A study on the status of usage of Information and Communication Technology (ICT) by the Biology Teachers of Vadodara city in teaching Biology during covid-19 Pandemic

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Guide **Researcher**

Dr . Deepika Rajawat **Kalyani Joshi**

Center of Advanced Study in Education (CASE)
Department of Education
Faculty of Education and Psychology
The Maharaja Sayajirao University of Baroda
Vadodara -390002 , Gujarat , India .

DECLARATION

I , Kalyani Joshi hereby declare that the Dissertation study titled "**A study on the usage of Information and Communication Technology (ICT) by the Biology Teacher of Vadodara city in teaching of Biology"** is my original research work and no whole or partial part in dissertation has been taken from anywhere . Wherever contributions of others are involved , every effort is made to indicate this clearly with due reference to the literature , acknowledgement of collaborative research and discussions . The work was done under the guidance of Dr. Deepika Rajawat.

Kalyani Joshi

Investigator

CERTIFICATE

It is Certified that , the dissertation entitled **" A study on the usage of Information and Communication Technology (ICT) by the Biology Teacher of Vadodara city in teaching of Biology"** Which is being submitted by **Kalyani Joshi** for the degree of Master of Education , Faculty of Education and Psychology , The Maharaja Sayajirao University of Baroda , Vadodara , Gujarat , is carried out by her under my supervision and guidance . I Certified that this is her original work for the submission and evaluation .

(Dr. Deepika Rajawat)
Guiding Teacher

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CHAPTER 1

CONCEPTUAL

1.0 INTRODUCTION

According to **Mahatma Gandhi,(1937) "By Education, I mean an all-round drawing out the best in child and man body , mind and spirit"** Education is a dynamic force in the life of every individual influencing physical , mental , emotional , social and ethical development .

We are living in the 21st century, which encompasses the Information Age - an era marked by rapid adoption of new technologies **(Holland,**

2015). Many new technologies, Information and Communication Technology (ICT henceforth) being the forerunner, have influenced the way we live, communicate, socialize, learn or educate. Introduction of ICT in almost all the sectors of our lives has created a new global economy that is powered by technology, fueled by information and driven by knowledge **(US Department of Labour, 1999).** Advent of the knowledge economy and global economic competition compel governments to prioritize educational quality, lifelong learning and the provision of educational opportunities for all. It is widely accepted that access to ICT in education can help individuals to compete in a global economy by creating a skilled work force and facilitating social mobility **(Wallet & Melgar, 2014)**

1.1 ICT in education

Technological Education is an area introduced in the study of education that focuses its analysis on the human being and its relationship with the artificial world. A new vision of the world that tries to answer the problems from the point of view of technology, giving solutions and proposing answers.

It is in the educational context when the community is positioned in the perspective that technology is a way of thinking and changing reality, in a more or less right way. For this reason, if we bet that technology education can intervene in our own culture we can achieve that all this favors the welfare of the community.

In short, if you use technological education as a teaching-learning methodology it is possible to give way to a full integration between theory and practice. This gives the possibility of a greater understanding of reality, since it is the union of theory and practice that is the main function of this technological revolution in education.

1.2 Characteristics of ICT applied to education

From the first moment we talk about ICT we must keep in mind what they are and what their characteristics are, once you know their usefulness will be very beneficial to use in any teaching-learning context.

To talk about ICT as the tools that help to teach, it is necessary to mention fourteen of its main characteristics, since they are benefits to use in the classroom of this new form of teaching that brings the 21st century:

1- They are used from anywhere

If something has to stand out as a priority of ICT is the possibility of maintaining a continuous and direct contact with students. The advantage that the student can connect to teaching from anywhere in the world, with the appropriate means to do so, facilitates learning, making it attractive.

For example, when the holiday periods begin, the child usually switches off during the time he does not come to the classroom. This disconnection, only subject to some exercise or list of tasks that must comply, gives way to oversight and a longer time of adaptation upon return.

If the student continues in connection through online platforms, blogs or e-mail, among others; The teacher or the teacher can send these exercises in a more leisurely way and the student will be able to receive answers to his doubts in a faster way as well as practice.

2- Union of culture, science and technology

ICT is the union of beliefs, customs and all those habits that society has adopted as routine.

On the one hand, talking about culture is about the everyday routine of society, about the benefits that technology brings to the whole community.

On the other hand, it encompasses science, as it is also responsible for giving answers to the human being of what happens in the world. It is the curiosity to learn that leads man to carry out scientific research to respond to his concerns, producing the Scientific knowledge.

And finally, the technique is responsible for responding to the need for transformation that man requires to meet his needs. It is the process that is carried out to create the necessary mechanism to alleviate the need and, after analyzing it from the scientific field, has been analyzed from a theoretical perspective, such as the creation of services.

Therefore, it is an activity characterized as creative that requires innovations that have not been created previously.

3- It is a mobilizing teaching

Teaching through ICT gives the possibility that the student can move in different contexts and different realities. In this way we choose a quality teaching in which the student can interact with the world and can face different situations.

For example, before subjects such as geography, the student will be able to contemplate images and videos of geographic features that he has never seen before. In this way, visualizing the content, making it more practical, is given the motivation that it needs.

4- It is based on other scientific aspects

ICTs applied to education are enriched by other scientific aspects, such as the pedagogical sciences, through innovations in teaching-learning methodologies; Of the psychology of the learning, showing special attention to the stimulus-answer; Of sociology, of anthropology and of philosophy.

5- Focuses on objectives

Teaching through ICT is based on keeping in mind, at all times, the objectives. Achieving the proposed goals is essential and, therefore, we are faced with a flexible working methodology.

For example, situations are commonly encountered in ordinary classrooms in which teachers, because of the need for the whole group to

carry out a temporary planning, move quickly, leaving behind students who do not carry the same pace.

Through the use of ICT the teaching is individualized, giving the student the possibility to advance and complete the levels once he has acquired the knowledge, regardless of the pace of his peers. For there is a possibility that you can repeat the activities or receive adapted exercises.

6- It is an excellent channel of communication

Another advantage of ICT is the promotion of communication. The use of new technologies favors the communication that the teaching - learning process needs.

For example, there is the possibility that the teacher can maintain daily and fast contact with the family. In addition to answering questions that the students raised when they left the classroom.

7- It is changeable

As time goes by, the world is changing and new technologies are also changing. Therefore, it adapts to the changes of the context itself and of education, based on the sciences that support them.

8- Possibility of interacting

The new technologies give the possibility to the student to interact with the world; Especially with the teacher and with their own peers.

Therefore, it is not simply a review and an understanding of the messages or symbols that are sent. ICTs give the possibility of using auditory and audiovisual resources to promote the attractiveness and ease in which the student acquires the knowledge.

9- Use different channels

The use of different channels of representation will give the possibility of faster learning through expression and communication using cognitive, motor and affective development.

For example, the possibility of obtaining the same information through reading, videos, music and images; Complement the traditional reading and images of the classic textbooks, since it gives the possibility to reinforce the information through other channels.

10- Power the intellectual abilities

ICTs develop the intellectual skills of children, betting on a fun and dynamic training. For this reason, the psychology of learning through the interaction between the stimulus and the response acts with the creation of levels that the student can acquire as he or she learns.

For example, before a grammar exercise, the student will be able to go to solving exercises where he receives scores and will go up in level. The novel"Gamification"will involve the child to keep him in the game while learning.

11- It is a channel of communication

They are a channel of communication because they are also feasible to convey feelings, opinions and ideas to the world. In addition to keeping the information intact, as this is recorded through the writing and the audiovisual channel.

For example, there is the possibility of using ICT so that the student can give opinions to tasks that are proposed to him. These will be registered and can be observed by the other classmates, in addition to the teacher can use this information in class or keep it as privacy data.

12- Reduced storage space

ICT has the possibility that all storage is online, so the space occupied is immaterial. Therefore, it is easier to be moved from one place to another, since it should not be moved in any heavy way.

For example, through the internet connection, the student can access the video that has been seen in the classroom and can carry out the proposed activity by sending it by email.

13- Compatibility

It is compatible with other teaching aids traditionally used in classrooms, such as the use of blackboards.

Electronic whiteboards are the most innovative material of the school in the 21st century, because it mixes all the elements that a tool must contain in the classroom, not forgetting the traditional, it also includes technological advances.

14- Feedback

The new technologies give the possibility of a feedback between students and teachers, in this way, from any place the student can receive answers to their doubts and qualifications of their tasks, quickly, without having to go to the classroom for it.

For example, before an objective test, type test, which is carried out as a self-assessment, students can respond and get the grade of this one at the time. In addition, you can also obtain information about this note and send to the teacher the question that you consider necessary to do at that moment.

1.3 Need for Integrated ICT in teaching learning process

- To use ICT tools for designing new learning environments for their own subject specific purpose to help their future students to use ICT.
- To provide the knowledge , skill and attitudes to better use of Technology in their research , communication , problem solving and continuing professional development .
- To critically apply the pedagogical principle of ICT integration in science education .

- To develop and facilitate ICT based learning activities in the context of teaching biology .
- To analyse and evaluate appropriate content and context for the use of ICT in biology teaching .
- To use ICT efficiently in research , problem solving , and project based learning in biology .
- To integrate ICT appropriately into Biology curriculum activities that will foster students ownership of their ICT -rich learning environment .

1.4 Role of Teachers to implement ICT in Teaching Learning process

Teachers play a crucial role in the adoption and implementation of new technologies in education. Their perceptions are an important aspect that influences their adoption of ICT in teaching and learning **(Zhu, 2010),** because teachers' educational beliefs are closely linked to their actual use of ICT in classrooms **(Dwyer, Ringstaff, & Sandholtz, 1991) (Tondeur, Valcke, & Van Braak, 2008).** The quality of teachers and their continuing professional education and training remain central to the achievement of quality education **(Ministry of Education GoB, 2013).** Understanding this fact, GoB regularly arranges teachers' training on ICT **(Mamataz, 2017) (PMID, 2013)**. Moreover, Digital Content Development has also been undertaken so that all teachers can collect subject based contents from a single source, for which an official web portal named ShikkhokBatayon **(www.teachers.gov.bd)** has been opened **(Mamataz, 2017) (Ministry of Education GoB, 2013) (PMID, 2013)**

1.5 Basic concept of biology

Biology is the scientific study of life. It is a natural science with a broad scope but has several unifying themes that tie it together as a single, coherent field. For instance, all living organisms are made up of cells that process hereditary information encoded in genes, which can be transmitted to future generations. Another major theme is evolution, which explains the unity and diversity of life. Finally, all living organisms require energy to move, grow, and reproduce, as well as to regulate their own internal environment.

Biologists are able to study life at multiple levels of organization.From the molecular biology of a cell to the anatomy and physiology of plants and animals, and evolution of populations. Hence, there are multiple sub disciplines within biology, each defined by the nature of their research questions and the tools that they used.Like other scientists, biologists use the scientific method to make observations, pose questions, generate hypotheses, and perform experiments to satisfy their curiosity about the world around them.

1.5.1 Teaching of Biology through ICT

As biology includes complex relationships of unfamiliar and abstract concepts, it is quite difficult to learn and teach. Students often experience difficulty in understanding certain biological subjects and try to learn them via memorization without understanding (Kilic & Salam, 2004). But the use of ICT can help understanding a difficult subject easily. The learning becomes interesting and lively through using multimedia equipment in the classroom through active participation of learners in the learning process (PMID, 2013). It is especially important in biology as computers can present the information visually through well-prepared pictures, three-dimensional models, animations, interactive environments etc (Wang Q. , 2017).

1.5.2 Role of ICT in biology Teaching

ICT simplifies the part of teaching as a visual presentation . a visual presentation of a particular topic could be easily understood by the student teacher , it will be more effective if the student teacher gains the knowledge of integrating ICT in their classroom instruction . Teaching through ICT in higher secondary level can deliver information in a very easy manner .Teaching of biology through ICT makes visual presentations which enhance subjects interest of students . There are different advantages of ICT :

- Eliminate time barrier in Education for learner as well as teacher .
- Eliminate geographical barriers as learners can log on from any place .

- Asynchronous interaction is made possible leading to thoughtful and creative interaction .
- Enhanced group collaboration made possible via ICT
- New Education approach can be applied .
- It can also be used for non formal education like health campaigns and literacy campaigns .

1.5.3 Technology in Biology classroom

There are various types of technologies currently used in traditional Biology classrooms ;

- **Computer in classroom :** Computer is a device that improves the teaching learning process easier . It is an essential tool for integrating ICT in the classroom . Here teachers are able to demonstrate new lessons , illustrate and show new websites .
- **Interactive Whiteboard :** An interactive whiteboard has given the opportunity to touch control of computer applications . This enhances teaching learning experience in the classroom . This is not only aids for visual learning , it is also interactive and students can draw , write , and manipulate images .
- **Digital games :** Games like Educational games have been growing significantly . The digital games are being provided as tools for the classroom and have given positive feedback I.e motivation for students .
- **Digital video :** LCD projector like equipment to make our teaching learning process as proper as possible . DVD players also help us instead of LCD projector .

- **Podcasts :** Podcast is a relatively new invention that allows anybody to publish files to the internet where individuals can subscribe and receive new files from the people by a subscription .

1.5.4 Criteria for implementation of ICT in Teaching biology

Some of the students felt that Biology was a tough subject , because of the theory part . Learning of Biology can be made easier and more comfortable by integrating ICT tools in instructional strategies for teaching biology . For this , teacher education programmes should give more emphasis on ICT training for the student teacher to apply ICT in their instruction . The curriculum of the teacher education programme should be revised by incorporating innovative technological equipment for the dissemination of knowledge . Integrated ICT pedagogy will lead to quality higher education . The process of teaching -learning process should be modified according to the needs of changing technology enabled education ICT directly improve quality of Education and indirectly improve economy of the country . ICT is the best way to convey information to the students in biology , because of the easy understanding and attractive experience to the students . ICT can change the traditional classroom into a smart classroom . So , ICT integrated

instruction is the best way to improve the quality of learning in higher education .

1.6 History of ICT used in Teaching Learning process :

In the last two decades “industrial society” turned into “Informative Society” due to the digital revolution. Information and Communication Technology (ICT) are having profound impact on Education. For implementation of ICT there are various thinkers, educators, and researcher have taken up the challenge of implementation of ICT science 1980s and get varied success. The internet was born in 1973 when Vint cerf developed TCP/IP protocol. In 1989 Robert Cailliau **(Gillies, J. & Cailliau, R., 2001)** and Tim Berners-Lee at CERN in Switzerland put forward a proposal for the management of documents using computers. Management at CERN received the proposal as ‘vague but exciting **(Gillies, 2001, p. 181).** Cailliau and Berners-Lee envisaged a service that could share files, documents, information, dialogue, graphics, sound files and more. They called this service the World Wide Web (WWW). Networking using the WWW continued frantically until in 2001 the dot com crash rationalised the services that could be provided and consolidated the first round of the WWW for the provision of information globally.

The initial stages of the WWW from 1990 to 2001 provided the capacity for an information service. Schools, training colleges and universities developed websites as part of the proliferation of information accessible globally. The websites were institutionally focussed and somewhat akin to reading manuals. This meant that access by users was limited to the provision of information only in text formats with little consideration for being user friendly or user focussed. This was described in a predictions about the internet in 1999 called The ClueTrain Manifesto **(Levine et**

al,2000) as a passive 'push' model of communication.The Cluetrain Manifesto predicted that users of the internet would become more actively involved in a networked 'pull environment.

Then beginning in 2001, other types of services began to appear on the WWW. These included Google, Wikipedia, MySpace, FaceBook, Digg, Technorati, Twitter, Spock and many more which provided their services remotely and freely.

Central and state governments arranged different programmes to implement ICT in school Education. Apart from that there are many private schools that provide laptop, tablets to the students for the implementation of ICT in school education.

Over the years ICT implementations have been required to improve computer literacy in a more comprehensive approach. There are two main broad approaches to implementing ICT in Educational system. (I) Improving quality of Education through teaching learning process (ii) Improving administration and management of School**.**

1.7 POLICIES

sustainability in the area of education. The government of India formulated the first National Policy on Education (NPE) in 1968. The NPE, 1968 focused on promoting national progress, a sense of common citizenship and culture, and on strengthening national integration. It gave importance to a radical reconstruction of the education system to improve its quality at all stages, and gave special attention to science and technology, the cultivation of moral values and a closer relation between education and the life of the people. The **Indian national educational policy of 1986,** which was subsequently modified in 1992, stressed the need for using Educational Technology (ET) to improve access, quality and governance policies. They include ET and Computer Literacy and

Studies in Schools (CLASS). These Two Central government schemes have emerged out of these policies.communication technology (ICT) in schools. The ICT role in education continued to get the attention of the Government of India. **National Curriculum Framework (2005)** and **Sar Shiksha Abhiyan (SSA)** also recommended creating an environment for optimal utilisation of ICT in education. In continuation to this, many schemes and programmes have been introduced to effectively implement ICT in teaching and learning to increase the access at all levels of education. The present paper attempts to discuss ICT related policies formulated by the Central and State governments in India.

The NPE 1986, as modified in 1992, stressed the need to employ educational technology to improve the quality of education led to two major centrally sponsored schemes,namely, Educational Technology (ET) and Computer Literacy and Studies in Schools (CLASS). By recognizing the importance of ICT (Interactive Classroom Technique) in education, Indian government introduced the Computer Literacy and Studies in Schools (CLASS) as a pilot project initially with the introduction of BBC micro-computers. Under this project, a total of 12,000 such computers were received and distributed to secondary and senior secondary schools through State governments. The project was subsequently adopted as a centrally-sponsored scheme during the 8th Plan (1993-98).

National Curriculum Framework 2005 (NCF) has also highlighted the 'significant role' ICT can play in school education. It talked about the essential component related to establishment of 'smart schools' designed to become technology demonstrators. ICT use improvement in excellence also figures in Government of India's flagship programme on education, Sarva Shiksha Abhiyan (SSA). Again, Central Advisory Board of Education (CABE) in the norm of schooling figured ICT comprehensively, in its report on Universal Secondary Education, in 2005.

The Information and Communication Technology (ICT) in Schools was launched in December, 2004 and revised in 2010 to give opportunities to secondary stage students to mainly construct their competence on ICT skills and make them learn through computer aided learning process. The scheme currently covers both Government and Government aided Secondary and Higher Secondary Schools.

The Information and Communication Technology (ICT) in schools have been subsumed in the Rashtriya Madhyamik Shiksha Abhiyan (RMSA). **Rashtriya Madhyamik Shiksha Abhiyan (RMSA)** will become the umbrella programme and ICT@Schools will be integrated with RMSA to provide greater flexibility, enable optimal utilisation of resources and yield better results. Now ICT in Schools is an element of the RMSA.

Importance of ICT in Higher Education is also equally emphasised in the National Mission on Use of ICT in Higher Education. During the Twelfth Plan various initiatives of the Eleventh Plan would be carried forward with an objective to make these programmes more effective,efficient and sustainable. These include: Digital Infrastructure Initiatives:

(i) upgrade connectivity for universities and colleges to 10GBPS and 1 GBPS, respectively; (ii) build computer labs in all institutions as required and increase availability of laptops and low-cost access devices for faculty and students; (ii) provide smart classrooms; (iii) set up classrooms with interactive video-conference facilities linking Meta-universities and affiliating

universities; (iv) set up 100 server farms for cloud computing. 2. Content Initiatives: (i) national-level consortium for propriety content; (iii) create open access content repositories including interoperable institutional repositories; (iv) create platforms to facilitate user generated content and related networks; (iv) create a single portal for access to all content; (v) continue current initiatives of DTH channels to telecast digital

educational videos. 3 Governance Initiatives: (i) rollout institutional Enterprise Resource Planning (ERP); (ii) computerised examination wings of all universities; (ii) provide robust online linkage of all affiliating universities with their affiliated colleges; (iii) create online data collection system; (iv) library automation; (v) automation of grants management. 4. Training and CapacityBuilding Initiatives: (i) train faculty in instructional design content creation; (ii) implement massive capacity-building efforts for adopting technology-mediated pedagogy in classrooms.

1.8 RATIONALE :

(Wallet & Melgar, 2014) study indicates that by implementing ICT in education an individual can complete a goal, which also enhances skill in the work force and improves social mobility.

All related literature reviewed indicates that ICT is more effective in Biology Teaching . Teaching Biology through ICT is more effective .

(Ward, Bronwyn Weston , & Tracy Bowker, 2007) reviewed that Teaching through ICT can enhance Teacher ‘s attitude towards the subject and willingness .

(Sipila, 2010) studied implication of ICT at primary level and found that ‘s by using laptop and usage of ICT more effective than traditional methods .

National Curriculum Framework (2005) and Sarv Shiksha Abhiyan (SSA) also recommended creating an environment for optimal utilisation of ICT in education. In continuation to this, many schemes and programmes have been introduced to effectively implement ICT in teaching and learning to increase the access at all levels of education.

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CHAPTER 2

REVIEW OF RELATED LITERATURE

CHAPTER -II

REVIEW OF RELATED LITRATURE

2.0 INTRODUCTION :

The present chapter includes a review of previous research related to the present study . This will help to give recommendations for previous research . Researcher gaining knowledge from the past research . Which provides background study from which researchers understand the latest knowledge on the topic under the research and also helpful for updating new knowledge in given research . By reviewing related literature researchers can avoid the selection of problems areas which were already selected earlier . It will help researchers to write delimitation and define the problem of study . Review of related literature will help for understanding research methodology .

Nikilaus (1985) assessed the attitudes of Tennessee teachers toward computers in schools. The relationship of present usage of computers to affluence of school districts, school level, gender, teaching area, years of education and years of experience was also examined. The sample for the study was 586 teachers in 18 randomly selected public schools in Tennessee. The attitudes of these teachers were inferred by their

responses to items on a questionnaire developed by the researcher.350 usable questionnaires were returned. In analyzing the data the chi square test and the.05 level of probability were utilized to determine significance. Findings were: (I) Teachers viewed instructional computing to be an enduring educational innovation and felt computer experiences should be provided for all students. (2) Teachers viewed instructional computing as being motivating for students, but they were undecided concerning the effect of instructional computing on student achievement.(3) Though teachers expressed a lack of confidence in their ability to use computers in their classrooms, they indicated a high level of interest in receiving instructional computing in service training. (4) Of the variables examined in the study, present usage or non usage of computers by teachers seemed to have the greatest influence on their attitudes toward computers. (5) With regard to present usage, teachers from schools in the middle financial subgroup, at the elementary level, and with a moderate amount of teaching experience (8-15 years) were significantly most inclined to be presently using computers in their classrooms.

Davis (1988) examined the attitude of early childhood teachers towards the use of computers in their classroom. The sample consisted of 229 randomly selected teachers from five school districts. A 25 item Likert scale was designed by the investigator to assess the subjects' attitude. ANOVA and Scheffe methods were used for analysis of data. Results indicated that 95.80% of childhood teachers participating in the study held a positive attitude towards the use of computers in their classroom. Although positive there were significant differences in the attitudes of early childhood teachers towards the use of computers in their classroom in terms of certain teacher characteristics like age, ethnicity, years of

teaching experience, prior instructional computer use, amount of computer training, amount of computer experience etc.

(Mumtaz, 2000) in her article, “Factors affecting teachers' use of information and communications technology”, opined that there were a number of factors which influence teachers' decisions to use ICT in the classroom: access to resources, quality of software and hardware, ease of use, incentives to change, support and collegiality in their school, school and national policies, commitment to professional learning and background in formal computer training. The role of pedagogy was highlighted by the article suggesting that teachers' beliefs about teaching and learning with ICT are central to integration. Successful implementation of ICT needed to address three interlinked frameworks for change: the teacher, the school and policy makers.

(Awan, 2011) conducted a research aiming to investigate the impact of challenging teachers‟ attitudes towards use of ICT in classrooms and encourage them to take up the use of ICT tools for teaching purposes. To boost the teachers‟ confidence in the use of technology they were provided a small training focused on the use of multimedia gaming resources in teaching learning. The results of this study revealed a positive transition in teachers‟ attitudes towards the ICT training they received as well as towards the use of ICT in teaching. Educational game playing workshops aligned to curriculum were highly recommended for sustainable in-service training and encouraging greater ICT use by teachers.

2.1 Resource Availability

(UNESCO, 2014) stated in their report that in order to support teaching and learning, as well as improve overall education management, a variety

of ICTassisted instructional methodologies may be implemented, varying from the use of radio, television, computers, internet and other hand held mobile devices. The report

said, the integration of ICT into schools required continuous and reliable supply of electricity (e.g. grid/mains connection, wind, water, solar or fuel-powered generator, etc.). Telecommunication facilities were also another basic element helpful in building

the educational and administrative capacity of schools which were recommended for use for pedagogical or administrative purposes. The facility could prove to be useful for communication between teachers with students, parents, various service providers to the schools, local education authorities, and other administrative organizations

(Sipila, 2010) opined in the study titled," The impact of laptop provision on teacher attitudes towards ICT", that the use of information and communication technologies (ICTs) in Finnish primary and secondary schools had been increasing for the last decade, but the full potential of the new technology had not been achieved; pedagogical thinking in educational institutes had not advanced in parallel with technological advances. The paper stressed on teachers‟ attitudes towards the use of ICTs in schools being significant factors in determining technology use in schools. The study revealed that teachers who used personal laptops in their work regarded the use of ICTs, both in teaching and in general, more positively than

teachers who did not.

(Ward, Bronwyn Weston , & Tracy Bowker, 2007) suggested that increasing teacher confidence and motivation were crucial mediating factors on teacher use of ICT. Teacher attitudes, including their confidence and willingness to use ICT, were found to be improving as a result of the network upgrade. The provision of laptops and opportunities

to learn to use the network all had a positive impact on both their teachers‟ skill levels and on their willingness to use ICT. The authors noted a positive cycle of change occurring in schools with increased confidence leading to increased use. Yet another study retorted, that although resources were available in
plenty the selection of appropriate tools and applications was a big challenge as these resources had to suit the needs of the participants and be of value to students .The study emphasized on the importance of proper project management by the information technology department and maintenance of the technology post the initial conversion stage (Johnston & Wierschem, 2007).

2.2 Teacher Technology Competence

Teacher professional development could be viewed as a schematized, early,unceasing, consistent and segmental process of professional development of educators in accordance with professional competency standards and frameworks. Teacher professional development would also include training in the adaptation to the evolution of change of the profession of teachers to managers of education systems. Professional development in the context of ICT can be placed under three broad headings, namely learning how to use ICT, learning through ICT and
integration of ICT in teaching and teacher learning.
National policy on ICT in School Education, MHRD, India (2009, revised 2012) presents three stages of ICT literacy that constitute set of competencies for students and teachers: basic level includes ability to operate a computer, manage data, word and data processing tasks, troubleshoot basic storage, use input output devices, email - web surfing - search engines, anti virus, operate- manage content

from external devices (sound recorders, digital cameras, scanners etc.); intermediate level includes ability to create and manage content using software applications, use digital devices, websites, search engines; advanced level includes capability to use database applications, use of ICT for problem solving, audio-video communication, research, documentation, presentation, cooperative - collaborative learning and handle cyber - copyright issues. These levels or stages constitute a set of ICT competencies for teachers and students.

(Drent & Martina Meelissen, 2008) explored the factors that stimulated or impeded the innovative use of ICT by teachers in schools. Based in the Netherlands the study defined innovative use of ICT as the applications supplementing the educational objectives derived from the needs of the current knowledge society. The paper emphasized the need for teachers to act as personal entrepreneurs more than anything else for successful integration of ICTs in schools. The paper highlighted school level factors and involvement of teacher training institutes having limited importance in such implementations.

2.3 Professional ICT Development for Teachers

The most common way of encouraging schools to adopt ICT, is to integrate it into their practice, and make pioneering use of it by focusing on professional development for teachers and school leaders that may inspire them to change the way they think about and use ICT. Many school ICT professional development initiatives are based on a model of teacher learning that comprehends the learning process in

terms of widely used stages of adoption model which conceptualizes teachers‟ use of ICT as a series of levels of adoption of ICT tools.

(Bolstad & Jane Gilbert, 2006) suggested the "loop" model of ICT innovation and change. The authors said that school ICT initiatives generally include most or all of these four strategies and it did not matter where one began in the loop the process of change, but what mattered was that all four strategies were essentially part of the
change, and that the right support was available at the right time.

The present study discussed on ICT usage on biology Teaching because biology is subject which having more amount of Diagrammatic representation which will teach with the help of animated videos. Teaching of biology with the help of traditional method is time consuming , with the help of ICT usage it will completed with in given time period.

2.4 Implication of present study :

All related literature reviewed indicates that ICT is more effective in Biology Teaching . Teaching Biology through ICT is more effective .

(Ward, Bronwyn Weston , & Tracy Bowker, 2007) reviewed that Teaching through ICT can enhance Teacher ‘s attitude towards the subject and willingness .

(Sipila, 2010) studied the implication of ICT at primary level and found that ‘s by using laptop and usage of ICT more effective than traditional methods .

CHAPTER -3

METHODOLOGY

3 . 0 INTRODUCTION

Endeavors across the globe, by various nations are being made to strategize,plan and prepare guidelines for ICT implementation into educational systems and these have become an integral part of educational reforms (Law, 2004). ICT implementation strategies often advocate for high investments in ICT infrastructure in schools and connectivity to the world internet. This chapter is methodology oriented where the researcher has concentrated on the plan and prepared the questionnaire to attain the objective of present study. This chapter includes the objective of the study, Explanation of terms, operationalization of the terms, Delimitation of study, population of study, Sample of study, Design of study, Tool for data collection, procedure of data collection and data analysis.The detail of the methodology with reference to above aspect has been described as under .

5.2 STATEMENT OF THE PROBLEM

A study on the usage of Information and Communication Technology (ICT) by the Biology Teacher of Vadodara city in teaching of Biology During CoVId-19 Pandemic

3.3 Objectives of the study

(i) To study the use of ICT in teaching of Biology in Higher Secondary School of Vadodara City .

(ii) To Study the use of ICT in terms of availability of resource in Higher Secondary School of Vadodara City

3.4 EXPLANATION OF TERM

Explanation of Term

Information and Communication Technology (ICT) : In the present study ICT refers to teaching Biology at Higher Secondary level by using electronic devices .

Desktop / Laptop

Smart Board

Digital Camera

Projector

Television

Social Media

3.5 Operationalization of Term :

(i) Usage of ICT :

Usage of ICT in the present study is using ICT in teaching-learning of Biology by teachers with respect to the usage of online websites, various Biology apps, youtube, social media used for content development and sharing with students, and also usage of Various assessment tools (like Kahoot, Mentimeter, Concept maps, Quizzes) and Learning Management system (LMS) used for teaching. It also comprises usage of various ICT tools like video and audio editor and powerpoint presentations used for the purpose of enhancing the student ‘s understanding through online teaching..

(ii) Effectiveness of usage of ICT Tool :

In the present study, the effectiveness of the usage of ICT Tools means the awareness and perception of teachers about usage of different ICT in teaching of Biology in terms of its effectiveness.

3.6 Delimitation of the Study :

The present study was delimited to the Higher Secondary School of Vadodara City affiliated with Gujarat Higher Secondary Education Board (GSEB) for the academic year 2020-2021 .

3.7 Population of the Study :

The Population of the present study consisted of all the Higher Secondary Biology Teachers of Vadodara City .

3.8 Sample of the Study :

The sample of the study consists of 33 Biology Teachers Selected through a snowball random sampling method.

3.9 RESEARCH DESIGN :

The present study was the Descriptive Research Survey Method . According to ‘ Best and Khan ‘ Descriptive Survey Method studies are used to find out ‘What is’ and therefore the detailed information is required for answering given questions .

3.10 Tools and Techniques :

The Following Tools and Techniques used for collection of data :

Questionnaires (For Teachers)

The above tools were developed by investigators . Questionnaires used for Objective 1 .

3.10.1 Questionnaire

There are 33 Questions developed by investigators .The Questionnaire starts from some basic Questions including age group of

teacher ,experience of teacher in Biology . The Questionnaire will help to analyze proficiency of the teacher in usage of ICT .

3.10.1.1 Development of Questionnaire

Questionnaires developed by using Google Form and Teachers gave responses to the questions at their own pace .

3.11 Data Collection :

Investigators collect the data through google form . The Questionnaire was filled by the Biology Teachers . It was important to know how effectively teachers were able to use ICT in teaching Biology.

3.12 Data Analysis :

Data was analyzed quantitatively . Responses from the teachers were analyzed by using Frequency and Percentage. Graphs were quite helpful in displaying the data in an understandable manner.

CHAPTER - 4

DATA COLLECTION AND INTERPRETATION

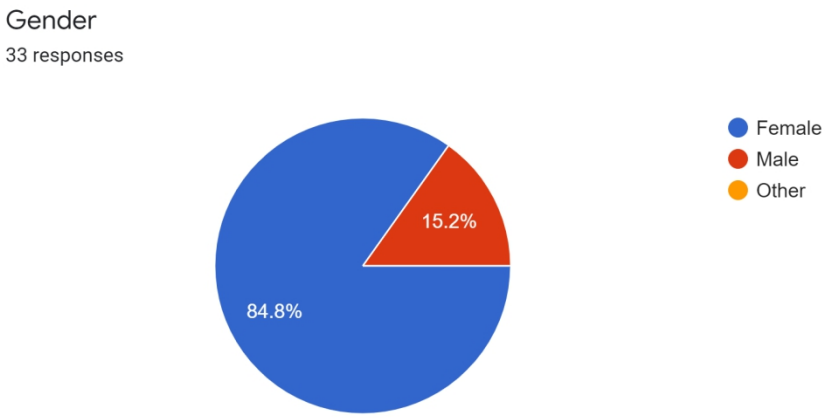
CHAPTER -IV
DATA ANALYSIS AND INTERPRETATION

4.0 INTRODUCTION :

The data analysis and interpretation of data are very crucial steps to get a meaningful picture . The present study analyses the data and interpretation with the objective of study . Data Analysis meaning statistical findings and tabulating raw data in a meaningful way . Interpretation of data means answering the problems .

4.1 TEACHERS PROFILE

Fig . 4.1 WITH RESPECT TO GENDER



Profile of the teachers with respect to gender 28 (84.8%) teachers are female out of 33 teachers and 5 teachers are male .

Fig.4.2 With respect to teacher's Designation

Profile of teachers with respect to Designation 31 (93.93%) teachers are Assistant biology teachers 1 (3.03%) is B.Ed Student and 1(3.03%) who is designated as the Principle . All the selected teachers who teach biology at Higher Secondary (11^{th} & 12^{th} Std)

level

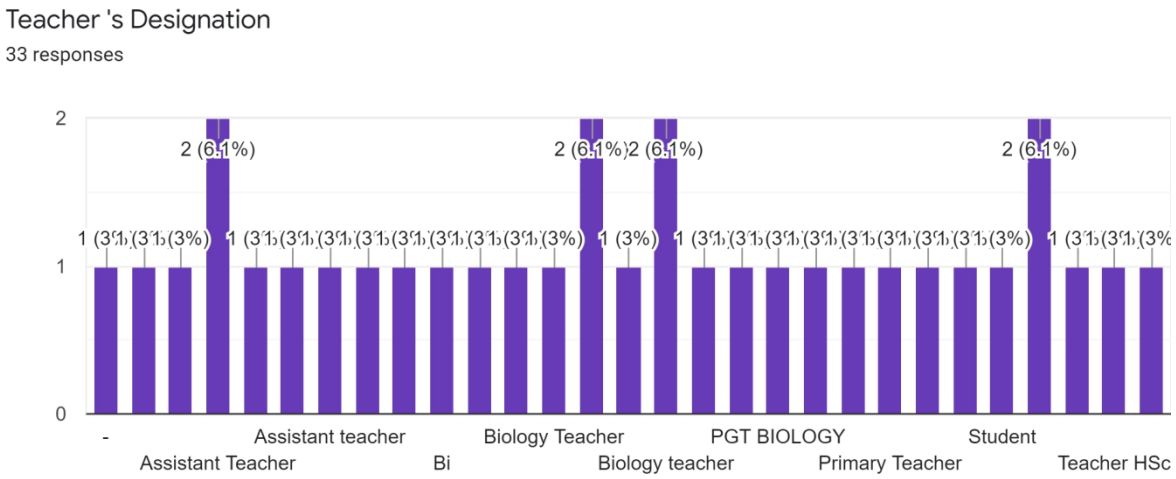


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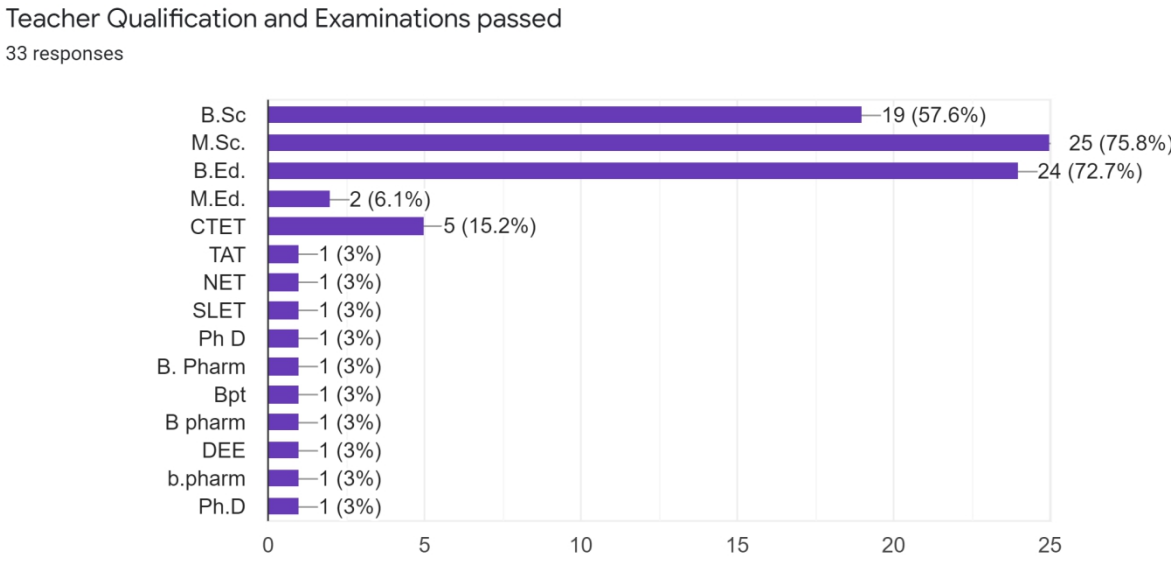
Fig.4.3 With Respect to Teachers Qualification and Examination passed



Name of Examination	Number of Teachers	Total number of

	who qualified exam	**teacher**
Bachelor of Science (B.Sc)	19 (57.6%)	33
Master of Science (M.Sc)	25 (75.8%)	33
Bachelor of Education (B.Ed)	24 (72.7%)	33
Master of Education (M.Ed)	2 (6.1%)	33
Central Teacher Eligibility Test (CTET)	5 (15.2%)	33
Teacher's Aptitude test (TAT)	1 (3%)	33
National Eligibility Test (NET)	1(3%)	33
State level Eligibility test (SLET)	1 (3%)	33
Ph.D	1(3%)	33

4.2 DATA ANALYSIS WITH RESPECT TO OBJECTIVE 1

To study the usage of ICT tools by Biology teachers of Higher Secondary Schools of Vadodara city for teaching Biology with respect to:

4.2.1 online sites and portals for content update

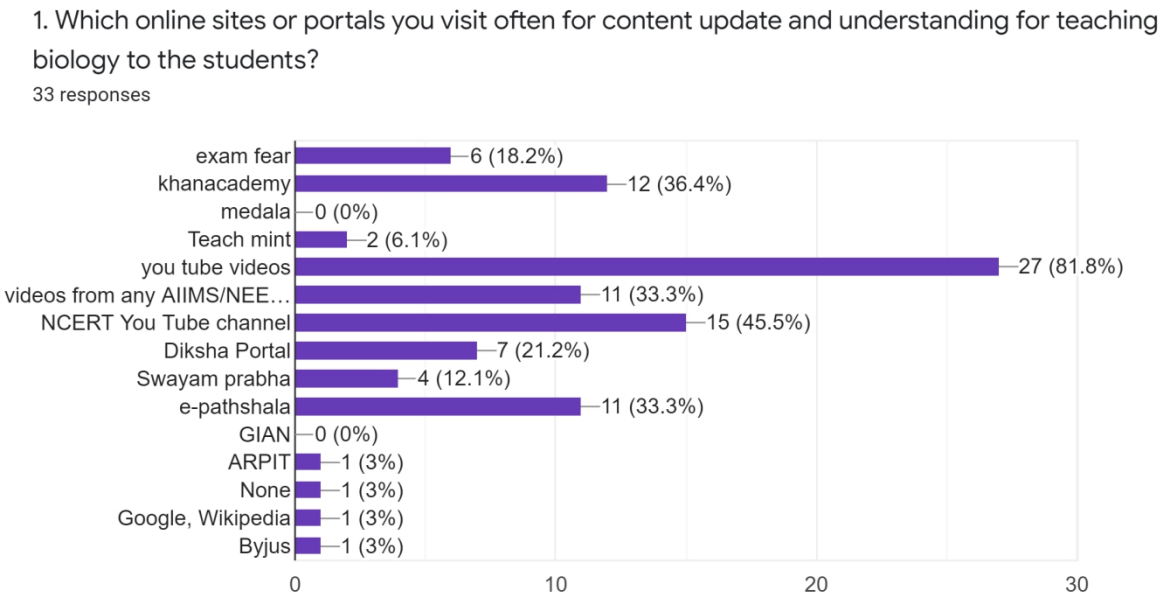


Fig.4.4 Online portal for content update and understanding teaching biology

-

Data represent that out of 33 teachers 27(81.8%) teachers used Youtube videos, 15 (45.5%) teachers used NCERT Youtube channels from 33 teachers, 12 (36.4%) teachers used Khanacademy out of 33 teachers, 11(33.3%) teachers used videos from AIIMS/NEET and e-pathshala out of 33 teachers,from 33 teachers 7 (21.2%) teachers used diksha portal,out of 33 teachers 6 (18.2%) teachers used exam fear, out of 33 teachers 4 (12.1%) teachers used swayam prabha, only 1(3%) teachers used , ARPIT, Byjus, Google and Wikipedia . Out of 33 teachers none of the teachers used GIAN and medala.

4.2.2 With respect to Social Media

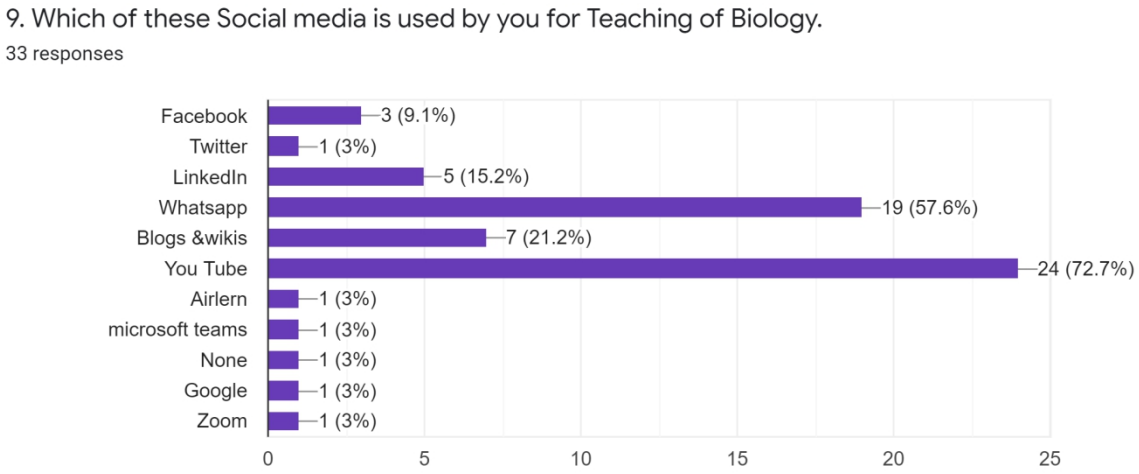


Fig. 4.4 Social media used for teaching biology

There are a number of social media used by the teacher in teaching biology. Out of 33 teachers 24 (72.7%) teachers used YouTube, Out of 33 teachers 19 (57.6%) teachers used Whatsapp, Out of 33 teachers 7 (21.2%) used blogs and wikis, Out of the 33 teachers 5 (15.2%) used Linkedin, Out of the 33 teachers 3 (9.1%) used Facebook, remaining 1 (3%) teachers out of 33 used Airlearn, google, zoom, etc..

4.2.3 With respect to E-Learning tools

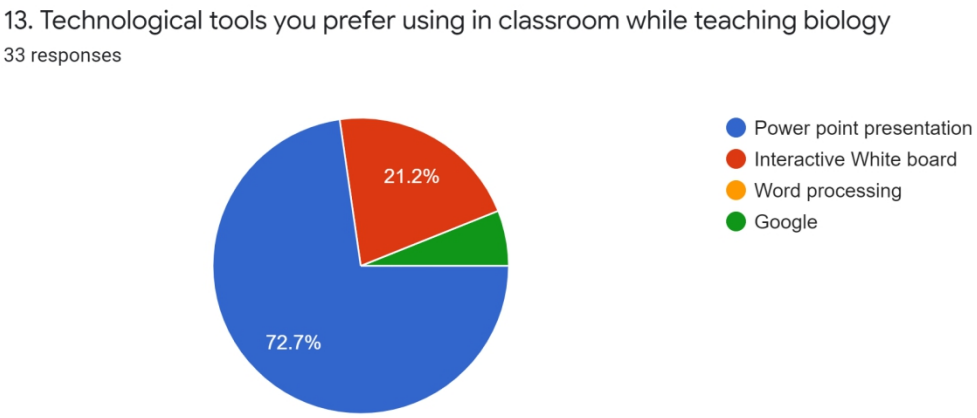


Fig. 4.5 E-learning Tool prefer by biology teachers

Teaching tools are a vital component of ICT. Above graph represents the awareness of the teachers regarding usage of technological tools while teaching biology. 24 teachers(72.7%) teachers are aware about usage of powerpoint presentation. 7 (21.2%) teachers are using Interactive white board, only 2 (6.1%) teachers are using google platform, and none of teachers are aware about usage of Word processing.

4.2.4 With respect to Learning Management system

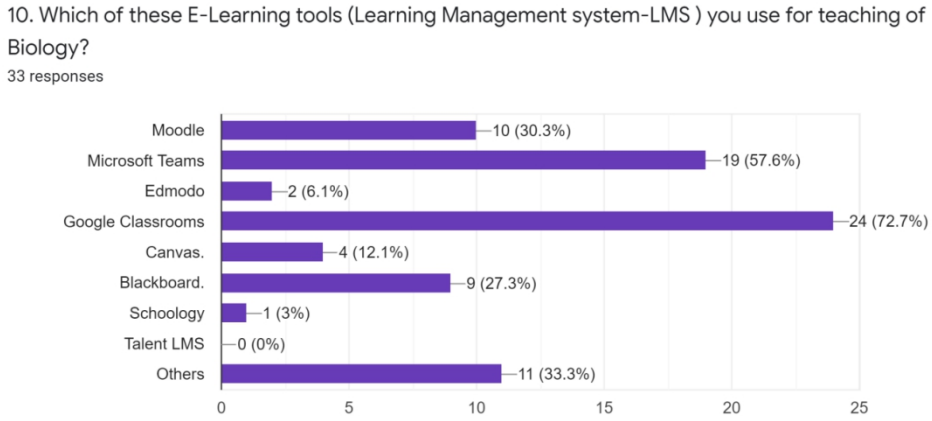


Fig. 4.6 Learning management system used by biology teacher

out of 33 teachers 24 (72.7%) teachers are used Google classroom, Out of 33 teachers 19(57.6%) teachers are used Microsoft Team, out of 33 teachers 10(30.3%) are used Moodle, out of 33 teachers 9 (27.3%) still used Blackboard, out of 33 teachers 4(12.1%) are used Canvas,out of 33 teachers 1 (3%) are used schoology, out of 33 teachers 11 are used others, out of 33 teachers no any teacher used Talent LMS.

4.2.5 With respect to E-Learning Tool (Group collaborative platform)

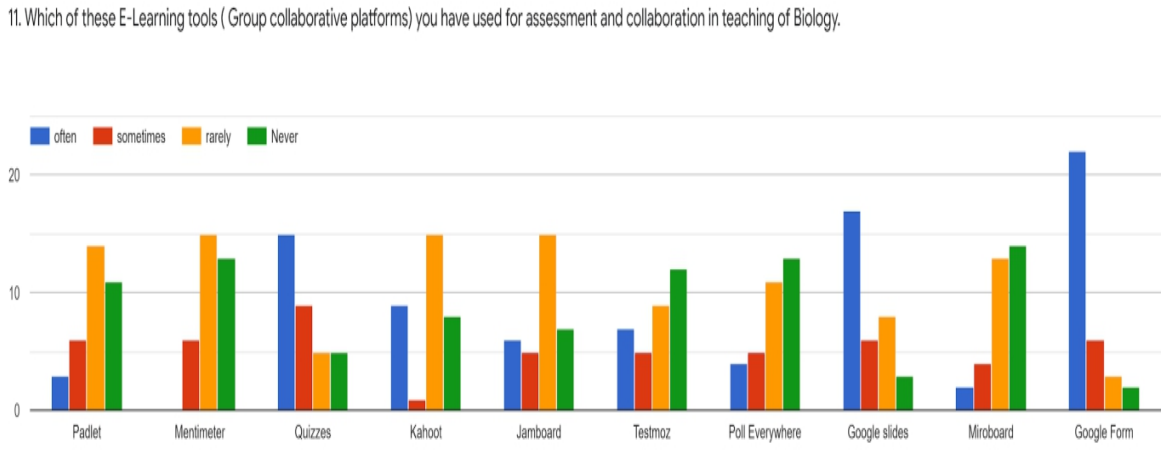


Fig. 4.7 E-Learning tool (Group collaborative method) used by biology teacher

Above graph represents awareness of the teacher about E-Learning tools which are used in assessment and collaboration in teaching of biology.

First bar graph represents data about the use of padlet. 14 teachers are aware about that, 6 teachers are sometimes used, 3 are often used, 11 teachers are never used.

Name of the E-Learning Tools	Frequency of the teachers				percentage			
	Often	sometime	rarely	never	often	sometime	rarely	never
mentimeter	0	6	15	13	0%	18.18%	45.45 %	39.39 %
quizzes	15	9	5	5	45.45	27.27%	15 %	15%

					%			
kahoot	9	1	15	8	27%	3%	45%	24%
jamboard	6	5	15	7	18%	15%	45%	21%
Testmoz	7	5	9	12	21%	15%	27%	36%
Poll everywhere	4	5	11	13	12%	15%	33%	39%
Google slides	17	8	6	3	51%	24%	18%	9%
Miroboard	2	4	13	14	6%	12%	39%	42%
Google form	22	6	3	2	66%	18%	9%	6%
padlet	3	6	14	11	9%	18%	42%	33%

4.3 Data Analysis with Respect to Objective 2

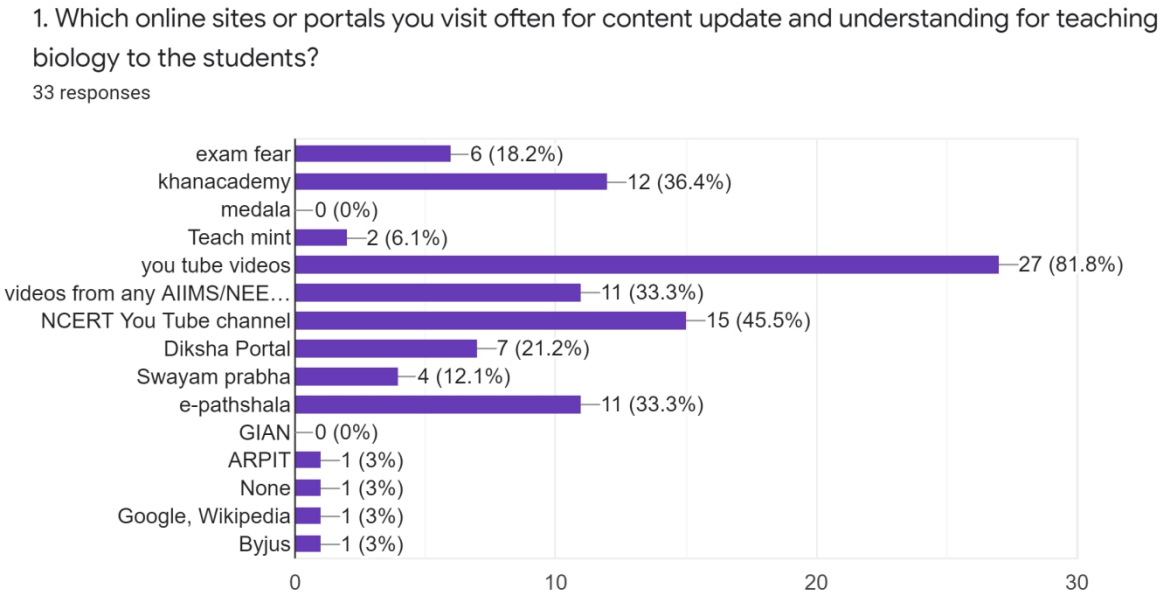


Fig. 4.8 Online portal used by teacher to update understanding of biology

Data represent that out of 33 teachers 27(81.8%) teachers used Youtube videos, 15 (45.5%) teachers used NCERT Youtube channels from 33 teachers, 12 (36.4%) teachers used Khanacademy out of 33 teachers, 11(33.3%) teachers used videos from AIIMS/NEET and e-pathshala out of 33 teachers,from 33 teachers 7 (21.2%) teachers used diksha portal,out of 33 teachers 6 (18.2%) teachers used exam fear, out of 33 teachers 4 (12.1%) teachers used swayam prabha, only 1(3%) teachers used , ARPIT, Byjus, Google and Wikipedia . Out of 33 teachers none of the teachers used GIAN and medala.

4.3.1 Effectiveness of teaching enhance by using ICT

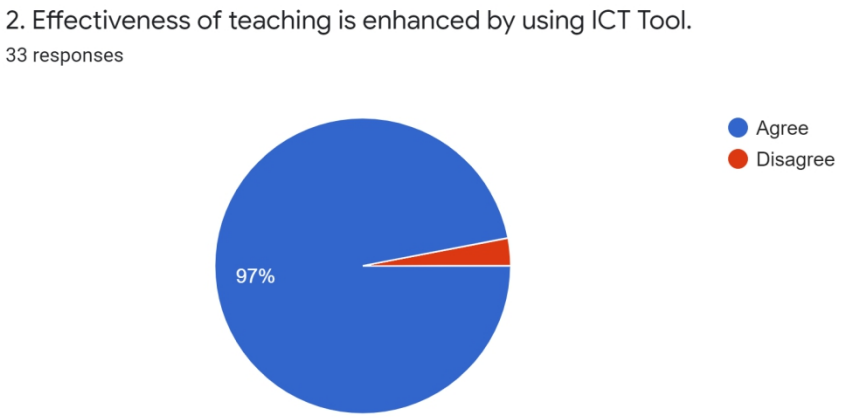


Fig.4.9 Use of ICT tool which enhance effectiveness of teaching

among 33 teachers 32 (97%) teachers are agree that ICT is most effective method in teaching biological science and only 1 (3%) teacher Disagree

4.3.2 Effectiveness of ICT method used teaching biology

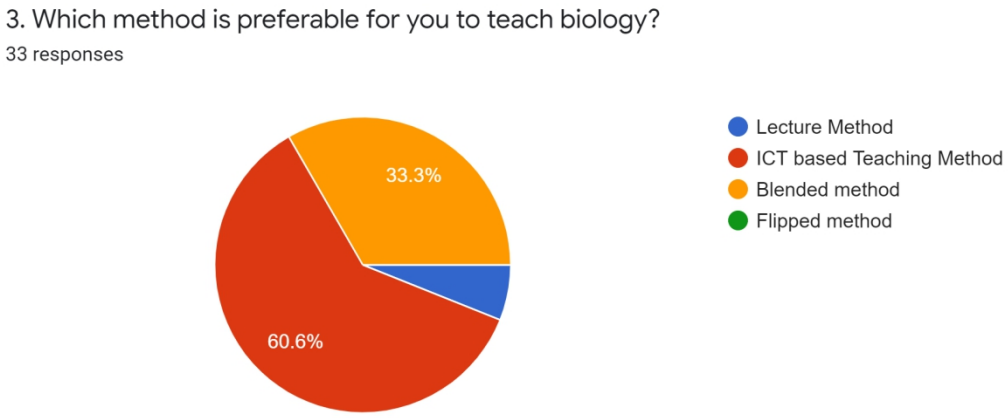


Fig.4.10 ICT method used by biology teacher

Researcher designed four methods in her questionnaires. Fig 4.6 indicate that total 20(60.6%) teachers used ICT based teaching method to teach biology, 11 (33.3%) teachers used blended method for teaching biology, only 2(6.1%) teachers used lecture method to teach biology out of 33 teachers .Flipped method is not used by any teachers .

4.3.3 Effectiveness of ICT Tool for completing biology syllabus

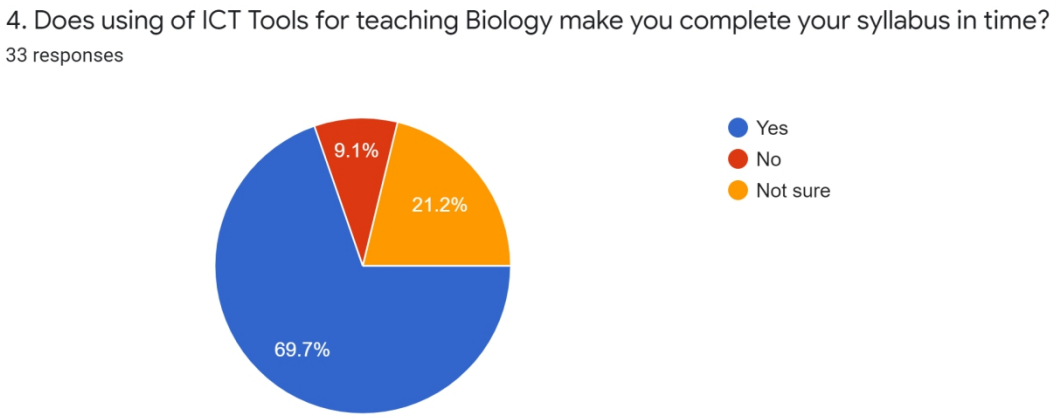


Fig.4.11 ICT tools used by biology teacher to complete syllabus

With respect to completing biology syllabus ICT is more effective than others. Fig 4.7 represent that 23 (69.7%) teachers are able to complete their syllabus within time by using ICT, 7(21.2%) teachers not assure that biology syllabus complete within time by using ICT, only 3 (9.1%) teachers are not able to complete their biology syllabus within time by using ICT.

Fig. 4.3.4 Biology teaching more effective by using ICT tool

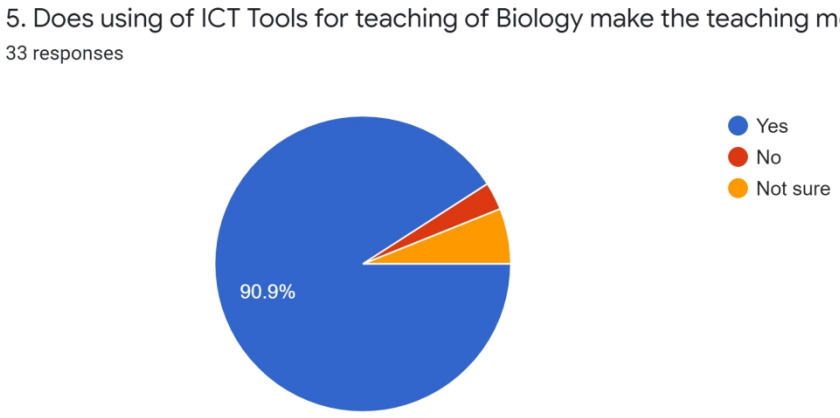


Fig.4.12 ICT tool which enhance effectiveness of Teaching in biology

Teachers believe that by using ICT tools that makes biology teaching more effective. 1(3%) teachers disagree that ICT tools don't make biology teaching more effective. 2 (6.1%) teachers are not sure that ICT tools make biology teaching more effective.

4.3.5 Effectiveness of teacher training programme which enhance effectiveness of teaching biology

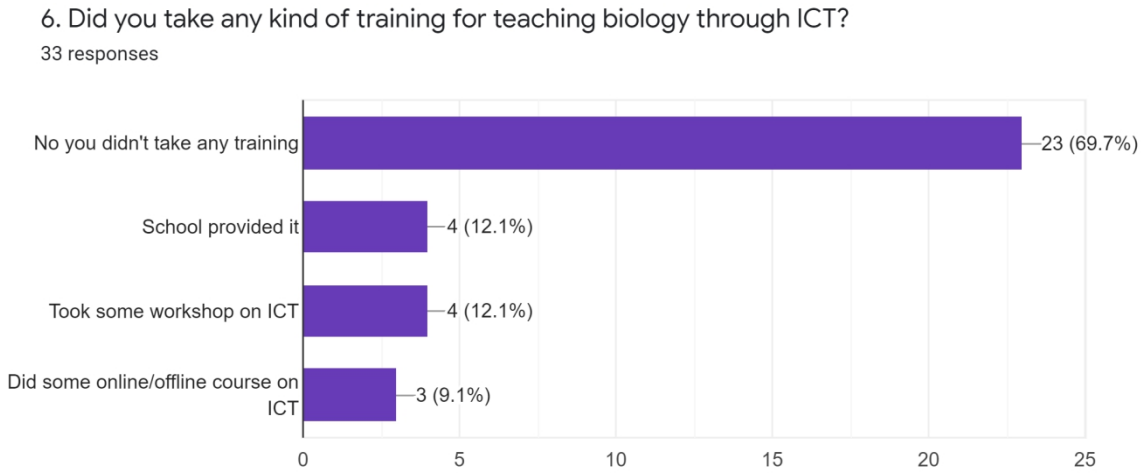


Fig.4.13 Teacher training programme related ICT

Represent that 4(12.1%) teachers are trained by school for teaching biology through ICT. 4(12.1%) teachers took some workshop on teaching of biology by using ICT. 3(9.1%) Teachers are took some online/offline course on ICT for teaching biology, but still majority of teachers, total 23(69.7%) teachers did not take any training for teaching biology through ICT.

4.3.6 Effectiveness of ICT to track the learner's progress, give Assignment work to learner, prepare biology material

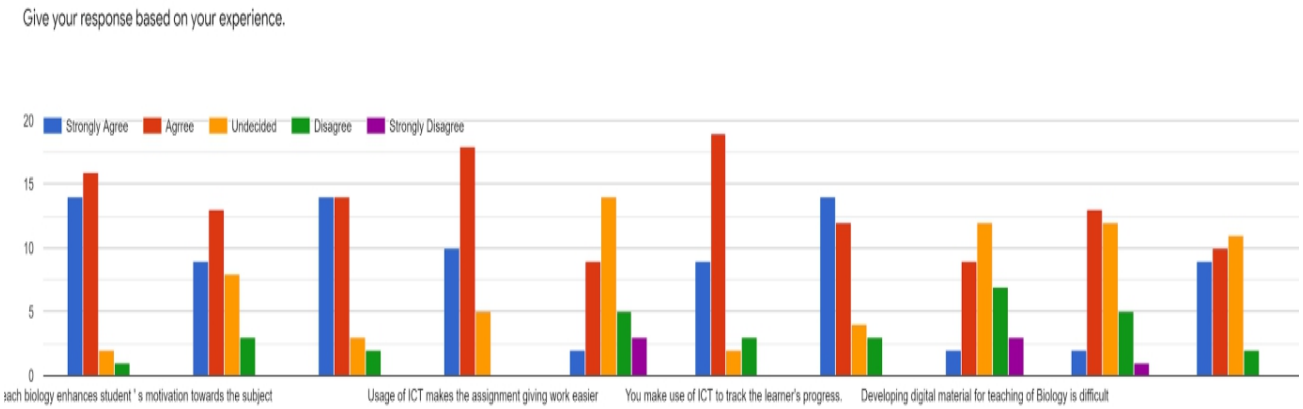


Fig.4.14 Usage of ICT with respective different purpose

First Bar-graph indicates that by using ICT which enhances motivation of the students towards biology. Out of 33 teachers 14(42.42%) teachers are strongly agree that ICT in teaching which enhance student's motivation, 16(48.48%) teachers are only agree that, 2(6.06%) teachers are still undecided, 1(3%) teacher disagree that teaching through ICT does not enhance student's motivation towards biology subject.

Second bar graph indicates that ICT provides a better platform to evaluate students. Above data represent that 9 (27.27%)teachers strongly agree,13(39.39%) agree, 8(24.24%) teachers are undecided, 3(9%) are Disagree out of 33 teachers.

Third bar graph represents that by using ICT teachers are able to give demonstrations in biology in an easy manner. In the given graph 14 (42.42%) teachers strongly agree, 14 (42.42%) agree, 3(9.09%) teachers are still undecided, and 2 (6%) teachers disagree among 33 teachers.

Fourth bar graph represents that teachers are able to give assignment work by using ICT. 10(30.30%) teachers strongly agree, 18 (54.54%) teachers agree, and only 5 (15.15%) teachers are undecided.

Fifth bar graph represents that teachers have the ability to enhance the engagement of learners by using ICT. Out of 33 teachers 14 (42.42%) teachers strongly agree, 12 (36.36%) teachers agree, 4 (12.12%) undecided, and 3 (9.09%) disagree.

Sixth graph represents that teachers are not able to develop digital material by using ICT.

9 teachers strongly agree that they faced difficulty in making digital material. 9(27.27%) teachers agree, 12 (36.36%) teachers are undecided, 7 (21.21%) disagree and 3 (9%) teachers strongly disagree, they are able to make digital material in an easy manner.

Seventh graph represents that teachers believe that ICT is more effective than chalk and talk methods. 10 (30.30%) teachers strongly agree that ICT is more effective than chalk and talk methods. 10 (30.30%) teachers agree that 11(33%) teachers are undecided, and 2 (6%) disagree.

4.3.7 Effectiveness of animated video , video creation software in teaching biology

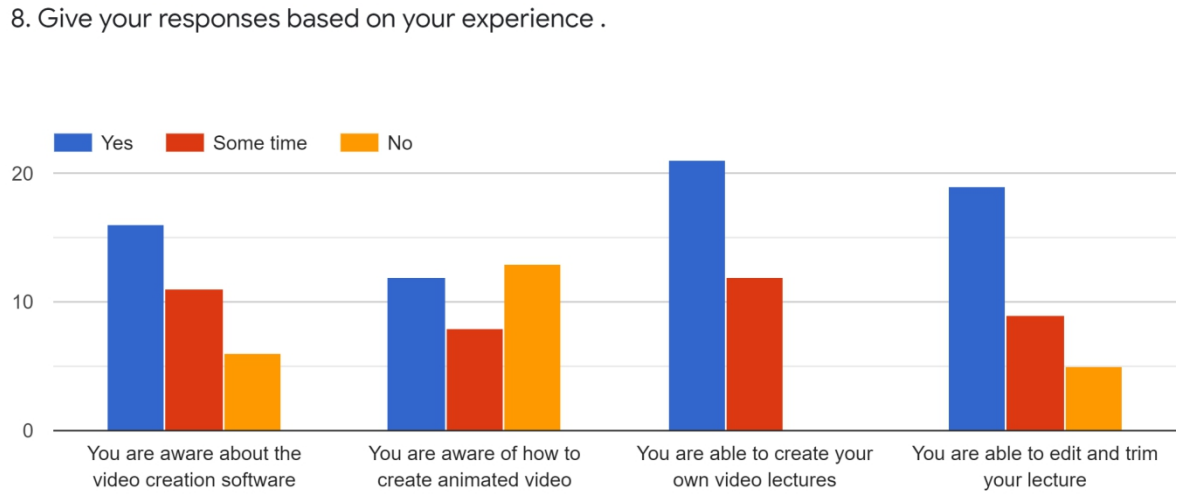


Fig.4.15 Effectiveness of video software in teaching biology

First bar graph of the above figure represents the teacher's awareness about video creation software. The data indicate that 16 (48.48%) teachers agree that they are aware of video creation software every time. Sometime 11 (33.33%) teachers are able to create videos. But 6(18.18%) teachers are not able to create videos by using software.

Second bar graph represents that Teachers are able to create animated videos. 12(36.36%) teachers easily create animated

videos. 8 (24.24%) teachers are able to create animated videos sometime . but still 13 (39.39%) teachers are not able to create animated videos.

Third graph represents the awareness of teachers that create their own video lectures. 21(63.63%) teachers are able to create their own video lectures. And only 12(36.36%) are not able to create their own video lectures.

Fourth graph represents the awareness of teachers with regards to editing and trimming their lecture. 19 (57.57%) teachers are aware about that, 9 (27.27%) teachers sometimes do that, and 5 (15.15%) are not able to edit and trim her/his lectures.

4.3.8 Effective biological app used teaching practical aspect

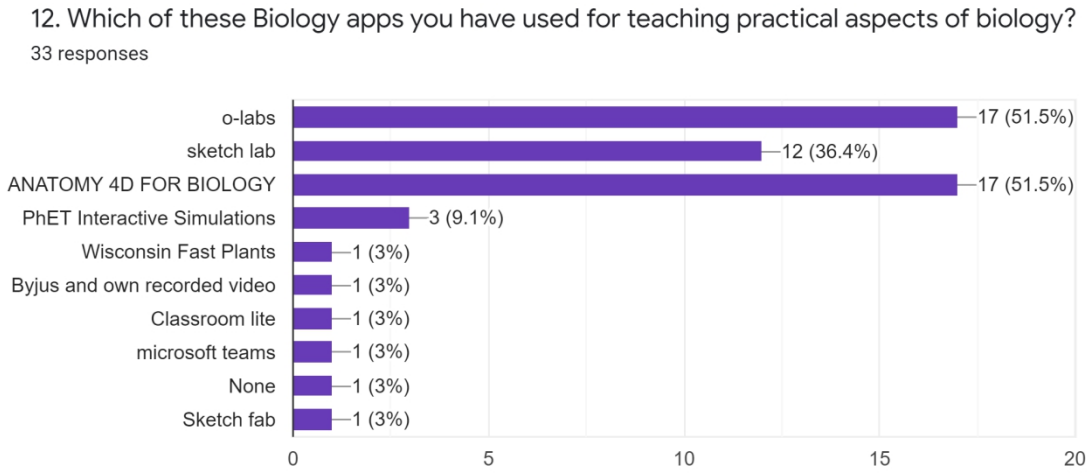


Fig.4.16 Name of the biological app used in practical teaching

mostly 17 (51.5%) teachers out of 33 are used Anatomy 4D for biology, 17 (51.5%) out of 33 are used o-labs, 12 (36.5%) out of 33 are used sketch lab, 3 (9.1%) are used PhET interactive simulation, 1 (3%) out of 33 used Wisconsin Fast Plants, 1(3%) out of 33 used Byjus and own recorded video, 1 (3%) out of 33 are used classroom lite, 1(3%) out of 33 used Microsoft teams, 1 (3%) out of 33 are used sketch fab, 1(3%) out of 33 are not used any App.

4.3.9 Effectiveness of ICT in particular topic of biology

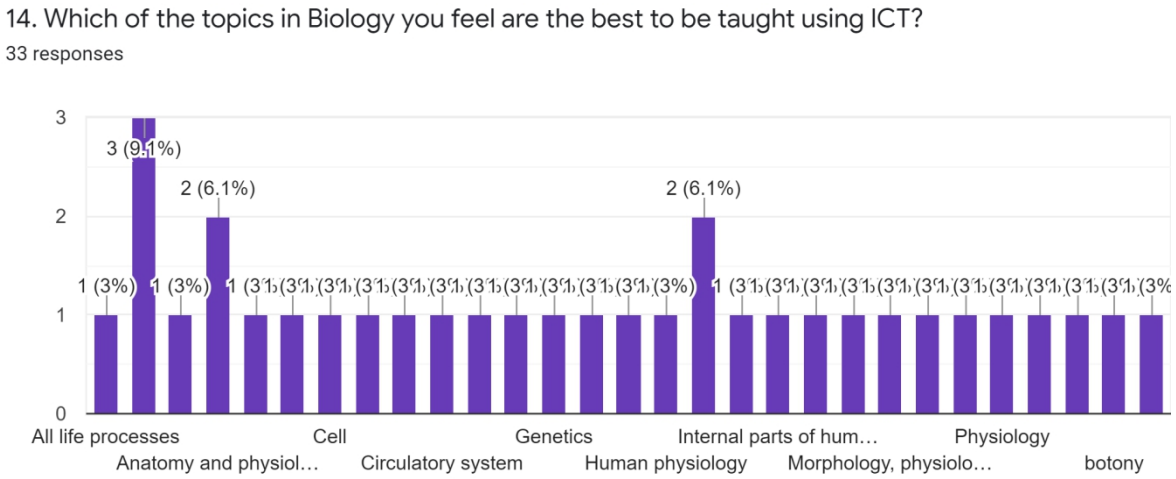


Fig.4.17 Different topic taught by teacher by using ICT

Name of the topic	Frequency	Percentage
All life process	1	3%
Anatomy and physiology	7	21%
Cell	2	6%
Evolution and biodiversity	1	3%
Genetics	1	3%
Human anatomy and physiology	7	21%
Immunology	1	3%
Plant physiology	3	9 %
Plant anatomy	1	3%

CHAPTER -5

SUMMARY , FINDINGS AND CONCLUSION

5.0 INTRODUCTION

According to **Mahatma Gandhi,(1937) "By Education, I mean an all-round drawing out the best in child and man body , mind and spirit"** Education is a dynamic force in the life of every individual influencing physical , mental , emotional , social and ethical development .

We are living in the 21st century, which encompasses the Information Age - an era marked by rapid adoption of new technologies **(Holland, 2015).** Many new technologies, Information and Communication Technology (ICT henceforth) being the forerunner, have influenced the way we live, communicate, socialize, learn or educate. Introduction of ICT in almost all the sectors of our lives has created a new global economy that is powered by technology, fueled by information and driven by knowledge **(US Department of Labour, 1999).** Advent of the knowledge economy and global economic competition compel governments to prioritize educational quality, lifelong learning and the provision of educational opportunities for all. It is widely accepted that access to ICT in education can help individuals to compete in a global economy by creating a skilled work force and facilitating social mobility **(Wallet & Melgar, 2014)**

ICTs in education

Technological Education is an area introduced in the study of education that focuses its analysis on the human being and its relationship with the artificial world. A new vision of the world that tries to answer the problems from the point of view of technology, giving solutions and proposing answers.

It is in the educational context when the community is positioned in the perspective that technology is a way of thinking and changing reality, in a

more or less right way. For this reason, if we bet that technology education can intervene in our own culture we can achieve that all this favors the welfare of the community.

In short, if you use technological education as a teaching-learning methodology it is possible to give way to a full integration between theory and practice. This gives the possibility of a greater understanding of reality, since it is the union of theory and practice that is the main function of this technological revolution in education.

Characteristics of ICTs applied to education

From the first moment we talk about ICT we must keep in mind what they are and what their characteristics are, once you know their usefulness will be very beneficial to use in any teaching-learning context.

To talk about ICT as the tools that help to teach, it is necessary to mention fourteen of its main characteristics, since they are benefits to use in the classroom of this new form of teaching that brings the 21st century:

1- They are used from anywhere

If something has to stand out as a priority of ICT is the possibility of maintaining a continuous and direct contact with students. The advantage that the student can connect to teaching from anywhere in the world, with the appropriate means to do so, facilitates learning, making it attractive.

For example, when the holiday periods begin, the child usually switches off during the time he does not come to the classroom. This disconnection, only subject to some exercise or list of tasks that must comply, gives way to oversight and a longer time of adaptation upon return.

If the student continues in connection through online platforms, blogs or e-mail, among others; The teacher or the teacher can send these exercises in a more leisurely way and the student will be able to receive answers to his doubts in a faster way as well as practice.

2- Union of culture, science and technology

ICT is the union of beliefs, customs and all those habits that society has adopted as routine.

On the one hand, talking about culture is about the everyday routine of society, about the benefits that technology brings to the whole community. On the other hand, it encompasses science, as it is also responsible for giving answers to the human being of what happens in the world. It is the curiosity to learn that leads man to carry out scientific research to respond to his concerns, producing the Scientific knowledge.

And finally, the technique is responsible for responding to the need for transformation that man requires to meet his needs. It is the process that is carried out to create the necessary mechanism to alleviate the need and, after analyzing it from the scientific field, has been analyzed from a theoretical perspective, such as the creation of services.

Therefore, it is an activity characterized as creative that requires innovations that have not been created previously.

3- It is a mobilizing teaching

Teaching through ICT gives the possibility that the student can move in different contexts and different realities. In this way we choose a quality teaching in which the student can interact with the world and can face different situations.

For example, before subjects such as geography, the student will be able to contemplate images and videos of geographic features that he has never seen before. In this way, visualizing the content, making it more practical, is given the motivation that it needs.

4- It is based on other scientific aspects

ICTs applied to education are enriched by other scientific aspects, such as the pedagogical sciences, through innovations in teaching-learning methodologies; Of the psychology of the learning, showing special

attention to the stimulus-answer; Of sociology, of anthropology and of philosophy.

5- Focuses on objectives

Teaching through ICT is based on keeping in mind, at all times, the objectives. Achieving the proposed goals is essential and, therefore, we are faced with a flexible working methodology.

For example, situations are commonly encountered in ordinary classrooms in which teachers, because of the need for the whole group to carry out a temporary planning, move quickly, leaving behind students who do not carry the same pace.

Through the use of ICT the teaching is individualized, giving the student the possibility to advance and complete the levels once he has acquired the knowledge, regardless of the pace of his peers. For there is a possibility that you can repeat the activities or receive adapted exercises.

6- It is an excellent channel of communication

Another advantage of ICT is the promotion of communication. The use of new technologies favors the communication that the teaching - learning process needs.

For example, there is the possibility that the teacher can maintain daily and fast contact with the family. In addition to answering questions that the students raised when they left the classroom.

7- It is changeable

As time goes by, the world is changing and new technologies are also changing. Therefore, it adapts to the changes of the context itself and of education, based on the sciences that support them.

8- Possibility of interacting

The new technologies give the possibility to the student to interact with the world; Especially with the teacher and with their own peers.

Therefore, it is not simply a review and an understanding of the messages or symbols that are sent. ICTs give the possibility of using auditory and audiovisual resources to promote the attractiveness and ease in which the student acquires the knowledge.

9- Use different channels

The use of different channels of representation will give the possibility of faster learning through expression and communication using cognitive, motor and affective development.

For example, the possibility of obtaining the same information through reading, videos, music and images; Complement the traditional reading and images of the classic textbooks, since it gives the possibility to reinforce the information through other channels.

10- Power the intellectual abilities

ICTs develop the intellectual skills of children, betting on a fun and dynamic training. For this reason, the psychology of learning through the interaction between the stimulus and the response acts with the creation of levels that the student can acquire as he or she learns.

For example, before a grammar exercise, the student will be able to go to solving exercises where he receives scores and will go up in level. The novel"Gamification"will involve the child to keep him in the game while learning.

11- It is a channel of communication

They are a channel of communication because they are also feasible to convey feelings, opinions and ideas to the world. In addition to keeping the information intact, as this is recorded through the writing and the audiovisual channel.

For example, there is the possibility of using ICT so that the student can give opinions to tasks that are proposed to him. These will be registered

and can be observed by the other classmates, in addition to the teacher can use this information in class or keep it as privacy data.

12- Reduced storage space

ICT has the possibility that all storage is online, so the space occupied is immaterial. Therefore, it is easier to be moved from one place to another, since it should not be moved in any heavy way.

For example, through the internet connection, the student can access the video that has been seen in the classroom and can carry out the proposed activity by sending it by email.

13- Compatibility

It is compatible with other teaching aids traditionally used in classrooms, such as the use of blackboards.

Electronic whiteboards are the most innovative material of the school in the 21st century, because it mixes all the elements that a tool must contain in the classroom, not forgetting the traditional, it also includes technological advances.

14- Feedback

The new technologies give the possibility of a feedback between students and teachers, in this way, from any place the student can receive answers to their doubts and qualifications of their tasks, quickly, without having to go to the classroom for it.

For example, before an objective test, type test, which is carried out as a self-assessment, students can respond and get the grade of this one at the time. In addition, you can also obtain information about this note and send to the teacher the question that you consider necessary to do at that moment.

Need for Integrated ICT in teaching learning process

- To use ICT tools for designing new learning environments for their own subject specific purpose to help their future students to use ICT.
- To provide the knowledge , skill and attitudes to better use of Technology in their research , communication , problem solving and continuing professional development .
- To critically apply the pedagogical principle of ICT integration in science education .
- To develop and facilitate ICT based learning activities in the context of teaching biology .
- To analyse and evaluate appropriate content and context for the use of ICT in biology teaching .
- To use ICT efficiently in research , problem solving , and project based learning in biology .
- To integrate ICT appropriately into Biology curriculum activities that will foster students ownership of their ICT -rich learning environment .

Role of Teachers to implement ICT in Teaching Learning process

Teachers play a crucial role in the adoption and implementation of new technologies in education. Their perceptions are an important aspect that influences their adoption of ICT in teaching and learning **(Zhu, 2010),** because teachers' educational beliefs are closely linked to their actual use of ICT in classrooms **(Dwyer, Ringstaff, & Sandholtz, 1991) (Tondeur, Valcke, & Van Braak, 2008).** The quality of teachers and their continuing professional education and training remain central to the

achievement of quality education **(Ministry of Education GoB, 2013).** Understanding this fact, GoB regularly arranges teachers' training on ICT **(Mamataz, 2017) (PMID, 2013)**. Moreover, Digital Content Development has also been undertaken so that all teachers can collect subject based contents from a single source, for which an official web portal named ShikkhokBatayon **(www.teachers.gov.bd)** has been opened **(Mamataz, 2017) (Ministry of Education GoB, 2013) (PMID, 2013)**

Basic concept of biology

Biology is the scientific study of life. It is a natural science with a broad scope but has several unifying themes that tie it together as a single, coherent field. For instance, all living organisms are made up of cells that process hereditary information encoded in genes, which can be transmitted to future generations. Another major theme is evolution, which explains the unity and diversity of life. Finally, all living organisms require energy to move, grow, and reproduce, as well as to regulate their own internal environment.

Biologists are able to study life at multiple levels of organization.From the molecular biology of a cell to the anatomy and physiology of plants and animals, and evolution of populations. Hence, there are multiple sub disciplines within biology, each defined by the nature of their research questions and the tools that

they used.Like other scientists, biologists use the scientific method to make observations, pose questions, generate hypotheses, and perform experiments to satisfy their curiosity about the world around them.

Teaching of Biology through ICT

As biology includes complex relationships of unfamiliar and abstract concepts, it is quite difficult to learn and teach. Students often experience difficulty in understanding certain biological subjects and try to learn them via memorization without understanding (Kilic & Salam, 2004). But the use of ICT can help understanding a difficult subject easily. The learning becomes interesting and lively through using multimedia equipment in the classroom through active participation of learners in the learning process (PMID, 2013). It is especially important in biology as computers can present the information visually through well-prepared pictures, three-dimensional models, animations, interactive environments etc (Wang Q. , 2017).

Role of ICT in biology Teaching

ICT simplifies the part of teaching as a visual presentation . a visual presentation of a particular topic could be easily understood by the student teacher , it will be more effective if the student teacher gains the knowledge of integrating ICT in their classroom instruction . Teaching through ICT in higher secondary level can deliver information in a very easy manner .Teaching of biology through ICT makes visual presentations which enhance subjects interest of students . There are different advantages of ICT :

- Eliminate time barrier in Education for learner as well as teacher .
- Eliminate geographical barriers as learners can log on from any place .
- Asynchronous interaction is made possible leading to thoughtful and creative interaction .
- Enhanced group collaboration made possible via ICT
- New Education approach can be applied .
- It can also be used for non formal education like health campaigns and literacy campaigns .

Technology in Biology classroom

There are various types of technologies currently used in traditional Biology classrooms ;

Computer in classroom : Computer is a device that improves the teaching learning process easier . It is an essential tool for integrating ICT in the classroom . Here teachers are able to demonstrate new lessons , illustrate and show new websites .

Interactive Whiteboard : An interactive whiteboard has given the opportunity to touch control of computer applications . This enhances teaching learning experience in the classroom . This is not only aids for visual learning , it is also interactive and students can draw , write , and manipulate images .

Digital games : Games like Educational games have been growing significantly . The digital games are being provided as tools for the classroom and have given positive feedback I.e motivation for students .

Digital video : LCD projector like equipment to make our teaching learning process as proper as possible . DVD players also help us instead of LCD projector .

Podcasts : Podcast is a relatively new invention that allows anybody to publish files to the internet where individuals can subscribe and receive new files from the people by a subscription .

Criteria for implementation of ICT in Teaching biology

Some of the students felt that Biology was a tough subject , because of the theory part . Learning of Biology can be made easier and more comfortable by integrating ICT tools in instructional strategies for teaching biology . For this , teacher education programmes should give more emphasis on ICT training for the student teacher to apply ICT in

their instruction . The curriculum of the teacher education programme should be revised by incorporating innovative technological equipment for the dissemination of knowledge . Integrated ICT pedagogy will lead to quality higher education . The process of teaching -learning process should be modified according to the needs of changing technology enabled education ICT directly improve quality of Education and indirectly improve economy of the country . ICT is the best way to convey information to the students in biology , because of the easy understanding and attractive experience to the students . ICT can change the traditional classroom into a smart classroom . So , ICT integrated instruction is the best way to improve the quality of learning in higher education .

History of ICT used in Teaching Learning process :

In the last two decades "industrial society" turned into "Informative Society" due to the digital revolution. Information and Communication Technology (ICT) are having profound impact on Education. For implementation of ICT there are various thinkers, educators, and researcher have taken up the challenge of implementation of ICT science 1980s and get varied success. The internet was born in 1973 when Vint cerf developed TCP/IP protocol. In 1989 Robert Cailliau **(Gillies, J. & Cailliau, R., 2001)** and Tim Berners-Lee at CERN in Switzerland put forward a proposal for the management of documents using computers. Management at CERN received the proposal as 'vague but exciting **(Gillies, 2001, p. 181).** Cailliau and Berners-Lee envisaged a service that could share files, documents, information, dialogue, graphics, sound files and more. They called this service the World Wide Web (WWW). Networking using the WWW continued frantically until in 2001 the dot com crash rationalised the services that could be provided and

consolidated the first round of the WWW for the provision of information globally.

The initial stages of the WWW from 1990 to 2001 provided the capacity for an information service. Schools, training colleges and universities developed websites as part of the proliferation of information accessible globally. The websites were institutionally focussed and somewhat akin to reading manuals. This meant that access by users was limited to the provision of information only in text formats with little consideration for being user friendly or user focussed. This was described in a predictions about the internet in 1999 called The ClueTrain Manifesto **(Levine et al,2000)** as a passive 'push' model of communication.The Cluetrain Manifesto predicted that users of the internet would become more actively involved in a networked 'pull environment.

Then beginning in 2001, other types of services began to appear on the WWW. These included Google, Wikipedia, MySpace, FaceBook, Digg, Technorati, Twitter, Spock and many more which provided their services remotely and freely.

Central and state governments arranged different programmes to implement ICT in school Education. Apart from that there are many private schools that provide laptop, tablets to the students for the implementation of ICT in school education.

Over the years ICT implementations have been required to improve computer literacy in a more comprehensive approach. There are two main broad approaches to implementing ICT in Educational system. (I) Improving quality of Education through teaching learning process (ii) Improving administration and management of School**.**

POLICIES

sustainability in the area of education. The government of India formulated the first National Policy on Education (NPE) in 1968. The NPE, 1968 focused on promoting national progress, a sense of common citizenship and culture, and on strengthening national integration. It gave importance to a radical reconstruction of the education system to improve its quality at all stages, and gave special attention to science and technology, the cultivation of moral values and a closer relation between education and the life of the people. The **Indian national educational policy of 1986,** which was subsequently modified in 1992, stressed the need for using Educational Technology (ET) to improve access, quality and governance policies. They include ET and Computer Literacy and Studies in Schools (CLASS). These Two Central government schemes have emerged out of these policies.communication technology (ICT) in schools. The ICT role in education continued to get the attention of the Government of India. **National Curriculum Framework (2005)** and **SarvSiksha Abhiyan (SSA)** also recommended creating an environment for optimal utilisation of ICT in education. In continuation to this, many schemes and programmes have been introduced to effectively implement ICT in teaching and learning to increase the access at all levels of education. The present paper attempts to discuss ICT related policies formulated by the Central and State governments in India.

The NPE 1986, as modified in 1992, stressed the need to employ educational technology to improve the quality of education led to two major centrally sponsored schemes,namely, Educational Technology (ET) and Computer Literacy and Studies in Schools (CLASS). By recognizing the importance of ICT (Interactive Classroom Technique) in education, Indian government introduced the Computer Literacy and Studies in Schools (CLASS) as a pilot project initially with the introduction of BBC micro-computers. Under this project, a total of 12,000 such computers

were received and distributed to secondary and senior secondary schools through State governments. The project was subsequently adopted as a centrally-sponsored scheme during the 8th Plan (1993-98).

National Curriculum Framework 2005 (NCF) has also highlighted the 'significant role' ICT can play in school education. It talked about the essential component related to establishment of 'smart schools' designed to become technology demonstrators. ICT use improvement in excellence also figures in Government of India's flagship programme on education, Sarva Shiksha Abhiyan (SSA). Again, Central Advisory Board of Education (CABE) in the norm of schooling figured ICT comprehensively, in its report on Universal Secondary Education, in 2005. The Information and Communication Technology (ICT) in Schools was launched in December, 2004 and revised in 2010 to give opportunities to secondary stage students to mainly construct their competence on ICT skills and make them learn through computer aided learning process. The scheme currently covers both Government and Government aided Secondary and Higher Secondary Schools.

The Information and Communication Technology (ICT) in schools have been subsumed in the Rashtriya Madhyamik Shiksha Abhiyan (RMSA). **Rashtriya Madhyamik Shiksha Abhiyan (RMSA)** will become the umbrella programme and ICT@Schools will be integrated with RMSA to provide greater flexibility, enable optimal utilisation of resources and yield better results. Now ICT in Schools is an element of the RMSA.

Importance of ICT in Higher Education is also equally emphasised in the National Mission on Use of ICT in Higher Education. During the Twelfth Plan various initiatives of the Eleventh Plan would be carried forward with an objective to make these programmes more effective,efficient and sustainable. These include: Digital Infrastructure Initiatives:

(i) upgrade connectivity for universities and colleges to 10GBPS and 1 GBPS, respectively; (ii) build computer labs in all institutions as required and increase availability of laptops and low-cost access devices for faculty and students; (ii) provide smart classrooms; (iii) set up classrooms with interactive video-conference facilities linking Meta-universities and affiliating

universities; (iv) set up 100 server farms for cloud computing. 2. Content Initiatives: (i) national-level consortium for propriety content; (iii) create open access content repositories including interoperable institutional repositories; (iv) create platforms to facilitate user generated content and related networks; (iv) create a single portal for access to all content; (v) continue current initiatives of DTH channels to telecast digital educational videos. 3 Governance Initiatives: (i) rollout institutional Enterprise Resource Planning (ERP); (ii) computerised examination wings of all universities; (ii) provide robust online linkage of all affiliating universities with their affiliated colleges; (iii) create online data collection system; (iv) library automation; (v) automation of grants management. 4. Training and CapacityBuilding Initiatives: (i) train faculty in instructional design content creation; (ii) implement massive capacity-building efforts for adopting technology-mediated pedagogy in classrooms.

5.1 RATIONALE :

(Wallet & Melgar, 2014) study indicates that by implementing ICT in education an individual can complete a goal, which also enhances skill in the work force and improves social mobility.

All related literature reviewed indicates that ICT is more effective in Biology Teaching . Teaching Biology through ICT is more effective .

(Ward, Bronwyn Weston , & Tracy Bowker, 2007) reviewed that Teaching through ICT can enhance Teacher ‘s attitude towards the subject and willingness .

(Sipila, 2010) studied the implication of ICT at primary level and found that ‘s by using laptop and usage of ICT more effective than traditional methods .

National Curriculum Framework (2005) and Sarv Shiksha Abhiyan (SSA) also recommended creating an environment for optimal utilisation of ICT in education. In continuation to this, many schemes and programmes have been introduced to effectively implement ICT in teaching and learning to increase the access at all levels of education.

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Rashtriya Madhyamik Shiksha Abhiyan (RMSA) will become the umbrella programme and ICT@Schools will be integrated with RMSA to provide greater flexibility, enable optimal utilisation of resources and yield better results. Now ICT in Schools is an element of the RMSA.

5.2 STATEMENT OF THE PROBLEM

A study on the usage of Information and Communication Technology (ICT) by the Biology Teacher of Vadodara city in teaching of Biology During CoVId-19 Pandemic

5.3 Objectives of the study

(iii) To study the use of ICT in teaching of Biology in Higher Secondary School of Vadodara City .

(iv) To Study the use of ICT in terms of availability of resource in Higher Secondary School of Vadodara City

5.4 EXPLANATION OF TERM

Explanation of Term

Information and Communication Technology (ICT) : In the present study ICT refers to teaching Biology at Higher Secondary level by using electronic devices .

Desktop / Laptop

Smart Board

Digital Camera

Projector

Television

Social Media

5.5 Operationalization of Term :

(i) Usage of ICT :

Usage of ICT in the present study is using ICT in teaching-learning of Biology by teachers with respect to the usage of online websites, various Biology apps, youtube, social media used for content development and sharing with students, and also usage of Various assessment tools (like Kahoot, Mentimeter, Concept maps, Quizzes) and Learning Management system (LMS) used for teaching. It also comprises usage of various ICT tools like video and audio editor and powerpoint presentations used for the purpose of enhancing the student ‘s understanding through online teaching..

(ii) Effectiveness of usage of ICT Tool :

In the present study, the effectiveness of the usage of ICT Tools means the awareness and perception of teachers about usage of different ICT in teaching of Biology in terms of its effectiveness.

5.6 Delimitation of the Study :

The present study was delimited to the Higher Secondary School of Vadodara City affiliated with Gujarat Higher Secondary Education Board (GSEB) for the academic year 2020-2021 .

5.7 Population of the Study :

The Population of the present study consisted of all the Higher Secondary Biology Teachers of Vadodara City .

5.8 Sample of the Study :

The sample of the study consists of 33 Biology Teachers Selected through a snowball random sampling method.

5.9 RESEARCH DESIGN :

The present study was the Descriptive Research Survey Method . According to ‘ Best and Khan ‘ Descriptive Survey Method studies are used to find out ‘What is’ and therefore the detailed information is required for answering given questions .

5.10 Tools and Techniques :

The Following Tools and Techniques used for collection of data :

Questionnaires (For Teachers)

The above tools were developed by investigators . Questionnaires used for Objective 1 .

5.10.1 Questionnaire

There are 33 Questions developed by investigators .The Questionnaire starts from some basic Questions including age group of teacher ,experience of teacher in Biology . The Questionnaire will help to analyze proficiency of the teacher in usage of ICT .

5.10.1.1 Development of Questionnaire

Questionnaires developed by using Google Form and Teachers gave responses to the questions at their own pace .

5.11 Data Collection :

Investigators collect the data through google form . The Questionnaire was filled by the Biology Teachers . It was important to know how effectively teachers were able to use ICT in teaching Biology.

5.12 Data Analysis :

Data was analyzed quantitatively . Responses from the teachers were analyzed by using Frequency and Percentage. Graphs were quite helpful in displaying the data in an understandable manner.

5.13 Major Findings of the study :

- 69.7% Teachers are not able to get the proper training of ICT, therefore they lack knowledge of ICT in teaching Biology .
- Teachers are not aware about the newly developed portal for online Teaching mostly 81.1% the used youtube .

- ICT is the most Effective method for Teaching Biology at Higher secondary school .97% teachers agree that ICT is the most effective method in teaching biology .
- ICT based teaching method is mostly used to teach biology at higher secondary level .60.6 % teachers prefer ICT based teaching .
- 69.7% Teachers are able to complete the biology syllabus in a given time by using ICT .
- 90.9 % teachers agree that By using ICT in teaching biology which enhances subject interest and motivation of the students towards the subject .
- By using ICT 90% Teachers are able to give assignment work in biology
- Teacher ‘ s are able to track learner ‘s progress by using ICT
- Teachers are able to make informative and attractive digital materials in biology .
- By using ICT Teachers are able to make animated video presentations which enhance students ' interest and understanding towards the subject .
- Teachers are aware about the use of social media ,E-Learning tool and different biology apps for teaching biology .
- Teachers are easily teach different biological topic in attractive form by using ICT

5.14 DISCUSSION

Today the entire world enters into Technological evolution . In every field impacted by development of technology . ICT is broadly used in Education for teaching , learning ,evaluation , collaboration etc. The Review of related literature resonates by ICT which enhances the potential ability in teaching learning process and makes the biology teaching more effective . **(Ward, Bronwyn Weston , & Tracy Bowker, 2007)** suggested that, most of the teacher's confidence and motivation towards the teaching is enhanced by using ICT . ICT provides a wide scope in teaching learning process .

5.15 IMPLICATION :

- Teaching of Biology can be made easier by using ICT tools.
- ICT can change traditional classrooms into smart classrooms.
- ICT based Teaching method is most effective in Teaching Biology.
- Youtube vedios as an online portal to update the content of biology.
- By using ICT Tools biology teachers to complete their syllabus within time.
- Using Technological Tools makes biological teaching more attractive and informative.
- Teachers are easily track the learner's progress by using ICT Tool.

- ICT can help the teacher's to give assignment work to learners

5.15 SUGGESTION :

- This study was limited to GSEB School of Vadodara city. It can be extended to other schools also.
- This study is limited to biology subjects. Future researcher to find out usage of ICT for other subjects also.
- This study is limited for Higher Secondary School of Vadodara City, Further research conduct on Primary and Secondary School also.
- This research is limited to the usage of ICT in terms of Social Media , E-Learning system, Learning Management System, further research is carried out for various aspects of ICT.
- This study analysed that there are not proper teacher training programmes conducted by any school or teaching institute. Future research conduct to enhance teacher training programmes regarding ICT.
- This Study was analysed effectiveness of biology in limited topics of biology further research carried out for other topics of biology.

5.16 CONCLUSION:

From the Analysis of Collected data, and interpretation of data the following conclusion can drawn :

- ICT usage in teaching learning process which is an effective method than traditional method of teaching. Data Analysis shows that there are a number of teachers who did not get any training programme regarding ICT teaching in Biology, still they developed knowledge of ICT teaching in biology.

- Various Online portals, ICT Based Teaching Method, Video creation software, Animated videos, Various learning tools of biology, are used by Teacher's of Higher Secondary School of Vadodara city, which enhance Effectiveness of teaching in biology.

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