1 Research and epistemology

Research is about knowledge processes: acquiring knowledge, investigating knowledge, and putting knowledge to work. These processes are not neutral; they rest on a number of assumptions about the value of knowledge. What is knowledge? How do we acquire knowledge? Whose knowledge counts? What are the criteria for assessing the validity of knowledge? These questions are the domain of epistemology. Being aware of these processes will help you put your methodology into perspective and remain critical of your work and that of others.

Epistemology is a branch of philosophy whose concern, broadly speaking, is the validity of knowledge. In other words, how can we know the difference between “true” knowledge and “false” knowledge? In terms of scientific research, this translates into the question of methodology: what are the most appropriate theories, concepts and models? How do we go about investigating an issue in order to get as close as possible to the reality?

There is an intimate relation between epistemology and methodology. Both are about how we acquire knowledge. Methodology is specifically about the practicalities (the methods) used to acquire knowledge. It is the set of procedures and rules that allow researchers to produce and organise increased knowledge.
2 Inductive and deductive reasoning

There are two basic types of reasoning that lead to new knowledge: *inductive* and *deductive* reasoning.

**Inductive reasoning** is a type of thinking that moves from the specific to the general. Arguments expressed inductively (i.e. ‘induced’) are based on experience or observation. If the same causal relation between phenomena (X causes Y) is observed systematically, it can lead to a theory establishing that relation. If I observe, over several years, that my crops die when there is no rain, I might develop a theory that crops need a certain amount of rainfall to give a good yield.

**Deductive reasoning** is generally a type of thinking moving from the general to the specific. Arguments expressed deductively (‘deduced’) are based on widely accepted principles or theories. If I believe, from what I have been taught in biology classes, that plants need water to be able to photosynthesise, carry nutrients from the soil etc., I might predict that my crop will fail this year if it does not receive certain amount of rainfall – even though I have never actually seen my crops fail due to lack of rainfall in the past.

Deduction of a phenomenon from a theory or hypothesis means making a *prediction* (‘this is going to happen because the theory says so, it has been showed to be so in the past’). But this is simply an *expectation* whose truth needs to be tested; the previous theory might have been based on observations conducted under a certain set of conditions that are not always present. The new test may validate or invalidate the prediction. It may lead to confirmation of the theory or its readjustment. It may also show that more observations are needed before the theory can be adequately tested.

Deduction or induction does not reside in the phenomena observed but in the way arguments are expressed. Any argument can be expressed inductively or deductively. But it is important for scientists to recognize whether the form of an argument is inductive or deductive, because each requires different sorts of support. The justification of inductive reasoning needs details of the observations on which it is based (with no need to elaborate theoretically), while deductive reasoning requires argumentation of the theories being referred to.

3 The scientific method

These two types of reasoning are combined to what is generally regarded as the “**scientific method**” (see Figure 1).

A **theory** is an abstraction - a mental construction - used by someone to structure observations and explain what the observer considers to be the reality. Based on theory, scientists formulate **hypotheses** about the object of their research: that is, they make a prediction of the sort “if I do this, then that should happen”. They then use a particular method to create the conditions required and observe if the predicted phenomena actually results; in other words, the hypothesis is either *validated* or *invalidated*. Based on these results, the original theory is reinforced, adjusted or rejected entirely.
Predicting a certain behaviour in this way is not the same as predicting the future or stating an absolute truth. Predicting a future phenomenon through a hypothesis is simply making a preliminary statement about the causal relation between two variables that needs to be validated. A hypothesis can be invalidated - ruled out with absolute certainty – and hence a particular theory might be rejected. However, validation does not mean the theory is proved to be necessarily or universally true: even if a hypothesis is validated today, using a particular method in a particular context, it might be invalidated tomorrow under different circumstances. This is specially so in the field of development where the multitude of other intervening events are, by definition, unpredictable.

The method used in the scientific procedure to validate (or invalidate) a hypothesis often represents some form of reductionism: a procedure whereby the object of study is reduced to its constituent parts. These components can then be more easily studied than the complex whole. The assumption is that if we understand the working of the parts and put them back together, we will progressively understand the working of the whole. Theories built in such a way do not always hold up if and when the whole object is actually observed: sometimes different emergent properties become evident – only visible or “emerging” when the whole object or system is observed. This phenomenon has given rise to the converse of the reductionist approach: the “systemic” approach, where it is important to study the whole and relationships between constituent parts, rather than the parts themselves.

4 Objectivity and subjectivity

All knowledge produced is tentative, subject to revision on the basis of new evidence. The scientific method systematically isolates phenomena, studies them, discovers uniformities and regularities and draws general laws, principles and theories. In this view, scientific knowledge should be testable. Other investigators should be able to ascertain the truth of a scientific explanation. For this reason, objectivity is normally regarded as an essential principle of the scientific method.

“Objective” derives from “object”. An objective description is therefore one made in terms of objects that are observable, measurable over time, independent of the observer and ways of observing. Being objective - impersonal and value-free – is a characteristic traditionally associated with science. Ideally an objective description
should allow reliable predictions: if the same conditions occur, then we would observe the same phenomena. In other words, science often assumes that the truth of a thing is independent from the observer.

“Subjective” derives from “subject”. A subjective description is one that depends on the nature of the subject - i.e. the prior knowledge, biases, judgements and values of the describer - rather than what is being described “out there” or the “reality”. Being subjective is usually considered to be the opposite of a scientific attitude.

The assertion that science can be completely objective has been questioned in recent years. Can a scientist, who is after all a human being, ever be truly objective? Can we be sure that our observations are free from bias: independent of what we already believe, what have been taught to see, what we expect to see? Can scientists always have the courage to develop hypotheses and theories that might conflict with those currently and generally accepted by others? Can we assume that “true” knowledge is independent from the ‘bias’ of one’s own knowledge “construction”? Can we actually “know” reality?

5  Positivism, constructivism and reality

Positivism, the dominant school in science, holds that there exists a “true” knowledge or “reality”, universal and unchanging, which the scientific method can gradually reveal. The notion of ‘reality’ is central to epistemology. What constitutes reality? Is there a ‘reality’ out there that we can grasp? Two important schools of epistemology - positivism and constructivism - have different views on this question.

Positivism and its diverse variations have long dominated science. It is the notion that science must be concerned with only those features of which we have direct experience. Science, it is thought, must limit itself to what is observable and measurable (‘empiricism’). It is a way of getting at the ‘true’ nature of things. The universe is governed by laws which science must understand in order to predict and control it.

This view has implications for the way we approach concepts and methods. For example:

- **Systems**, in a positivist perspective, are seen as existing, real entities. They have features that are universally valid, and can be identified and studied as such. This is sometimes called a ’hard’ perspective.

- **Problems and solutions** are also real, since the system is real. They are due to a discrepancy between the existing and ideal states of the system. The problems need to be identified and fixed by those who have the necessary expertise (who can also determine what is “ideal”). Under a positivist perspective, problems and solutions are “objective” and exist independently of what people may think about them.

- **Research methods** must be oriented to collecting data that is “objective” and close as possible to the “reality”, given that the problems are “real”. Measuring and quantifying are a means of achieving that objectivity, and the role of the researcher is well defined.

- **The role of the researcher**, as expert, is to identify the objective problem and to propose the ideal solution. This researcher may or may not involve
others – e.g. rural people - in the necessary activities, but remains the one who is closer to the truth of the matter.

Constructivism is interpreted in many ways, although when used in an epistemological sense its main thrust is to assume that knowledge is a function of how the individual “constructs” meaning from his or her experience. What we call “reality” is not independent of our perception. Different people may interpret the same phenomenon in different ways. Knowledge is not transferred like material goods. During its ‘transfer’ from a ‘supplier’ to a ‘receiver’, it is ‘reconstructed’ by the latter, who produces his/her own version of it through interpretation with past experiences, personal values and assimilation into his/her own body of present knowledge.

This view has implications for the way we approach concepts and methods. For example:

- **A system**, in a constructivist perspective, is recognised as being a representation of reality seen by certain persons; in other words a model, only valid in a certain context, place and time. As such it is subjective and has no real existence. It is conceptualised as a system for purely instrumental reasons. This is sometimes called a “soft” perspective.

- **Problems and solutions**, in a constructivist perspective, are not independent from people’s perception. Their perceptions of a particular problem are different. Thus an optimal solution is one which is acceptable to most.

- **Research methods and resulting data** in a constructivist perspective need to reflect people’s diverse perceptions and interpretation. They are equally “socially constructed”. Precision is not necessarily taken as an indication of ‘truth’. Research methods and information sources must be varied (“triangulated”) to cover the diversity of opinions. Data is often less important than the processes activated during their collection.

- **The role of the researcher** is to account for diversity, given the multiplicity and subjectivity of opinions. Ideally the researcher should attempt to facilitate processes of communication between diverse interests and get views closer to each other.

However, a more radical school of constructivism, sometimes called post-modernism, rejects all claims to knowledge. It states that knowledge has no ground beyond mere “text” or “discourse” - constructions of the mind that need to de ‘deconstructed’. Post-modernism falls into absolute relativism or “solipsism” because it does not recognise legitimacy to any form of established knowledge and offers no way to choose between alternative ways of learning and knowing.

### 6 Hypothesis testing

Objective criteria can be used to judge the reliability of predictions and hypothesis testing:

- **Invariance** (also regularity or consistency) requires that the effect of a phenomenon must not be unique, but share some properties with changes associated with similar phenomena. In short, similar causes should lead to similar effects. A minimal regularity or invariance of effect is needed in order to make predictions.
Distinctiveness requires that a phenomenon, as well as its effect, must be distinguishable from other phenomena and their effects. Otherwise we cannot explain what caused what or predict anything. In short, we need a "difference that makes a difference". A distinction is useful because it can be used to predict deviations or variations from a given state, which means that some change must follow or precede the appearance of the distinguished phenomenon; phenomena that do not make any difference, are not informative, and, hence cannot be considered to be real in any practical sense.

Controllability means that a phenomenon must react differentially to different stimuli, or actions performed on it. It must not react randomly or not at all. This is the basis of scientific experimentation. Random reaction, or no reaction, allows no definite conclusion to be made and offers no ground for knowledge. Source: http://pespmc1.vub.ac.be/, Heylighen (1989).

7 Individual Learning

Subjective criteria can be used to judge the ease with which individual subjects will assess, accept or retain new knowledge (i.e. "learn"):

- Individual utility is the degree to which a user values a piece of knowledge. People will only bother to acquire or accept knowledge if they deem it useful for increasing personal competence, solving problems or reaching goals.
- Simplicity (and coherence) means that knowledge should be easy to learn. The more coherent the idea with what the individual already knows the more likely it is to be accepted and integrated into a personal knowledge construction.
- Novelty (and curiosity) enhances knowledge acquisition. New and unexpected ideas attract attention, arouse curiosity and stimulate the learner into exploring them. This is the basis of all exploratory behaviour.

8 Social Learning

Beliefs are mostly acquired through interaction with other individuals: it is the subjectivities of many ("inter-subjectivity") that leads to the selection and replication of certain ideas to the detriment of others.

To some extent, what is defined as "objective" is the result of inter-subjectivity: if more people believe something, it tends to be regarded as more "objective" — more "true".

As well as the individual subjective criteria mentioned above, additional intersubjective criteria can be used to judge the conditions under which knowledge is likely to be accepted by society:

- Publicity (or propaganda). The extent to which and idea is publicised by those who have an interest in diffusing it is the most important factor in the spread of an idea.
Expressivity. Ideas need a medium to be diffused. Those that are easier to express in a particular language or medium will propagate more easily. The predominance of a particular code, language, or other medium, in a community will favour some ideas over others.

Formality. The diffusion of ideas is context-dependent; different individuals under different conditions may interpret a statement differently. A scientific statement, or theory, is said to be formal when there is the least ambiguity as to its meaning, so that it is interpreted in the same way everywhere. The less ambiguous the idea is, the most likely it is to survive repeated transmissions. It is however debatable whether any definition relying on language can ever be completely rid of ambiguity. This applies particularly to concepts: “farming systems” and “livelihoods” are difficult to translate into French or Spanish – and the nearest translations mean something slightly different.

Conformity. An idea is more likely to be adopted by individuals if it is already shared by many; through group pressure to conform, it is also more difficult to reject the idea.

Conformity can be seen as being irrational because useful knowledge can be rejected for fear of group ostracism. It can also be seen as rational since collectively held beliefs are the outcome of a collective selection of knowledge (‘consensus’) that has some consistent truth to the group (invariance).

Collective utility. Some forms of knowledge benefit the collective, while being useless for an isolated individual. Languages, traffic regulations, technical standards and moral codes are examples of knowledge that only have value for social purposes. Such collective ideas will be selected at the group level: groups having such beliefs will be more fit than groups lacking them.

Authority: As communities get more complex, individuals tend to specialize in a particular knowledge domain. Those who are recognised as competent, because of proven success in problem solving, will get their ideas more easily accepted. Sometimes – and this depends partly on culture – the support to an idea by individuals with a “higher” or more respected position in society (political leaders, elders or just “bosses”) will ensure its adoption by the community.

9 Types of knowledge

There are various, overlapping forms of knowledge:

Tacit knowledge and focal knowledge. These are two complementary dimensions of knowledge. Focal knowledge is knowledge about the object or phenomenon that is in focus. Tacit knowledge is the knowledge that is used to handle or improve what is in focus. For example, reading a book requires focal knowledge to understand the meaning of the text, while tacit, or background, knowledge (understanding words, grammar and semantic rules) enables you to read in the first place.

Static knowledge and dynamic knowledge. Should knowledge be considered as passive or as action oriented? Is knowledge, rather than a uniform stock, a dynamic process of knowing similar to learning? If so, the ability to actively seek for new knowledge is itself a form of knowledge. For example, indigenous knowledge cannot
be considered as a stock of uniform practices from which scientists can draw and incorporate into their programmes. It is fragmented and constantly evolving. It is not simply ‘practices’ either, it is also comprised of the cultural and cognitive processes which create and reproduce these practices.

**Propositional knowledge** is knowledge that something is so: this includes facts, concepts, and propositions, built and assimilated over a lifetime of experience. We are rarely conscious of this type of knowledge and yet it constitutes the cognitive structures within which new knowledge is accommodated.

**Procedural knowledge** is knowledge about how to do things (techniques, skills, abilities). Like propositional knowledge it is a form of knowledge that make up our cognitive structures and determines what new knowledge we acquire and how we acquire it.

### 10 A model of knowledge construction

![Diagram of knowledge construction](image)

**Figure 2. A model of knowledge construction**

**Data** is the basic building block of knowledge. Data are simply recorded observations; they have no meaning out of their context. This context consists of the conditions (geographic, social, economic, etc.) in which these observations were made.

In a general sense, **information** can be considered as data that has been assimilated, related, and organised. It represents the sum of an individual’s past experience, which is remembered, categorized and recalled when necessary.

Past experience constantly influences the way we receive and treat information, and hence how we construct our knowledge. New information is most likely to be accepted and assimilated if it concurs with past experience. This can lead to
unconscious bias: what we see depends on what we look at, what we have been taught to see, and what we expect to see.

A dictionary definition of knowledge is the “awareness or familiarity gained by experience of a person, a fact or a thing”. Information provides this “experience”, but knowledge is more than just a collection of information. Knowledge adds understanding and retention to information. Therefore, to have "knowledge" requires information to be assimilated in conjunction with other pre-existing patterns of information and other knowledge. Knowledge and learning are therefore “situated” - acquired and constructed in a specific context (social, cultural, economic) that gives it its relevance. Language and tradition form part of this context, as do the norms, rules, ideals and values of a community. These factors thus define what is "relevant" knowledge, the value given to this knowledge and how it is transferred. We may not be aware of the subtle ways in which these different contextual factors influence our thinking.

Knowledge is often assumed to lead to wisdom. Wisdom can be considered to be the enlightened application of the knowledge one has. However, knowledge is always evolving and being redefined, and even the wisest person may be acting on the basis of imperfect knowledge or information.

Finally, values evolve from wisdom. Our values – which largely depend on our cultural context - determine what we think is important or ethical, and thus influence our interpretations of phenomena and the decisions we make.

11 Acknowledgements

This learning resource was prepared by Nour Sellamna, and edited by Richard Hawkins for ICRA (www.icra-edu.org).

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