A STUDY ON EFFECT OF ICT MEDIATED TEACHING ON THE ACADEMIC ACHIEVEMENT OF SECONDARY SCHOOL STUDENTS IN PHYSICS

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DECLARATION

I, Hemanta Kumar Dash, hereby declare that the dissertation entitled **A STUDY ON EFFECT OF ICT MEDIATED TEACHING ON THE ACADEMIC ACHIEVEMENT OF SECONDARY SCHOOL STUDENTS IN PHYSICS** has been carried out by me during the academic year 2022-25 in partial fulfillment of the requirement of the degree B.Ed. M.Ed. (Integrated) program from Barkatullah University, Bhopal.

The study has been conducted under the supervision and guidance of **Dr. Manju**, Associate Professor, Department of Education, Regional Institute of Education, Bhopal, Madhya Pradesh.

It is also declared that the research work done by me is original to the best of my knowledge. This dissertation has not been submitted by me for award of any other degree or diploma in Barkatullah University, Bhopal or any other University.

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CERTIFICATE

This is to certify that the dissertation entitled **A Study on Effect of ICT Mediated Teaching on the Academic Achievement of Secondary School Students in Physics** being submitted by **HEMANTA KUMAR DASH**, a student of Three year B.Ed. M.Ed. (Integrated) program bearing Roll Number 2306600318 and Enrolment Number R230664070015, Regional Institute of Education, NCERT, Bhopal, M.P., is a bonafide student and this research is carried by him in the Department of Education under my supervision and guidance. The work is original to the best of his knowledge and it has not been submitted earlier in any form for any degree at any university by him.

This is further certified that the dissertation in its present form is fit for the submission to Barkatullah University for the award of the degree of Three year B.Ed. M.Ed. (Integrated) program

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Date :

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LIST OF ABBREVIATIONS

ICT	Information and Communication Technology
CBSE	Central Board of Secondary Education
IT	Information Technology
NCERT	National Council of Educational Research and Training
UNESCO	United Nations Educational, Scientific and Cultural Organisations
UNICEF	United Nations International Children's Emergency Fund
GHVM	Ghanashyam Hemlata Vidya Mandir
NEP 2020	National Education Policy 2020
NCF 2005	National Curriculum Framework 2005
NCF-SE	National Curriculum Framework for School Education
CLASS	Computer Literacy And Studies in Schools
PAT – 1	Physics Achievement Test – 1
PAT – 2	Physics Achievement Test - 2

CHAPTER 1

INTRODUCTION

1.1 Introduction

The 21st century transformation of education systems across the globe is induced by the fast pace of rapidly advancing Information and Communication Technology. It opens up a wider array of exciting opportunities for the teaching-learning processes, and ICT has become one among its emerging norm-enhanced tools for better ways of teaching, learning, and assessing students' understanding. Furthermore, ICT-facilitated teaching has emerged as a potential avenue for offering more interactive, student-centred, and effective learning-the building blocks for subjects like Physics.

Information and Communication Technology has recently emerged as a significant resource for the development of education throughout the world. In particular, for science subjects such as physics, ICT provides an active environment to visualise abstract concepts and increase conceptual understanding through simulations, animations, virtual labs, and interactive media (Alagumalai & Amirtha, 2023).

Even though they are highly ubiquitous, conventional teaching methods cannot always be said to cater to the attentiveness and active engagement of students, particularly in subjects calling for strong conceptual clarity and critical thinking, such as physics.

In addition to space technology, India is also known for being a global leader in information and communication technology. Transforming the entire nation into a digitally-empowered and knowledge-oriented economy is the Digital India Campaign. Education would play a key role in that transformation process, but technology development as well would be important in the transformation of educational processes and outcomes; and hence the fact that the relation between technology and education inclusively at all levels is bidirectional (NEP-2020).

Basically total broadened cyberspace space teaching and learning integration has proved potential improvement in academic success and student motivation. Studies have shown that students exposed to ICT-based instruction exhibit better academic performance and retention of scientific concepts than their counterparts taught using traditional methods (Malik & Ashraf, 2023; Ohanaka & Onyia, 2024).

Physics is a core subject in the curriculum of secondary stage school, broadly developing a student's scientific reasoning, critical thinking, and problem-solving skills. Traditional teaching approaches (paper and pencil and teacher-centred) may not promote comprehensive understanding and sustained interest in the subject. This is even more true for Class 9th students who are going through a transition period in their academics and often develop discomfort in learning very abstract scientific concepts.

ICT mediated instruction through such instruments as digital simulation, animation, interactive presentations, and virtual laboratories offers alternative dynamism beyond conventional methods. These facilitate visualization of phenomena and manipulation of models, which lead to active student participation in the learning process. Benefit could thus be drawn in terms of enhancing conceptual clarity, improving academic performance, and catering to different learning styles.

The introduction of technology into teaching-learning transaction changes the teacher's role from simply holding chalk and talk 'sage on the stage' to what can now also be termed as 'guide on the side' changing the role of the students from passive receivers of content to more active participants and partners in the process of learning (Alley, 1996; Repp, 1996; Roblyer et al, 1997).

As per the World Education Report by UNESCO in 1998, the new technology is going to sever the link of chalk and talk teaching and learning, and it will transform the present processes of teaching and learning by changing how teachers and learners get access to knowledge. ICT enabled teachings provide an array of powerful tools which facilitate transformation from teacher-centered, textbound classrooms to rich interactive knowledge environments that are student-focused. Information and communications technologies (ICTs), then, are totally diverse among themselves as technology as tool and resources to communicate, create, disseminate, store and manage information. With communication and information, education is possible and takes into account formal and informal settings including programs by government agencies, public and private educational institutions, profit corporations and non-profit groups together with secular and religious ones.

As both technology advances and the widening classroom integration require an improved outcome of science education, actual empirical investigations into the impacts of ICT-mediated teaching upon student achievement need to be conducted. This

study will investigate whether and how much the ICT-based instructional strategies influence the academic performance of Class 9th students in physics.

Human life changes every day from before to now. From ancient times to the present day, human beings learn continuously in different aspects according to need-from building a shelter to form a roof to protect the body from the elements; to make food for the body to satisfy hunger; and to manufacture cloth to cover the human body from the climate condition.

NEP 2020 envisions the transformation of instructional processes in schools as well as their realities through effective use of technology for educators. It recommends digitalisation of tools like simulations and virtual laboratories, moving beyond textbooks for conceptual comprehension especially in subjects such as physics. Further, it recommends digital backbone development, teacher training in ICT skills, and provision of high-quality digital content for an inclusive and equitable education.(NEP 2020)

The NCF-SE 2023 presents various approaches to teaching which include learner-centric, competency-based, and technology-enabled education, including recommending the use of ICT tools augmented reality (AR), virtual reality (VR), data-loggers and interactive simulations-for the teaching of complicated scientific concepts. With respect to physics education, these tools link theory to context and enhance learner achievement and engagement. Furthermore, the framework promotes project-based learning and formative assessments in a digital context to enable deeper understanding and constant feedback.(NCF-SE 2023)

Information and communications technology: transfigures daily life. For example, one would have to depend on the postman in the past to communicate with people who live far away. Today, one can easily say that an email service is the cheapest and fastest communication method. Another area that greatly impacts is education. One was accustomed to having to physically read from books or attend actual classes where things are taught. This can now be done simply by softcopy books available online, and that person can learn through a non-traditional way using educational tools. The wide-ranging impact that ICT has attracted has drawn substantial attention in both industries and academia. From an industry perspective, it is argued that ICT impacts output growth in the economy and develops skill demand. From an academic perspective, ICT

is said to offer such alternatives for learning (self-learning through educational tools or distance learning) even if these learning styles are beneficial to the learner only when the academia is amenable to it. Considering the critical role ICT plays in human life, it must be also introduced to students in schools. Information, Communications, and Technologies (ICT) influence the all dimensions of life. The ICT employments are really and significantly important in workplaces, businesses, entertainment, and in fact education. There is a thing needed in supporting the teaching and learning processes. The students can be involved more in active learning and creative learning when the ICT is well applied.

According to one of his findings, ICTs may as well improve the quality, accessibility, and motivation to learn in their shed. For this reason, the study aims to equip students with knowledge regarding the integration of ICT so that they may realize progressive learning.

1.2 Concept of Information and Communication Technology (ICT)

Information and communication technology (ICT) can be understood as an elaborate array of technology and resources that assists in storing, creating, sharing, and exchanging information. These technologies are: computers and the internet (websites, blogs, and emails), live broadcasting technologies (radio, television, and webcasting), recorded broadcasting technologies (podcasting, audio and video players, and storage), and telephony (fixed or mobile, satellite, and video conferencing, etc.). ICT in education means using technology to support, enhance, and optimize the delivery of information. Global research has found ICTs to result in better student learning dependent on better teaching. Findings by Japan National Institute of Multimedia Education indicate a positive correlation between higher ICT use in education, wherein technology is integrated with curriculum teaching, and improved student achievement. Outcomes further showed that students continually exposed to technology during the teaching learning process exhibited better cognitive skills, presentation skills, innovative skills, and more willingness to expend effort in learning compared to students not exposed to technology (Fujitani et al., 2003).

The great information and communications technologies (ICTs) are the critical propellers of societal progress, economic victory, and global interconnectedness in today's digital revolution (Qiang & Rossotto, 2009). The seamless merging of the

various components of technology, such as computers, networks, software, and digital devices, has resulted in paradigm shifts in the conduct of human relationships and business. They have transformed industries, agriculture, medicine, business, engineering, etc. ICTs are thus instrumental in investing with the change and shaping of our lives in many ways as the globe becomes increasingly interlinked. In the digital age, ICT could facilitate bridging the socioeconomic divides and engender inclusion. ICT has changed the way information is accessed, exchanged, and disseminated, making information and resources available for people (UN General Assembly, 2015). With e-governance projects, citizens can be more engaged in decision-making processes, enhancing transparency and accountability. ICT will also transform education through new forms of learning and transform the roles of students and teachers in the learning process. Some interpretations that bring out the meaning of ICT say that:

"Information and communication technology deals with an information system, creation, data collection, data storage, access, processing, retrieval, analyses, use and dissemination of information accurately and effectively to enrich the knowledge and develop intelligence decision-making as well as the problem-solving capacity of the user"(Walia, 2011).

As for UNESCO'S point of view, "Information and communication technology (ICT) include scientific-technological and engineering disciplines and the management techniques employed in information handling and processing their application, computers and their interaction with the man and machines and also the socio-economic and their cultural dimensions".(Walia, 2011).

The document National Policy on Information and Communication Technology (ICT) in School Education (2012) defines Information and Communication Technologies as hardware, tools, contents, resources, forums, and services that can be transformed or delivered in digital format and used to actualize the objectives of teaching learning processes, enhance accessibility to resources, build capacity, and manage the education system.

This will cover everything from hardware and software to interactive digital content, internet and satellite communication tools, radio and television services, online content

repositories, interactive forums, learning management systems, and other management information systems.

1.3 Concept and Significance of ICT mediated teaching at Secondary Stage of schooling in India

The ICT in secondary school programs was initiated in December 2004 and revised in 2010 that provided opportunities to secondary stage students mainly to build on their capacity on ICT skills and to learn essentially through computer-assisted learning. Integration of ICT in school education is focused on preparing the young to participate creatively in establishing, sustaining, and furthering a knowledge society that is the foundation for both socio-economic development of the nation and global competitiveness. Per the 2012 National Policy on Information and Communication Technology in school education, information and communication technologies are defined as all devices, tools, content, resources, forums, and services, both digital or convertible into or delivered through digital means, that may be applied or availed for accomplishment of the teaching-learning goals, resource accessibility and reach, capacity building, and educational system management. These will include not just hardware tools in connecting desktop computers and software applications but also interactive digital content, internet, other satellite communication devices, radio, television services, web-based content repositories, interactive forums, learning management systems, and management information systems.

The one who does not consider or does not make use of ICT denies its impairment and import to life. Information and Communication Technology (ICT) is technology that supports activities within information gathering or data processing including storage and presentation. It contains any product that will electronically store, retrieve, manipulate, transmit, or receive information in a digital form like personal computers or digital televisions. Conventional ICT is the abbreviation for information and communication technology. In this sense, however, information (I in ICT) refers to meaning and value, controls over information, capturing, verifying, and storing data for later effective use, manipulation, processing and distribution of information and communications. The other part of ICT, C, refers to electronic means of communication of data over a distance. Most of these are wind up into networks with sending and receiving equipment connections through wires and satellites-reached links. T for

technology is a collection of techniques on storing, retrieving, manipulating, and transmitting or receiving information in a digital form electronically. Such can be found in personal computers, digital televisions, email, etc.

It is termed as ICT, which is a broad term for any device or applications used for communication such as Radio, Television, Mobile, Computer, Internet, Wireless and other associated means of communication. ICT is thus all the components coupled with Information Technology (IT) which mostly tend to put more attention to the effect of integrated united communication and convergence of telecommunications, computers, as well as necessary software, middleware, storage and audiovisual system that enables the users to access, store, transmit and manipulate information. It refers, in fact, to convergence of audio visual and telephone networks along with computer networks into a common cabling or link systems (Wikipedia). Information along with other forms of communication technology are important for processing of information. In other context, it refers to the use of computer, computer software and other devices to convert, store and process, transmit and retrieve information. According to Sansalwal (2000), 'IT is hardware and software for effective information management, that involves storage, retrieval, processing, communication, diffusion and sharing of information for bringing about social, economic and cultural upliftment.

The school, being part of the society or a miniature of the society, integrates ICT for the effective imparting of education. As stated by the National Curriculum Framework (NCF - 2000), the introduction of information and communication technologies is to be taken on a larger scale in education. Many attempts have been made previously for the same. ICT, according to NCF-2005, allows the students to interact and create their own productions and give expression to their own experiences, which could have provided them with new avenues for creative exploration. With respect to ICT, India first recognized this field in 1984-85 with the introduction of the computer literacy and studies in schools (CLASS) project. The initiatives have been initiated by the Education and Research Network (ERNET) during 1988-Winter by the Department of Electronics in association with the Government of India and United Nations Development Programme. Gyan Darshan was another national project initiated on 26 January 2000 to provide satellite-based Educational Channels nationwide. Gyan Vani, an interactive Radio Counselling initiative through an educational FM radio channel, is complemented by IRCs by IGNOU, which is amongst the largest open universities in

the world. The scheme ICT for schools launched in December 2004 was a window of opportunity given to the students of secondary stage schools across the country in collaboration with States and UTs. There was an emphasis on computer literacy programs, but advantages are now realized with using ICT tools for developing e-content for computer-aided learning activities. The prime objective of this scheme is to act as a support to teaching and learning in classrooms, making learning more interesting and interactive. Self-learning is also being strongly emphasized.

Goa University for the first time has established an Internet portal for administration and management, The Institute of Education DAVV Indore has started a project on computer literacy. Yashwantrao Chavan Maharashtra Open University (YCMOU) has put networking into the School of Science and Information Technology. Indira Gandhi Open University (IGNOU) through the project E-Gyankosh has developed digital repositories for enhancing knowledge accessibility with the aims of sharing its resources with educational institutions internationally."

Information and communication technologies (ICT), having evolved rapidly, have become one of the fundamental building blocks for the modern world. Understanding ICT and mastering its basic skills and concepts are now considered to be part of the core education in many countries, India included. In all likelihood, one of UNESCO's overriding aims will be to ensure that every country, both developed and developing, is equipped with appropriate educational resources that will permit them to prepare the youth for an active role in modern society, thereby making a contribution toward a knowledge nation.

1.4 The National Policy on ICT in School Education - 2012

The National Policy on Education 1986, even modified in 1992, laid stress and a need to use educational technology for augmenting the quality of education. This policy statement was responsible for the initiation of two major centrally sponsored schemes, namely, Educational Technology (ET), and Computer Literacy and Studies in Schools (CLASS). These schemes lead to a very much larger and comprehensive centrally sponsored scheme-under information and communication technology in schools-2004. Educational technology is also definitely a proper place to improve Science Education. Again, the special dosage that ICT has in school education has been emphasized in the National Curriculum Framework (NCF)-2005. Very much in like that, ICT figures

under the flagship program of Government of India on education, called Sarva Shiksha Abhiyan (SSA). In turn, it would be a document of comprehensive coverage about the norms of schooling recommended by the Central Advisory Board of Education (CABE).

It is now necessary, in light of convergence in all technologies, to take the comprehensive look at all possible information and communication technologies for improving school education in the country. Such a holistic approach to ICT as a means in developing education may only rest on a sturdy policy. Induced by the gigantic potential of ICT to extend the outreach and improve the quality of education, the Government of India launched "National Policy on Information and Communication Technology (ICT) in School Education-2012". This policy will thus bring guidelines out to help the States in realizing optimum utilization of ICT in school education within a national policy framework. The policy aims at preparing youth to creatively participate in the making, sustenance, and growth of a knowledge society that would lead to all-round socio-economic development and competition of the nation at the global level. The very purpose of this policy is to design, catalyze, and support as well sustain ICT and ICT-enabled activities and processes that aim at improving access, quality, and efficiency in the school system.

The ICT Policy in School Education will seek to achieve the following:

- the creation of an environment to develop a community knowledgeable about ICT;
- the creation of an ICT literate community whose members are able to deploy, utilize, benefit from ICT and contribute to nation building; collaborative and cooperative and sharing conducive environment towards demand for an optimal utilization and the most optimum return from the potential of ICT in education;
- facilitate open access to all students and teachers, at equal levels and with all fees waived, to state-of-the-art ICTs and ICT-enabled tools;
- create and nurture local and localized quality content, and enable students and teachers to partake in the development and constructive use of shared digital resources;
- develop professional networks of teachers, resource persons and schools to catalyze and facilitate resource sharing, development and continuing education

of teachers, guidance, counselling and academic support to students-resource sharing, management and networking of school managers and administrators to bring improvements in efficiencies in schooling process;

- ❖ foster research, evaluation and experimentation in ICT tools and ICT enabled practices to inform, guide and utilize the potentials of ICT in school education; promote critical understanding of ICT, its benefits, dangers and limitations; and motivate and appropriate all sections of society to wider participation in making the school education process stronger via appropriate use of ICT.

1.5 Integrating Information and Communication Technology (ICT) in School Education

Technology integration into education means that it is meant to use technology for improvement of student learning experience. Schools have developed diverse sets of ICT tools for communicating, creating, disseminating, storing and managing information (Blurton, C. 2000). In some ways, ICT has very much become part of that teaching-learning interaction as with replacing black boards by interactive digital smartboards, learning while in class with the students own smart phones or other gadgets, and such approaches as the “flipped classroom” model where learners watch lectures at home on the computer and spend time in the classroom engaged in more interactive activities.

Many of the major institutions have changed, and how we have lived our daily lives has much of an impact on the technological tools that have come to place today. The effect of such a tool, however, on education was just beginning to be felt as the new technology evolved into the teacher's methods of teaching and learning.

With the use of ICT in classrooms, new horizons have opened and pathways to the usage of ICT have broadened massively, making available resources from the four corners of the world at a click of a button for students and teachers. For example, the Internet carries all kinds of information and data, images, much more, and even computer software into the classroom from places it could have otherwise never entered, and it does all of that almost instantly. Such resources can empower learning by means of meaningful individual and collaborative learning settings.

Teaching methods, which include technology, when understood and used effectively by educators, cultivate higher-order thinking skills, foster creativity, and give students

individualized ways with which to express their understanding. Students also gain better readiness for adopting changes in technology in society and workplaces.

Since Technology provides instant access to information, its importance in the classroom cannot be overstressed. In the life of students and teachers, the use of smart phones, computers, and tablets is already a norm. Therefore, experimentation with the use of technological devices for creating constructive learning experiences for students learning at all levels can be expected.

Computer technologies and other aspects of digital culture have changed the way people live, work, play and learn, affecting global power and knowledge construction and distribution (Deuze, M., 2006). Thus, digital literacy-searching, discriminating and producing information, and critically using these new media to be active in society-becomes a consideration of major importance in any curriculum framework. Moreover, the application of any given technology in a classroom setting also encourages active learner engagement. At the same time, the application of technology also allows for differentiated instruction that will meet the individual needs of students as individual learners in the broader climate of classrooms.

Technology is an avenue for teachers to do differentiated instruction and to modify information for the appropriate level of learning ability of their students. The technology can also facilitate students to progress in learning at their own desired space. There are some challenges that encounter the integration of ICT in school curriculum.

Instead, ICT has facilitated convergence of a wide range of technology-based and technology-mediated resources that include teaching and learning. Thus, it has indeed become possible to consider ICT as an all-purpose support for education.

The following understanding ICT with respect to the Indian educational scenario would be like the following-

(i) ICT can be used in many ways: to disseminate information and advocate for adaptation/adoption. Translation and distribution of already available educational resources in varied media and forms would encourage its dissemination and use.

(ii) Digitisation and making available many academic audio-and video-products in diverse languages, media standards and formats are urgent.

(iii) In view of the few print-resource as well as web-content in Indian languages, the ICT should employed gainfully for digitizing. ICT will certainly be invaluable in digitizing and disseminating what is available in an existing vast repertoire of print materials such as books, documents, handouts, charts and posters, which have been used extensively in the school system, and make it reach and useable.

(iv) ICT can address teacher capacity building and ongoing teacher support, in addition to strengthening the ability of the school system to manage and improve efficiencies-in other words make it possible for the school system to develop the ability to manage and improve efficiencies-without referring to such an enormous system and traditional ways of training and support.

(v) Using computers and the Internet as mere information delivery devices grossly underutilizes their power and capabilities. There is an urgent need to develop and deploy a large variety of applications, software development tools, media and interactive devices to promote the creative, aesthetic, analytical, and problem solving abilities and sensitivities of students and teachers.

Less than satisfactory infrastructure for ICT, basic but minimum, should be made available for schools under their policies. Such infrastructure must comprise stable and affordable internet connectivity and security measures like filters and site blockers. On teacher policies, basic ICT literacy skills, ICT application in the pedagogical environment and discipline-specific applications should be targeted. This should be complemented by series of ongoing technical, human and organizational support on the issues to see to it that the students get access to and use of the ICT effectively in schools. (Kopcha, T.J., 2012). There exists the need for the inclusion of ICT in the school curriculum. Construction of digital content in the vernacular languages needs to be done along cultural lines (Voogt et al., 2013). This will help students be more effective learners of various concepts.

1.6 The Rationale for Integrating ICT Into the Teaching-Learning Process

ICT is a powerful tool that supports the transition to student-centered training in which teachers and students actively participate. Consequently, the process of integrating ICT will facilitate the creation of a new learning environment. The very successful

integration of ICTs into the educational system can analyze the paradigm shift concerning both content and pedagogy, which is integral to the education reform movement of the 21st century. ICTs particularly, computer and Internet technologies, provide opportunities for new methods of teaching and learning that do not merely enhance the existing methods, but truly transform them. These new methods of teaching and learning are theory-based on the constructivism of learning and are moving closer towards learner-centered pedagogy as opposed to teacher-centered pedagogies.

Actively engaging students in inquiry-based learning, ICT-enhanced learning mobilizes tools for examination, calculation, and analysis of information. Thus students learn from solving real-life problems becoming more decontextualized from mere memorization and rote learning. ICT blends in with "just-in-time" learning, allowing learners to choose what to learn at the time they need it.

Collaborative learning- It allows interaction and cooperation among students, teachers, and even authorities elsewhere, and strengthens the concept of collaboration beyond the real-world situations. ICT enables collaborative learning enhancing cross-cultural interaction; it helps learners develop communicative skills and global awareness.

Creative learning- ICT-supported learning encourages manipulating that existing information rather than regurgitating it for the sake of real-world learning environment.

Interactive learning- Now, ICT-enhanced learning encourages a thematic and interactive teaching-learning paradigm. This somewhat dissolves the artificial boundary built within traditional classroom between different disciplines and theory and practice.

Evaluative learning- Student-directed and diagnostic, the ICT-enhanced educational process recognizes the existence of multiple pathways for individual learning, as well as multiple articulations of knowledge. It differs from traditional forms of teaching and learning based on the transmission of information whereby students listen and remember. Instead, the use of ICT provides opportunities for learning through exploration and discovery.

1.7 Benefits of ICT Integrated Teaching Learning Materials at Secondary Stage

- It lets students easily get resources or information with a click of a button on sites like Google, Wikipedia, and Yahoo which enable students to type in their

query and get relevant results within seconds. Also, students learn to be effective independent learners, gear up themselves for their future.

- Integrated ICT at the High School stage gives the students headway towards their future by staying ahead of the rest.
- It augments the abilities of student critical thinking and problem solving as well as improves the oral and written communication, accessing and analyzing information, inquiry, and imagination.
- Cultivating skills by watching power point during the lecture, teacher uses interactive while bound during lecture, students view website on large screen, students listen to a lesson. Include these students are enhancing their competencies by technology use. They type papers using word make graphs with excel and online searches. They have the ability to record a product like movie, poster session in power point.
- Exploration, whereby the students are engaged in discovery learning prior to installing formal instruction. Students use an online applet to learn about a subject, students conduct a lab with probes, collaborating students interact with peers' instructors and outside resources students make group contributions in text format to a wiki, work together on a Google Doc, used web 2.0 tools email etc. They can use Excel, Probes and accompanying software power point MP3 Movies, wiki which are making sound choices about the appropriate synthesis to content and technology.
- Studies has shown that the appropriate usage of ICTs could be analyzed through paradigmatic shift in both content and pedagogy that is in education reform during the 21st century. When used, particularly appropriate, ICTs such as computers and Internet technologies are said to enable new ways of teaching and learning-the replacement of old ways which improved what learners and teachers have done previously. These new ways of teaching and learning are underpinned by constructivist theories of learning and constitute a shift from teacher-centered pedagogy-in its worst form characterized by memorization and rote learning-to learner-centered pedagogy.

1.8 Academic Achievement

Possibly one of the principal foundations for personal and professional development among students is found in academic performance. One principal achievement of the educational process has been academic performance. Whether indirectly or directly conversely, educators considered academic achievement since it represents an important need in the learners' lives. Teachers are also held to measure fairly the outcomes of their teaching concerning progress made by students in mastering the content taught. During their learning process, students come into contact with many different subjects and experiences, and they are also greatly affected by their academic results, which in turn greatly affect their future opportunities and well-being. The accomplishment of application is referred to as achievement, and depending on the leve1 of marks obtained, people are labelled as high achievers, average and low achievers. Academic achievement is the athlete's self-perception and self-evaluation of the athlete's objective academic success." Academic achievement generally means the learning outcome of a pupil.

Oxford Advanced Learner's Dictionary (2000) defines “achievement as a task that somebody has done successfully, especially using his /her efforts and skills. Academic achievement or performance is the outcome of education – the extent to which a student, teacher, or institution has achieved their educational goals.”

According to Good (1973) “academic achievement is a knowledge, attitude, or skill developed in the school subject usually designed by test scores or by marks assigned by the teacher or by both.”

To a student, a kind of success from fulfilling short- and long-term educational goals for academic achievement. The level of learning outcome in a certain area of subject related knowledge, understanding, skill, and application, which are usually evaluated by the concerned teacher in the form of test scores and examinations. This becomes one of the major tools through which the students can learn about their talents and competencies recognized as a vital part in developing aspiration in careers.

1.9 Rationale of the Study

Multiple sectors have been reshaped by ICT integration, including education. The actual integration of ICT within education has adapted the teaching-learning

mechanism radically, especially in science education. Rapid advances in technology have innovated tools and resources to enhance student engagement, simplify difficult scientific concepts, and create learner-accessible interactive learning experiences. Such tools include digital simulations, visualizations, and virtual labs which can promote deep understanding and learning outcomes among students, especially in science where much weight is given to abstract theories and experiments.

The rapidly growing age of digitization has witnessed the entry of Information and Communication Technology (ICT) in education as a means for "transformation." The conventional methods of teaching were relatively ineffective in motivating the student minds. Physics is a subject that has an abstract character, and consequently, because of that, in the minds of students, it does not have a clear concept in their understanding. Teaching through ICT brings something new-experiential with interactive, visual and simulation-based learning-that can render the obscure again illuminative and enjoyable.

Learning physics requires instructional strategies that go beyond rote memorization. Physics, being highly conceptual and application-based, requires the use of instructional strategies and methods that encourage the use of very visual ICT tools, such as animations, simulations, virtual laboratories, and interactive modules. These ICT tools can help to visualize the abstract concepts, shore up active learning, and provide real-time feedback. These facilitate better academic performance of students and also build conceptual understanding and retention of scientific principles for the longer term.

Though there is much availability of such resources in almost all schools, effective use of them in the classroom, especially for science education, is extremely low. There is an increasing need to evaluate the contribution of ICT integration in actual academic performance in the subject of physics for secondary school students. This study focused on filling that gap by ascertaining the effect of ICT-mediated instruction on the academic performance of 9th grade learners in physics.

This study has such findings that they would have to educate the educators and policy makers as well as curricular developers on the improvement of teaching practices which could make a positive change in student engagement and academic success as far as physics is concerned.

1.10 Statement of the Problem

The statement of the problem is '**A Study on Effect of ICT Mediated Teaching on the Academic Achievement of Secondary School Students in Physics'.**

1.11 Operational Definition of Key Terms

ICT Mediated Teaching :- Teaching is mediated through ICT, that is, instructional processes can be conducted using Information and Communication Technology (ICT) tools and devices. The inclusion of digital technologies using the computer, internet, and multimedia in a classroom for learning makes the experience more interesting and less boring.

Academic Achievement :- Academic achievement can be understood as the level to which a student has reached their educational objectives or an institution has with respect to them- short term or long term. It is measured quantitatively through different potential indicators like grades, standardized test scores, and degrees, among others.

Secondary School Students :- Pupils attending a school offering any secondary curriculum for grades 9, 10, 11, or 12. Individuals enrolled in a formal education stage that follows primary education and precedes higher education, typically encompassing grades 9-12.

1.12 Objectives of the Study

1. To analyze the effect of ICT-mediated teaching on the academic achievement of secondary school students in Physics.
2. To compare the effectiveness of ICT-based instruction with traditional teaching methods in Physics.

1.13 Research Questions

1. What is the effect of ICT-mediated teaching on the academic achievement of 9th-grade students in Physics?
2. What is the difference between the mean academic achievement scores of experimental and control group?

1.14 Variables of the Study

Use of ICT Mediated and traditional method are the independent variables in this study. Academic achievement in Physics is the dependent variable in this study.

1.15 Hypotheses

$H_0$1 : There is no significant difference between the mean scores of pre-test of the experimental and control groups in the academic achievement test of Physics.

$H_0$2 : There is no significant difference in the academic achievement of students taught through ICT-mediated teaching in Physics.

$H_0$3 : There is no significant difference between the academic performance of students taught using ICT-Mediated instruction and those taught using traditional teaching methods in Physics.

1.16 Delimitations of the study

1. The Study has been delimited to Jharsuguda district only.
2. The study has been delimited to the Physics subject only.
3. The study has been delimited to the 9^{th} class student only.

CHAPTER 2

REVIEW RELATED LITERATURE

2.1 Studies Related to ICT Mediated Teaching and Academic Achievement

Imafido and Ijeh (2023) studied how teachers' backgrounds and use of ICT resources affected students' academic progress in Mathematics. The study used the ex post facto research design. Three hundred and thirty pupils of the eighth class from secondary schools in Delta State's Delta Central Senatorial District make up the study's sample. The findings indicated that teachers with a background in education and those who use ICT tools when teaching Mathematics have a positive impact on their student's academic success in the subject.

Josephine, Osei, and Asamoah (2023) explored the role of ICT in teaching and learning Mathematics at the College level. A systematic literature review was conducted on a sample of twenty-seven studies using various academic databases. The findings indicate that the use of ICT in Mathematics education has positively impacted teaching and learning. The studies review reported improved student engagement, motivation, and achievement in Mathematics, as well as increased teacher effectiveness and confidence in their ability to teach Mathematics.

Courtney, Karakus, Ersozlu, and Nurumov (2022) examined the relationship between students' usage of ICT and their performance in Maths and science by analyzing the four PISA surveys from 2009, 2012, 2015, and 2018 using the ICT engagement theory as a theoretical framework and a three-level hierarchical linear modeling strategy. ICT-related interest as an independent variable was incorporated into the models at the student, school, and country levels. Across the four cycles, the total school students' sample size was two hundred forty-seven thousand three hundred fifty-two, two hundred forty-three thousand sixty, one hundred ninety-four thousand three hundred ninety-nine, and two hundred twelve thousand six hundred fifty-two respectively. The set of models showed that ICT use had no substantive positive relationship with student performance in Math or science. Conversely, higher student attitude toward ICT was associated with higher Math and science performance for each of the four years of the study.

Huang, Jiang, Yin, and Jong (2021) extensively investigated the relationships between East Asian students' Science achievement and their ICT use in learning, ICT self-efficacy, motivating variables, and socioeconomic level using the PISA 2015 dataset. Six East Asian nations and regions' data were utilized. The synthesized structural equation modeling results revealed a positive relationship between students' ICT self-efficacy and their use of technology during learning, whereas a negative relationship existed between ICT use during learning and students' degree of science proficiency. Socioeconomic status had a strong correlation with students' levels of science proficiency but only a slight relationship with their use of ICT.

Muhammad and Prema (2017) conducted a study on awareness about ICT and academic achievement and the relationship between ICT awareness and academic achievement. The study was conducted in Tarauni and Nassarawa Local Government Areas of Kano State, Nigeria. A descriptive survey design was used for the study with a sample size of one hundred and eighty-three students. Results revealed that (i) The level of ICT knowledge was high (ii) The academic achievement level is average (iii) The mean scores of ICT awareness and academic achievement change significantly depending on (a) gender (b) branch of study, and (iv) there is a substantial correlation between ICT awareness and academic achievement among senior secondary school students.

Nwokocha, Emeka, and Timothy (2016) conducted a study on "Bridging the barriers: ICT in girl-child education in Nigeria". The study, which selected a sample of 300 female respondents from the Department of Social Studies, was carried out at the College of Education in Zing, Taraba State. The study used a survey approach, and the results showed that access to ICT, particularly the Internet, increases female students' enthusiasm and interest, which in turn boosts their academic performance.

Kaur (2015) observed the effect of computer-based interactive simulations on achievement in physics, problem-solving ability, and attitude towards physics of senior secondary school students with different levels of intelligence. This experimental investigation is carried out in Chandigarh schools with a sample size of 180 pupils. The results showed that using interactive computer-based simulations improved student mean gains. Additionally, pupils who were exposed to computer based interactive

simulations as opposed to the conventional method had a higher attitude towards Physics.

Fernandez-Gutierrez, Gimenez, and Calero (2020) analysed the impact of ICT on secondary school pupils' Maths, reading, and science skills. Data was collected from three PISA cycles (2009, 2012, and 2015) for the areas in Spain. The findings revealed that while there was a beneficial impact on PISA scores in science, there was no evidence of a positive impact on maths or reading PISA scores when ICT use at schools in autonomous communities increased. Findings also showed that the subject matter and method of technology used determine the ICT effects on educational achievements.

Das (2019) explored the role of the application of ICT tools in Mathematics teaching. Document-based analysis was done based on data from research papers, books, edited books, reports, and online documents. Document analysis showed that students can use ICT as a tool to perform calculations, draw graphs, and help solve problems. A dynamic geometry program's image can assist a pupil in comprehending, resolving, and demonstrating a geometrical problem. Maxima-an algebra solver software, GeoGebra, and SymPy-like software can be used to understand Mathematics easily.

Kucuk (2023) studied the positive and negative consequences of technology's impact on education. A total of twenty-six educators from various education levels participated in the survey via Google Forms. The findings indicated that educators found it challenging to incorporate technology into lessons, despite their belief that doing so will increase students' success. Some of the negative consequences were attention problems in students, limited students' face-to-face communication, and increased incidences of cheating among students.

Mutlu-Bayraktar, Cosgun, and Altan (2019) systematically reviewed papers dealing with cognitive load and multimedia learning from 2015 to 2019. A total of ninety-four publications were explored in terms of the different forms of cognitive load, multimedia learning principles, cognitive load measurements, cognitive processes, various multimedia learning environments, and study demographics. The findings showed that extraneous cognitive burden was explored more frequently than other types of cognitive load in the papers that were reviewed. Modality and signalling/cueing concepts were the two that were most frequently discussed in articles. Researchers from Europe, particularly Germany, followed by researchers from Asia, America, Australia, and

Africa conducted the maximum of reviewed cognitive load studies on multimedia learning.

Demir and Akpiner (2018) examined the impact of mobile learning apps on undergraduate students' academic performance, mobile learning attitudes, and animation development levels. The study employed a quasi-experimental design. The control group with twenty-six students attended a lecture-based classroom, while the experimental group with fifteen students employed a mobile learning-based technique. Student interviews were done as part of the exploratory investigation. The results imply that mobile learning encourages pupils to achieve academically. The attitudes towards mobile learning were highly positive for both groups. Furthermore, mobile learning helped in increasing their motivation.

Heflin, Shewmaker, and Nguyen (2017) examined students' involvement, critical thinking, and attitudes in three different collaborative learning environments, both with and without the use of mobile devices. Six intact classes of first-year courses were taken as sample. A quasi-experimental research methodology was used. Multiple data sources, including student surveys, classroom behavioural observations, and a finished written product were employed in a multimethod analysis. According to the findings, mobile technology is linked to increasing student disengagement in class but also favourable student impressions of collaborative learning. Comparing students who used a computer keyboard or wrote their comments by hand to those who used a mobile device, the latter group showed much less critical thinking.

Schneider, Nebel, and Rey (2016) studied the effect of decorative images as a prime for emotions and context-relatedness. In this study, four categories of decorative images are examined. The cells of a between-subjects, factorial design with two (emotionally positive vs. emotionally negative photos) and two (school context vs. leisure context pictures) were randomly assigned to eighty-two pupils. According to the findings, positively valenced images improve memory and transfer abilities. The relationship between the valence of images and learning outcomes is found to be mediated by pleasure.

2.2 Studies Related to ICT Integration Teaching Pedagogical

John (2022) designs an ICT integration framework in primary schools in a district of Uganda with the objectives: to investigate the factors affecting ICT integration situation; to design a framework for ICT integration and to validate the framework for integrating ICT in the primary schools in Bundibugyo district. The study used a cross sectional research design with a sample size of 189 respondents (60 pupils and 129 teachers).Stratified and simple random sampling was used as sampling techniques while questionnaires and interviews were used as research instruments. The study found the factors including lack of teacher preparedness, lack of learners‘ preparedness, and lack of administrative preparedness.

Melo et al. (2020) established a pedagogical strategy aimed at supporting the integration of ICTs into the higher education process. A survey was carried out aiming focus on the analysis of teachers‘ practices so that competences in ICT use at university education in Colombia could be enlarged. 81 universities answered the survey questionnaire: 51 private and 30 public, and a total of 423 lecturers from different academic disciplines. Our findings show the degree of attention paid by teachers to strengthening ICT skills in their training tasks. This research is complemented with Strengths, Weaknesses, Opportunities, and Threats (SWOT) analysis performed with 50 professionals experienced in ICT use in higher education.

Maruti (2020) in his work on the role of ICT in teaching and learning process in higher education assessed that language learning and teaching is taken into account to be a posh process. ICT has its noticeable impact on the standard and quantity of teaching learning process. ICT can enhance teaching and learning through its dynamic, interactive and engaging content and it can provide real opportunities full stop in the current situation when any teacher used ICT at that time. This paper casts the sunshine on the ICT tools which will help the event of English learning and teaching process to point out how Technology affects the foreign language education and how it can be used effectively in the higher education.

Pico and Rodríguez (2021) found in their study that the way of teaching learning process has significantly changed. The main objective of their research was to analyze the use of ICT and their impact on the educational practices of teachers. To establish a method aimed at reducing monotony, it is necessary to establish a new form of

discipline that allows reflection and acquisition of the most recent knowledge in combination with the teacher's guidance. The incorporation of technological tools allows changing traditional training methods by integrating new methodologies. Traditional preparation includes teachers as evaluation entities and learners as evaluated persons.

Bhattarai (2019) in his paper focuses on the issues of the management of multicultural classes, and the role of ICT-integrated pedagogy to manage such a classroom context. The finding of the study shows that ICT-integrated pedagogy is the best strategy to manage multicultural classes by respecting students‘ personal feelings.

Okeke et al. (2018) in their work examined the role of ICT in improving teaching and learning in Nigerian Universities. They adopted a descriptive survey design and simple random sampling technique was used to select sample population of 360. The findings of the study revealed that Nigeria University suffers lack adequate skills no online discussion with lecturers and there are partial limited bandwidths.

2.3 Studies Conducted in India on the Perceptions of Secondary School Teachers Towards Integration of ICT in School Curriculum

Subaveerapandiyan, A. and Nandhakumar, R. (2021) conducted a study to know the teaching faculties’ ICT skills and related online class skills in higher educational institutions in India. 220 faculties were selected randomly from 26 Central Universities, 43 State Universities, 6 National Institutions and 2 other Institutions. These faculties have been working in the Departments of Education, Institutions of Educational Technology, Departments of Special Education and Continuing Education in India. The researchers used questionnaires to collect data from the respondents. The variables considered for the study include age, gender, academic rank, teaching experience and type of organization. Out of 220 participants, only 201 faculties filled-in the questionnaires properly and returned. The data were analyzed using a one-way ANOVA and independent t-test on SPSS software**.**

The results of the study revealed that based on the teachers’ demographic information, the teaches in the age group of 35-49 years were more skilful in the use of ICT as compared to their counterparts belonging to other age groups. Computer competency is intermediary among majority of teachers using it. The Google platform and Zoom

online platforms are preferred as major online platforms in online teaching. The researchers suggested for a strategic long term plan for online teaching providing necessary computers and sufficient internet connectivity. ICT training should be integrated in the curriculum of Teacher Education Institutions so as to enable pre-service teachers acquire necessary skills in online teaching.

Himanshoo Kumar Sharma (2021) conducted a study to explain the concept and importance of ICT in the present education scenario. The study also focused on the challenges and barriers to integrate ICT in Indian schools; and discussed the role of the teachers in the process. These challenges include: lack of infrastructure, lack of funds, lack of trained teachers to use ICT, lack of uniform abilities on the part of the students and the psychological thinking of teachers and students that the use of ICT tools is very complex. The study concluded that ICT applications are not going to replace the physical form of information sources completely; but no doubt these applications are useful to meet present demands, to satisfy the remote users and to provide information instantly. With the help of ICT enabled services, it is easy for users to gather information, to segregate information, to use multiple search words, to save cost, time and efforts of staff and users and to provide remote access to information and different databases. Now, innovative strategies can be adopted to develop the knowledge innovation culture in education.

Nagaraj, D. and Tholappan, A. (2020) felt that Information and Communication Technology (ICT) has brought lot of positive changes on human life such as business, transport, communication, administration, agriculture, health, industry etc.; and the field of education has no exception. Drastic changes have been happened every page of teaching and learning for the past two decades. Redesigned strategies have arrived in all aspects of education right from primary to higher education. The research paper intended to examine the perception of secondary level teachers of social science towards Information and Communication Technology (ICT) for which researcher used self- structured perceptional scale to the 100 sample size by using simple random sampling technique under the method of normative survey. The findings of the study revealed that there is average level in perceptional level among these teachers and significantly differ in terms of their gender, locality, age and experience.

Arnab Kundu and Tripti Bej (2020) conducted a study to investigate the state of ICT integration and the degree of expertise these schools have attained. A survey of forty teachers from twenty purposively selected private high schools was conducted using a set interview protocols. Data were analyzed following the grounded theory approach. Results revealed that despite a high level of appreciation among teachers of the importance of ICT integration into teaching and learning, classroom integration was not found problem-free. Several factors that hinder the integration of ICT in schools were identified in the study. There factors include: lack of ICT infrastructure, lack of institutional encouragement, weak policies; and above all lack of sufficient skills among teachers at all levels – technological, pedagogical and integrative. This shows poor conviction in the hypothesis that private schools are good at ICT integration. Based on the analysis the study proposed 3E-Model along with a program of action for its implementation to improve ICT integration by dampening down the challenges and recommending schools to establish independent authorities; for example Working School Governing Bodies (WSGBs) that would look after the model and issues relating to the promotion of ICT integrated pedagogies in schools.

Soumen Biswas (2019) conducted a study to focus on integration of ICT with Indian school education system. The researcher felt that the ability to work with ICT is recognized as one of the key competencies necessary for success in life. Worldwide research has shown that, demands are growing for ICT, not only in business and economic sector, but also in the domain of teaching and learning. In this digital era, ICT can improve the teachers' role as creators of pedagogical environments. Moreover, teaching-learning may become very easy and attractive with the help of ICT. But for a developing country like India, it is a challenging issue to integrate ICT with all the schools of the country. The study discussed in detail the emerging challenges of ICT integration in Indian schools. The researcher identified some barriers like infrastructure, finance, language, lack of trained teachers, lack of motivation among educators etc., are the key challenges for integration of ICT in Indian schools. Though the 'Operation Blackboard' ensured the minimum requirements of all schools of India up to upper primary level, we have a good number of schools where facility of electricity or telephone is unavailable till now. So we cannot think about modern technology in such schools. Language is another powerful barrier to access online contents. Worldwide research has already shown that, 80% online contents are in English language.

Moreover maximum educational software is being produced in English only. This is creating difficulties not only in India, but also in other countries where English is not treated as first language. Economic reality is another obstacle to achieve the educational goals. The researcher concludes that integration of ICT in school education always helps for knowledge building and consolidation; and application in new contexts. Teachers can integrate their pedagogic expertise with technology.

2.4 Studies Conducted in Abroad on The Perceptions of Secondary School Teachers Towards Integration of ICT in School Curriculum

Shephard Pondiwa et al. (2022) conducted a study on 'Integration of ICT into Education: Lessons Learnt at the State University of Zanzibar and the Midlands State University in Zimbabwe'. This study looks at how the Midlands State University (MSU) and State University of Zanzibar (SUZA) have adopted the use of ICT in many ways. ICTs do not work for everyone in the same way. It has become inevitable, in the current digital era for educators to integrate ICT in their teaching and gradually replace traditional teaching methods with modern ones which are ICT led. The main objective of this study is to find out challenges and opportunities of using ICT in education.

The study employed a case study approach to study the integration of ICT in education at Midlands State University and the State University of Zanzibar. The study used a total of 100 University workers and 150 students from the two institutions. 60 of the workers were from MSU and 40 from SUZA. Of the 150 students, 100 were form MSU whilst 50 were from SUZA. The study purposively selected the Directors of ICT of the two institutions and the rest of the respondents were randomly selected. This comparative analysis of the two institutions helped to make a closer look at the differences and similarities in the adoption and use of ICT in the two institutions. Two questionnaires were developed and used for collection of data from the participants. One was used to collect data from lecturers from the two institutions while the other one was used to collect data from students. Interviews were also conducted with randomly selected lecturers and students, as well as the Directors of ICT.

The results of the study indicated that there has been the integration of ICT in education at both the SUZA and MSU and this has greatly changed the way teaching and learning taking place at the two institutions. The integration of ICT in education has been influenced by the fact that the major stakeholders of the two government institutions,

lecturers and students have embraced in the use of ICT. This is in line with the Technology Acceptance Model (TAM), where adoption of technology largely depends on it been accepted by the users. This study also revealed that new technologies spur spontaneous interest more than tradition approaches of learning. Both Lecturers and students from the two institutions indicated that they would prefer the use of ICT in education. 78% of students who answered the questions from the questionnaire indicated that they would prefer to have lectures and other teaching material delivered using ICT. One learner from the MSU Harare campus indicated that instead of lecturers having to travel to campus, they could just use ICT facilities such as Google class, Skype or the E- learning accounts of students to deliver teaching and learning material.

Murithi, J. and Yoo, J.E. (2021) felt that the use of Information and Communication Technology (ICT) in education has been widely advocated as much needed 21st century skills by governments and policymakers. Nevertheless, several challenges in integrating ICT into the curriculum have been reported in previous research, especially in studies on Sub-Saharan African countries. Focusing on the case of Kenyan public primary schools, the researchers investigated the availability of ICT facilities; teacher capacity to integrate technology into their lessons; and teacher perceptions towards technology in schools. In particular, the study is based on the constructivist learning theory and the Technology Acceptance Model. A total of 351 teachers completed an online questionnaire. Teachers perceived that ICT facilities were inadequate in schools, which presented a challenge in the integration of technology during the implementation of the new curriculum. Most of the teachers answered that they received only basic computer literacy training. Although teachers perceived the use of computers as necessary, they faced difficulties in integrating technology in their lessons. The effect of age and gender on teacher capacity was also investigated in inferential statistics, specifically with Welch tests and Games-Howell post hoc comparisons. Teachers in their 40s had a higher perception of usefulness than teachers in the 30s. Male and female teachers did not show any differences in their perceptions in terms of teacher capacity and perceived usefulness towards use of technology in schools.

Kelemnesh Seifu and Shuyan Wang (2020) conducted a study to investigate factors that determine the integration of Information and Communication Technology (ICT) in teaching-learning process in Aksum University, Ethiopia. Descriptive survey research design was employed in the present study. The size of population was 550 teachers and

5 College deans. Of these, 385 teachers and 5 college deans were selected as samples with the help of stratified random sampling and comprehensive sampling techniques, respectively. For the purpose of collecting data, questionnaire and semi-structured interview were employed. The quantitative data gathered through the questionnaire were analyzed with the help of both descriptive and inferential statistical techniques. That is, one sample t test, Pearson product moment correlation, and multiple regressions were mainly employed to analyze the quantitative data.

The result of a one sample t-test shows that teachers' attitude towards the use of ICT, accessibility of ICT facilities, teachers' self-efficacy, teachers' competence, and technology characteristics highly influenced the ICT integration while technical support, the nature of curriculum, administrative support and ICT policy were less likely to influence ICT utilization. In addition, the result of correlation indicated that ICT integration had positive relationship with all independent variables. With regard to regression, 88.1 % of ICT integration was predicted with the combination of teachers' self efficacy, attitude, the characteristics of technologies, accessibility of ICT facilities, teachers' competence, ICT policy and administrative support. The results of interview also indicated that inadequate administrative and technical support, restrictive nature of curriculum, lack of sufficient time, shortage of electric power and concrete models to integrate technologies hinder from using ICT in teaching-learning process.

Peggy Siamisang et al. (2019) opined that Information and Communication Technology (ICT) has been growing so fast for the past 20 years in most of sectors, but still a lot of done in the education sector. Teachers are still relying on the old traditional way of teaching methods. Botswana schools are still far behind in benefiting from ICT usage in classroom. This study reviews various technology adoption frameworks such as Technology Pedagogy and Content knowledge, Teacher Development model, and Conceptual framework. This study aims at knowing the ICT infrastructure found in Botswana public junior secondary schools, makes an assessment of teachers' skills, knowledge, confidence and the perception on the integration of ICT in teaching and learning. A quantitative research design is used to collect data from teachers in Botswana Junior Secondary Schools. The major findings show that integration of ICT in Botswana Junior secondary schools is very low or not yet started. This has been influenced by factors such as lack of skill, lack of confidence in the use of technology by teachers, and lack of ICT equipment in schools. The study recommends that schools

should be equipped with education ICT supporting infrastructure, and teachers should be trained on the pedagogy of ICT in teaching. Furthermore, the curriculum should be designed in such a way that it includes ICT integration in subject areas.

2.5 Studies Related to Academic Achievement in Physics

Maamin and et al. (2022) present an article on "The Influence of Student Engagement on Physics Achievement among Secondary School Students." The primary goal of this was to investigate the relationship between secondary school student's mathematics achievement and engagement. The researcher adopted the survey method to complete his research. 227 schools were selected from Selangor, Malaysia, using random sampling, and the researcher selected a total of 1000 students from 227 schools using stratified random sampling. The researcher included students' previous year's physics achievement for data acquisition and developed 57 questions for student engagement in physics, which were based on 5-Likert scales. Using Pearson correlation, multiple regression, and ANOVA techniques, we concluded that there is a positive relationship between secondary school student's physics achievement and engagement. In particular, there is a positive relationship between behavioural engagement and affective engagement in physics achievement. A negative relationship was found between math achievement and cognitive engagement.

Rashid and Singh (2021) wrote a research paper on "Analysing physics achievement among students." The main objective of this study was to find out the physics achievement of public and private school students, and the researcher formulated the null hypothesis that there is no significant difference between the physics achievement of government and private school students. The researcher adopted the descriptive survey method to complete his research. The researcher selected a total of 200 students from Class IX using random sampling techniques. The researcher used the instrument developed by Sharma, S. S (2015) to collect the data. The collected data were analysed using descriptive and comparative analysis techniques, and it was determined that there is no significant difference in the physics achievement of public and private school students.

IIIlyas and Charles (2017) presented an article on "Interest in Physics and Academic Achievement of High School Students in the Chennai District." The main purpose of this article was to study the interest in Physics and the academic achievements of

secondary school students. Researchers used the survey method to complete their research. With the help of a stratified random sampling technique, 9 schools were selected from the Chennai district that included urban and rural schools. The researchers enrolled 300 students from 9 schools. The researcher used two types of tools to collect the data; one is an interest in Physics and the other is the Academic Achievement Inventory. There was a significant difference in the interests of secondary school students in Physics and in their management of higher education. There was no significant difference in interest and Physics achievement between male and female students, i.e., there was no difference between them on the basis of gender. There was no significant difference in Physics achievement between rural and urban school students.

Anjum (2015) wrote a research paper on "Gender differences in Physics Achievement and its relation with Reading comprehension of children at the upper primary stage." The main purpose of study the basis of gender in the Physics achievement of Western UP students. To study on the basis of gender in the reading comprehension of Western UP students. The researchers adopted descriptive research. Researcher included 307 students from four city of Western UP, Aligarh, Buland Shahar, Khurja and Jahagirabad out of which 147 boys and 160 girls were included in the study. Researcher used standard instruments Mathematics Achievement Test and Reading Comprehension Test developed for data. Using mean, SD, t-test and correlation statistical techniques to analyze the collected data, researcher concluded that there is a difference in Physics achievement between boys and girls at the upper primary school level. At the upper primary school level, there was a significant difference in reading comprehension between girls and boys, and there was a positive correlation between Physics achievement and reading comprehension.

2.6 Studies Related to ICT – Mediated Constructivist Approach

Kumari (2021) writes in her article that Constructivist Approach of communication is an emerging Approach of teaching and learning process which is basically student centric. This theory is based on the premise that students build their creation of knowledge and new information with the help of their previous knowledge, understanding, experience and mental perception. Today, in the modern age, ICT has become an important part of all aspects of life. ICT always provides a wide platform

for student self-learning. In this article, the researcher concludes that in the present era, ICT is affecting all aspects of life, including education. Learning style, learning environment, transfer of information and teaching methods are being promoted. The use of ICT facilitates the learning environment to be more active, collaborative, creative, and integrative and to evaluate. Constructivist Approach is a student-centred in which students actively involved in the creation of knowledge based on their mental cognition. Constructivist approach promotes students to be more active, critical thinking, decision-making, knowledge-seeking, and more. In this way, in the process of teaching and learning, it creates knowledge by making the students passive and active.

Kaur and Kaur (2022) examined the "Effect of constructivist approach on achievement in mathematics in relation to problem solving ability." Its main objectives were to compare the constructivist approach and the traditional methods taught to mathematics groups and to compare the problem-solving abilities of high and low-achieving groups of students. An experimental method was used to carry out this research. In this, math achievement is the dependent variable and problem-solving ability is the independent variable. The researcher made 12 lesson plans based on data on different math topics and constructivist ways of looking at them. used the tool developed by Dr. Kawaljit Kaur (2017) for testing mathematics knowledge and the tool developed by L.N. Dubey (2011) to test problem solving ability. The researcher used descriptive statistics, three-way analysis of variance (2×2), and F-test and t-test techniques for data analysis. His researcher analyzed the data and concluded that the achievement of students in mathematics taught by the constructivist approach was more effective than the traditional method and that there was no difference between a high and low-achieving group of students in problem-solving ability.

Manas (2020) write in his article that technology refers to the design and environment that engages the learner. The researcher based his study on two areas. The first concern is to promote constructivist learning in ICT in the classroom today and the second is the educational and professional development of the teachers especially for the implementation of constructivist approach in the classroom. Constructivist approach is student-centred learning and supports student participation. From which the student builds new information or creation with the help of his previous knowledge. Teachers are less hesitant to use ICT because they know that it helps them to design or instruct teaching methods that support their theoretical approach. The ICT and the constructivist

approach used better together and can effectively integrate technology tools into the classroom.

Majumder (2022) presented the research paper "Review of literature on Constructivist Approach." Their main objectives were to analyze the review of constructivist theory according to different strata and to understand the trend of constructivist theory. The documentary analysis method was used to carry out this research. The researcher reviewed a total of 56 papers for data collection in this study. The researcher concluded that a constructivist approach is a modern learning approach. It is a child-centred approach where students are actively involved in constructing information. Most research findings have indicated that the constructivist approach was more effective than any other approach. When compared to behavioural teaching, the constructivist approach worked just as well for boys and girls, and it helped teachers learn and get better at what they do.

Viquarunnisa (2019) writes in his article that ICT has affected the education system and every aspect of life, which has made teaching in the classroom easier and more effective. ICT has made an impact in the teaching and learning process and ICT is being used from primary education to higher education. The main objective of the researcher in this article was to find out the effect of ICT mediated Constructivist and accessibility approach through ICT on the success of secondary students of Hyderabad. The purpose of this research was to investigate whether ICT mediated constructivist approach or traditional methods of teaching improve achievement in science of students. This study's design, which included an experimental group and a control group, was based on pre and post testing. The control group received traditional instruction whereas the experimental group received ICT-mediated constructivist instruction. After that, post test of both groups was taken. The study concluded that students who were taught ICT mediated Constructivist teaching approach significantly improved their skills in science, knowledge, understanding, application and science skills.

Chand (2018) published an article entitled "Constructivism approach towards integration of ICT for collaborative learning." This article focused the point of Constructivist approach by integrating ICT for collaborative learning. The process of learning through constructivist approach builds new information by changing the mind from passive to active mind. ICTs provide learning opportunities in which learners

formulate their ideas, test and draw conclusions and convey their knowledge in a coherent learning environment. ICT provides collaborative learning techniques to help learners develop content knowledge, critical thinking, and problem solving skills. ICT-integrated tools facilitate collaborative learning opportunities in the constructivist approach.

The constructivist classroom environment promotes in social and communication skills. Students should express their ideas, communicate with others and participate in a socially acceptable manner. ICT integrated tools offer an unlimited gift, challenging human intelligence, imagination and a variety of learning initiatives. It will guide the student towards a better and higher standard of living.

Sandhu and Rani (2017) examined the "effect of constructivist approach on the academic achievement of an elementary school student." and had two main objectives. The first objective is to construct a constructivist approach to teach the concepts of Hindi grammar to seventh grade students and the second objective is to find out the effect of constructivist approach in elementary school students' Hindi learning. Researchers chosen experimental research to carry out his research. One is the control group and the other is the experimental group. The researcher selected 60 students from the seventh grade through Purposive Sampling in which he placed 30 students in the experimental group and another 30 students in the control group. The researcher first took pre-test of both the groups. The experimental group was then taught a lesson plan based on the constructivist approach and the control group was taught a lesson plan traditional method. Researchers then found that the Hindi achievement of the experimental group was significantly higher than the control group.

Adak (2017) published an essay on the "Effectiveness of constructivist approach on academic achievement in science at secondary level." The main purpose of study to find out the effect of constructivist theory on the traditional method for learning physical science of students and the second purpose was to find out the effect of constructivist theory on the traditional method for learning physical science in terms of students' intelligence. To compare the researcher adopted quasi-experimental pre-test, post-test control group design. The researcher selected a secondary school with a purposeful sampling technique to enable his research to be successful, which included 58 students. Out of these, two groups were formed, one experimental group and the

other control group. The research was limited to Bengali medium students, physical science and ninth grade. The researcher used two types of tools to collect the data, one is the project lesson based on 7E model and the other is Reven Progressive Matrices. The researcher analyzed the obtained data using ANOVA, t-test, SD, Mean statistical techniques. The researcher concluded from his research that no significant difference was found in the attainment of high, average and low intelligence students by constructivist theory on traditional teaching methods. Constructivist theory is an effective and efficient means of learning that has a significant impact on students' scientific achievement.

2.7 Studies Related to ICT Mediated Physics Teaching

Sarmah, et al. (2020) presented an article on "Role of ICT in teaching and learning Physics - An overview." The main purpose of which is to investigate the various roles of ICT in the teaching of Physics in the secondary classroom and to study the functions of tools as well as the skills of teachers and the effective use of ICT in the teaching of various subjects of Physics in the classroom. ICT is the ability to provide more interactive skills to enhance the mental and creative abilities of the users. The digital education system makes students more efficient and effective than the traditional education system. Digital technology is changing the way concepts are learned in school. The traditional chalk and talk method has adapted itself to interactive teaching and the rapidly evolving technology and change of ICT. ICT is an important tool in the modern education system. Therefore, proper use of ICT is essential to make the teaching process effective and efficient. The math classroom needs to be integrated with ICT and advanced planning. Proper ICT infrastructure is required and the result is an effective learning environment and maintaining what is being taught.

Pandey and Pandey (2020) writes in their essay that the use of Information and Communication Technology (ICT) has been widely acknowledged for decades. The impact of ICT is an interesting place in teaching that should be known in order to find the output. The main objective of researchers is to get an overview of the use of ICT in teaching and learning in India. Researchers collected data with the help of Internet, Institutional Library, Google and Google Scholar to complete his research. The study was limited to India. Researchers found in his study that the use of ICT in various research articles has shown a positive effect on the quality of education. ICT is more

prominent in urban areas than in rural areas. The researcher has studied the role of ICT in this article from secondary school to higher education. Based on the published data, it is observed that studies in the southern, eastern and northern zones of India use ICT more. In contrast, it is very rare in Central India. It has also been observed that the use of ICT in India among developing countries is less than in developed countries. Researchers conclude that there is a lack of such studies, so more studies are needed to know the global impact of ICT in the future.

Das (2019) studied the "Role of implementation of ICT tools in teaching Physics." Technologies (ICT) are now an essential component of daily life in the processes of teaching, learning, and communication. The science of mathematics is revered as the supreme discipline. For a very long period, Physics was used exclusively in academic settings. But the use of Physics nowadays is not just restricted to the academic world. It has entered the field of technology and industry. In this paper, the researcher seeks to emphasize the importance of integrating Information and Communication Technology (ICT) into the teaching and learning of teacher training college and school-level Physics. The researcher has used different methods and techniques, which includes secondary sources of communication, discourse, observation, and study, which collected its data through books, articles, dissertations, university news, expert opinions, and websites. The researcher found in his study that the integration of ICT in Physics education has a positive effect on both teaching and learning process. The researcher also found that there are barriers to the integration of ICT in the teaching and learning of Physics at the level of colleges and secondary schools.

Suparman, et al. (2019) presented an article on "The Use of ICT in Physics Learning." The main purpose of this article was to find out the potential of teachers in ICT field before and after training. In this study, Researchers has adopted non experimental pre-test / post-test design. Researchers selected 25 math teachers through Purposive Sampling. Researchers used the questionnaire to collect the data. To analyze the data obtained, the researcher used descriptive statistics and Wilcoxon rank sum test technique. Researchers analyzed the data and concluded that in the field of ICT, there is a difference in the abilities of teachers before and after training. After training teachers in the field of ICT, their ability improves.

Sharma (2022) gives immense importance to New Education Policy (NEP) 2020 and emphasizes the role of ICT as an effective tool in facilitating teacher education and encourages the utilization of technology platforms for online teacher training. ICT integration for pre-service teacher training programs plays a crucial to equip and prepare future teachers for the classroom. Teacher Education Institutes must create an environment for teachers to enable them to create an appropriate learning experience for teachers to enable them to create an appropriate learning experience for students in the new age of learning.

Usou and Joseph (2022) highlighted NEP 2020 and various provisions for ICT in teacher education and the present status of ICT usage in B.Ed colleges in Nagaland with some challenges for implementation. NEP 2020 were recommended the education policy which has broaden the horizon of India education system mainly focused on technological based education which will develop in students‘ inventive thinking, higher- order thinking and sound reasoning, effective communication, and high productivity.

Sharma (2021) examines the impact of ICT on teaching practices, perceptions of teachers about the use of technology in the classroom, and their professional development. Teachers' well-equipped preparation with ICT tools and facilities is one of the main factors in the success of technology-based teaching and learning. Although the perception of Indian teachers towards the use of ICT is positive, still need more support with the infrastructure and training especially in the rural regions.

Marong (2021) focused on integrating the use of ICT into teaching and learning in the teacher training program in the Gambia shows the integration of ICT and use is generally linked to traditional teaching approaches. Most of the barriers are due to the lack of available resources. ICT is not integrating properly in the teacher training program to making efficient use of technology in the classroom. The advantages of ICT depend on the learning approach used, the attitude, belief, and skills of the teacher, and the availability of teaching and learning support.

Devi (2021) in his work pointed out the increasing use of information and communication technologies (ICTs) has revolutionized the teaching-learning process in the 21st century. The use of ICT in education not only improves classroom teaching learning process, but also provides the facility of e-learning and distance learning to the

learners. Currently, a teacher is been teaching his students through the use of ICT even though they are geographically scattered. People are using ICT in every walk of life for their various purposes and also from higher educational books to online courses that all are beneficial for the learners in 21st century.

Niroula (2021) investigates the role of ICT in educational development during the COVID-19 pandemic in three zones of Nepal. Teachers who were not fully equipped with ICT knowledge and the skills required to teach online, had to go through the learning process quickly in order to teach their students, especially in inaccessible areas of the given zones. Using the mixed methods approach and analyzed 64 high school teachers‘ responses and finds that teachers‘ using ICT tools in such remote areas indicates that teachers had to go through intensive learning during the pandemic.

Murithi and Yoo (2021) investigated the availability of ICT facilities; teacher capacity to integrate technology into their lessons; and teacher perceptions towards technology in schools. The study is premised on the constructivist learning theory and the Technology Acceptance Model. A total of 351 teachers completed an online questionnaire. Teachers perceived that ICT facilities were inadequate in schools, which presented a challenge in the integration of technology during the implementation of the new curriculum. Most of the teachers answered that they received only basic computer literacy training.

Alghamdi et al. (2020) found in their study that work on online and face-to-face classroom multitasking and academic performance in the classroom has been demonstrated to have a negative impact on students' academic performance in studies. The indirect impacts of multitasking on academic achievement Grade Point Average (GPA) in males and females were explored using self-efficacy for self-regulated learning (SESRL), by gender. University students were given SESRL and measures of multitasking behaviors in both online and traditional, face-to-face format courses. Female students with higher levels of SESRL experience a limited impact of online multitasking on GPA, resulting in better academic performance.

Mahdy (2020) in his cross-sectional investigated how COVID-19 lockdown affected the academic performance of veteran medical students and researchers. The study revealed that COVID-19 pandemic lockdown had varied degrees of impact on the academic achievement of the majority of participants. Although, online education

allows for self-study but the fundamental problem that online education faces in the field of veterinary medicine is how to deliver practical courses because most of the subjects are practical, learning them online is difficult and students believe that completing veterinary competencies only through an online education system is challenging.

CHAPTER 3

RESEARCH METHODOLOGY

3.1 Introduction

This chapter expounds the methods employed to conduct this study and provides discussions on research design; population, sample size, and sampling methods, research tools, data-gathering procedure, data analysis, and consideration of ethics.

3.2 Research Design

The Quasi-Experimental research design (non-equivalent pre-test post-test control group design) present study was carried out through to compare the effect of ICT Mediated teaching on the academic achievement of Class 9th students in Physics. The reason for adoption of such design is based on the fact that intact classes were randomly assigned as experimental and control groups, respectively, as complete randomization of subjects was impossible. The experimental group experienced ICT Mediated teaching while the control group received instructions through traditional method of teaching. Both groups were assessed before (pre-test) and after (post-test) the treatment was given to the experimental group.

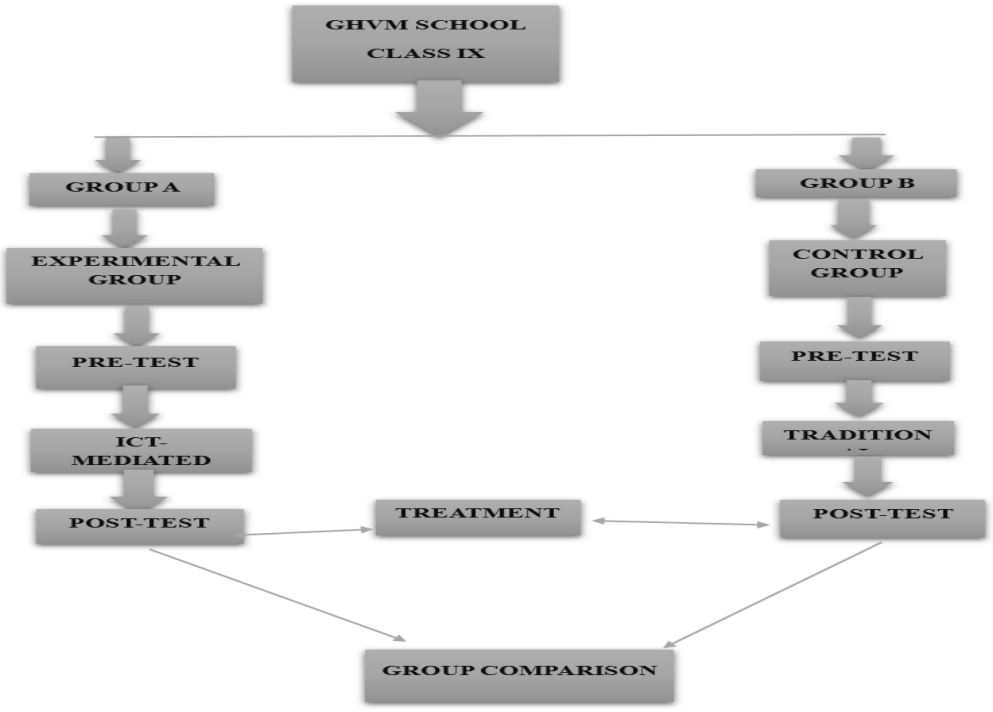

Fig. 3.1 Conceptual framework of the research

3.3 Population

The target population for this study comprises all Class 9th students studying physics in Senior Secondary Schools within Jharsuguda district, Odisha.

3.4 Sample

Class 9th students of GHVM Senior Secondary School, Jharsuguda district, Odisha.

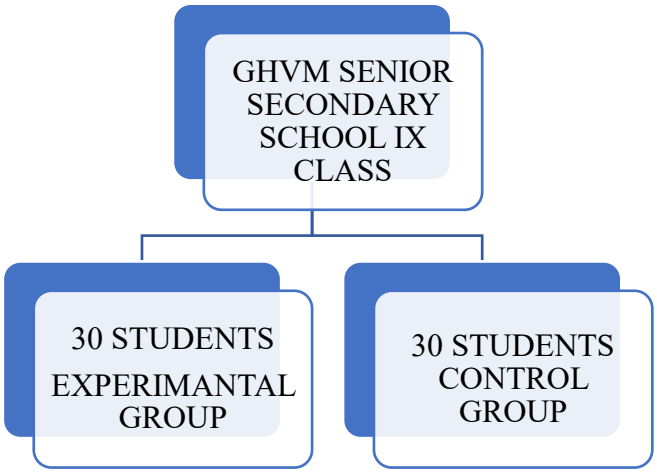

Fig. 3.2 Numbers of students in experimental and control group

3.5 Variables

Variables simply constitute the periphery in research. They are entities that take on different values. The dependent variable is the factor being measured so that the effect of the independent variable can be determined. In other words, what is being studied in a particular research endeavour is the dependent variable. It bestows on a researcher their predictions. Hence in this study, the ICT Mediated Teaching and traditional teaching is an independent variable and the dependent variable is academic achievement in Physics.

3.6 Research Methodology

For the present research, three tools and teaching models were developed and then adopted earlier in the quasi experimental process of the present study, which later formed the bases for the collection of data from students involved in the research. The detailed elaboration is as follows in two steps

1. Developmental Phase

The current phase encompasses the development of constructivist-based teaching materials using the 5E model. Two types of a Physics Achievement Tests were prepared namely; PAT - 1 (Pre-test) and PAT – 2 (Post-test)

2. Implementation Phase

In this phase, researcher conduct PAT – 1 on both the groups. Then, researcher teaches using ICT Mediated lesson plan to experimental group and traditional lesson plan to control group. After completion of chapter researcher conducts PAT – 2 for both groups and result is analyzed.

3.7 Tools of the Study

Two kinds of tools had been used in the study:

1. Instructional Tool
2. Assessment Tool

3.7.1 Instructional Tools

Teaching tools were utilized for the experimental and control groups. A lesson plan was developed considering the ICT-mediated constructivist approach for the experimental group and the other traditional methods for the control group. Materials have been selected from Ninth Grade Physics Book of N.C.E.R.T. Work and Energy topic was selected and 5 lessons plan of each for both the group were developed.

- Lesson Plan based ICT- mediated Constructivist Approach
- Lesson Plan based Traditional Approach

3.7.2 Instructional Materials for ICT Mediated Teaching

The present study aims to investigate the effects of ICT-mediated teaching on the students' academic achievement in Physics. Hence, teaching materials were developed following the ICT-based constructivist approach that would be tested in the classroom and had passed through the following steps.

- Selection of content
- Content analysis
- Stating instructional objectives

3.7.3 ICT Mediated Lesson Plan

The researcher chose the 5E model from constructivist approach as a basis for teaching the experimental group and then created a lesson plan with this model. The researcher finished the lesson plan by including ICT in it. ICT involved in the lesson plan were PowerPoint, projector, projection screen, laptop, photo, animated video etc.

3.7.4 Assessment Tools

Assessment tools assessed students' Physics achievements and tested previous knowledge which are as follows :

- Physics Achievement Test for Pre-Test
- Physics Achievement Test for Post-Test

3.7.5 Physics Achievement Test

The researchers selected the 'questionnaire' as the instrument used for gathering the responses of the students regarding their academic success in Physics due to ICT Mediated teaching.

The formulation of Questionnaire include:

a) Selection of Questions
b) Formation of Questions
c) Try-out Questionnaire
d) Item Analysis
e) Final Draft of Questionnaire

The questionnaire consists of 16 items. The set of questions are divided into three parts

a) Ten multiple-choses index items were counted on one item for each correct response and scored at 1 whereas for incorrect responses they were scored at 0.
b) Short Answer Question 5 involves scoring of correct responses by giving 2 points while incorrect responses are scored 0.
c) Long-answer questions are those items that scored responses correctly on the questionnaire and were given a 5 as the score for such a response. Misleading responses on the questionnaire scored 0.

3.7.6 Statistical Techniques

1. Mean
2. Standard Deviation
3. T-test

CHAPTER 4

ANALYSIS OF DATA AND INTERPRETATIONS OF THE RESULT

4.1 Introduction

In the previous chapter, the researcher defined the appropriate methodology and sample of the study. The researcher prepared the appropriate tool for data collection and determined the scoring criteria for the tool.

In this chapter, the appropriate statistical tools have been used to analyse the data collected from the student through the questionnaire, such as sum, mean and t-test and the results obtained thereby have been interpreted.

4.2 Testing of Hypotheses

4.2.1 Hypothesis 1

$H_0$1 : There is no significant difference between the mean scores of pre-test of the experimental and control groups in the academic achievement test of Physics.

Table 4.1 : Independent Samples t-test for control and experimental group (Pre-test)

Group	N	Mean	SD	Df	P	t-cal	t-crit	Interpretation	Decision
Control	30	8.33	3.13					Not	$H_0$1
Experimental	30	9.43	3.61	58	0.18	1.25	1.67	Significant	Accepted

Note: Df = Degree of Freedom, t-cal = t-calculated, t-crit = t-critical, SD = Standard Deviation

Table 4.1 reveals the outcome of the analysis of the pre-test scores of the learners who underwent ICT - Mediated learning and the traditional approach to teaching. In the control group, the mean and standard deviation were M = 8.333, SD = 3.133, whereas in the experimental group, they were M = 9.4333, SD = 3.616. From the table, it is also evident that no statistically significant difference exists between the pre-test scores of the two groups of learners. At the 0.05 level of significance, the calculated t-value (1.259) is less than the critical t-value (1.671). In addition, the p-value (0.181) is greater

than the 0.05 level of significance. Hence, $H_0$1 receives support, implying that there was no significant difference between the two groups, meaning that both experimental and control groups were equal before the start of the treatment, coming from the same class.

4.2.2 Hypothesis 2

$H_0$2 : There is no significant difference in the academic achievement of students taught through ICT-mediated in Physics.

Table 4.2 Paired sample t-test for experimental group (Pre-Test and Post Test)

Test	N	Mean	SD	Df	P	t-cal	t-crit	Interpretation	Decision
Pre test	30	9.43	3.61	29	0.00	23.42	1.69	Significant	$H_0$2 not Accepted
Post test		17.96	3.99						

Note: Df = Degree of Freedom, t-cal = t-calculated, t-crit = t-critical, SD = Standard Deviation

Table 4.2 describes the comparative study of learner outcomes of the pre-test and post-test scores of the experimental group undertaking a ICT – Mediated teaching. According to the table, there is a significant difference between the pre-test (M=9.433, SD= 3.616) and post-test results (M= 17.966, SD= 3.995) of the students exposed to ICT – Mediated learning. From the output result, it is clear that learner test results in the pre-test and post-test scored highly significant difference for those exposed to the game-based instructional method. The p-value of 0.0000 is less than the 0.05 level of significance. Furthermore, a t-test analysis also confirmed that the computed value of the t-statistic (23.423) is greater than the critical t-value (1.699). Hence, the null hypothesis $H_0$2, which states that there is no significant difference in the pre-test and post-test scores of the experimental group, is rejected. This implies that students can get better marks when ICT - Mediated strategy is at work.

4.2.3 Hypothesis 3

$H_0$3 : There is no significant difference between the mean academic achievement scores of students taught using ICT-mediated instruction and those taught using traditional teaching methods in Physics.

Table 4.3 Independent Samples t-test for Post-test of control and experimental group

Group	N	Mean	SD	Df	P	t-cal	t-crit	Interpretation	Decision
Control	30	14.5	3.84						$H_0$3 not
Experimental	30	17.96	3.99	58	0.00	3.42	1.67	Significant	Accepted

Note: Df = Degree of Freedom, t-cal = t-calculated, t-crit = t-critical, SD = Standard Deviation

Table 4.3 shows the results of an independent t-test, where the variance is assumed to be unequal, to compare the overall mean score of the experimental and control group concerning the post-test. In the control group, the mean and standard deviation were 14.5 & 3.848, while those of the experimental group were 17.96 & 3.995. In Table 4.3, at the 0.05 level of significance, the t-calculated value 3.42 is greater than the t-critical value of 1.671. Since the computed p-value 0.0014 is less than the 0.05 level of significance, there is a significant difference in the post-test scores of the students of both groups. $H_0$3 was thus rejected. This outcome underpinned that the difference does exist between the achievement of students exposed to the ICT – Mediated teaching strategy and those taught through the traditional method. In another way, the experimental group outscored significantly the control group.

CHAPTER 5

FINDINGS, IMPLICATIONS, SUGGESTIONS AND CONCLUSION

5.1 Major Findings of the Study

- Students who received ICT-mediated teaching (using videos and PowerPoint presentations) showed significantly higher academic achievement as compared to those taught using traditional methods of teaching. Post-test scores of the experimental group were consistently higher, indicating better conceptual understanding through ICT-mediated teaching .
- ICT tools such as animations and simulations helped students grasp abstract Physics concepts (e.g., work, energy, force) more effectively. Thus, reducing misconceptions regarding many important abstract concepts.
- The positive impact of ICT-mediated teaching was observed across all students' ability levels—high, average, and low achievers—with notable gains among lower-performing students who benefited from self-paced and visual learning support.
- The study outcomes align with the educational objectives outlined in NEP 2020 and NCF-SE 2023, which promote the use of technology to foster inquiry-based and competency-driven science education.
- The use of ICT mediated teaching showed significant difference in learning outcomes among the students, indicating that ICT tools are effective.

5.2 Conclusion of the Study

Based on the findings presented and discussed, the researcher made the following conclusions:

- The findings of this study clearly demonstrate that ICT-mediated teaching has a positive and significant effect on the academic achievement of Class 9th students in Physics. The use of digital tools such as simulations, animations, and interactive presentations not only enhanced students' conceptual understanding but also increased their engagement, motivation, and overall interest in learning physics. Compared to traditional teaching methods, ICT integration provided a

more student-cantered and visually enriched learning experience that catered to diverse learning styles and needs.

- ❖ The pre-test scores of both the groups were not significantly different, but post-test results, however, sited a wide margin with the treatment group performing better. It means the experimental group showed better performance in academic achievement as compared to the control group. The result therefore shows the efficacy of ICT – Mediated teaching in enhancing better performance in Physics among students.
- ❖ There is a significant difference between the mean academic achievement scores of the control and experimental groups during pre- and post-tests, thereby proving the effect their respective teaching methods.

5.3 Educational Implications

5.3.1 For Teachers

- ✓ Teachers should integrate ICT tools such as simulations, video lessons, and interactive presentations into Physics to make abstract concepts more concrete and engaging.
- ✓ The findings highlighted the importance of continuous training of teachers in the effective use of digital resources, software, and virtual labs to enhance teaching quality.
- ✓ ICT mediated teaching methods encourages teachers to move from lecture-based instruction to more interactive, student-cantered strategies that promote inquiry, exploration, and problem-solving.
- ✓ ICT mediated teaching provides platforms for quick formative assessments, data tracking, and personalized feedback, helping teachers better understand students' learning needs.
- ✓ Teachers can enhance the Physics curriculum by incorporating real-life applications, virtual experiments, and multimedia content aligned with NEP 2020 and NCF-SE 2023.

5.3.2 For Students

- ✓ ICT-mediated learning helps students visualize and interact with complex Physics concepts, leading to deeper understanding and higher academic performance.
- ✓ The use of multimedia content and interactive tools makes Physics more interesting, encouraging with active participation and reducing fear or disinterest in the subject.
- ✓ Exposure to ICT tools helps students acquire essential digital skills that are critical for future academic and career opportunities in a technology-driven world.
- ✓ ICT mediated teaching allows students to learn at their own pace, revisit content, and receive differentiated instruction, supporting both advanced learners and those needing remediation.
- ✓ Through repeated exposure and interactive learning, students retain concepts longer and perform better in assessments, especially when traditional methods fall short.

5.4 Suggestions for Further Research

- Future studies could be conducted across different states or regions to examine whether the effectiveness of ICT-mediated teaching varies based on demographic, socio-economic, or infrastructural factors.
- Similar research can be extended to other science subjects (such as Chemistry or Biology) or different grade levels (e.g., Classes 8 or 10) to explore the broader impact of ICT in science education.
- Researchers may conduct long-term studies to assess the sustained impact of ICT-mediated teaching on students' academic performance, interest, and conceptual retention over time.
- Comparative studies can be undertaken to evaluate the relative effectiveness of different ICT tools—such as simulations, virtual labs, AR/VR, or educational apps—in enhancing learning outcomes in physics.
- Further research could investigate how ICT-mediated teaching influences higher-order thinking skills, such as problem-solving, reasoning, and scientific inquiry among students.

- Studies focusing on teachers' readiness, attitudes, and competence in using ICT tools effectively can provide valuable insights into professional development needs.
- Investigating the challenges and barriers (e.g., infrastructure, access, training) in ICT implementation can help policymakers and educators develop targeted interventions.
- Future research could explore the impact of blended learning models (combining ICT with traditional methods) on academic achievement and engagement in physics education.
- Studies may also focus on how ICT tools can be tailored to support inclusive education, especially for students with special needs or learning disabilities in science classrooms.

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APPENDIX 1

PAT - 1

PRE – TEST QUESTIONS

Please fill the following personal details: Date:

Name _____

Age_____ Gender: Male ☐ Female ☐

Class _____ School_____

Total marks : 25 Time : 1 hour

Section A: Multiple Choice Questions (10 marks)

Choose the correct option for each question. Each question carries 1 marks.

1. What is the SI unit of work?
   a) Joule
   b) Watt
   c) Newton
   d) Pascal
2. If a force acts on a body and the body moves in the direction of the force, the work done by the force is:
   a) Positive
   b) Zero
   c) Negative
   d) Cannot be determined
3. The work done to lift an object of mass 5 kg to a height of 2 meters is:
   a) 10 Joules
   b) 20 Joules
   c) 50 Joules
   d) 100 Joules

4. Which of the following energy forms is associated with motion?
   a) Kinetic energy
   b) Potential energy
   c) Chemical energy
   d) Thermal energy

5. If an object's velocity is doubled, the kinetic energy:
   a) Increases by a factor of 2
   b) Increases by a factor of 4
   c) Decreases by a factor of 2
   d) Remains constant
6. What is the SI unit of work?
   a) Watt
   b) Joule
   c) Newton
   d) Meter
7. Which of the following is NOT a form of energy?
   a) Kinetic energy
   b) Potential energy
   c) Work done
   d) Force
8. Which of the following is the formula for calculating kinetic energy?
   a) $KE=\frac{1}{2}mv^2$
   b) KE=mgh
   c) KE=F x d
   d) $KE=\frac{1}{2}m$
9. If no work is done on an object, its kinetic energy cannot change. (True/False)
10. Work is done when the force and the displacement are in the same direction. (True/False)

Section B: Short Answer Questions (10 marks)

Answer the following questions. Each question carries 2 marks.

11. What is the difference between work and energy? Explain with examples.

12. A person pushes a car with a constant force of 100 N for 10 meters in the direction of the force. How much work is done by the person?

13. Define work done.

14. What is the relationship between force, displacement, and work?

15. What is the difference between kinetic energy and potential energy? Give one example of each in real life.

Section C: Long Answer Questions (5 marks)

16. A ball of mass 0.5 kg is dropped from a height of 5 meters. Calculate:

a) The potential energy of the ball before it is dropped.

b) The kinetic energy of the ball just before it hits the ground.

(Use $g = 9.8\ m/s^2$)

APPENDIX 2

PAT - 2

POST – TEST QUESTIONS

Please fill the following personal details: Date:

Name _____

Age_____ Gender: Male ☐ Female ☐

Class _____ School_____

Total marks : 25 Time : 1 hour

Section A: Multiple Choice Questions (10 marks)

Choose the correct option for each question. Each question carries 2 marks.

1. Which of the following is the SI unit of energy?
   a) Newton
   b) Watt
   c) Joule
   d) Meter

2. What happens to the potential energy of an object as it is raised to a greater height?
   a) It decreases
   b) It stays the same
   c) It increases
   d) It becomes kinetic energy

3. A 5 kg object moves with a velocity of 3 m/s. What is the kinetic energy of the object?
   a) 7.5 J
   b) 15 J
   c) 22.5 J
   d) 30 J

4. The work-energy theorem states that the work done on an object is equal to:
   a) Its change in potential energy
   b) It’s change in kinetic energy
   c) Its change in momentum
   d) The force applied

5. The energy stored in a stretched spring is known as:
   a) Gravitational potential energy
   b) Kinetic energy
   c) Elastic potential energy
   d) Chemical energy

6. If a force of 10 N acts on an object for a distance of 5 meters, the work done is:
   a) 50 J
   b) 5 J
   c) 15 J
   d) 25 J

7. What is the SI unit of power?
   a) Newton
   b) Joule
   c) Watt
   d) Pascal

8. A machine has an efficiency of 80%. This means that:
   a) 80% of the input energy is converted to useful work
   b) 80% of the input energy is lost
   c) 80% of the output energy is wasted
   d) The input energy is equal to output energy

9. If the velocity of an object is doubled, its kinetic energy becomes:
   a) Half
   b) Double
   c) Four times
   d) Unchanged

10. Which of the following is an example of energy conversion?
    a) A car moving on a flat road
    b) A battery supplying energy to a fan
    c) A person climbing stairs
    d) A light bulb producing light from electrical energy

Section B: Short Answer Questions (10 marks)

Answer the following questions. Each question carries 2 marks

11. What is the difference between work done and power?
12. A car of mass 1500 kg is moving at a speed of 30 m/s. Calculate its kinetic energy.
13. A 100 kg object is lifted 10 meters vertically. Calculate the work done against gravity.
14. Define mechanical energy and explain how it is conserved in an ideal system.
15. A spring with a spring constant of 500 N/m is compressed by 0.2 meters. What is the potential energy stored in the spring?

Section C: Long Answer Questions (5 marks)

16. A spring has a spring constant of 300 N/m. If it is compressed by 0.5 meters, calculate the potential energy stored in the spring.