

Course Two: Science and Scientific Research (Basic Terminology)

1- Science Definition

Etymologically, the word “science” is derived from the Latin word *scientia* meaning knowledge.

Science refers to a systematic and organized body of knowledge in any area of inquiry that is acquired using the scientific method.

Science can be grouped into two broad categories: natural science and social science:

Natural science is the science of naturally occurring objects or phenomena, such as light, objects earth, celestial bodies, or the human body. Natural sciences can be further classified into physical sciences, earth sciences, life sciences, and others.

In contrast, **social science** is the the science of people or collection of people, such as groups, firms, societies or economies and their individual or collective behavior.

Social sciences can be classified into disciplines such as psychology (the science of human behavior) sociology (the science of social groups), and economy (the science of firms, markets, and economies)

2- Differences between natural sciences and social sciences

The natural sciences are different from the social sciences in several respects.

1-The natural sciences are very precise, accurate, deterministic, and independent of the person making the scientific observations. However, the same cannot be said for the social sciences, which tend to be less accurate, deterministic, or unambiguous.

In other words, there is a high degree of “measurement error” in the social sciences and there is considerable uncertainty and little agreement on social science policy decisions.

Sciences can also be classified based on their purpose. **Basic sciences**, also called pure sciences, are those that explain the most basic objects and forces, relationships between them, and laws governing them. Examples include physics, mathematics, and biology. **Applied sciences**, also called practical sciences, are sciences that apply scientific knowledge from basic sciences in a physical environment. For instance, engineering is an applied science that applies the laws of physics and chemistry for practical applications such as building stronger bridges or fuel efficient combustion engines, while medicine is an applied science that applies the laws of biology for

solving human ailments. Both basic and applied sciences are required for human development. However, applied sciences cannot stand on their own right, but instead relies on basic sciences for its progress.

3- Scientific Knowledge

The purpose of science is to create scientific knowledge. **Scientific knowledge** refers to a generalized body of laws and theories to explain a phenomenon or behavior of interest that are acquired using the scientific method.

Laws are observed patterns of phenomena or behaviors, while **theories** are systematic explanations of the underlying phenomenon or behavior. In natural sciences we have Newton theory

Similar theories are also available in social sciences. For instance, cognitive dissonance theory in psychology explains how people react when their observations of an event is different from what they expected of that event, general deterrence theory explains why some people engage in improper or criminal behaviors, such as illegally download music or commit software piracy, and the theory of planned behavior explains how people make conscious reasoned choices in their everyday lives.

The goal of scientific research is to discover laws and postulate theories that can explain natural or social phenomena, or in other words, build scientific knowledge. It is important to understand that this knowledge may be imperfect or even quite far from the truth. Sometimes, there may not be a single universal truth, but rather an equilibrium of “multiple truths

4- Scientific Research

Given that theories and observations are the two pillars of science, scientific research operates at two levels: a theoretical level and an empirical level. The theoretical level is concerned with developing abstract concepts about a natural or social phenomenon and relationships between those concepts while the empirical level is concerned with testing the theoretical concepts and relationships to see how well they reflect our observations of reality, with the goal of ultimately building better theories. Over time, a theory becomes more and more refined (i.e., fits the observed reality better), and the science gains maturity. Scientific research involves continually moving back and forth between theory and observations. Both theory and observations are essential components of scientific research.

Depending on a researcher’s training and interest, scientific inquiry may take one of two possible forms: inductive or deductive. In **inductive research**, the goal of a researcher is to infer theoretical concepts and patterns from observed data. In **deductive research**, the goal of the researcher is to test concepts and patterns known from theory using new empirical data.

Hence, inductive research is also called theory-building research, and deductive research is *theory-testing* research. Note here that the goal of theory-testing is not just to test a theory, but possibly to refine, improve, and extend it.

Unlike theories in the natural sciences, social science theories are rarely perfect, which provides numerous opportunities for researchers to improve those theories or build their own alternative theories. Conducting

scientific research, therefore, requires two sets of skills – theoretical and methodological – needed to operate in the theoretical and empirical levels respectively.

5- Types of Scientific Research

Depending on the purpose of research, scientific research projects can be grouped into three types: exploratory, descriptive, and explanatory.

A- Exploratory research

Is conducted in new areas of inquiry, where the goals of the research are:

- (1) to scope out the magnitude or extent of a particular phenomenon, problem, or behavior,.
- (2) to generate some initial ideas about that phenomenon.
- (3) to test the feasibility of undertaking a more extensive study regarding that phenomenon.

B- Descriptive research

is directed at making careful observations and detailed documentation of a phenomenon of interest. These observations must be based on the scientific method (i.e., must be replicable, precise, etc.), and therefore, are more reliable than casual observations by untrained people

C- Explanatory research

Seeks explanations of observed phenomena, problems, or behaviors. While descriptive research examines the what, where, and when of a phenomenon, explanatory research seeks answers to why and how types of questions. It attempts to “connect the dots” in research, by identifying causal factors and outcomes of the target phenomenon.

3- Overview of the research Process

