

ASSIGNMENT No. 1

Q. 1 What are the sources of knowledge? Define scientific method and describe its different steps.

Epistemic Awareness:

Epistemology is the branch of philosophy defined as “the study of human knowledge.” Like epistemology TOK involves questioning our sources and the nature and accuracy of our knowledge in the hope that we will develop a more informed understanding of what we know and don't know. That is, enabling us to become more epistemically aware.

It is important because accurate knowledge of our two worlds - the real world and the inner world - correctly informs us of the conditions we must cope with. To know facts is to survive; not to know, or to assess one's environment wrongly, is to lose the fight for survival.

We face two serious epistemological problems.

1. How can we determine which facts are true

As human beings living in the 21st Century we are surrounded by a wealth of information but not all of it is trustworthy, so we must find a way to double check fact-claims. We must learn somehow to screen out the fictions but let in the facts. On what criteria can we decide what are facts and what are false claims?

2. How can we determine which facts are important

However, it is not enough to simply determine which facts are true, we must also consider which facts are useful. A correct catalogue of the size and shape of every blade of grass on my lawn may well be factually true but it will not be as useful as knowing that my lawn is on fire and about to

engulf my house. Given the overwhelming number of facts available to us, what criteria can we use for deciding what is more important, what less?

Almost everything that we know originates from four basic sources:

- **Senses** (possibly the most important)
- **Authority** (knowledge from other sources, hopefully experts)
- **Reason**
- **Intuition**

The Senses

Information from the senses is called empirical knowledge and *empiricists* believe that the fundamental source of all knowledge is our senses. Our senses are exploratory organs; we use them all to become acquainted with the world we live in. We learn that candy is sweet, and so are sugar, jam, and maple syrup. Lemons are not, and onions are not. The sun is bright and blinding. Glowing coals in the fireplace are beautiful if you don't touch them. Sounds soothe, warn, or frighten us. Through millions of single sense-events we build a fabric of empirical information which helps us interpret, survive in, and control the world about us.

We have a number of different kinds of senses:

- The objective senses that tell us about the world: sight, sound, smell, touch and taste
- The visceral senses, in our mouths and gut that give us the sense of stomach ache
- The proprioceptive senses, in our muscles that tell us if our fist is clenched or not
- The balance senses, mostly in our ears that tell us if we are ... um ... balanced

However, our senses present us with a serious credibility problem. Before we start the TOK course most of us are *naïve realists* people who simply accept what their senses are telling them as the truth ... but is there any way we can actually be sure about this? Can we really trust what our senses seem to tell us?

Unfortunately the answer must be a reluctant no. Our senses do not give us a "true picture" of the real world; they give us useful picture – a picture that is designed to help us move around, survive in and take advantage of our world. To take a simple example: if you think about it we know that the chairs we sit on are not actually not solid: they are made of atoms which are actually more space than anything else. Yet our

senses tell us that they *are* solid. Why? Because in terms of day to day survival there is no point knowing about atoms: you need to know that a chair will hold you up if you sit on it and that a rock will hurt if it falls on you: a sensitive awareness of the arrangement of the sub-atomic particles of a boulder as it plummets towards you will not do your survival chances any good.

Authority:

Other people are continual sources of information. Such information, however, is always second-hand knowledge - or third-, fourth-, or nth-hand knowledge. It is all "hearsay." The farther it is removed from our own personal experience, the more caution we must exercise before accepting a fact-claim.

All of our historical knowledge is acquired in this way as is most of our knowledge of the sciences. We can't experience the past or personally repeat every experiment, so we must trust the specialists and accept, though not blindly, the discoveries they record for us. The key thing with knowledge from authority is that it can be double-checked and the work of scientists and historians is continually being 'double checked' as other workers in the same field (even sometimes us in our classrooms) repeat their experiments or investigations. A healthy cynicism of sources, the development of the skills required to check facts and an awareness of which sources are more or less reliable is a good way to ensure that the knowledge we receive from authority is as good as it can be.

Reason:

Reasoning might be defined as the process of using known facts to arrive at new facts. In this way Reason can help us arrive at new facts or new knowledge BUT only as long as the original facts we put into the process are correct and the process itself is reliable.

Imagine you are travelling in Japan and you know that the exchange rate is 200 yen to a dollar, you can easily work out that an 800 yen sushi meal will actually cost you \$4. This is new knowledge (you didn't know it before) but ... it only works if your original facts are right (i.e. you've got the correct exchange rate and are correct about the cost of the meal) and if the process is right (you can do multiplication / division properly)

Reasoning generally comes in two forms: ***deduction*** and ***induction***. Deduction is the kind of reasoning usually used in Maths and is the more certain of the two as it involves 'drawing out' valid

conclusions from previously known facts – e.g. All cats are animals, Jack is a cat, so Jack is an animal. Induction, on the other hand, is usually used in Science and is less certain as it involves jumping from some things you have observed to making universal statements about all things – e.g. I drop this pencil and it falls, so it is *likely* all dropped pencils (and indeed things) will fall. Notice that both forms are usually dependent on sensation to give us the initial facts or ideas in the first place.

The problem with reasoning is that deduction (the most certain form of reasoning) can never teach us anything new because all the information is there in the facts at the start, while induction (the thing that can give us what seems like new knowledge) can't ever give us anything certain, only things that are *likely* to be the case.

Intuition:

Although the word intuition has connotations of the mystical or unscientific, when carefully defined it can be considered a source of knowledge. Intuition refers to insights or bits of knowledge which suddenly 'pop' into consciousness as our deeper subconscious chugs away working on data that we have collected earlier. We have all probably had the experience where the answer to a question we were previously thinking about but have currently forgotten has suddenly popped into our minds for no reason. This is intuition and, as such, like reason, it too is dependent on our senses to provide the raw material on which the subconscious works.

Sometimes intuition seems to be a 'feeling'. We often say something like "I have the feeling he's not telling the truth," without being sure of why. The psychologist Jung suggested that actually this is actually a form of unconscious reasoning where your subconscious picks up on the tell-tale signs of lying (sweating, nervous movements, etc) that are too subtle for your conscious mind to notice and processes them resulting in the 'feeling' that this person is untrustworthy.

The problem with intuition however, is that most of our intuitions are wrong and they need careful double checking before they are trusted.

Other Sources:

- Faith often accompanied by supernatural revelation;
- Instinct;

- Racial Memory / the Collective Unconscious – another idea of Jung's, that we have cultural memories that we can all inherit and share without actually experiencing the thing that caused the memory in the first place;
- Extrasensory Perception;
- Anamnesis ("recollection") or the remembrance of things from a past life;
- Spiritualism and the Occult, such as Ouija boards, tarot cards, etc.

Scientific method

Scientific method, mathematical and experimental technique employed in the sciences.

More specifically, it is the technique used in the construction and testing of a scientific hypothesis.

The process of observing, asking questions, and seeking answers through tests and experiments is not unique to any one field of science. In fact, the scientific method is applied broadly in science, across many different fields. Many empirical sciences, especially the social sciences, use mathematical tools borrowed from probability theory and statistics, together with outgrowths of these, such as decision theory, game theory, utility theory, and operations research. Philosophers of science have addressed general methodological problems, such as the nature of scientific explanation and the justification of induction.

The scientific method is critical to the development of scientific theories, which explain empirical (experiential) laws in a scientifically rational manner. In a typical application of the scientific method, a researcher develops a hypothesis, tests it through various means, and then modifies the hypothesis on the basis of the outcome of the tests and experiments. The modified hypothesis is then retested, further modified, and tested again, until it becomes consistent with observed phenomena and testing outcomes. In this way, hypotheses serve as tools by which scientists gather data. From that data and the many different scientific investigations undertaken to explore hypotheses, scientists are able to develop broad general explanations, or scientific theories.

Q. 2 Describe different types of research categorized on the basis of methods used and the purpose of research

Types of Research

Research is about using established methods to investigate a problem or question in detail with the aim of generating new knowledge about it.

It is a vital tool for scientific advancement because it allows researchers to prove or refute hypotheses based on clearly defined parameters, environments and assumptions. Due to this, it enables us to confidently contribute to knowledge as it allows research to be verified and replicated.

Knowing the types of research and what each of them focuses on will allow you to better plan your project, utilise the most appropriate methodologies and techniques and better communicate your findings to other researchers and supervisors.

Classification of Types of Research

There are various types of research that are classified according to their objective, depth of study, analysed data, time required to study the phenomenon and other factors. It's important to note that a research project will not be limited to one type of research, but will likely use several.

According to its Purpose

Theoretical Research

Theoretical research, also referred to as pure or basic research, focuses on generating knowledge, regardless of its practical application. Here, data collection is used to generate new general concepts for a better understanding of a particular field or to answer a theoretical research question.

Results of this kind are usually oriented towards the formulation of theories and are usually based on documentary analysis, the development of mathematical formulas and the reflection of high-level researchers.

For example, a philosophical dissertation, since the aim is to generate new approaches from existing data without considering how its findings can be applied or implemented in practice.

Applied Research

Here, the goal is to find strategies that can be used to address a specific research problem. Applied research draws on theory to generate practical scientific knowledge, and its use is very common in STEM fields such as engineering, computer science and medicine.

This type of research is subdivided into two types:

1. **Technological applied research:** looks towards improving efficiency in a particular productive sector through the improvement of processes or machinery related to said productive processes.
2. **Scientific applied research:** has predictive purposes. Through this type of research design, we can measure certain variables to predict behaviours useful to the goods and services sector, such as consumption patterns and viability of commercial projects.

For example, market research, because by examining consumption patterns, strategies can be developed for the development of new products and marketing campaigns, etc.

According to your Depth of Scope

Exploratory Research

Exploratory research is used for the preliminary investigation of a subject that is not yet well understood or sufficiently researched. It serves to establish a frame of reference and a hypothesis from which an in-depth study can be developed that will enable conclusive results to be generated.

Because exploratory research is based on the study of little-studied phenomena, it relies less on theory and more on the collection of data to identify patterns that explain these phenomena.

For example, an investigation of the role social media in the perception of self-image.

Descriptive Research

The primary objective of descriptive research is to define the characteristics of a particular phenomenon without necessarily investigating the causes that produce it.

In this type of research, the researcher must take particular care not to intervene in the observed object or phenomenon, as its behaviour may change if an external factor is involved.

For example, investigating how the public census of influential government officials differs between urban and non-urban areas.

Explanatory Research

Explanatory research is the most common type of research method and is responsible for establishing cause-and-effect relationships that allow generalisations to be extended to similar realities. It is closely related to descriptive research, although it provides additional information about the observed object and its interactions with the environment.

For example, investigating the brittle behaviour of a specific material when under compressive load.

Correlational Research

The purpose of this type of scientific research is to identify the relationship between two or more variables. A correlational study aims to determine whether a variable changes, how much the other elements of the observed system change.

According to the Type of Data Used

Qualitative Research

Qualitative methods are often used in the social sciences to collect, compare and interpret information, has a linguistic-semiotic basis and is used in techniques such as discourse analysis, interviews, surveys, records and participant observations.

In order to use statistical methods to validate their results, the observations collected must be evaluated numerically. Qualitative research, however, tends to be subjective, since not all data can be fully controlled. Therefore, this type of research design is better suited to extracting meaning from an event or phenomenon (the ‘why’) than its cause (the ‘how’).

For example, examining the effects of sleep deprivation on mood.

Quantitative Research

Quantitative research study delves into a phenomena through quantitative data collection and using mathematical, statistical and computer-aided tools to measure them. This allows generalised conclusions to be projected over time.

Q. 3 Define casual comparative (Ex-Post Factor) research and discuss it in detail with example.

Causal-comparative/Ex Post Facto Design

Causal-Comparative Research Design Introduction and Focus - While causal research is experimental research designed to compare groups in a more natural way, causal comparative research design attempts to identify causes or consequences of differences in a non-experimental setting. These differences already exist, and their impact on the outcome is identified by comparing groups. Causal-comparative designs can have different foci: (i) exploration of effects, (ii) exploration of causes, and (iii) exploration of consequence

When do we use the design? – This design is used as an alternative to experimental design because sometimes the latter is expensive, non-feasible and difficult to conduct and while in experimental design the independent variables are manipulated, in causal-comparative design the predictors are not. Causal research uses different terms: *ex post facto* studies gather data retrospectively (e.g. given the obvious effects of smoking, the researcher will look in the past to find the potential cause), causal comparison where data are gathered from pre-formed groups and the independent variable is not manipulated in the experiment. For this, the researcher will have either to find a population on which the data are available, or to find an already existing appropriate group.

Review of literature suggests that there are instances when causal comparative design” and “*ex post facto* design” are not clearly defined and the expressions are used interchangeably. While both designs are non-experimental. *ex post facto* design refers to studies that use extant or secondary data (i.e. data that has already been collected while in studies using causal comparative design data are obtained from pre-formed groups and the independent variable is not manipulated as it is done in experimental studies (Laura M. O'dwyer, 2013)

Additionally, some students make a wrong assumption that the word ‘causal’ means that the design allows causal inferences when it does not, but this case is very exceptional and not compare to the true (Laura M. O'dwyer, 2013; Leedy & Ormrod YEAR)

Type of problem appropriate for this design – The type of problem that this design addresses. should relate to the impact or effect of X on Y. This type of design has some similarities with the correlational design. Both designs are suitable when conducting an experiment is either impossible or unethical. Both try to establish relationships among variables, but the main difference is that causal comparative will compare two or more groups after one of the groups has been exposed to some treatment and/or condition (e.g. new training or intervention)) and the design will be used to compare the grades and/or GPA in two or more groups. in causal comparison, we compare groups, while in correlational design we attempt to explain one variable by the other. (Brewer & Kuhn, 2010)

Theoretical framework/discipline background: Causal-comparative design is used in a number of context

Specific Characteristics –

Sample Size - Causal-comparative studies use different types of data analysis (e.g. if 2 groups are compared then a t-test or a one-way ANOVA is appropriate, or is more than 2 groups are compared and ANOVA is appropriate) and the sample size should be calculated accordingly. The sample size can be calculated using G*Power.

Sampling Method – In causal research samples will be selected because they will have certain characteristics and as stated above will be non-equivalent. The researcher can construct groups or use performed groups. For instance, if the researcher is interested in studying the effects of meat eating on health, he/she can construct three groups of meat eaters, fish eaters and vegetarians so that comparisons between them are conducted related to the effects of meat eating. An example of using a performed group could be when in an inclusion program the researcher is interested in studying the use of classroom time by disability students. In this scenario the researcher will use non-disability students as a control group, but will not have freedom for assigning students to control or experimental groups if the researcher will be studying both categories of learners in the same class.

Another way of sample selection might be to find a population that already has the data (e.g. effect of smoking) or to find an existing appropriate group to study the effects of the cause.

Q. 4 What is an experiment and how you will conduct and experimental research? What will be the threats to internal and external validity and how you will minimize these threats?

Experimental research

Definition:

Experimental research is research conducted with a scientific approach using two sets of variables. The first set acts as a constant, which you use to measure the differences of the second set. Quantitative research methods, for example, are experimental.

If you don't have enough data to support your decisions, you must first determine the facts. Experimental research gathers the data necessary to help you make better decisions.

Any research conducted under scientifically acceptable conditions uses experimental methods. The success of experimental studies hinges on researchers confirming the change of a variable is based solely on the manipulation of the constant variable. The research should establish a notable cause and effect.

You can conduct experimental research in the following situations:

- Time is a vital factor in establishing a relationship between cause and effect.
- Invariable behavior between cause and effect.
- You wish to understand the importance of the cause and effect.

Types of experimental research design

The classic experimental design definition is, "The methods used to collect data in experimental studies."

There are three primary types of experimental design:

- Pre-experimental research design
- True experimental research design

- Quasi-experimental research design

The way you classify research subjects, based on conditions or groups, determines the type of design.

1. Pre-experimental research design:

A group, or various groups, are kept under observation after implementing factors of cause and effect. You'll conduct this research to understand whether further investigation is necessary for these particular groups.

You can break down pre-experimental research further in three types:

- One-shot Case Study Research Design
- One-group Pretest-posttest Research Design
- Static-group Comparison

3. True experimental research design:

True experimental research relies on statistical analysis to prove or disprove a hypothesis, making it the most accurate form of research. Of the types of experimental design, only true design can establish a cause-effect relationship within a group. In a true experiment, three factors need to be satisfied:

- There is a Control Group, which won't be subject to changes, and an Experimental Group, which will experience the changed variables.
- A variable which can be manipulated by the researcher
- Random distribution

This experimental research method commonly occurs in the physical sciences.

4. Quasi-experimental research design:

The word "Quasi" indicates similarity. A quasi-experimental design is similar to experimental, but it is not the same. The difference between the two is the assignment of a control group. In this research, an independent variable is manipulated, but the participants of a group are not randomly assigned. Quasi-research is used in field settings where random assignment is either irrelevant or not required.

Advantages of experimental research

It's vital to test new ideas or theories. Why put time, effort, and funding into something that may not work?

Experimental research allows you to test your idea in a controlled environment before taking it to market. It also provides the best method to test your theory, thanks to the following advantages:

- Researchers have a stronger hold over variables to obtain desired results.
- The subject or industry does not impact the effectiveness of experimental research. Any industry can implement it for research purposes.
- The results are specific.
- After analyzing the results, you can apply your findings to similar ideas or situations.
- You can identify the cause and effect of a hypothesis. Researchers can further analyze this relationship to determine more in-depth ideas.
- Experimental research makes an ideal starting point. The data you collect is a foundation on which to build more ideas and conduct more research.

Q. 5 Write notes on following:

- a) Survey Studies**
- b) Interrelationship Studies**

survey

A survey is a research method used for collecting data from a predefined group of respondents to gain information and insights into various topics of interest. They can have multiple purposes, and researchers can conduct it in many ways depending on the methodology chosen and the study's goal. In the year 2020, research is of extreme importance, and hence it's essential for us to understand the benefits of social research for a target population using the right survey tool.

The data is usually obtained through the use of standardized procedures to ensure that each respondent can answer the questions at a level playing field to avoid biased opinions that could influence the outcome of the research or study. The process involves asking people for information through a questionnaire, which can be either online or offline. However, with the arrival of new technologies, it is common to distribute them using digital media such as social networks, email, QR codes, or URLs.

advantages of an online survey

1. **Accuracy:** In an online research study, the margin of error is low, as the respondents register their responses by easy selection buttons. Traditional methods require human interference, and according to a study, human intervention increases the margin of error by 10%.

2. **Easy and quick to analyze:**

Since all the responses are registered online, it is straightforward to analyze the data in real-time. It is also ready to draw inferences and share the result.

3. **Ease of participation:**

In this new age technology-oriented universe, most people on this planet have access to the internet. Respondents prefer receiving the survey over the email. Ease of participation dramatically increases as the respondents can choose a suitable time and place, according to their convenience, to register their responses.

4. **Great branding exercise:**

In an online design, organizations or businesses have this opportunity to develop their questionnaire to align with their brand. Using logos and similar brand language (color and fonts) gives the companies an advantage as respondents can connect better with the brand.

5. **Respondents can be honest and flexible at the same time:**

According to a study, researchers have found increased participation by respondents when deployed with online surveys rather than answering lengthy questions. By designing questionnaires that ask relevant questions, respondents are honest with their answers and can skip the questions or respondents to a more neutral option, increasing their flexibility to respond.

6. **Survey templates:**

Leading online research tools have expert-designed ready survey templates that make it easier for researchers to choose from and conduct their research study. These templates are vetted questionnaires and are specific to every industry, making the study even more efficient.

Good survey templates and examples

A researcher needs to conduct surveys using the right questions and the right medium to administer and track responses. QuestionPro is a platform that helps create and deploy different types and sets of questionnaires, polls, and quizzes.

We have 350+ varieties of survey templates. including:

- Customer Satisfaction (CSAT) + Net Promoter Score (NPS) Survey: We hear this time and again that the customer is king, which is true. A satisfied customer is a customer that helps your brand and organization grow, through direct means as well as being an advocate for your brand. This template talks about the goodwill your brand has created and how referenceable it is.
- Employee Satisfaction Template: This template is the perfect fit for organizations that want to measure their employees' satisfaction levels. This template will give you insights into your organizations' culture and job satisfaction of your workforce within that culture.
- B2B Templates: The business to business templates are efficient modes of collecting feedback around entities that directly contribute to your business. These may include vendors, clients, their experiences, and so on.
- Company Communications Evaluation Template: This example is essential to analyze employee perspective about the subject of internal company communications, topics to cover in the newsletter, updates on the bulletin board, the efficiency of an organization's management in conversation, etc.
- Hardware Product Evaluation Template: Improving hardware product features isn't a straightforward proposition due to a lot of elements like raw materials, supply chain, and manufacturing lines getting affected by it. Hence, while eliciting feedback for hardware, it is essential to be as objective as possible. It helps us understand the kind of necessary product innovations.
- Strategic Planning Survey: Innovation is essential to any organization's product or service lines. Hence, implementing customer support and making product or service tweaks when required is necessary for the sustenance and growth of an organization. This template helps organizations chalk out their business strategy.
- Business Demographic Survey: This template aims to ask demographic questions and examples that help gain information on occupation, the primary area of business, job function and description, organization's gross income, etc.
- Course Evaluation Survey: This template helps educational institutions conduct period feedback on their course and if students find it helpful or not if it's stimulating enough and students to see this is as value for money along with accentuated learning.

Inter-relationships

Human–environmental inter-relationships are complex and nuanced. On the one hand, resources vary over time and are unevenly distributed in geographical space, so that strategies for utilization will differ for the short and long term, and at small or large scales (Butzer 1982). On the other, human communities subscribe to a wide array of subsistence and cultural modes, and attempt to reconcile new information with traditional values.

Alternative pathways for possible change are evaluated through economic and cultural choices, which presume a major role for cognition, information, and decision-making. Environmental factors set 'boundary conditions' to human behavior at a particular technological and organizational level only in so far as they pose socially unacceptable risk. Short- or long-term environmental crises may be met by routine accommodation, active mitigation, or shifts in subsistence pursuits or social organization. Outcomes therefore are unpredictable.