
UNIT 11 ICT IN SOCIAL RESEARCH*

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11.0 OBJECTIVES

After going through the Unit, you will be able to:

- What exactly is ICT and how is it related to social science research?
- Understand how ICT impacts social science research;
- Explain the changes that have emerged in social science research after adoption of the ICT; and
- To assess how academia has benefitted from this holy association.

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11.1 INTRODUCTION

ICT or Information and Communication Technologies or ICT refers to such technologies that provide us access to the vast body of knowledge through telecommunications. This may include a wide range of communication technologies like the internet, wireless networks, cellular phones, and of, course other modes of communications. Undoubtedly, information and communication technologies had gifted our society with an extensive range of dynamic communication modalities which enabled our people to communicate in real-time especially with others¹ inhabiting far-off countries through such technologies as instant messaging, voice over IP, Video Conferencing and teleconferences. Social networking sites like Facebook, Twitter, Instagram allow users across the globe to establish contacts with one another frequently and with considerable warmth and comfort. We can say that ICT serves as the base of modern computation which in turn had engineered the most modern form of virtual communication and dialogue. Though it is quite difficult to find one universal definition for ICT, we generally take the coinage to mean all those apparatus, devices, network-related configurations, applications and system rubrics that grossly account for individuals and government or corporate bodies, that work in unison as stakeholders to interact themselves or to enable interaction in a digitized world.



Picture 11.1. : Information and Communication Technology (ICT)

Photo credit: <https://www.piqsels.com/en/search?q=Phone+in&page=196>

While talking of the nitty-gritty of an ICT system, it must be said that it consists of both the wired and the wireless networks. At the same time, it would also imply the existence of the near archived technologies like the land-line telephones, radio, and televisions. Though updated as they may have become, their use has not become redundant for we still use them in the automated world today, perhaps in an altered version alongside the contemporary artificial intelligence and robotic technology. The list of ICT constituents can be exhaustively long for it keeps adding to one after the other and just, for instance, our smartphones, digital devices, and robotic systems are just a few additions to the existing ones. ICT, in short, is the technological arrangement made to expedite the process of interaction or social communication among individuals, groups, or organizations in the digital age. In short, ICT, therefore, is an all-encompassing term that covers all and every device, system or application that ranges from radio, television, digital phones, computers, both hardware and software network, satellite coverage; and at the same time various applications, systems, and services related to them such as video-calling and distance education.

Along with ICT came the age of the ubiquitous 'digital divide' for it brought along with it a notorious gender gap in the society riding on the tide of socio-economic factors which tore the society apart. ICT has increasingly been used as an initiator for higher education since the 1990s. A decade ago we spoke of technical and vocational education as well as training the teachers. It was only in the late 1990s that we could see a change and this was reflected in the wider world.

11.2 EVOLUTION OF ICT IN ACADEMICS AND RESEARCH: A BRIEF HISTORY

The seeds of the evolution of ICT perhaps were sown with the development of speech in human beings. It was especially through speech that knowledge could be shared and transmitted to future generations. Other than speech, men also created symbols to communicate their feelings to each other. The invention of the first writing skill seemed to have been traced to the beginning of the Bronze age.

11.2.1 Invention of Writing



It was as early as the 3000 B.C when the earliest Papyrus rolls were said to have been invented by the Egyptians soon after which people began their writing spree. The Papyrus plant grew

Photo: Papyrus

Photo credit: <https://en.wikipedia.org/wiki/File:Papyrus1.JPG>

aplenty across the Nile delta and was used extensively for writing. It was also said to have been well used throughout the Mediterranean region as well in the kingdom of Kush. papyrus persisted till it was replaced by a parchment and paper came to be used in the Byzantine Empire, though papyrus did not completely disappear. The writing system that started in the early Bronze age should not be a sudden invention of writing rather it was preceded by a few earlier traditions of symbolic systems. Though such earlier forms could not be taken as the proper form of writing but they still could be taken as the precursors of the modern

forms of writing. They were often termed as "proto-typings" that drew upon ideographic or the early mnemonic symbols to express ideas, though it contained no natural language. These systems were presumed to have emerged in the early Neolithic period, as early as the very 7th millennium BC. Soon after the neolithic age when one speaks of the Bronze age in ancient history, the role of writing becomes quite prominent. The different cultures in the Bronze age saw the prolific growth of various scripts. Some notable amongst them were cuneiform writing of the Sumerians, Egyptian hieroglyphs, Chinese logographs, Indus script, and the Olmec script of Mesoamerica. Cuneiform was probably one of the earliest forms of writing invented by the Sumerians in ancient Mesopotamia. A hieroglyph⁶ was on the other hand, a character of the ancient Egyptian writing system. It was Egypt which invented the pictorial script that supposedly marked the initiation of the Egyptian civilization.

Chinese character or logograms, as they are popularly called, constitute the oldest system of writing in the world. They find a widespread use in eastern Asia though Chinese characters are numerous and number in tens of thousands. Unlike the Chinese logograms extensively used even today, the Indus script as produced by the Indus valley civilization, still remains difficult to decipher. Likewise the Olmec script flourished in the Gulf coast region of Mexico between 1250-400 BCE. In tandem with these are the Cascajal Block which are nothing but tablet sized writing slabs in Mexico that uses characters that might represent one of the earliest writing systems in the Americas.

Soon after the Bronze age, came the Iron age when the Phoenecian alphabet ruled. This alphabet, in particular, gave rise to the Aramaic and Greek alphabets. The Greek alphabet must be credited for producing the first-ever exclusive symbols for vowel sounds. The Greek and the Latin alphabets in the early centuries gave birth to many European scripts such as those of the Gothic and Cyrillic scripts used across Euro-Asia and in various Turkic, Mongolic, and Iranic speaking countries in Eastern Europe. Aramaic alphabets, on the other hand, evolved into the Hebrew and South Arabian alphabets. Greek, in short, might be taken as the spring bed for all the modern scripts of Europe. The most popular descendants of Greek is the Latin scripts, also at times known as the Roman script. However, with the suspension of the Roman authority in Western Europe, drives for literacy were confined only to the Eastern Roman Empire and the Persian empire. Incidentally, the rise of Islam in the 7th century led to the evolution of a major language like Arabic. However, the renaissance of the 14th century saw the return of Greek and Latin as popular literary languages. Ever since the nature of writing had been evolving especially after the development of the tools and allied its technologies. The discovery of the pen and the printing press had only facilitated this on-going process. Historically though, reed pens, quill pens, and dip pens were used, with their nibs dipped in the ink, their modern counterparts like a ballpoint, rollerballs, fountain, and felt pens had only further consolidated this writing tradition. Especially, after the printing press was discovered in Germany in around 1440 by Johannes Gutenberg, a man who introduced printing to Europe and sparked off the printing press revolution. Perhaps, this could be taken as the stepping stone to the evolution of ICT across the world. Following these phenomenal spurts, we sensed jaw dropping developments in the 20th and 21st centuries which probably ushered the growth of ICT almost everywhere, notwithstanding education, research and practise. Let us now briefly see how ICT made its inroad into education before we concentrate on social research in particular.



Photo: Hebrew Scripture found embedded in Kochangadi Synagogue in Cochin, India dated to 1344.

Photo credit: https://en.wikipedia.org/wiki/Medieval_Hebrew

Do You Know?



Picture: Johannes Gutenberg

Picture Credit: <https://freesvg.org/johannes-gutenberg-vector-image>

Johannes Gutenberg was a German goldsmith, inventor, printer and a publisher. His introduction of the mechanical movable typing machine to printing was considered a milestone of the second millennium. The invention was considered a broad factor in hailing the modern period of human history.

11.2.2 Induction of ICT through Mass-Media

Probably, the first known exploration or negotiation of ICT with education may date back to the colonial era when India aired its first radio broadcasting session

in June 1923 by Radio Club of Mumbai. Way back in the 1930s, the British Broadcasting Corporation, better known as BBC used to broadcast educational and culturally flavored programmes through Broadcast Radio. In 1937, All India Radio started broadcasting its educational programmes for school going children (Agarwal, 2005). It had been a long time, way back in 2002 that India's first educational radio station called Gyan Vani was launched. Gyan Vani was an educational FM radio station serving several cities of the country. Its programmes are sketched out by various bodies like educational organizations, Non-Government Organizations, United Nations agencies, ministries of the government, central and particularly state open universities. Coming to television, we find that it definitely was more effective than its radio given its unique feature of combining both the audio and visual technology. Role of television as an instructional medium found its first appearance in 1932 by the State University of Iowa in USA on an experimental mode. Later on owing to World War II, the use of television had to be minimized. However, the USA by now had very well understood the importance of television in imparting education and had therefore, reserved 242 frequencies for educational broadcast on the basis of neither profit nor commercialization in 1952 (Magnuson: 1965). However, by 1961, educational television began to grow by leaps and bounds and there was no turning its back. Some of the universities who took the pioneering role in creating networks for reaching both on-campus and off-campus student populace were Ohio University, University of Texas and the University of Maryland.

Do You Know?

The University of Maryland, one of the harbingers of televised educational programmes, merging ICT with research, are still working on the outcomes of educational television, especially on young minds. A newly published

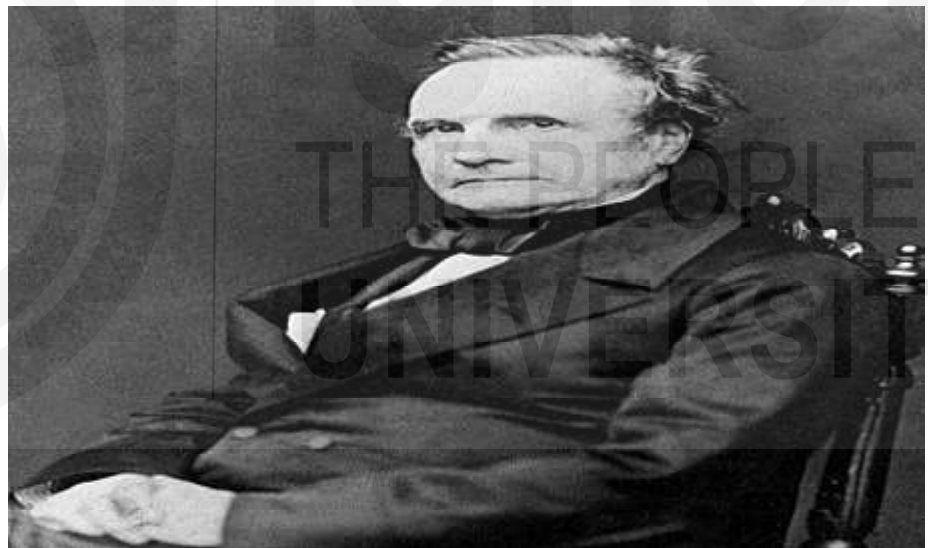


research driven by the University of Maryland School of Public Health Research Professor Dina Borzekowski (Department of Behavioral and Community Health) in the Journal of Applied Developmental Psychology, helps us address this issue with a study involving a locally-produced Tanzanian children's show called Akili and Me. Research findings pointed out that children who watched Akili and Me gained valuable and foundational educational substance above and beyond other factors grossly associated with achievement like existing knowledge and greater sense of maturity. The greatest effects of exposure were observed in the child's ability of counting, a measure that was featured and repeated often in the Akili and Me videos. The next greatest effect was seen with English skills in the Tanzanian children. Professor Borzekowski concluded that with lack of schools and infrastructure for toddlers, televised mediations often act as an agent of stimulation and supplementation. You can follow the below mentioned You tube link to watch the show:

https://youtu.be/o_gxC_4zI8M

11.2.3 Evolution of ICT through Computer and Multimedia

Information and Communication Technology (ICT) probably reached its peak with the coming of computers and multimedia. Computers date back to the early 19th century when Charles Babbage, an English mechanical engineer conceived the idea of a programmable computer. In 1980, Microsoft Disc Operating System (Ms-Dos) originated. Subsequently in 1982, International Business Machines Corporation (IBM), an American multinational technology company headquartered in New York introduced personal computers for both domestic and industrial purposes. Soon later, efforts were made to build the interconnected computer networks that originated in the United States through on-going collaborations with the researchers in the United Kingdom and France. Early packet switching networks like the NPL network, ARPANET, Merit Network and CYCLADES in the early 1970s made intensive research to provide data networking. Much later, Local Area Networks (LANS) were developed and started functioning through Transmission Control Protocol (TCP) and Internet Protocol (IP). It was soon followed by the birth of the World Wide Web (WWW) that the Internet gradually assumed the form it took today. The first popular search engine on the web was Yahoo search. Soon thereafter, several other search engines made their appearances such as Megallen, Excite, Infoseek, Inktomi etc. it was only around 2000 that Google's search engine rose into limelight. Other prominent ones soon followed such as Microsoft's MSN, Bing and plenty others like Baidu, Gigablast and Mojeek.



Picture: Charles Babbage

Photo credit: https://commons.wikimedia.org/wiki/File:Charles_Babbage_-_1860.jpg

Do You Know?

Charles Babbage (26 December 1791 - 18 October 1871) was an English mathematician, philosopher, inventor and mechanical engineer, Babbage originated the concept of a digital programmable computer. Considered by some to be "father of the computer", Babbage is credited with inventing the first mechanical computer that eventually led to more complex electronic designs.

11.3 E-LEARNING AND ICT

E-learning however did not have a very chequered history. It only started back in the early 1970s which however expanded rapidly from the mid-nineties in the developed nations. Online learning appeared in 1982 when the renowned Western Behavioral Sciences Institute in La Jolla, California opened its School of Management and Strategic Studies. A little later, in 1989, the University of Phoenix started offering education programmes through internet networks. The school supposedly deployed the mode of computer conferencing to deliver a distance educate based course to the business executives. In 1989, the University of Phoenix started offering its educational programmes through e-learning tactics. In 1993 again, the University of Illinois, created its own web browser which helped it prosper. It was much later in 1998 that the first ever full-fledged online programmes made their debut. Some of such programmes were offered by New York University, Western Governor's University, the California Virtual University²⁷ and Trident University International.

Likewise in India, we find that the computer industry originated in India with the establishment of Tata Group in collaboration with Burroughs in Mumbai in 1967. The Santacruz Electronics Export Processing Zone (SEEPZ) was the first ever software export zone that was set up in the Andheri East area of Mumbai. It was a Special Economic Zone in Mumbai that housed electronic hardware manufacturing companies and software companies of India. Soon after in 1976 National Informatics Centre (NIC) was established under the wings of the Ministry of Electronics and Information Technology. It helped the Indian Government to gear up for large-scale semblance with IT in the 1990s³⁰. It played a big role in setting up the building blocks of e-governance across the nooks and gullies of the Indian society.

In India since 1990, with the incidence of economic reforms, the human resource development sector had seen a revolutionary change. Direct deployment of computer and internet services had been vital in bringing such revolutionary changes in various sectors, especially education. Internet services have been enjoyed by the people in India by Videsh Sanchar Nigam (VSNL) since 1995. Though the service was primarily enjoyed from our four prime metros, Calcutta, Mumbai, Delhi and Madras only, it was later extended to other areas in 1998. Slowly and steadily, IT services tip-toed in homesteads and schools. India understood that it was high time that it should appreciate the prominence and significance of information technology in education, higher education and research. The nation therefore started the computer literacy studies in schools (CLASS) project to introduce computer literacy in schools. It later on graduated to higher education and institutions delivering such education. In 1964, Smt Indira Gandhi, the then Prime Minister proclaimed that education must be brought to all the parts of our country, especially the weaker sections of our populace. The establishment of the first open university was initiated on August 26, 1982 in Andhra Pradesh. The Andhra Pradesh Open University, now known as B.R Ambedkar Open University radicalized the sphere of education and research in the country. Far away from the sedentary classroom anatomy, this open system challenged the conventional system and resolved to democratize education through rampant use of technology and popular mass media. Indira Gandhi on September 20, 1985 inaugurated an open university that was eventually named after her, viz. Indira Gandhi Open University³¹. She believed that the Open

University would extend educational exposure and opportunities to all the nooks and corners of the country. The National Policy on Education (1986) proclaimed that the university had been set up to offer programmes through distance learning, redolent with the massive use of mass media and technology. Thus it was quite clear that ICT was tip-toeing into our educational threshold, right from schools to higher education and research, all over the country.

11.4 APPLICATIONS OF ICT IN SOCIAL RESEARCH

Thus we saw how a holy association between ICT and social research was formed for the former seems to have a large number of its applications in social research. ICT seems to have its application in the social research domain largely owing to its ability to facilitate the knowledge accumulation process which is a prerequisite for building a robust system of inquiry. Let us have a look at the areas where ICT can be of immense help to social research. The relevant areas of application for ICT in social research can be broadly classified into three major areas. These three categories are given below:

- 1) Application of ICT in pre-data collection and analysis.
- 2) Application of ICT in data collection and analysis.
- 3) Application of ICT in post-data collection and analysis.

Let us come to each of these stages as we examine the use of ICT in research.

11.5 APPLICATIONS OF ICT IN PRE-DATA COLLECTION AND ANALYSIS

Application of ICT in social research can be traced to each of its stages of research design. As we shall explore each of these stages of research design, we shall be able to understand how ICT pitches in. Let us first begin with the pre-data analysis stage to understand the use of ICT at this level.

11.5.1 Literature Review

Soon as we choose the research problem, we move into literature-review for we want to introduce the reader to the topic we wish to address. We actually want to make it clear to the readers what we have already learnt about the problem in question. For instance, if you are working on drug addiction, it must be made clear that we have learnt enough about the topic from all the past researches done on the subject. The important works must be read and thoroughly delved into before we choose to start our project on this topic. Your review of the literature must point to the inconsistencies and disagreements to be found among the present research findings. Therefore, your task will be to find out the research gap and then to look for the ways to address the gap or resolve such incongruities. Performing this arduous task of literature review can be extremely painstaking and rigorous. To help this out, a lot of research materials, literature and artefacts today can be accessed through internet search engines and databases. These are useful in academic settings for finding and accessing articles in books, academic journals, institutional repositories, archives, or other collections of scientific and other articles. We can have a general list of search engines that help us for academic

purposes. On the other hand, bibliographic databases can give us information finding books and journal articles. Some providers that supplement us with such databases are EBSCO Publishing, African Journals Online, Airiti INC, DeepDyve, Google Scholar, Indian Citation Index, J-Gate, JSTOR, Mendeley, Microsoft Academic, OpenEdition.org, Project Muse, Social Science Citation Index, Social Science Research Network, Springer Link, Shodhganga, Swayam Prabha. Cambridge Core, Taylor and Francis, Wiley Online Library, World Cat etc. let us have a look at a few of the databases to have an idea of the intervention of technology within the confines of basic and applied research. It is not possible for us to study each of these frequently. Therefore, we shall look at a few of the Database and their functions.

11.5.2 Shodhganga

It is the name termed to denote digital repository of Indian Electronic Theses and Dissertations set-up by the INFLIBNET Centre. The word "Shodhganga" had been coined in order to identify the digital repository of Indian electronic theses and dissertations set up by the INFLIBNET Centre. It is a classic instance of how we can use technology to set up a database and use it extensively for literature review while researching our specialized field. It had been set up using an open source digital repository software called DSpace developed by MIT (Massachusetts Institute of Technology) in collaboration with Hewlett-Packard (HP). The Shodhganga provides us with a platform for the research scholars to deposit their doctoral theses so that it could be made available to the entire scholarly community in open access mode. The repository has the versatile capacity to capture, index, store, disseminate and preserve the electronic research works submitted by the researchers.

11.5.3 Mendeley

Mendeley is a company based in London which is a provider of products and services required for academic research. It is best known for its service for reference management, which is extensively used for managing and sharing research papers. It alongside generates bibliographies for scholarly articles. These functions greatly help our literature review for Mendeley has a very strong data set. Alongside it takes care to cite the articles we use in our literature review. Mendeley was purchased by the academic publisher Elsevier in early 2013.

11.5.4 Google Scholar

Google Scholar is a freely accessible web search engine that indexes the full text or metadata of scholarly literature across a collection of publishing formats and disciplines. It came into inception from November, 2004, and since then it included most peer-reviewed online academic journals and books, conference papers, theses and dissertations, pre-prints, abstracts, technical reports and other scholarly literature. It allows users to search for digital or physical copies of articles, whether online or in libraries. It is engaged in indexing "full-text journal articles, technical reports, pre-prints, theses, books, and other documents which also include web pages that are taken as 'scholarly'. Since Google Scholar's search results feed on commercial journal articles, often we can access only an abstract and citation outline of an article. Only after we pay a fee, we may be allowed access to the content we are looking for. Nevertheless, since 2006, it has provided us with

links to both published versions and major open access repositories. This includes those materials posted on individual faculty web pages and other unstructured sources identified by similarity. This added feature of the Google Scholar has greatly aided the literature review work by the researchers.

11.5.5 Microsoft Academic

Microsoft Academic is a free public web search engine for academic publications and literature. It had been developed by Microsoft Research. It had been launched in 2016 to emerge with a totally new data structure and search engine. It presently harbours over 220 million publications, 88 million of which are journal articles. Compared with Google Scholar, the latter can find about 99.33 million, or around 87% of an estimated 114 million English language scholarly documents on the web. As a technological tool Google scholar not only bypasses Microsoft Academic, it also outwits subscription products like Thomson Reuter's Web of Science or Elsevier's Scopus databases. It is assumed that Google Scholar indexes more documents than many of its counterparts. After the literature review, time comes for conceptualization, operationalization and selection of research methods. Having explored the structuring of inquiry in detail, the researcher gradually moves into the various data collection techniques and their subsequent analysis. Data collection largely depends on the observational techniques available to the researcher.

11.6 APPLICATION OF ICT IN DATA COLLECTION AND ANALYSIS

Data collection remains an optimal stage of social research through which the researcher collects the data that he wants to study. It is the process of gathering and measuring information about the variables we want to study in a given set-up. This enables the researcher to answer the relevant questions about the variables he wants to study and to eventually present his findings. Data collection is essential in almost any discipline we wish to name. Though methods vary in sync with the priorities of each discipline, data collection along with its allied tool remains an inevitably essential component of all research projects. Whatever may be the discipline, the objective of all data collection is to fish out the most appropriate data and quality evidence. Such authentic data will help the researcher to get reliable data from the respondents which will eventually lead to proper data analysis. Let us first study data collection after which we shall go to data analysis.

11.7 OBSERVATION

There are different methods of observation such as experiments, survey research, qualitative field research, unobtrusive and the evaluation techniques. Experiments are possibly the most rigorously controllable of the methods that social scientists use. Survey research, on the other hand, is one of the most popular methods in social science. This type of research engages itself with collecting data by asking people questions. These can be done, as you know, through self-administered questionnaires or through interviews. Interviews can be both telephonic or face-to-face. The qualitative field research, on the other hand, examines the natural form of data collection by the researchers. The direct observations of social phenomena in natural settings, as you must have read, is

the most spontaneous form of data collection. For participant observers, observation may be a more intimate and embedded part of their everyday living with which they juxtapose their research motives. Again on another note, we can talk of three still other forms of unobtrusive data collection such as content analysis, analysis of existing statistics and of course, historical documents remain the most valuable asset for social science research. Evaluation research involves the application of experimental and quasi-experimental models for testing social interventions in real life situations. After having discussed the methods of data collection, let us explore the ways in which ICT have come forward to ease the different ways of data collection, already stated.

11.7.1 Technology Assisted Experiments

We find that with greater enthusiasm, researchers are using the World Wide Web as a tool for conducting experiments. Since representative samples are not essential in most experiments, social researchers often use volunteers who respond to invitations online. We find experiments set up in conditions far away from natural set-ups through the help of ICTs. A Microcomputer-Based Laboratory (MBL) (in UK data-logging) tool is all but a combination of the hardware and software that are generally used for collecting data. Data is collected using sensors connected to a micro-computer through an interface. These collected data can be analysed and displayed in graphic forms, in real or delayed time. The MBL package for instance, can be taken as a large podium with different tools and environments for the user. Even when working and experimenting in a computer assisted environment, they still get a flavor of the real environment. It is as if they are studying the natural setting and conducting their experiments out there. This method is highly recommended compared to the hard copy method in which the researcher has to manually convert the scores from the hardcopy into softcopy before the statistical processing can be initiated.

11.7.2 Computer Assisted Survey

Data can now be collected via online, web based or internet survey by using for instance Google Documents and survey monkey. If we use these methods to collect quantitative data, it can be both time saving and cost-cutting. Besides, we can reach a lot more individuals and groups, who otherwise might not be available online easily. For instance people with disability, HIV or other forms of stigma may hesitate to go for face to face surveys. These are purpose-built software and Internet Technology which are undoubtedly more effective forms of collecting data from the respondents. Another advantage of this computer assisted survey is that data collection conducted in its original format can be fed directly into the statistical software package. Therefore, this kind of direct input is undoubtedly faster and more appropriate in comparison to hardcopy method. In the hard copy method the researcher has to manually convert the scores from hard to soft copy before statistically processing the data. In this direct method, data is entered directly into the computer conducive mode. The data which is entered is verified and validated by computer and then it is eventually transferred to tape or disk for further processing. Data is captured directly without there being any conversion stage. Specially marked or printed documents, for e.g questionnaires can be read by a special input device. The technology for online survey research is evolving every day. Today social researchers find themselves at ease with online survey work. There are presently around dozens of online survey software packages

and web survey services accessible to researchers, most of which ought to be subscribed. Some of these packages had been enlisted below:

CreateSurvey	http://www.createsurvey.com
EZSurvey	http://www.raosoft.com
FormSite	http://www.formsite.com
HostedSurvey	http://www.hostedsurvey.com
InfoPoll	http://www.infopoll.net/
InstantSurvey	http://www.netreflector.com
SurveyMonkey	http://www.surveymonkey.com
SurveySite	http://www.surveysite.com
WebSurveyor	http://www.websurveyor.com

These packages definitely help us navigate our survey research processes. Let us look at yet another form of observation that extensively uses ICT.

11.7.3 Computer-Assisted Personal Interviewing (CAPI)

It is a technique used frequently for data collection on a handy device. For the last decade the apt use of this technology can be noticed especially owing to its cost-effectiveness, usability, and prompt availability of data. Researchers use CAPI in large scale surveys because it restrains them from missing out on data, self-reliance on mathematical calculations and persistently tracks the unavailable responses. CAPI though is a face-to-face data collection method in which the researcher uses a tablet, a mobile phone, a computer or a laptop to record answers rendered during an interview. There is a wide range of CAPI softwares and therefore it can be used even for somebody with absolutely zero programming experience to properly program a CAPI questionnaire. CAPI software commonly used in data collection are given below:

Name	Developer
Blaise	Statistics Netherlands
CSPro	United States Census Bureau
Dooblo	Dooblo Ltd., Israel
Open Data Kit(ODK)	University of Washington's Department of Computer Science and Engineering
SurveyBe	Economic Development Initiatives Limited, UK
SurveySolutions	The World Bank

Source: https://en.wikipedia.org/wiki/Data_collection

11.8 APPLICATION OF ICT IN DATA ANALYSIS

Now we shall move to the data analysis part which is yet another important stage of research design. It is a process of inspecting, cleansing, transforming and modelling data with the objective of discovering crucial facts that influence decision making in research policies. Data analysis has several facets and

perspectives pertaining to the disciplines in which it is used. In statistical applications, which you will learn in the methodology course itself, data analysis has been dealt with in a rigorous manner. Data analysis can be divided into quantitative and qualitative types. Let us dive deeper into these brackets to enable a thorough understanding of how data analysis works in social sciences:

11.8.1 Quantitative and Qualitative Variable

One of the core objectives of the social and behavioral sciences is to help explain the human attributes or characteristics. For instance, we may want to find out why students are happy with female teachers or vice-versa? One way to understand this is to collect data relevant for the sample we are studying. As you already must have known, a variable is a quality or a certain characteristic that varies. If its quantity remains unchanged, then it is better to call it a constant. The socio-behavioral sciences are interested in expatiating why certain attributes vary while others remain constant.

The primary type of variable is a dichotomous one, that which has that is either existent or not. For eg, belonging to the Hindu religious community is dichotomous because you either belong to one or not. There can be absolutely nothing in between. Students, you see the dual categories or variables, as you say may be represented or coded, as we term it in statistics, by two distinct numbers, say 1 and 2 or say, 11 and 15. For instance, if you are a Hindu by religious affiliation, you are coded as 1 and the other belonging to say, Islam religious affiliation may be coded as 2. There are two main kinds of variables, such as qualitative, categorical, nominal, or frequency variables. For instance, we can say that religions are qualitative such as Hindu, Islam, Christian and Sikh are variables. They can stand coded with any range of random numbering such as 1, 2, 3, 4 and 5 or say, 23, 24, 28, 45 and 56. The numbers do not have any other implication excepting that they refer to each different category. The frequency of cases subsumed under each of the categories can be separately counted. Therefore this variable can be labelled as the frequency variable. The frequency, proportion and percentage of such cases can be ascertained. Therefore, we can say that data containing qualitative variables is at the same time quantitative in character since the frequency counts, proportion or percentage of cases can be quantified. (*Duncan, 2003*).

The other kind of a variable is called qualitative. Qualitative variables cannot be ordered on a numerical scale in statistics so they are termed as nominal scales. The word "nominal" means "name", which is exactly what qualitative variables are all about. A nominal scale is a scale where no underlying ordering is ever possible or implied. In other words, the nominal scale is where data is assigned to a category. For example, we can take eye colors, states, dog breeds, marital status etc. In social sciences, we get interested to find out whether one variable is related to one or more variables. It is evident that if the relationship between variables is robust, more common features are found among the variables. Bivariate data analysis explains the relationships between three or more variables simultaneously. A statistical tool that examines two variables at a time is the one way analysis of variance. All other statistical techniques three or more variables at a time.

Look students, a one-way analysis of variance looks at the relationship between a qualitative variable such as marital status and a quantitative one. Likewise

there can be a multivariate analysis that involves three or more variables, such that one is quantitative and the other two qualitative. It is undoubtedly clear that any aspect of human behaviour is impacted by two or more variables. Therefore, any day, a multivariate analysis is far far more sturdy than a one-way analysis. We can say that several analyses can be used during the initial data analysis phase, such as univariate statistics is used for single variable and bivariate associations for determining correlations between variables.

11.8.2 Software for Data Analysis

Now let us look at the ways ICT s help us in making such analysis. Some of these free software come handy for data analysis. Notable amongst them are DevInfo, ELKI, KNIME, Orange, Pandas, PAW, R, ROOT, SciPy and Dta.Analysis. Let us discuss a few of these packages in detail:

1) **Devinfo**

It was a database system created under the patronage of the United Nations and endorsed eventually by the United Nations Development Group for monitoring human development. Devinfo was an essential tool for organizing, storing and presenting data in a systematic and uniform way such that data sharing can be facilitated across government departments, UN agencies and development partners.

2) **ELKI**

ELKI or Environment for Developing KDD-Applications Supported by Index-Structures is a data mining software framework used extensively for teaching and research. It is originally associated with the database systems research unit of the university of Munich, Germany.

3) **Pandas**

It is a computer programming software library written for data manipulation and analysis. It specializes in offering data structures and time-series. Pandas is quite popular for importing data from a plethora of file formats such as JSON, SQL and microsoft Excel. Pandas , it is seen, allows various data manipulation operations such as merging,re-shaping and selecting.

Thus we see that there are innumerable organizations that provide software packages for data analysis to researchers and research organizations. Different companies or organizations vye among themselves in data analysis contests to encourage the researchers to use their data or to solve a particular question using data analysis. A good example may be the international data analysis contest of Kaggle. Do you know what Kaagle is? Kaggle is a subsidiary of Google LLC. Google LLC is an United States based multinational technology company that specializes in Internet-related services and products. It is considered one of the Big Four technology companies alongside Amazon, Apple, and Microsoft464748. Kaggle has an online community of data scientists and machine learning practitioners which allows users to find and publish data sets. They also encourage researchers to explore and set-up models in a web-based data-science environment and work along with other data scientists and machine learning engineers.

11.9 APPLICATION OF ICT IN POST DATA COLLECTION AND ANALYSIS

After data collection and analysis had been done, it's time to move into the last leg of the research, which we term as the post-analysis phase. It is here that we try to chalk out the various strategies for wrapping up our research findings and presenting them on the public domain. Speaking broadly the pockets of the post data interpretation phase can be generating citations for our research, sharing our paper on the academic forefront and of course plagiarism check, without which our research remains incomplete. Let us discuss each of these briefly to understand the essence of this phase especially to bring out the relevance of ICT at this particular stage.

11.9.1 Citations in Research and the ICT

We use various tools with support from ICT to assemble citations with limited efforts. These are the mechanisms we can use with a variety of systems that help us format the complete references for our paper with the minimized effort. As you know, while we write a paper we have to identify the sources of books, journal or any other scholastic content that we have used in our article to give due credit to the source author. This not only retains the academic integrity of the research community, but also at the same time maintains the transparency of our research article. Some of the tools that we use for this purpose are Citation Hunt, Citer, Citoid, MakeRef, RefScripr, WebRef etc. these tools usually generate citations on the basis of the information that we provide them. ICT at the same time uses templates for the researchers with similar purpose in mind. Some of the well-known templates are WebCite, Zotero, refToolbar etc. Many of these templates may even generate an alphabetical bibliography of all the works cited in the scholarly paper from a list of books and journals available with them.

Do You Know?

Zotero is a free and open-sourcereference management software that can manage bibliographic data and related research matters (such as PDF files). It was produced by the Center for History and New Media at George Mason University. The name "Zotero" is loosely derived from the Albanian verb *zotëroj*, meaning "to master".

11.9.2 Plagiarism Check

Plagiarism is the un-authoritarian use of another author's language, thoughts, ideas, or expressions as one's own original work. Plagiarism is considered an academic breach of trust and a violation of journalistic ethics. It is subject to sanctions such as penalties, suspension, expulsion, substantial fines and even incarceration. Recently, cases of "extreme plagiarism" have been identified in academia. The modern concept of plagiarism as immoral and originality as an ideal emerged in Europe in the 18th century, particularly with the inception of the Romantic movement. Free online mechanisms have become handy in detecting plagiarism. There are a range of approaches that make serious endeavours to delimit copying. The ICT helps protect the originality of such research articles by disabling the right clicking option and putting warning banners related to copyrights on web pages. Besides, after a research material has been prepared,

attempts are taken to test its authenticity to check for plagiarism through the copious use of ICT. We shall look for some of such softwares and tools that help detect plagiarism. Such softwares are for instance, Quetext, Turnitin, iThenticate, Viper, checktext.org, plagscan.com, Grammarly, Crossref, Plagiarism Software, DupliChecker, Copyleaks, PaperRater, Plagiarisma, Plagiarism Checker, Plagium, PlagScan, PlagTracker, Plagiarism Hunt, etc. Besides, some other engines are VeriCite, Unicheck, Crot Plagiarism Checker, UNPLAG, URKUND, SafeAssign, CopyCheck, StrikePlagiarism.com, Crot Pro, Moss, Compilatio, Ephorus, PlagiarismSearch.

At the national level, on the basis of the recommendations of Sub-Committee, National Steering Committee (NSC) of eShodh Sindhu., The MHRD, Govt of India has initiated a programme "Shodh Suddhi" which shall provide access to Plagiarism Detection Software (PDS) to all our universities and Institutions in India since Sept 1, 2019. The programme shall cover all the Central Universities, State Universities, Deemed to be University, Private Universities, Centrally funded Technical Institutions(CFTIs) and Inter University Centre (IUCs) of UGC. We find that Under this initiative, URKUND a Web Based Plagiarism Detection Software system has provided to all the universities and Institutions in the country. This programme was formally launched by the Honorable Minister of Human Resource Development (HRD) on 21st September, 2019.

11.9.3 Publishing the Research Findings

We have come to the last stage of our research process that is publishing our research findings. Here again we can take the help of ICT for choosing the right place for publishing our scholarly work and following the allied processes. Instead of manually submitting our manuscripts we generally go for online submissions, for such digital platforms are both convenient and time-saving. We choose journals according to our interest areas and usually visit their website. We have to follow their instructions strictly for submitting our manuscripts online. Besides a variety of journals available at our disposal, we now have the strict instructions of UGC to publish journals as prescribed in their CARE List. The University Grants Commission has established the Consortium for Academic and Research Ethics (CARE) for creation and maintenance of a reference list of quality journals. The UGC has also constituted an Information and Communication Cell for its journal analysis. The Savitribai Phule Pune University (SPPU) had been entrusted with this responsibility of journal analysis. The UGC has established its ICT cell for journal analysis and verification at SPPU. INFLIBNET Centre, Ahmedabad serves as the supporting agency for this ICT approach of the government of India. Besides, four regional universities have been identified as the CARE Universities which functions under the supervision of the CARE empowered committee. ICT had set up the journal analysis protocol for the CARE system which gives the detailed information about these journals on the UGC website. Proposals of manuscripts to be submitted by the researchers can only be done through the CARE Portal established by the ICT Cell of the UGC at Pune. The same process is also adopted while including a new journal by the publisher of a journal in the CARE list.

11.10 LET US SUM UP

We thus have seen how ICT has helped us in each of the stages of our research. Right from selecting a topic for our research to publishing our works in distinguished journals and other platforms, digitization had immense support. Even people can enroll themselves for a course or a MOOCs (Massive Open Online Courses) to equip themselves with the fundamentals of research before undertaking their own research project.

We have started with our objectives of the chapter. Then we have introduced the theme to our learners. After this, spoke about the evolution of ICT in academia and deliberated briefly on the history of ICT both across the national and the international panorama. Then we moved in the core of research and discussed the steps one by one. Then we made three broad phases such as pre data collection and analysis, data collection and analysis and post data collection and analysis. Then we saw the detailed application of ICT in each of these phases and examined their vitality in carrying out the research.

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GLOSSARY

Action Research : This form of research counters the conventional social science paradigm by going against the reflective form of knowledge created by the external theoretical experts by observing respondents or decisions. It is in fact based on immediate observation of the social situations where the respondents are not mere observers but active participants of the research. They inform the research questions and help take major decisions.

Positivism : A philosophical theory that recognizes only those facts as scientifically valid, which are objective and can be perceived, and therefore discouraging all forms of metaphysics and theism.

Post-Foundationalism : The Post-Foundationalist model of rationality has come

out of the ongoing conflict over the Foundationalist and the Non-Foundationalist models. Post-Foundationalism is the search for a middle way between the objectivism of Foundational-ism and the relativism of many forms of Non-Foundationalism. (Denzin,2010:29). Each of these moments not only have distinctive characteristics, what make the qualitative research rich is its distinctive strategies of enquiry which are both diverse and unique. Let us now look into these strategies of enquiry.

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