Degrees of freedom	Level of significance (0.01 level)
C-group Pre-test	20	62.85	7.12	0.9	0.272	38	Not Significant
E-group Pre-test	20	63.75	12.93				

The mean of the attitude scores in the pre-test of the control group towards learning chemistry through conventional method is found to be 62.85 with an SD 7.12. The mean of the attitude scores in the pre-test of the experimental group through the E-Content is found to be 63.75 with an SD 12.93. The mean difference 0.9 is found to be not significant for the 't' value 0.272 for 38 degrees of freedom at a 1% level of significance. Therefore, the hypothesis is accepted.

It is concluded that there is no significant difference between pre-tests attitude scores towards E-Content in learning chemistry at the higher secondary level in the control and experimental groups.

Figure 4.18 shows the Pre-tests attitude scores towards E-Content in learning chemistry at the higher secondary level in the control and experimental groups



Hypothesis: 20

There is no significant difference between post-tests attitude scores towards E-Content in learning chemistry at the higher secondary level in the control and experimental groups.

Table - 4.22

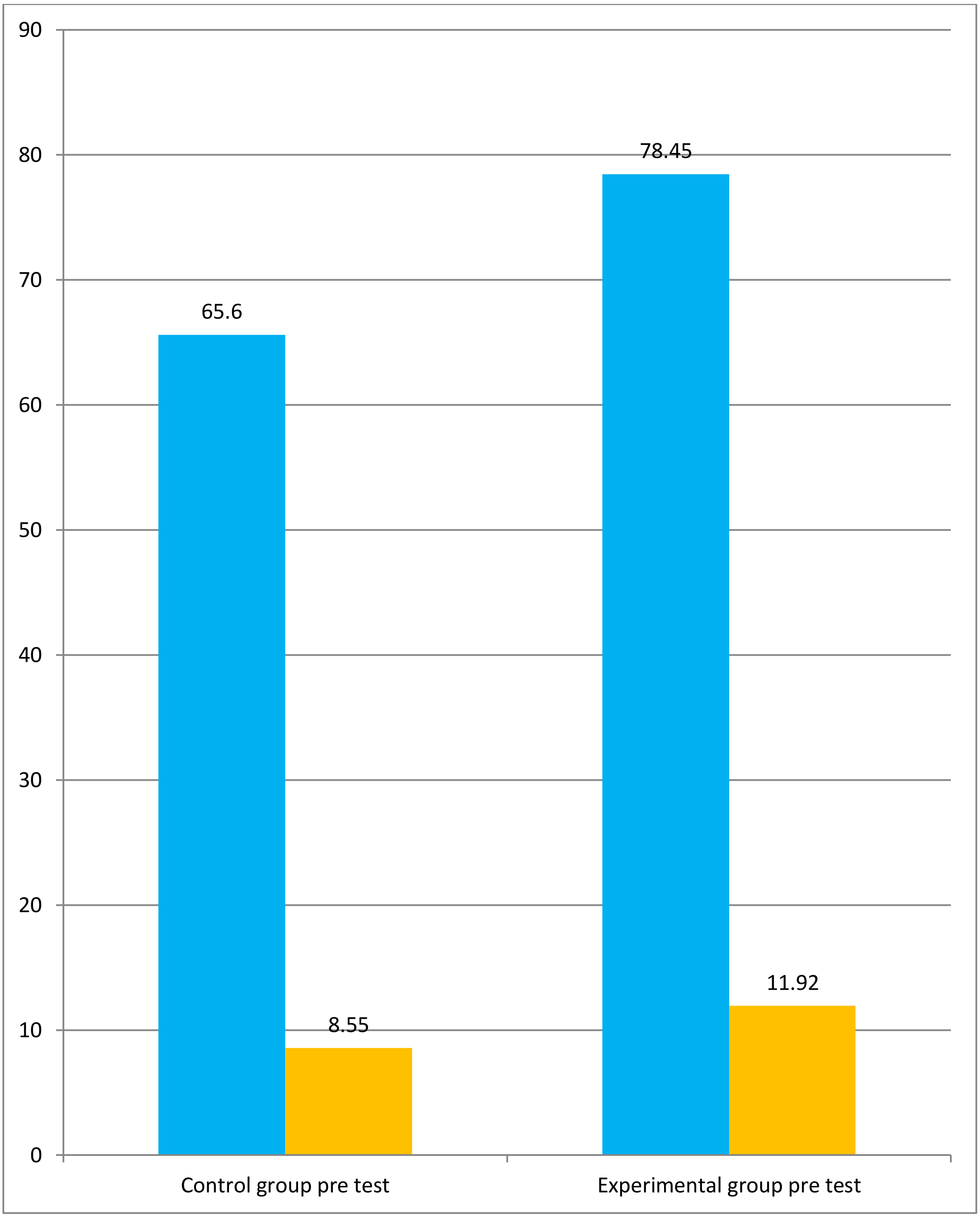
Post-tests attitude scores towards E-Content in learning chemistry at the higher secondary level in the control and experimental groups.

Test	No. of students	Mean	S.D	Mean difference	't' value	Degreesof freedom	Level of significance (0.01 level)
C-group Post-test	20	65.60	8.55	12.85	3.917	38	Significant
E-group Post-test	20	78.45	11.92				

The mean of the attitude scores in the post-test of the control group towards learning chemistry through conventional method is found to be 65.60 with an SD 8.55. The mean of the attitude scores in the pre-test of the experimental group through the E-Content is found to be 78.45 with an SD 11.92. The mean difference 12.85 is found to be significant for the 't' value 3.917 for 38 degrees of freedom at a 1% level of significance. Therefore, the hypothesis is rejected.

It is concluded that there is a significant difference between pre-tests attitude scores towards E-Content in learning chemistry at the higher secondary level in the control and experimental groups.

Figure 4.19 shows the Post-tests attitude scores towards E-Content in learning chemistry at the higher secondary level in the control and experimental groups.



Hypothesis: 21

There is no significant difference between the post-test and retention-test scores in learning chemistry at the higher secondary level in the control group.

Table - 4.23

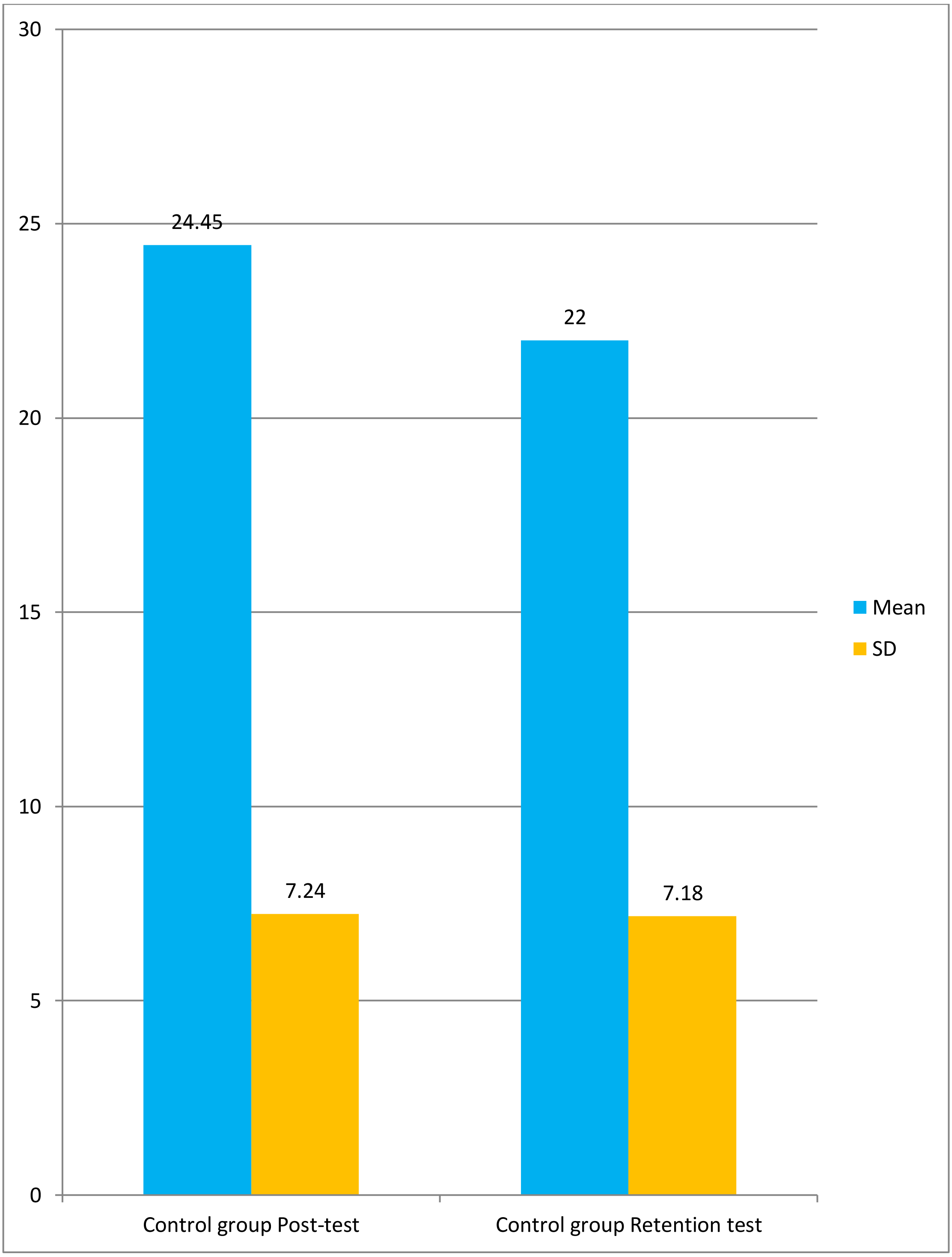
Post-test and retention-test scores in learning chemistry at the higher secondary level in the control group.

Test	No. of students	Mean	S.D	Mean difference	't' value	Degreesof freedom	Level of significance (0.01 level)
C-group Post-test	20	24.45	7.24	2.45	2.854	19	Significant
C-group Retention -test	20	22.00	7.11				

The mean of the post-test scores of the control group towards learning chemistry through conventional method is found to be 24.45 with an SD 7.24. The mean of the retention test scores of the control group through the conventional method is found to be 22.00 with an SD 7.11. The mean difference 2.45 is found to be significant for the 't' value 2.854 for 19 degrees of freedom at a 1% level of significance. Therefore, the hypothesis is rejected.

It is concluded that there is a significant difference between the post-test and retention-test scores in learning chemistry at the higher secondary level in the control group.

Figure 4.20 shows the Post-test and retention-test scores in learning chemistry at the higher secondary level in the control group.



Hypothesis: 22

There is no significant difference between the post-test and retention-test scores in learning chemistry at the higher secondary level in the experimental group.

Table - 4.24

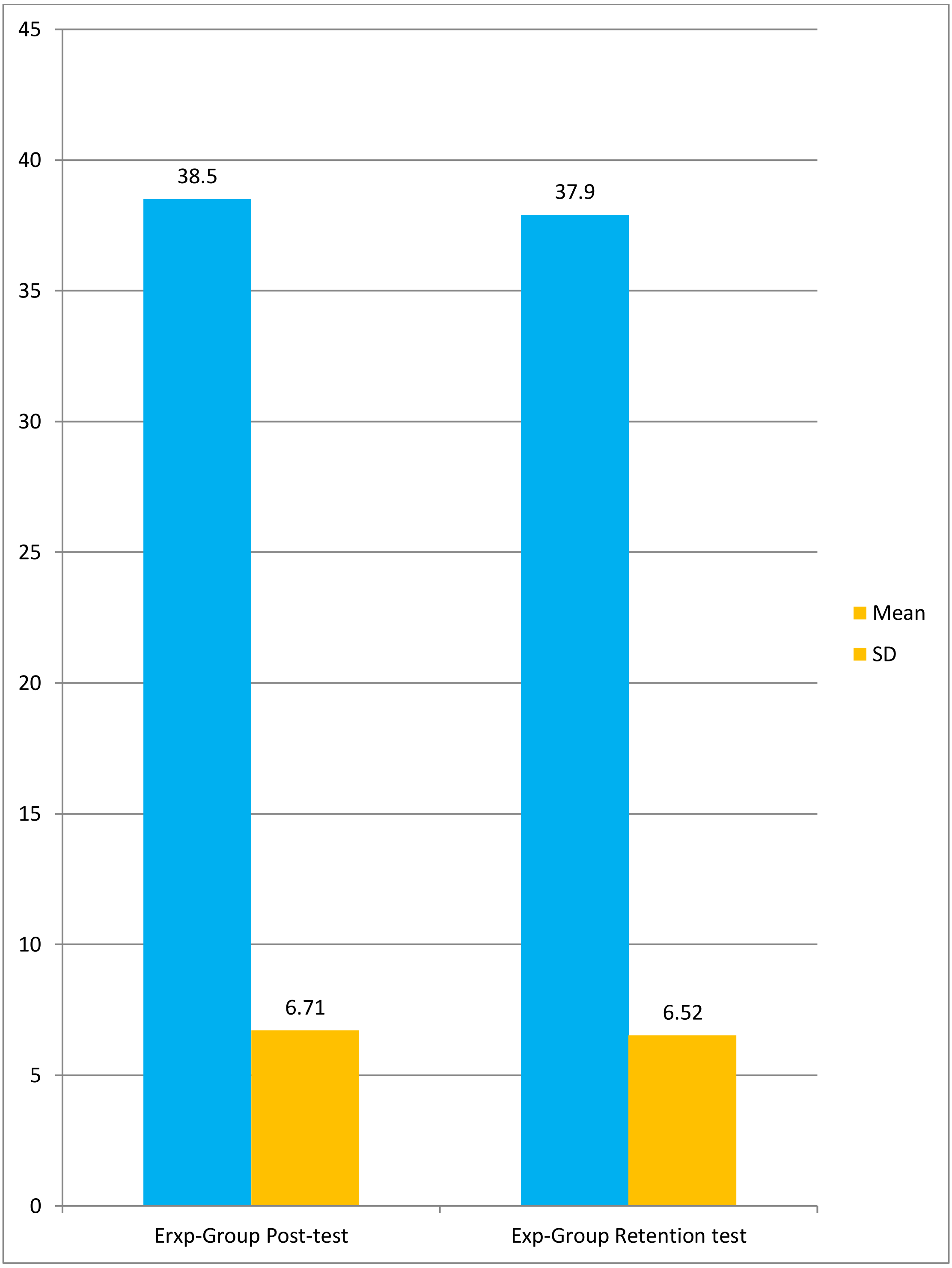
Post-test and retention-test scores in learning chemistry at the higher secondary level in the experimental group.

Test	No. of students	Mean	S.D	Mean difference	‘t’ value	Degreesof freedom	Level of significance (0.01 level)
E-group Post-test	20	38.50	6.71	0.19	1.552	19	Not Significant
E-group Retention -test	20	37.90	6.52				

The mean of the post-test scores of the experimental group towards learning chemistry through E-Content is found to be 38.50 with an SD 6.71. The mean of the retention test scores of the experimental group through the E-Content is found to be 37.90 with an SD 6.52. The mean difference 0.19 is found to be significant for the ‘t’ value 1.552 for 19 degrees of freedom at a 1% level of significance. Therefore, the hypothesis is accepted.

It is concluded that there is no significant difference between the post-test and retention-test scores in learning chemistry at the higher secondary level in the experimental group.

Figure 4.21 shows the Post-test and retention-test scores in learning chemistry at the higher secondary level in the experimental group.



Hypothesis: 23

There is no significant difference between retention-tests scores in learning chemistry at the higher secondary level in the control and experimental groups.

Table - 4.25

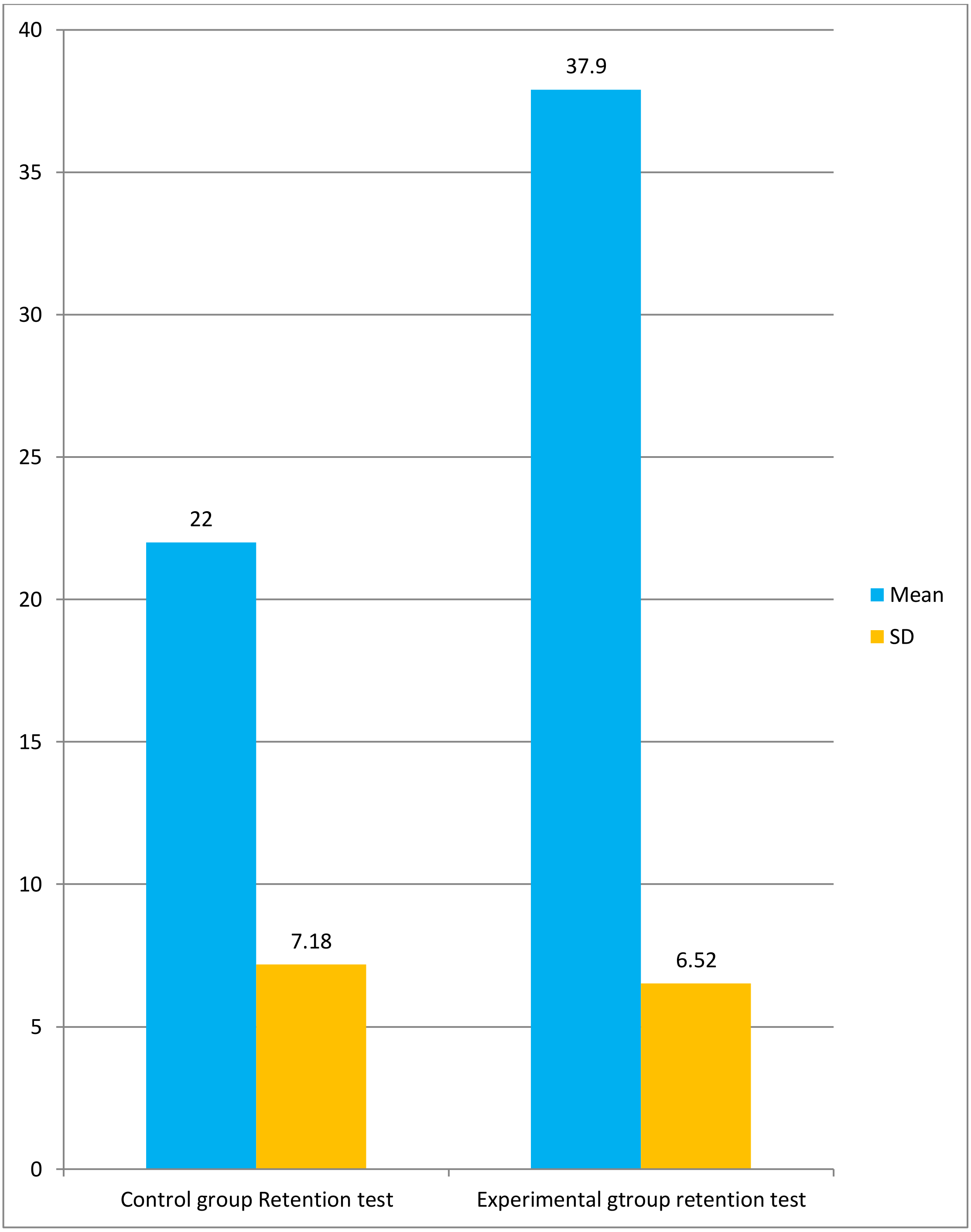
Retention-tests scores in learning chemistry at the higher secondary level in the control and experimental groups.

Test	No. of students	Mean	S.D	Mean difference	't' value	Degrees of freedom	Level of significance (0.01 level)
C-group retention-test	20	22.65	7.11	15.25	7.068	38	Significant
E-group retention-test	20	37.90	6.52				

The mean of the retention test scores of the control group towards learning chemistry through conventional method is found to be 22.65 with an SD 7.11. The mean of the retention test scores of the experimental group through the E-Content is found to be 37.90 with an SD 6.52. The mean difference 15.25 is found to be significant for the 't' value 7.068 for 38 degrees of freedom at a 1% level of significance. Therefore, the hypothesis is rejected.

It is concluded that there is a significant difference between retention-tests scores in learning chemistry at the higher secondary level in the control and experimental groups.

Figure 4.22 shows the Retention-tests scores in learning chemistry at the higher secondary level in the control and experimental groups.



4.6 RESULTS OF HYPOTHESES TESTING

E-Content in learning chemistry at the higher secondary school level is found effective.

1 There is a significant difference between pre-test and post-test mean achievement scores of the control group.
2 There is a significant difference between pre-test and post-test meanachievement scores of the experimental group.
3 There is no significant difference between pre-tests mean achievement scoresof the control and experimental groups.
4 There is a significant difference between post-tests mean achievement scoresof the control and experimental groups.
5 There is no significant difference between the low achievers in the pre-test andpost-test mean achievement scores of the control group.
6 There is a significant difference between low achievers in the pre-test andpost-test mean achievement scores of the experimental group.
7 There is no significant difference between low achievers in the pre-tests meanachievement scores of the control and experimental groups.
8 There is a significant difference between low achievers in the post-tests meanachievement scores of the control and experimental groups.
9 There is a significant difference between moderate achievers in the pre-test andpost-test mean achievement scores of the control group.
10 There is a significant difference between moderate achievers in the pre-test and post-test mean achievement scores of the experimental group.

11 There is no significant difference between moderate achievers in the pre-tests mean achievement scores of the control and experimental groups.

12 There is a significant difference between moderate achievers in the post-tests mean achievement scores of the control and experimental groups.

13 There exists a significant difference between the effect size of pre-test and post-test mean achievement scores of the control group.

14 There exists a significant difference between the effect size of pre-test and post-test mean achievement scores of the experimental group.

15 There is a gain between the mean achievement scores of the pre-test and post-test of the control group.

16 There is a gain between the mean achievement scores of the pre-test and post-test of the experimental group.

17 There is no significant difference between the pre-test and post-test mean scores of the attitude towards learning chemistry at the higher secondary school level throughE-Content in the control group.

18 There is a significant difference between the pre-test and post-test mean scoresof the attitude towards learning chemistry at the higher secondary school level throughE-Content in the experimental group.

19 There is no significant difference between pre-tests attitude scores towards E-Content in learning chemistry at the higher secondary level in the control and experimental groups.

20 There is a significant difference between post-tests attitude scores towards E-Content in learning chemistry at the higher secondary level in the control and experimental groups.

21 There is a significant difference between the post-test and retention-test scores in learning chemistry at the higher secondary level in the control group.

22 There is no significant difference between the post-test and retention-test scores in learning chemistry at the higher secondary level in the experimental group.

23 There is a significant difference between retention-tests scores in learning chemistry at the higher secondary level in the control and experimental groups.

4.7 DISCUSSION OF THE STUDY BASED ON THE FINDINGS

The E-Content developed in learning chemistry at the higher secondary school level is found to be effective. The mean difference between the pre-test and post-test scores of the experimental group is calculated as 16.9 with a significant' value of 32.78 whereas the mean difference between the pre-test and post-test scores of the control group is calculated as 2.9 with an insignificant 't' value of 15.22 at 1% level of significance. The mean difference between the experimental and control groups is 16.9 and 2.9 respectively, proving that the E-Content is effective rather than the control group learn through the Conventional method.

It is concluded that there is a significant difference between the pre-test and post-test mean achievement scores of the control group through the Conventional method. It also observed the difference of mean difference between control group learnt through conventional method and experimental group learnt through E-Content is 14. It is also noted that, chemistry learning through E-Content mean difference score is 5.827% higher than the chemistry learning through conventional method mean difference score.

It is derived from the differential analysis that the pre-post achievement tests conducted in the control group shows there is no significant difference between the pre and post- test achievement scores of the low achievers but there is a significant difference exists between the pre and post- test achievement scores of moderate achievers in the control group. For the experimental group, the pre-post achievement test scores of the low achievers and moderate achievers showed a significant difference in their mean scores at a 1% level of significance.

It is also observed that there is a significant difference between the mean scores of the post-test of the control and experimental groups. The mean difference between the post-test scores of the control and experimental groups is 14.05 with a ‘t’ value of 6.368 at a 1% level of significance. There is no significant difference between the pre-test scores of the control and experimental groups under the low achievers and moderate achievers categories.

The mean difference between the pre-test and post-test attitude scores towards E-Content in the control group is 2.75 whereas it is 14.7 in the experimental group treated with the E-Content in learning chemistry at the higher secondary school level. There is a significant difference in the attitude of the learners who have been treated through the E-Content and there is no significant difference in the pre-test and post-test scores of the control group.

The mean difference between the post-test and retention test of control group learnt through conventional method is 2.45, whereas the mean difference between the post-test and retention test of experimental group learnt through E-Content is 0.19. There is no significant difference in the post-test and retention test of the learners who have been treated through the E-Content and there is a significant difference in the post-test and retention test of the learners who have been treated through the conventional method.

It is also observed that there is a significant difference between the retention test of the control and experimental groups. The mean difference between the retention test scores of the control and experimental groups is 15.25 with a ‘t’value of 7.068 at a 1% level of significance.

It is found that the effect size of the control group and the experimental groups are 0.419 and 2.60 respectively. The effect size of the control group is not as large as that of the experimental group. The effect size of the experimental group 2.60 which is greater than 0.419, a value decided by Cohen as a large effect size. It shows that E-Content is effective in learning chemistry at the higher secondary school level**.**

The gain ratio obtained by the experimental group through the E-Content is 59.50% and that of the control group is 10.19%. There is a gain in the achievement level to the tune of 59.50% as far as the experimental group is concerned whereas it is just 10.19% in the control group treated through the Conventional method.

4.8. CONCLUSION

The investigator has presented the data analysis and interpretation in this chapter. The descriptive and differential analyses are presented in a presentable way. The tables and figures have been used to present the conclusions using statistical techniques. At the end of each table, a brief discussion with inferences is given the investigation's summary and conclusions are presented in the following chapter.

CHAPTER – V

SUMMARY AND CONCLUSION

CHAPTER - V

SUMMARY AND CONCLUSION

'To interpret is to explain, to find meaning''.

- Fred Kerlinger

5.1 INTRODUCTION

The aim of my research work is to find out an answer to the problem and the answer is generally stated in the form of education. The researcher undertook the work in order to test the formed hypothesis and to achieve certain objectives. On the basis of the study, the investigator accepts or rejects the hypothesis and draws certain conclusions.

In this chapter, the summary of the entire experimental research work comprising its results, discussions, educational implications of the study, recommendations and suggestions for further research in the field of developing E-Content in learning chemistry at the higher secondary school level is furnished.

5.2 SALIENT FINDINGS OF THE STUDY

1 The E-Content developed in learning chemistry at the higher secondary school level is found to be effective.

2 There is no significant difference between pre-tests mean achievement scoresof the control and experimental groups.

3 There is a significant difference between post-tests mean achievement scoresof the control and experimental groups.

4 There is no significant difference between low achievers in the pre-tests meanachievement scores of the control and experimental groups.

5 There is a significant difference between low achievers in the post-tests meanachievement scores of the control and experimental groups.

6 There is no significant difference between moderate achievers in the pre-tests mean achievement scores of the control and experimental groups.

7 There is a significant difference between moderate achievers in the post-tests mean achievement scores of the control and experimental groups.

8 There exists a significant difference between the effect size of pre-test and post-test mean achievement scores of the control group.

9 There exists a significant difference between the effect size of pre-test and post-test mean achievement scores of the experimental group.

10 There is a gain between the mean achievement scores of the pre-test and post-test of the control group.

11 There is a gain between the mean achievement scores of the pre-test and post-test of the experimental group.

12 There is no significant difference between pre-tests attitude scores towards E-Content in learning chemistry at the higher secondary level in the control and experimental groups.

13 There is a significant difference between post-test attitude scores towards E-Content in learning chemistry at the higher secondary level in the control and experimental groups.

14 There is a significant difference between retention-tests scores in learning chemistry at the higher secondary level in the control and experimental groups.

5.3 DISCUSSION OF THE STUDY BASED ON SALIENT FINDINGS

The E-Content developed in learning chemistry at the higher secondary school level is found to be effective. The mean difference between the pre-test and post-test scores of the experimental group is calculated as 16.9 with a significant' value of 32.78 whereas the mean difference between the pre-test and post-test scores of the control group is calculated as 2.9 with an insignificant 't' value of 15.22 at 1% level of significance. The mean difference between the experimental and control groups is 16.9 and 2.9 respectively. It is also noted that, chemistry learning through E-Content mean difference score is 5.827% higher than the chemistry learning through conventional method. It is proving that the E-Content is effective rather than the control group learnt through the Conventional method. **(Finding No. 1)**

It is also observed that there is a significant difference between the mean scores of the post-test of the control and experimental groups. The mean difference between the post-test scores of the control and experimental groups is 14.05 with a 't' value of 6.368 at a 1% level of significance. There is no significant difference between the pre-test scores of the control and experimental groups under the low achievers and moderate achievers categories. **(Finding No. 5, 7)**

It is found that the effect size of the control group and the experimental groups are 0.419 and 2.60 respectively. The effect size of the control group is not as large as that of the experimental group. The effect size of the experimental group 2.60 which is greater than 0.419, a value decided by Cohen as a large effect size. It shows that E-Content is effective in learning chemistry at the higher secondary school level. **(Finding No. 8,9)**

The gain ratio obtained by the experimental group through the E-Content is 59.50% and that of the control group is 10.19%. There is a gain in the achievement level to the tune of 59.50% as far as the experimental group is concerned whereas it is just 10.19% in the control group treated through the Conventional method. **(Finding No.10, 11)**

Finding No. 5 reveals that there is a significant difference between low achievers in the post-test mean achievement scores of the control and experimental groups. The low achievers in the post-test mean achievement scores of the control group (17.13) are lower than the low achievers in the post-test mean achievement scores of the experimental group (32.63). This finding is also supported by **Campbell, Kristin R., Wilson, Sandra B., Wilson, P. and Christopher He, Zhenli (2011).**

Finding No. 7 reveals that there is a significant difference between moderate achievers in the post-test mean achievement scores of the control and experimental groups. The moderate achievers in the post-test mean achievement scores of the control group (29.33) are higher than the moderate achievers in the post-test mean achievement scores of the experimental group (42.42). This finding is also supported by **Angadi, G.R. (2010).**

Finding No. 13 reveals that there is a significant difference between post test attitude scores in the control and experimental groups. Post-Test mean achievement scores of the control group (65.60) is higher than the post-test mean achievement scores of the experimental group (78.45). This finding is also supported by **Campbell, Kristin R., Wilson, Sandra B., Wilson, P. and Christopher He, Zhenli (2011).**

Finding No. 14 reveals that there is a significant difference between the retention-test mean achievement scores of the control group and experimental groups. The mean score of the control group (22.65) is lower than the experimental group (37.90) with respect to their pre-test and post-test. This finding is also supported by **Pratibha Sharma (2012).**

5.4. RECOMMENDATIONS OF THE STUDY

1 As the E-Content technology enhances the achievement level of the learners, separate periods should be allotted in learning chemistry at the higher secondary school level.

2 ICT laboratories must be commissioned in all higher secondary schools in Tamil Nadu so that students will have easy access to electronic media.

3 Learners must be motivated to utilize E-Content for effectivelearning.

4 This study recommends that separate E-Content can be developed for each other chemistry units with special reference to the classes exclusively.

5 On-the-job support may be provided to teachers in developing e teaching materials for chemistry concepts found to be hard by the learners.

6 This study can be extended to areas other than chemistry viz. teaching Physics, Botany and Zoology at the higher secondary school level.

7 Smart classrooms with laptop and computer facilities to all students must beset up in all government and aided schools.

8 The attitude of the students must be manipulated in such a way that they must learn independently without anybody's intervention but the interventions of the computers.

5.5. EDUCATIONAL IMPLICATIONS

- As the utilization of E-Content in learning chemistry enhances the achievement level of higher secondary school students, the said E-Content can be expanded to high school and middle school students studying science subject.
- Learners belonging to rural areas find this E-Content attractive and learner- friendly.
- E-Content helps the learners to learn themselves according to their choice of interest and their own pace. Evaluation of their performance every now and then by the computers motivates their achievement.
- E-Content instills self-confidence and independence among the rural students with a poor background which in turn will improve their achievement level. They are exposed to the modern world and the modern techniques of instruction.
- Learning chemistry through E-Content improves the pass percentage of students at the higher secondary school classes.

5.6. SUGGESTIONS FOR FURTHER RESEARCH

As a sequence to the findings of the present study, further investigations in thefollowing areas can be taken up. The areas suggested are as follows;

- This study may be extended to higher secondary schools located in the urbanareas too.
- This study may be extended to other subjects viz. Tamil, Maths, and Physicsbeing taught in higher secondary schools.
- This study may be taken up with samples from other classes that are X and XII.
- Further investigation is suggested for developing E-Content for students of Tamil medium schools, CBSE and ICSE boards.
- The effectiveness of the E-Content can be compared with samples taken from different boards and also between Tamil medium and English medium learners and matriculation students.
- Correlation if any in the effectiveness of learning among English and Tamil medium students and also between State board and other board students studying in higher secondary school classes.
- Separate studies can be conducted taking into account the socio-economic aspects of the learners and their parents and teachers.
- Effectiveness of the E-Content on application to urban school students and rural school students shall be studied.

5.7 CONCLUSION

The present study was carried out to find out the effectiveness of E-Content in learning chemistry at the higher secondary school level. As the present teaching- learning process at the higher secondary school level is rigid, time-bound and outmoded, it was planned to device teaching tasks in the form of E-Content for the benefit of the learners so that the learners could attain the mastery of the subject according to their own pace and ability and feel motivated through personal involvement in the process of learning. It is pointed out that the E-Content is user control as the tasks are constructed and offered to each learner through a separate personal computer. The present study clearly demonstrates the effectiveness of E-Content in learning chemistry and academic achievement at the higher secondary school level. As the E-Content provides ample scope for learner motivation and user-friendliness, it is recommended that this type of technology supported E-Content should be employed in the process of learning for all categories of learners.

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APPENDICES

APPENDIX – I

DEPARTMENT OF EDUCATION
BHARATHIDASAN UNIVERSITY,
TIRUCHIRAPALLI – 24.

R. Selvaganapathy
Research Scholar,
Department of Education,
Bharathidasan University,
Tiruchirapalli-24.

Dr. A. Edward William Benjamin
Research Supervisor, Professor,
Department of Education,
Bharathidasan University,
Tiruchirapalli-24.

Dear student,

I am pursuing a research on "**EFFECTIVENESS OF E-CONTENT IN LEARNING CHEMISTRY AND ACADEMIC ACHIEVEMENT AT THE HIGHER SECONDARY LEVEL"**. Hence, I request your kind responses for the research. I assure you that the responses will be kept strictly confidential and will be used only for the research purpose.

Yours sincerely,
R.SELVAGANAPATHY.

==

ATTITUDE SCALE TOWARDS E-CONTENTIN LEARNING CHEMISTRY AT THE HIGHER SECONDARY LEVEL

Name of the student : ___________________

Gender : Male/ Female

Age : ____________________

Residence : Day scholar/ Hosteller

School :

Read the following statements carefully and give your responses by marking (√) against the respective questions. There is no right or wrong answer, so please giveyour response on the items.

பின்வரும் கூற்றுக்களை கவனமாகப் படித்து, அந்தந்த வினாக்களுக்கு எதிராக (√) குறியிட்டுஉங்கள்பதில்களைக்கொடுக்கவும்.

இதில்சரியானபதில்கள்அல்லதுதவறானபதில்கள்என்றுஎதுவும்இல்லை, எனவே ஒவ்வொரு கூற்றுக்கும் உங்கள் பதில்களைக்கொடுக்கவும்.

A- Strongly Agree/ உறுதியாக ஒப்புக்கொள்கிறேன்
B- Agree/ ஒப்புக்கொள்கிறேன்
C- Neutral/ நடுநிலை
D- Disagree/ மறுக்கிறேன்
E- Strongly Disagree/ உறுதியாக மறுக்கிறேன்

S. NO.	STATEMENT	A	B	C	D	E
1	Learning through the computer is interesting.					
	கணினி மூலம் கற்றுக்கொள்வது சுவாரஸ்யமாக உள்ளது.					
2	E-Content does not scare me at all.					
	மின் பாடங்கள் என்னை அச்சுறுத்துவதாக இல்லை.					
3	Learning through E-Content is informative.					
	மின் பாடங்கள் மூலம் கற்றுக்கொள்வது அதிக தகவல் அளிப்பதாக உள்ளது.					
4	Learning chemistry with graphics is fascinating.					
	வரைகலை மூலம் வேதியியலக் கற்றுக்கொள்வது ஆர்வத்தை தூண்டும் விதமாக உள்ளது.					
5	I don't support learning through E-Content.					
	மின் பாடங்கள் மூலம் கற்றுக்கொள்வதை நான் ஆதரிக்கவில்லை.					
6	Computers are not always time-consuming.					
	கணினிகள் எப்போதும் அதிக நேரம் எடுப்பதில்லை.					
7	I feel happy in learning chemistry with self-learning E-Content.					
	சுயமாக கற்றக் கூடிய மின் பாடங்களுடன் வேதியியலைக் கற்றுக்கொள்வதில் நான் மகிழ்ச்சியாக உணர்கிறேன்.					
8	Learning chemistry with a computer would make me nervous.					
	கணினி கொண்டு வேதியியலைக் கற்றுக்கொள்வது என்னைப் பதற்றமடையச் செய்கிறது .					

S. NO.	STATEMENT	A	B	C	D	E
9	I feel comfortable in observing chemistry concepts with anE-Content assistance.					
	மின் பாடங்கள் உதவியுடன் வேதியியல் கருத்துகளை கவனிப்பதை நான் சௌகரியமாக உணர்கிறேன்.					
10	E-Content based learning concepts can never be as good as conventional aspects.					
	மின் பாடங்கள் அடிப்படையில் கருத்துக்களைக் கற்றுக்கொள்வது பாரம்பரிய கற்றல் முறைகள் (கரும்பலகை மூலமாகக் கற்றல்) போன்று சிறந்ததாக இருக்க முடியாது.					
11	Computers will not be available in each and everyclassroom.					
	ஒவ்வொரு வகுப்பறையிலும்கணினிகள் இருக்காது.					
12	E-Content- animations make me feel uncomfortable.					
	மின் பாடங்கள்- இயங்குபடங்கள் எனக்கு அசௌகரியத்தை ஏற்படுத்துகின்றன.					
13	E-Content in learning chemistry is less adequate compared tothe conventional learning.					
	பாரம்பரிய முறையில் கற்பதோடுஒப்பிடுகையில் வேதியியல் கற்பதில் மின் பாடங்கள் போதுமானதாக இல்லை.					
14	Listening chemistry concepts assisted by E-Content is lessproficient than conventional methods.					
	மின் பாடங்கள் உதவியுடன் வேதியியல் கருத்துகளைக் கவனிப்பது பாரம்பரிய முறைகளைக் காட்டிலும் திறன் குறைவாக உள்ளது.					
15	E-Content-assisted learning gives firsthand experience.					
	மின் பாடங்கள் உதவியுடன் கற்பது நேரடியாக கற்கும் அனுபவத்தை அளிக்கிறது.					
16	E-Content-assisted chemistry gives flexibility to learningtough chemistry concepts.					
	மின் பாடங்கள் உதவியுடன் வேதியியல் கற்பது கடினமான வேதியியல் கருத்துகளைக் கற்றிட நெகிழ்வுத் தன்மையை வழங்குகிறது.					
17	Animated pictures give achievement motivation.					
	இயங்குபடங்கள் சாதிக்கும் உந்துதலை அளிக்கின்றன.					
18	E-Content-assisted chemistry constitutes a more relaxed andstress-free atmosphere.					
	மின் பாடங்கள் உதவியுடன் வேதியியல் கற்பது மிகவும் சாந்தமான, மன அழுத்தம் இல்லா சூழ்நிலையை உருவாக்குகிறது.					
19	The feedback provided by computer is clear.					
	கணினி வழங்கும் பின்னூட்டங்கள் தெளிவாக உள்ளன.					

S. NO.	STATEMENT	A	B	C	D	E
20	E-Content-assisted chemistry develops my skills moreanalytical.					
	மின் பாடங்கள் உதவியுடன் வேதியியல் கற்பது எனது திறன்களை திறம்பட வளர்க்கிறது.					
21	I have faith in computer-based chemistry tests.					
	கணினி அடிப்படையிலான வேதியியல் தேர்வுகளில் எனக்கு நம்பிக்கை உள்ளது.					
22	I have faith in computer-based chemistry exercises.					
	கணினி அடிப்படையிலான வேதியியல் பயிற்சிகளில் எனக்கு நம்பிக்கை உள்ளது.					
23	I would like to learn chemistry with multimedia based E-Content techniques.					
	நான் மல்டிமீடியா அடிப்படையிலான மின் பாட நுட்பங்களுடன் வேதியியல் கற்க விரும்புகிறேன்.					
24	I feel unhappy walking into a classroom filled withcomputers.					
	கணினிகள் நிரம்பிய வகுப்பறைக்குள் நுழைவது குறித்து நான் மகிழ்ச்சியாக உணரவில்லை.					
25	I would like to spend more time for listening chemistry withwork books.					
	பாடப்பயிற்சிப் புத்தகங்களுடன் வேதியியலைக் கவனிப்பதில் அதிக நேரம் செலவிட விரும்புகிறேன்.					

APPENDIX – II

SCORING KEY FOR ATTITUDE SCALE

Scale	**Strongly Agree**	**Agree**	**Neutral**	**Disagree**	**Strongly Disagree**
Rating for positive statement	5	4	3	2	1
Rating for negative statement	1	2	3	4	5

APPENDIX –III

ACHIEVEMENT TEST

1. பின்வரும் d ஆர்பிட்டால் இணைகளில் எலக்ட்ரான் அடர்த்தியினை அச்சுகளின் வழியே பெற்றிருப்பது எது?

அ) d_z2, d_{xz} ஆ) d_{xz}, d_{yz} இ) d_z2; $d_x2\text{-}_y2$ ஈ) d_{xy}; $d_x2\text{-}_y2$

Which of the following pairs of d-orbitals will have electron density along the axes ?

a) d_z2, d_{xz} b) d_{xz}, d_{yz} c) d_z2; $d_x2\text{-}_y2$ d) d_{xy}; $d_x2\text{-}_y2$

2. பௌலியின் தவிர்க்கை தத்துவத்தின்படி ஒரே ஆர்பிட்டாலில் உள்ள இரண்டு எலக்ட்ரான்களின் சுழற்சி என்னவாக இருக்கும்

அ) அதே சுழல் ஆ) எதிர் சுழல் இ) வெவ்வேறு சுழல் ஈ) செங்குத்து சுழல்

What will be the spin on two electrons in the same orbitals as per Pauli's Exclusion principle

a) Same spin b) Opposite spin c) Different spin d) Vertical spin

3. ஒரே ஆர்பிட்டாலில் உள்ள இரு எலக்ட்ரான்களையும் வேறுபடுத்தி அறிய உதவுவது

அ) கோண உந்தக் குவாண்டம் எண் ஆ) தற்சுழற்சிக் குவாண்டம் எண்

இ) காந்தக் குவாண்டம் எண் ஈ) ஆர்பிட்டால் குவாண்டம் எண்

Two electrons occupying the same orbital are distinguished by

a) azimuthal quantum number b) spin quantum number

b) magnetic quantum number d) orbital quantum number

4. Eu (அணுஎண்63), Gd (அணுஎண்64) மற்றும் Tb (அணுஎண்65) ஆகியவற்றின் எலக்ட்ரான் அமைப்புகள் முறையே (NEET- Phase II)

அ) [Xe] $4f^6$ $5d^1$ 6s2, [Xe] $4f^7$ $5d^1$ $6s^2$ மற்றும் [Xe] $4f^8$ $5d^1$ $6s^2$

ஆ) [Xe] $4f^7$, $6s^2$, [Xe] $4f^7$ $5d^1$ $6s^2$ மற்றும் [Xe] $4f^9$ $6s^2$

இ) [Xe] $4f^7$, $6s^2$, [Xe] $4f^8$ $6s^2$ மற்றும் [Xe] $4f^8$ $5d^1$ $6s^2$

ஈ) [Xe] $4f^6$ 5d1 $6s^2$, [Xe] $4f^7$ $5d^1$ $6s^2$ மற்றும் [Xe] $4f^9$ $6s^2$

The electronic configuration of Eu (Atomic no. 63) Gd (Atomic no. 64) and Tb (Atomic no. 65) are (NEET - Phase II)

a) [Xe] 4f6 5d1 6s2, [Xe] 4f7 5d1 6s2 and [Xe] 4f8 5d1 6s2
b) [Xe] 4f7 , 6s2, [Xe] 4f7 5d1 6s2 and [Xe] 4f9 6s2
c) [Xe] 4f7 , 6s2, [Xe] 4f8 6s2 and [Xe] 4f8 5d1 6s2
d) [Xe] 4f6 5d1 6s2, [Xe] 4f7 5d1 6s2 and [Xe] 4f9 6s2

4s ஆர்பிட்டாலில் எத்தனை ஆர கணுக்கள் (radial nodes) உள்ளன?

5. அ) 6 ஆ) 3 இ) 2 ஈ) 4

How many radial nodes does a 4s orbital possess?

a) 6 b) 3 c) 2 d) 4

ஒரு துணைக்கூட்டில் உள்ள அதிகபட்சமான எலக்ட்ரான்களின்

6. எண்ணிக்கையினை குறிப்பிடுவது

அ) $2n^2$ ஆ) 2I + 1 இ) 4l + 2 ஈ) மேற்கண்டுள்ள எதுவுமில்லை

The maximum number of electrons in a sub shell is given by the expression

a) 2n2 b) 2l + 1 c) 4l + 2 d) none of these

d- எலக்ட்ரானுக்கான, ஆர்பிட்டால் கோண உந்த மதிப்பானது

7. அ) $\frac{-\sqrt{2h}}{2\pi}$ ஆ) $\frac{-\sqrt{2h}}{2\pi}$ 22πh இ) $\frac{-\sqrt{2x4h}}{2\pi}$ ஈ) $\frac{-\sqrt{6h}}{2\pi}$

For d-electron, the orbital angular momentum is

a) $\frac{-\sqrt{2h}}{2\pi}$ b) $\frac{-\sqrt{2h}}{2\pi}$ 22πh c) $\frac{-\sqrt{2x4h}}{2\pi}$ d) $\frac{-\sqrt{6h}}{2\pi}$

n = 3, l= 1 மற்றும் m = -1ஆகிய குவாண்டம் எண்களின் தொகுப்பினை அதிகபட்சமாக எத்தனை எலக்ட்ரான்கள் பெற்றிருக்க முடியும்?

8. அ) 4 ஆ) 6 இ) 2 ஈ) = 10

What is the maximum numbers of electrons that can be associated with the following set of quantum numbers ? n = 3, l = 1 and m = –1

a) 4 b) 6 c) 2 d) = 10

ஒரு ஆர்பிட்டாலில் சுழலும் எலக்ட்ரான்கள் கீழ்கண்ட எதை நிலையாக பெற்றிருக்கும்

9. அ) தடிமன் ஆ) வடிவம் இ) கோண உந்தம் ஈ) வடிவம்

Electrons revolving in an orbit have fixed

a) Thickness b) Shape c) Angular momentum d) Shape

கூற்று: 3p ஆர்பிட்டாலுக்கான ஆர மற்றும் கோண கணுக்களின் எண்ணிக்கை முறையே

1 காரணம்: ஆர மற்றும் கோண கணுக்களின் எண்ணிக்கை முதன்மைக் குவாண்டம் எண்ணை மட்டுமே பொறுத்து அமையும்

10. அ) கூற்று மற்றும் காரணம் இரண்டும் சரியானது. காரணமானது, கூற்றிற்கு சரியான விளக்கமாகும்.

ஆ) கூற்று மற்றும் காரணம் இரண்டும் சரியானது. ஆனால், காரணமானது, கூற்றிற்கு சரியான விளக்கமல்ல.

இ) கூற்று சரி காரணம் தவறு

ஈ) கூற்று மற்றும் காரணம் இரண்டும் தவறு.

Assertion : Number of radial and angular nodes for 3p orbital are 1, 1 respectively.

Reason : Number of radial and angular nodes depends only on principal quantum number.

a. both assertion and reason are true and reason is the correct explanation of assertion.
b. both assertion and reason are true but reason is not the correct explanation of assertion.
c. assertion is true but reason is false
d. both assertion and reason are false

11. குறியீடு ‘ml’ எந்த குவாண்டம் எண்ணைக் குறிக்கிறது

அ) முதன்மை குவாண்டம் எண் ஆ) கோண உந்த குவாண்டம் எண்
இ) காந்த குவாண்டம் எண் ஈ) தற்சுழற்சி குவாண்டம் எண்

The term 'ml' denotes which quantum number?

a) Principal b) Azimuthal c) Magnetic d) Spin

12 n=3 என்ற முதன்மைக் குவாண்டம் எண்ணை பெற்றிருக்கும் ஆர்ட்டால்களின் மொத்த எண்ணிக்கை

அ) 9 ஆ)8 இ) 5 ஈ)7

The total number of orbitals associated with the principal quantum number n = 3 is

a) 9 b) 8 c) 5 d) 7

13. n=6 எனில், எலக்ட்ரான்கள் நிரப்பப்படும் சரியான வரிசை

அ) ns → (n – 2) f → (n – 1)d → np ஆ) ns → (n – 1) d → (n – 2) f → np
இ) ns → (n – 2) f → np → (n – 1) d ஈ) இவை எதுவும் சரியல்ல

If n = 6, the correct sequence for filling of electrons will be,

a) ns → (n – 2) f → (n – 1)d → np b) ns → (n – 1) d → (n – 2) f → np
c) ns → (n – 2) f → np → (n – 1) d d) none of these are correct

14. பின்வரும் குவாண்டம் எண்களின் தொகுப்பினைக் கருதுக.

	n	l	m	s
(i)	3	0	0	+ ½
(ii)	2	2	1	− ½
(iii)	4	3	–2	+ ½
(iv)	1	0	–1	+ ½

(v) 3 4 3 − ½

பின்வரும் எந்த குவாண்டம் எண்களின் தொகுப்பு சாத்தியமற்றது?

அ) (i), (ii), (iii) மற்றும் (iv) ஆ) (ii), (iv) மற்றும் (v)

இ) (i) மற்றும் (iii) ஈ) (ii), (iii) மற்றும் (iv)

Consider the following sets of quantum numbers :

n l m s

(i) 3 0 0 + ½

(ii) 2 2 1 − ½

(iii) 4 3 –2 + ½

(iv) 1 0 –1 + ½

(v) 3 4 3 − ½

Which of the following sets of quantum number is not possible ?

a) (i), (ii), (iii) and (iv) b) (ii), (iv) and (v)

b) (i) and (iii) d) (ii), (iii) and (iv)

அணு எண் 105 உடைய அணுவில் உள்ள எத்தனை எலக்ட்ரான்கள் (n+l) = 8 என்ற மதிப்பினை பெற்றிருக்க முடியும்.

15. அ) 30 ஆ) 17 இ) 15 ஈ) தீர்மானிக்க இயலாது

How many electrons in an atom with atomic number 105 can have (n + l) = 8 ?

a) 30 b) 17 c) 15 d) unpredictable

$3d_{xy}$ ஆர்பிட்டாலில் yz தளத்தில் எலக்ட்ரான் அடர்த்தி

அ) பூஜ்யம் ஆ) 0.50 இ) 0.75 ஈ) 0.90

16. Electron density in the yz plane of 3dx2 y2 orbital is

a) zero b) 0.50 c) 0.75 d) 0.90

குறியீடு ‘n’ எந்த குவாண்டம் எண்ணைக் குறிக்கிறது

அ) முதன்மை குவாண்டம் எண் ஆ) கோண உந்த குவாண்டம் எண்

இ) காந்த குவாண்டம் எண் ஈ) தற்சுழற்சி குவாண்டம் எண்

17 The letter 'n' denotes which quantum number?

a) Principal b) Azimuthal c) Magnetic d) Spin

18 இணைதிற பிணைப்புக் கொள்கையின்படி, இரண்டு அணுக்களுக்கிடையே எந்நிலையில் பிணைப்பு உருவாகும்?

அ) முழுவதும் நிரம்பிய அணு ஆர்பிட்டால்கள் மேற்பொருந்தும்போது

ஆ) சரிபாதி நிரம்பிய அணு ஆர்பிட்டால்கள் மேற்பொருந்தும்போது

இ) பிணைப்பில் ஈடுபடாதஅணு ஆர்பிட்டால்கள் மேற்பொருந்தும்போது

ஈ) காலியான அணு ஆர்பிட்டால்கள் மேற்பொருந்தும்போது

According to Valence bond theory, a bond between two atoms is formed when

a) fully filled atomic orbitals overlap

b) half filled atomic orbitals overlap

c) non- bonding atomic orbitals overlap

d) empty atomic orbitals overlap

19 ஆ.ஃ.பா கொள்கையின்படி, பின்வரும் எந்த ஆர்பிட்டாலில் குறைந்த ஆற்றல் உள்ளது?

அ) 3p ஆ) 4s இ) 2p ஈ)3s

As per the aufbau principle, which of the following orbitals have the lowest energy?

a) 3p b) 4s c) 2p d)3s

20 ClF_3,NF_3 மற்றும் BF_3 மூலக்கூறுகளில் உள்ள குளோரின், நைட்ரஜன் மற்றும் போரான் அணுக்கள் ஆகியன

அ) sp3 இனக்கலப்படைந் துள்ளன . ஆ) முறையே sp3 >sp3 மற்றும் sp2 இனக்கலப்படைந் துள்ளன .

இ) sp2 இனக்கலப்படைந் துள்ளன . ஈ) முறையே sp3d> sp3 மற்றும் sp2 இனக்கலப்படைந்துள்ளன .

In ClF_3 ,NF_3 and BF_3 molecules the chlorine, nitrogen and boron atoms are

a) sp3 hybridised

b) sp3 ,sp3 and sp2 respectively

c) sp2 hybridised

d) sp3d, sp3 and sp hybridised respectively

21 ஒரே ஆற்றல் மட்டங்களைக் கொண்டுள்ள எலக்ட்ரான் ஆர்பிட்டால்கள் ....என்று அழைக்கப்படுகின்றன

அ) குறைந்த ஆற்றலுடைய ஆர்பிட்டால்

ஆ) அதிக ஆற்றலுடைய ஆர்பிட்டால்

இ) நடுநிலை ஆற்றலுடைய ஆர்பிட்டால்

ஈ) சம ஆற்றலுடைய ஆர்பிட்டால்கள்

Electron orbitals having the same energy levels are called

a) Lower orbitals b) Higher orbitals

c) Neutral orbitals d) Degenerate orbitals

ஒரு s மற்றும் மூன்று p ஆர்பிட்டால்கள் இனக்கலப்பிற்கு உட்படும்போது,

அ) ஒன்றுக்கொன்று 90^o ல் அமைந்துள்ள நான்கு சமான ஆர்பிட்டால்கள் உருவாகும்.

22. ஆ) ஒன்றுக்கொன்று 109^o 28'-ல் அமைந்துள்ள நான்கு சமான ஆர்பிட்டால்கள் உருவாகும்.

இ) ஒரே தளத்தில் அமைந்துள்ள நான்கு சமான ஆர்பிட்டால்கள் உருவாகும்.

ஈ) இவற்றில் எதுவுமில்லை

When one s and three p orbitals hybridise,

a) four equvivalent orbitals at 900 to each other will be formed
b) four equvivalent orbitals at 109^o 28'
c) 28' to each other will be formed.
d) four equivalent orbitals, that are lying the same plane will be formed none of these

23. 'S' ஆர்பிட்டாலுக்கு கோண உந்த குவாண்டம் எண் (l) மதிப்பு என்ன?

அ) 0 ஆ) 1 இ) 2 ஈ) 3

What is the value of l for the s orbital

a) 0 b)1 c) 2 d) 3

24. சிக்மா மற்றும் பை பிணைப்புகள் இதன் வகைகளாகும்

அ) ஹைட்ரஜன் பிணைப்பு ஆ) சகபிணைப்பு

இ) ஈதல் சகபிணைப்பு ஈ) அயனிப்பிணைப்பு

Sigma and pi bonds are types of

a) Hydrogen bond b) Covalent bond c) Coordinate bond d) Ionic bond

பின்வருவனவற்றுள் எது, அவற்றின் பிணைப்புத்தரங்களின் ஏறுவரிசையில் அமைந்தசரியான வரிசையை குறிப்பிடுகிறது.

25 அ) $C_2 < C_2{}^{2-} < O_2{}^{2-} < O_2$ ஆ) $C_2{}^{2-} < C_2{}^{+} < O_2 < O_2{}^{2-}$

இ) $O_2{}^{2-} < O_2 < C_2{}^{2-} < C_2{}^{+}$ ஈ) $O_2{}^{2-} < C_2{}^{+} < O_2 < C_2{}^{2-}$

Which of these represents the correct order of their increasing bond order.

a) $C_2 < C_22- < O_22- < O_2$ b) $C_2\,2- < C_2 + < O_2 < O_22-$

c) $O_22- < O_2 < C_2\,2- < C_2 +$ d) $O_22- < C_2 +< O_2 < C_22-$

26. ஆக்சிஜன் மூலக்கூறுவின் பாரா காந்த தன்மைகளை விளக்குவது

அ) உடனிசைவு ஆ) மூலக்கூறு ஆர்பிட்டால் கொள்கை

இ) இனக்கலப்பு ஈ) பிணைப்பு கொள்கை

Oxygen molecule is paramagnetic. It can be explained by

a) Resonance b) Molecular orbital theory c) Hybridisation d) Valence bond theory

27. PCl_5 இல் உள்ள மைய அணுவின் இனக்கலப்பின்ப போது, கலப்பில் ஈடுபடும் ஆர்பிட்டால்கள்.

அ) s, p_x, $p_{y,}$ d_{x2} , d_{x2-y2} ஆ) s, p_x . p_y, p_{xy} . d_{x2-y2}

இ) s, p_x , p_y , $p_{z\,,}$ d_{x2-y2} ஈ) s, $p_{x\,,}$ $p_{y\,,}$ $d_{xy,>}$ d_{x2-y2}

Hybridisation of central atom in PCl_5 involves the mixing of orbitals.

a) s, p_x, p_y, d_{x2} , d_{x2-y2} b) s, p_x . p_y, p_{xy} . d_{x2-y2}

c) s, p_x , p_y , p_z , d_{x2-y2} d)s, p_x , p_y , d_{xy} , d_{x2-y2}

28. எத்தனை வகையான துணை ஆற்றல் மட்டங்கள் (orbitals) உள்ளன?

அ) 1 ஆ) 2 இ) 3 ஈ) 4

How many knids of orbitals are there?

a) 1 b) 2 c) 3 d) 4

29. No மூலக்கூறுவின் பிணைப்பத் தரம் என்ன?

அ) 2 ஆ) 1 இ) 3 ஈ) 2.5

The bond order of NO molecule is

a) 2 b) 1 c) 3 d) 2.5

30. ஹைட்ரஜன் பெராக்சைடு, ஓசோன் மற்றும் ஆக்சிஜன் ஆகியவற்றில் O-O பிணைப்பு நீளத்தின் சரியான வரிசை

அ) $H_2O_2 > O_3 > O_2$ ஆ) $O_2 > O_3 > H_2O_2$

இ) $O_2 > H_2O_2 > O_3$ ஈ) $O_3 > O_2 > H_2O_2$

The correct order of O-O bond length in hydrogen peroxide, ozone and oxygen is

a) $H_2O_2 > O_3 > O_2$ b) $O_2 > O_3 > H_2O_2$

c) $O_2 > H_2O_2 > O_3$ d) $O_3 > O_2 > H_2O_2$

சமச்சீரற்ற அமைப்பினால் மூலக்கூறுகளில் நடைபெறும் Sp^3

31. இனக்கலப்பானது

அ) அதிக நிலைபபு தன்மை அதிக வினைதிறன் கொண்டது

ஆ) குறைவான நிலைப்பு தன்மை அதிக வினைதிறன் கொண்டது

இ) குறைவான நிலைப்பு தன்மை குறைந்த வினைதிறன் கொண்டது

ஈ) இவற்றில் ஏதுமில்லை

Due to unsymmetrical structure, the molecules having sp^3d hybridisation are

a) More stables and more reactive

b) More stable and less reactive

c) Less stable and more reactive

d) Less stable and less reactive

32. IF_5 மூலக்கூறின் வடிவம் மற்றும் இனக்கலப்பு

அ) முக்கோண இருபிரமிடு வடிவம், Sp^3d^2 ஆ) முக்கோண இருபிரமிடு வடிவம், Sp^3d

இ) சதுரபிரமிடு வடிவம், Sp^3d^2 ஈ) எண்முகி வடிவம், Sp^3d^2

Shape and hybridisation of IF_5 are

a) Trigonal bipyramidal, Sp3d2 b) Trigonal bipyramidal, Sp3d

c) Square pyramidal, Sp3d2 d) Octahedral, Sp3d2

33. ஜீரோ பிணைப்பத் திறன் உள்ளதால் கீழ்க்கண்ட எந்த மூலக்கூறு உருவாவதில்லை

அ) H_2^+ ஆ) He_2 இ) He_2^+ ஈ) H_2^-

Which of the following molecule does not exist due to its zero bond order?

a) H_2^+ b) He_2 c) He_2^+ d) H_2^-

34. எந்த ஆர்பிட்டால் கோள வடிவமுடையது?

அ) s ஆ) p இ) d ஈ) f

Which orbital is shaped spherically and have spherical symmetry?

a) S b) P c) D d) F

35. பின்வருவனவற்றிலிருந்து தவறான கூற்றைத் தேர்ந்தெடு

அ) sp^3 இனக்கலப்பு ஆர்பிட்டால்கள் சமமானவை மேலும் அவை ஒன்றுக்கொன்று 109^0 28’ கோணத்தில் அமைந்துள்ளன .

ஆ) dsp^2 இனக்கலப்பு ஆர்பிட்டால்கள் சமமானவை மே லும் அவற்றில் எந்த இரண்டுக்கும் இடையே உள்ள கோணம் 90^0

இ) ஐந்து sp^3d இனக்கலப்பு ஆர்பிட்டால்களும் சமமற்றவை . இந்த ஐந்து $s^{p3}d$ இனக்கலப்பு ஆர்பிட்டால்களில், மூன்று 120^0, கோணத்திலும், மீதமுள்ள இரண்டு ஆர்பிட்டால்கள் மற்ற மூன்று

ஆர்பிட்டால்கள் அமைந்துள்ள தளத்திற்கு செங்குத்தாகவும் அமைந்துள்ளன .

ஈ) இவற்றில் எதுவுமில்லை

Pick out the incorrect statement from the following

a) Sp3 hybrid orbitals are equivalent and are at an angle of 1090 28' with eachother

b) dsp2 hybrid orbitals are equivalent and bond angle between any two of them is 900

c) All five sp3d hybrid orbitals are not equivalent out of these five sp3d hybrid orbitals, three are at an angle of 1200, remainir two are perpendicular to the plane containing the other three

d) none of these

36. ஆ.ஃ.பா கொள்கையின்படி, பின்வரும் எந்த ஆர்பிட்டாலில் அதிக ஆற்றல் உள்ளது?

அ) 3p ஆ) 4s இ) 3s ஈ) 3d

As per the aufbau principle, which of the following orbitals have the greatest energy?

a) 3p b) 4s c) 3s d)3d

37. ஒத்த இனக்கலப்பு, வடிவம் மற்றும் தனித்த எலக்ட்ரான் இரட்டை எண்ணிக்கையை கொண்ட மூலக்கூறுகள்

அ) SeF_4, XeO_2F_2 ஆ) SF_4, XeF_2

இ) $XeOF_4$, TeF_4 ஈ) $SeCl_4$, XeF_4

The molecules having same hybridisation, shape and number of lone pairs of electons are

a) SeF_4, XeO_2F_2 b) SF_4, XeF_2

c) XeOF4, TeF4 d) SeCl4, XeF4

38. மணி வடிவம் உடைய ஆர்பிட்டால் எது?

அ) s ஆ) p இ) d ஈ) f

Which orbital is dumbbell- shaped?

a) s b) p c) d d) f

39. பின்வரும் மூலக்கூறுகள்/அயனிகளில் BF_3, NO_2 -, H_2O எவற்றில் உள்ளமைய அணு sp^2 இனக்கலப்பில் உள்ளது?

அ) NH_2 - மற்றும் H_2O ஆ) NO_2- மற்றும் H_2O

இ) BF_3 மற்றும் NO_2- ஈ) BF_3 மற்றும்NH_2-

In which of the following molecules / ions BF_3, NO_2-, H_2O the central atom is sp2 hybridised?

a) NH_2- and H_2O b) NO2- and H2O c) BF3 and NO2- d) BF3 and NH2-

40. நீர் மூலக்கூறுவில் உள்ள அணுக்கள் எந்த வடிவம் கொண்டுள்ளது

அ) நேர்கோடு வடிவம், ஆ) எண்முக வடிவம், இ) நான்முகி வடிவம்,

ஈ) சமதள முக்கோண வடிவம்

. The atoms in a molecule of water adopt what kind of geometry?

a) Linear b) Octahedral c) Tetrahedral d) Trigonal planar

41. இரண்டு அயனிகள் NO_3 - மற்றும் H_3O^+ ஆகியவற்றின் சில பண்புகள் கீழே விவரிக்கப்பட்டுள்ளன . அவற்றில் எந்த ஒன்று சரியானது?

அ) வெவ்வேறுவடிவங்களுடன், மைய அணுவின் இனக்கலப்பிலும் வேறுபடுகின்றன.

ஆ) ஒத்தவடிவங்களுடன், மைய அணுவின் இனக்கலப்பிலும் ஒத்துள்ளன .

இ) ஒத்தவடிவங்களுடன், மைய அணுவின் இனக்கலப்பில் வேறுபடுகின்றன.

ஈ) இவற்றில் எதுவுமில்லை

Some of the following properties of two species, NO_3- and H_3O+ are described below. which one of them is correct?

a) dissimilar in hybridisation for the central atom with different structure.

b) isostructural with same hybridisation for the Central atom.

c) different hybridiration for the central atom with same structure

ள) none of these

42. அணுவின் அடிஆற்றல் நிலையில் உள்ளஎலக்ட்ரான், முதலில் குறைந்த ஆற்றல் கொண்ட ஆர்பிட்டாலிலும் பின்னர் அதிக ஆற்றல் கொண்ட ஆர்பிட்டாலிலும் நுழைகிறது என்று எந்த விதி கூறுகிறது.

அ) ஹூண்ட் விதி ஆ) பௌலியின் தவிக்கைத் தத்துவம்

இ) ஆ.ஃபா தத்துவம் ஈ) டால்டனின் கொள்கை

Which rule states that in an atom's ground state the electron enters the lowest energy orbital first and later the higher energy orbitals.

a) Hund's rule b) Pauli's exclusion principle

c) Aufbau principle d) Dalton's principle

2,3 பெண்டாடை யீனில் (2,3 pentadiene) வலமிருந்து இடமாக உள்ள ஐந்து கார்பன் அணுக்களின் இனக்கலப்பு வகைகள்.

அ) sp^3, sp^2, sp, sp^2, sp^3 ஆ) $sp^{3,}$ sp, sp, sp, sp^3

இ) $sp^{2,}$ sp, sp^2,sp^2, sp^3 ஈ) $sp^{3,}$ sp^3, sp^2, sp^3, sp^3

43. The types of hybridiration on the five carbon atom from right to left in the, 2,3 pentadiene.

a) sp3, sp2, sp, sp2, sp3 b) sp3, sp, sp, sp, sp3

c) sp2, sp, sp2,sp2, sp3 d) sp3, sp3, sp2, sp3, sp3

44. கீழ்க்கண்டவற்றுள் எந்த சேர்மம் அதிக பட்ச சகபிணைப்ப தன்மை பெற்றுள்ளது?

அ) சிங்க் குளோரைடு ஆ) இரும்பு குளோரைடு

இ) அலுமனியம் குளோரைடு ஈ) மெக்னீசியம் குளோரைடு

Which of the following compound will show the maximum covalent character

a) Zinc Chloride b) Iron Chloride

c) Aluminium Chloride d) Magnesium Chloride

45. மீத்தேன், ஈத்தேன், ஈத்தீன் மற்றும் ஈத்தைன் ஆகியவற்றில் உள்ள இனக்கலப்பு ஆர்பிட்டால்களின் s- பண்பு சதவீதங்கள் முறையே

அ) 25, 25,33.3,50 ஆ) 50,50,33.3,25 இ) 50,25,33.3,50 ஈ) 50,25,25,50

The percentage of s-character of the hybrid orbitals in methane, ethane, ethene and ethyne are respectively

a) 25, 25,33.3,50 b) 50,50,33.3,25 c) 50,25,33.3,50 d) 50,25,25,50

46. VSEPR கொள்கைப்படி, வெவ்வேறு வகை எலக்ட்ரான்களுக்கு இடைப்பட்ட விலக்கம் வரிசையில் அமைகிறது.

அ) l.p – l.p > b.p–b.p> l.p–b.p ஆ) b.p–b.p> b.p–l.p> l.p–b.p

இ) l.p–l.p> b.p–l.p > b.p–b.p ஈ) b.p–b.p> l.p–l.p> b.p–l.p

According to VSEPR theory, the repulsion between different parts of electrons obey the order.

a) l.p – l.p > b.p–b.p> l.p–b.p b) b.p–b.p> b.p–l.p> l.p–b.p

c) l.p–l.p> b.p–l.p > b.p–b.p d) b.p–b.p> l.p–l.p> b.p–l.p

47. ClF_3 இன் வடிவம்

அ) முக்கோணசமதளம் ஆ) பிரமிடுவடிவம்

இ) "T" வடிவம் ஈ) இவற்றில் ஏதுமில்லை

Shape of ClF_3 is

a) Planar triangular b) Pyramidal c)'T' Shaped d) none of these

பூஜ்ஜிய மற்ற இரு முனை திருப்புத் திறனைக் காட்டுவது

அ) CO_2 ஆ) p-டைகுளோரோபென்சீன்

இ) கார்பன்டெட்ராகுளோரைடு ஈ) நீர்

48. Non- Zero dipole moment is shown by

a) CO_2 b) p-dichlorobenzene c) carbontetrachloride d) water.

49. பின்வருவனவற்றுள், அயனி, சகப்பிணைப்பு மற்றும் ஈதல் சகப்பிணைப்பு இணைப்புகளை கொண்டுள்ள சேர்மம்

அ) NH_4Cl ஆ) NH_3 இ) NaCl ஈ)இவற்றில் ஏதுமில்லை

Among the following, the compound that contains, ionic, covalent and Co-ordinate linkage is

a). NH_4Cl b). NH_3 c). NaCl d). none of these

50 p ஆர்பிட்டாலில் எத்தனை சமஆற்றல் கொண்ட ஆர்பிட்டால்கள் உள்ளன?

அ) 1 ஆ) 2 இ) 3 ஈ) 4

How many degenerate orbitals does p orbital have?

a) 1 b) 2 c) 3 d) 4

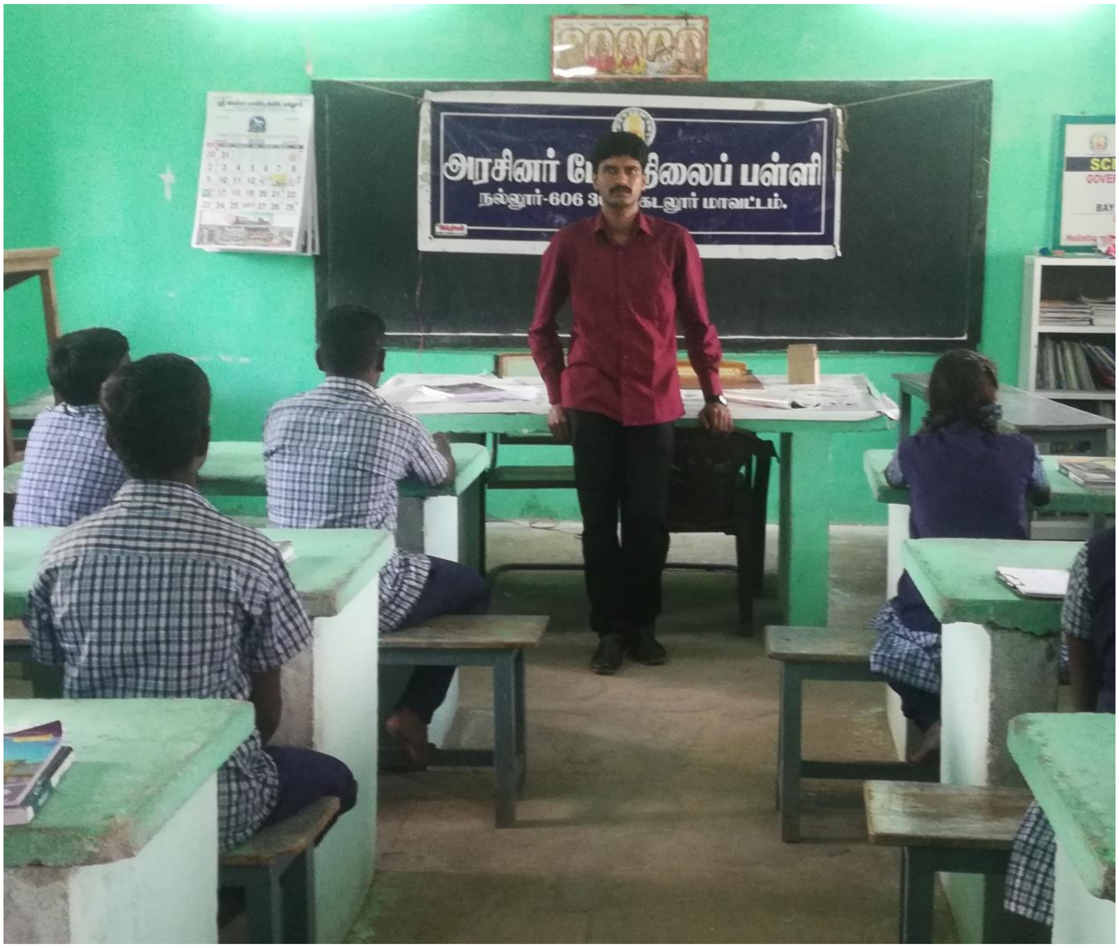
APPENDIX – IV

SCORING KEY FOR ACHIEVEMENT TEST

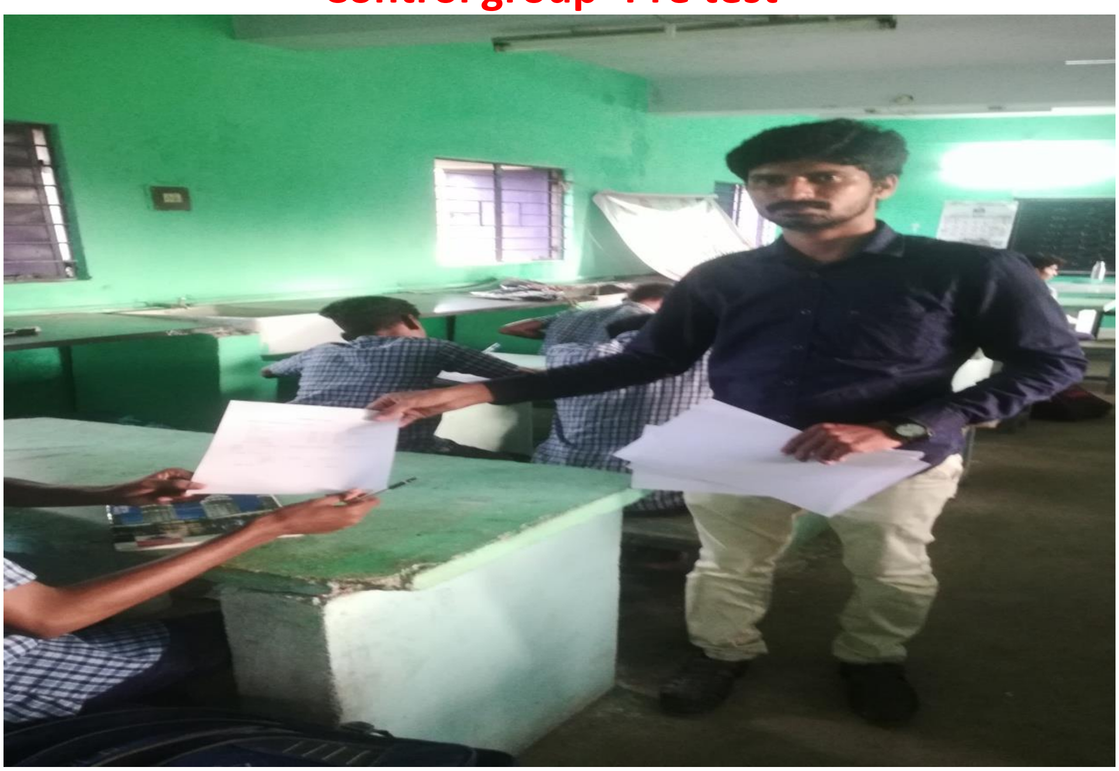
QUESTION No.	ANSWER	MARK
1	C	1
2	B	1
3	B	1
4	B	1
5	B	1
6	C	1
7	D	1
8	C	1
9	C	1
10	C	1
11	C	1
12	A	1
13	A	1
14	C	1
15	B	1
16	A	1
17	A	1
18	B	1
19	C	1
20	D	1
21	D	1
22	B	1
23	A	1
24	B	1

25	D	1
26	B	1
27	C	1
28	D	1
29	D	1
30	B	1
31	C	1
32	C	1
33	B	1
34	A	1
35	C	1
36	D	1
37	C	1
38	B	1
39	C	1
40	C	1
41	A	1
42	C	1
43	A	1
44	C	1
45	A	1
46	C	1
47	C	1
48	D	1
49	A	1
50	C	1

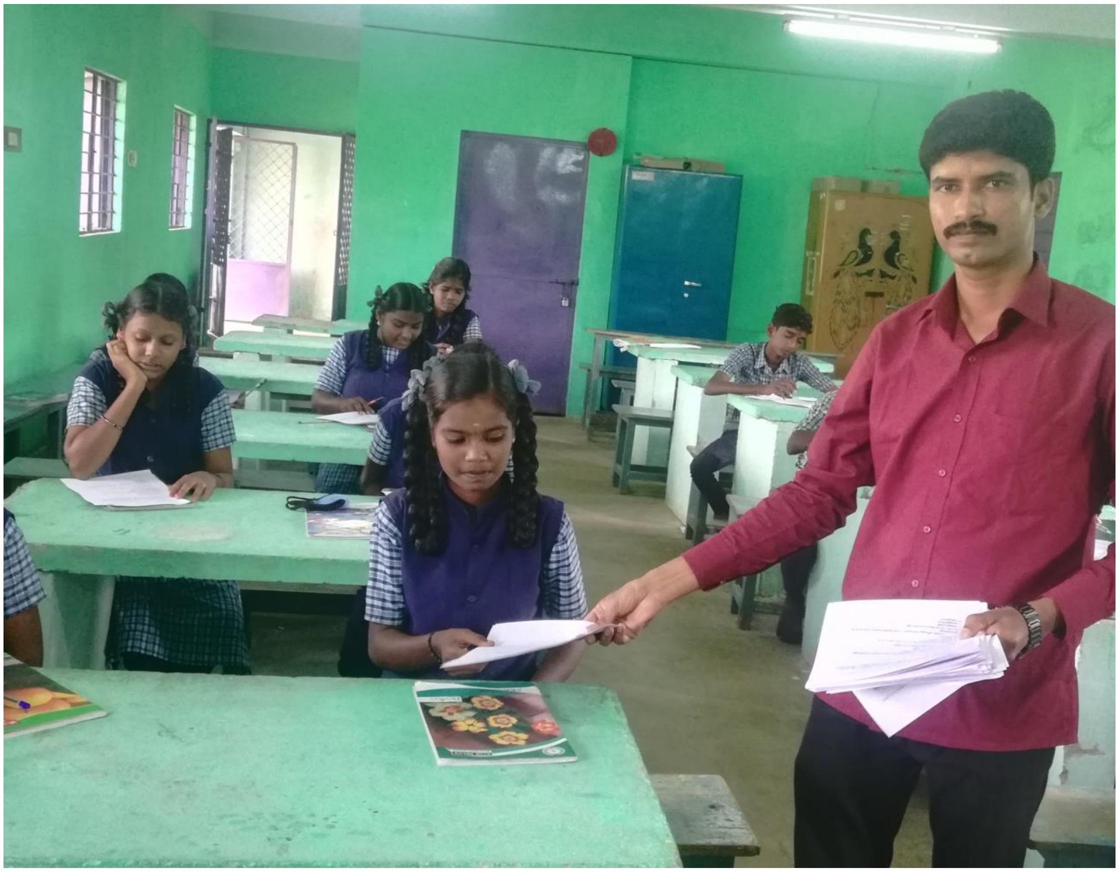
Snapshots of Data collection



Control group- Pre test



Experimental group- Pre - Test



Control group- Traditional Method

Experimental group – E-Content Courseware

Control group- Post-test

Experimental group- Post-test

PAPERS PUBLISHED

IMPACT OF SLM IN TEACHING CHEMISTRY AT THE HIGHER SECONDARY LEVEL

UGC CARE APPROVED

ABSTRACT

The study aimed to find out the impact of SLM (Self Learning Module) in teaching chemistry at the higher secondary level. SLM in education is a powerful tool that may be used effectively and efficiently within the classroom to create a more exciting learning environment and deliver a higher level of educational expertise to students. An experimental method has been used for the present study. The sample of this study consisted of 20 XI standard students in the Control group 20 XI standard students in the Experimental group. The currently sent experiment brings out a clear-cut idea about the impact of SLM in teaching chemistry for the XI Standard Students. The data were collected using appropriate tools, and suitable statistical techniques were analysed. The finding is that the experimental group students' achievement scores were higher than the Control group Students.

Key Words : *Impact of SLM, Achievement in chemistry, XI Standard Students*

Introduction

Traditionally, teachers used traditional tactics that emphasised a deep mastery of the chemistry subject. While disseminating material to students, they attempted to link the imparted knowledge in a novel method. With the advancement of technology, new educational teaching, learning theories and modern resources, particularly multimedia-oriented resources, traditional teaching methodologies are no longer viable and adequate to support the chemistry teaching-learning process and the mass education system. For meaningful and joyful chemistry learning, a teacher must not only have a solid understanding of the teaching content to be taught but also a well-developed understanding of how students learn the chemistry subject, i.e. New pedagogical approaches that are appropriate to their specific requirements and also commensurate with students' learning abilities. They should be familiar with their students' developmental stages and critical, caring, and active knowledge importers who can contribute to educational improvement and social change. As a result, the emphasis should be placed on process-oriented skills connected to chemistry pedagogy rather than product-related skills associated with mastering chemistry.

Need and significance of the study

The quality of education are heavily influenced by the quality of teachers. It is a well-known truth that great teachers choose to innovate by using technology in classroom instruction to provide the best possible education to their students. To be effective in the classroom, teachers must acquire the knowledge and skills to use new challenges in promoting innovative teaching strategies that are student-centred, collaborative, engaging, authentic, self-directed, and based on the development of higher-order thinking skills with regard to handling classes for students who strive for high academic standards. Education technology can significantly improve the teaching-learning process. Educational technology is creating, applying, and assessing systems, techniques, and assistance in human learning. Individualised instruction, which allows us to employ self-instruction programming, is one of the critical contributions of educational technology. Teachers, in general, are unable to satisfy a diverse set of students in learning using traditional instructional processes. This issue could be solved with the use of

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innovative educational technologies. Individualised instruction via SLM was used as an alternative to the conventional model in this study. This strategy allows students to proceed and learn at their own pace, based on their talents and performance. It also encourages students to learn on their own.

Objectives of Study

1. To find out the significant difference between mean scores of control group on achievement in chemistry in the Pre test and Post test.
2. To find out the significant difference between mean scores of experimental group on achievement in chemistry in the Pre test and Post test.
3. To find out the significant difference between low achievers in their mean scores on achievement in chemistry in the pre-test and post test.

Hypotheses of study

1. There is no significant difference between the pre and post-test mean scores on achievement in chemistry of control group.
2. There is no significant difference between the pre and post-test mean scores on achievement in chemistry of experimental group.
3. There is no significant difference between low achievers in the control group in their mean scores on achievement in chemistry in the pre-test.
4. There is no significant difference between low achievers in the experimental group in their mean scores on achievement in chemistry in the post-test.

Experimental design of the study

In the present study, Parallel group, the investigator applies experimental design (Pre test-Post test Equivalent-groups design).

Population and sample

All the students studying at the higher secondary schools in Cuddalore district constitute the population for the present study. The investigator has chosen the standard eleventh standard students of Government Higher Secondary School, functioning in Virudahachalam educational district as a sample by using a purposive sampling technique. This group has 65 students on roll. The investigator has chosen 40 students based on their marks obtained in the II term-end examinations. A homogenous group is formed according to their achievements through randomisation. Randomisation reduces systematic error. Equivalence of the groups is also considered while choosing the samples from the population. Twenty students are treated as experimental groups, and the other 20 students formed the control group

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Tools used for the study

The following research tools are used in the present study;

1. Self Learning Module (SLM) for teaching chemistry at higher secondary school constructed and validated by the investigator.
2. Academic Achievement test in Chemistry constructed and validated by the investigator.

Testing the hypotheses

Hypothesis 1: There is no significant difference between the pre and post-test mean scores on achievement in chemistry of control group.

Table 1

Difference between the pre and post-test mean scores on achievement in chemistry of control group

Test	N	Mean	S.D	Mean difference	't' value	df	Re mark
C-group Pre-test	20	21.41	5.74	3.14	1.612	38	NS
C-group Post-test	20	24.53	6.49				

The mean scores of the control group in the pre-test is found to be 21.41 with an SD 5.74. The mean scores of the control group in the post-test is found to be 24.53 with an SD 6.49. The mean difference 3.14 is found to be not significant for the 't' value 1.612 for 38 degrees of freedom at 1% level of significance. Therefore, the hypothesis is accepted.

Hypothesis 2: There is no significant difference between the pre and post-test mean scores on achievement in chemistry of experimental group.

Table 2

Difference between the pre and post-test mean scores on achievement in chemistry of experimental group

Test	N	Mean	S.D	Mean difference	't' value	df	Re mark
E-group Pre-test	20	21.4	5.97	17.29	9.15	38	S
E-group Post-test	20	38.85	6.01				

The mean scores of the experimental group in the pre-test is found to be 21.40 with an SD 5.97. The mean scores of the experimental group in the post study is found to be 38.85 with an SD 6.01. The mean difference 17.29 is found to be significant for the 't' value 9.15 for 38 degrees of freedom at 1% level of significance. Therefore, the hypothesis is rejected.

Hypothesis 3: There is no significant difference between low achievers in the control group in their mean scores on achievement in chemistry in the pre-test.

Table 3

Difference between low achievers in the control group in their mean scores on achievement in chemistry in the pre-test

Test	N	Mean	S.D	Mean difference	't' value	df	Re mark
C-group Pre-test	8	14.45	1.48	2.34	1.58	10	NS
C-group Post-test	8	16.8	1.51				

The mean scores in the pre test of the achievement in chemistry of the low achievers in control group is found to be 14.45 with an SD 1.48. The mean scores in the post test of the achievement in chemistry of the low achievers in control group is found to be 16.80 with an SD 1.51. The mean difference 2.34 is found to be not significant for the 't' value 1.58 for 10 degrees of freedom at 1% level of significance. Therefore, the hypothesis is accepted.

Hypothesis 4: There is no significant difference between low achievers in the experimental group in their mean scores on achievement in chemistry in the post-test.

Table 4

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Difference between low achievers in the experimental group in their mean scores on achievement in chemistry in the post-test

Test	N	Mean	S.D	Mean difference	't' value	df	Re mark
E-group Pre-test	8	14.32	1.79	16.75	12.15	10	S
E-group Post-test	8	31.43	2.85				

The mean scores in the pre test on achievement in chemistry of the low achievers in experimental group is found to be 14.32 with an SD 1.79. The mean scores in the post test on achievement in chemistry of the low achievers in experimental group is found to be 31.43 with an SD 2.85. The mean difference 16.75 is found to be significant for the 't' value 12.15 for 10 degrees of freedom at 1% level of significance. Therefore, the hypothesis is accepted.

Conclusion

On the basis of research findings, it is concluded that SLM learning promotes critical and active learning. With self-learning materials, the student and instructor will recognize that they are shifting from a provider of facts to a facilitator of a learning environment. This inquiry seeks to design a new teaching technique using the SLM approach based on this premise. This empirical investigation has shown that SLM improves students' achievement at the higher secondary level.

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Remedial teaching technique to overcome learning difficulties in chemistry at the higher secondary level

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***Abstract*---**This article meticulously discusses the effectiveness of remedial teaching techniques in overcoming learning difficulties in chemistry at the higher secondary level using an experimental design with a sample of 60 students. This study only used a pre-test-post-test control group design. The primary goal of this research is to evaluate the efficacy of a remedial teaching technique specialized for learning chemistry without learning difficulties at the higher secondary level. This study also demonstrated that there is a significant relationship between remedial teaching techniques and learning difficulties in chemistry. As a result, this study sheds light on a remedial teaching strategy for overcoming learning challenges in chemistry at the higher secondary level.

***Keywords*---**Remedial teaching technique, electronic courseware, learning chemistry, learning difficulties.

Introduction

Chemistry is one of the most important subjects in schools and colleges because chemistry plays a vital role in our day-to-day life. It enables learners to realize what happened around them. The chemistry curriculum often covers numerous abstract topics that are essential for furthering one's education in both chemistry and other sciences. Chemistry is extensively perceived as difficult because of its specialized language like International Union of Pure and Applied Chemistry (IUPAC) names and chemical reaction terms, mathematical representations, and its abstract conceptual nature. Chemistry proves a difficult subject for many students and also students have chemistry learning difficulties at school and college level. For the past decade, chemistry experts and researchers have been

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attempting to explain how students might be assisted in better understanding chemistry (Ben-Zvi et al. 1986 & Wu et al. 2001). Mirroring the global pattern, in Tamil Nadu higher secondary school education scenario too, learning chemistry is found to be difficult for students, as compared to other subjects. This trend is evident in class XI board exam results in recent years. So the purpose of this investigation is to overcome the learning difficulties in chemistry at higher secondary level through the remedial teaching.

Need and significance of the present study

Many of the higher secondary school students feel Chemistry is a difficult subject because of the abstract nature of many chemical concepts, teaching styles applied in classroom, lack of teaching learning materials, lack of teaching techniques and the difficulty of the language of chemistry. All of this leads to a lack of knowledge and misunderstanding of chemical ideas among students at all levels, from elementary school to university. Herron (1996) claims that pupils face the following challenges: A lack of knowledge of common words used in chemistry to communicate meaning; a lack of grasp of technical terms introduced in the study of chemistry; ascribing a familiar meaning to a common phrase used in a technical sense; erroneous conclusions about chemical occurrences based on everyday meaning; failing to achieve the level of automatization required to read chemistry smoothly by failing to acquire the conventions used to specialized chemical language (Herron, 1996, p. 165). A variety of studies on various chemistry issues have been undertaken. A review of studies on students' understanding of chemical concepts reveals that the majority of the fundamental concepts were poorly understood. More research needs to be done to identify what sort of difficulties students face in the learning of chemical concepts. For both teaching and learning, learning difficulties are important. Hence, it has been concluded that it is worthwhile to conduct a research study on how to reduce the learning difficulties and improve the chemistry learning efficiently.

Objectives

1. To study the effectiveness of remedial teaching techniques in overcoming learning difficulties in chemistry at the higher secondary level
2. To compare the effect of remedial teaching technique on learning difficulties of students in chemistry with relation learners gender.

Operational Definitions

1) Remedial teaching technique
   Remedial teaching technique is a technique to identify slow learners and providing them with the necessary help and guidance to help them overcome their problems, after identifying their areas of difficulty. In this study e-content based learning referred as remedial teaching technique.
2) Learning difficulties in chemistry
   A person having specific problems in processing certain forms of information and also an issue with the brains ability to process information in chemistry subject.
3) Higher secondary level

In this study, higher secondary school level refers to students who are studying in XI Standard.

Hypotheses

1. Remedial teaching technique approach significantly decreases the learning disability of higher secondary level learners in chemistry compared to the traditional teaching method.
2. There is no significant difference in learning difficulty of students concerning different kind of learners (among boys and girls) at the higher secondary level.

Methodology of the study

a) Method of Study
The current study is an experimental design with a randomised control group pre-test post-test" design. Following randomization, the students are divided into two equal groups, one experimental and one control. In this study, the independent variable is the 'Remedial teaching technique,' while the dependent variable is the 'Learning difficulties in Chemistry.'
b) Population and Sample
Population was drawn from higher secondary schools in the Cuddalore district of Tamil Nadu. All 60 pupils from class XI at "Government higher secondary school" in the Nallur locality are used as a sample. The school was chosen on purpose to test the study's hypothesis. The researcher separated the class XI students into two equivalent groups based on their roll numbers, 30 students with even roll numbers in one group as an experimental group, and 30 students with odd roll numbers in another control group.

Research Tools
The following tools were utilized by the investigator to conduct the study: -

Measuring Tool

For class XI standard pupils, the investigator created achievement test was established to assess students' learning difficulties on the topics "Atomic structure, solid state, and coordination compounds." The tool includes 20 multiple-choice questions, 10 fill-in-the-blank questions, 5 matching questions, and 5 true/false questions. The investigator developed and standardized it based on the blueprint.

Development of remedial teaching tool

The major goal of this research is to create a remedial teaching tool for learning chemistry at the higher secondary level. Here multimedia Courseware (e-content) is identified and created as a remedial teaching tool. The researchers chose three chapters from the Class XI Chemistry text book provided by the Tamil Nadu government under the Uniform System of School Education. Atomic structure, solid state, and coordination compounds are among the topics. These topics have been transformed into structured lessons with rich illustrations and photographs along with videos.

Analysis and interpretation of data
Testing of the Hypotheses

Research hypothesis: Remedial teaching technique significantly reduce the learning difficulties of higher secondary level learners in chemistry compared to the traditional teaching method.

Null hypothesis: There is no significant difference between the remedial teaching technique and the traditional teaching method in reduce the learning difficulties of learners in chemistry.

Table 1
Comparison of PRT scores of CG and EG

Group	N	Mean	SD	Mean Difference	df	Calculated 't'- value	Sig.
CG	30	10.16	3.539				
EG	30	10.38	3.415	0.22	62	0.252	0.809

Table 1 shows that the difference between the control and experimental groups' pre-test averages is 0.22. The table value for the df 62 at the 0.05 level of significance and 2.66 at the 0.01 level. At the 0.05 level, the t-value is 0.252, which is not significant. As a result, there is no statistically significant difference in the pre-test scores of control and experimental group pupils. As a result, both the control and experimental groups have the same degree of intelligence.

Table 2
Comparison of POT scores of CG and EG

Group	N	Mean	SD	Mean Difference	df	Calculated 't'-value	Sig.
CG	30	12.34	3.51				
EG	30	18.28	3.45	5.94	62	6.830	0.000

Table 2 shows that the difference in post-test averages between the control and experimental groups is 5.94. At 0.05 levels, the t-value is 6.830, which is significant. As a result, at 0.05 levels, the null hypothesis "there is no significant difference between the remedial teaching technique and the traditional teaching method in reduce the learning difficulties of learners in chemistry" is rejected.

As a result, it can be concluded that the experimental group's mean value has increased significantly from M=12.34 to M=18.28. As a result, hypothesis 1 is accepted, and the initial premise that the remedial teaching strategy will improve students' thinking skills and reduce the learning difficulties in chemistry in comparison to the traditional style of teaching is determined to be valid.

Table 3
Comparison of the gain score of the CG and EG

Group	N	Mean	SD	Mean Difference	df	Calculated 't'-value	Sig.
CG	30	2.06	1.8	5.53			
EG	30	7.59	1.92		62	11.920	0.000

Table 3 shows that the 't'-value is 11.920, which is significant at 0.05 levels. As a result, the experimental group's gain scores differ significantly from the control group's gain scores. In comparison to traditional teaching methods, remedial teaching strategy appears to be more helpful in strengthening students' understanding skill and thinking abilities.

Null hypotheses: There is no significant difference in achievement of students with respect to gender at the higher secondary level.

Table 4
Comparison of PRT of the EG with respect to boys and girls

Students gender of the EGPRT	N	Mean	SD	Mean Difference	df	Calculated 't'-value	Sig.
Girls	14	9.84	2.983	0.89	30	0.829	0.464
Boys	18	10.73	3.649				

Table 4 shows that the 't'-value is 0.829, which is not statistically significant at the 0.05 level. As a result, at 0.05 levels, the null hypothesis "no significant difference in pre-test achievement scores of boys and girls in the experimental group" is accepted. As a result, it can be concluded that the experimental group's boys and girls are of equal in learning difficulties.

Table 5
Comparison of POT scores of the EG with respect to boys and girls

Students' gender of the EGPOT	N	Mean	SD	Mean Difference	df	Calculated 't'-value	Sig.
Girls	14	17.46	2.757				
Boys	18	18.84	3.819	1.38	30	1.117	0.27

The 't'-value in table 5 is 1.117, which is not significant at the 0.05 level. As a result, at 0.05 levels, the null hypothesis "no significant difference achievement test scores of boys and girls in the experimental group" is accepted. As a result, it can be inferred that teaching through remedial teaching technique is equally successful in significantly reduced the learning difficulties of the experimental group.

Major Findings

After analysis of the collected data, the following objective wise findings are drawn from thestudy.

***To study the* effectiveness of remedial teaching techniques in overcoming learning difficulties in chemistry at the higher secondary level**

There is no significant difference between of the control and experimental group pre-test scores but a significant difference between the post-test scores of the control and experimental group. On the other hand, thereis a significant difference between the pre-test and post- test scores of the control group and the experimental group.

To compare the effect of remedial teaching technique on learning difficulties of students in chemistry with relation to learners gender

There is no significant difference in pre-test and post-test scores of the experimental group of boys and girls.

Conclusion

In light of the findings, it is believed that the current study will aid in the improvement of transactional competences among Higher Secondary students. Remedial teaching techniques were found to be helpful in achieving chemistry learning skills in all areas, and this study also shows that remedial teaching techniques (e-content based learning) can effectively overcome learning challenges in chemistry at the high school level. Many educational professionals have recognized this, and as a result, there is an urgent need to focus national efforts on the implementation of novel teaching strategies such as remedial teaching.

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