Introduction to knowledge theory and (social) scientific method - what and how

or:
Epistemology, quantitative & qualitative methods

or:

How do we know that we know what we know?

Lecture notes

Use these notes as a starting point for literature and web search - there are lots of description, discussion, uses, eg. of the various techniques described here.

Edgar Bostrøm

The lectures are divided into 2 main parts

Things & knowlegde

- **What does it mean to know something?**
  - **a little about epistemology**
- **Different views on research**
  - **and a little about hard and soft aspects of research**

Research methods

- **Quantitative vs. qualitative methods vs. other metods**
- **Quantitative Methods**
- **Qualitative methods**
  - **and some qualitative evaluation methods**
- **Research vs. development**
- **Research used in political and commercial arguments**
- **Can we trust the results?**
  - **a bit about reliability and validity**
  - **can we <u>really</u> trust what the results?**

What does it mean to know something?, I

- A little on epistemology

Atomism **Holism**

Objectivism **Subjectivism**

Positivism **Interpretism**

Constructivism

Rationalism **Intuition**

Determinism **vs.** **free will**

Truth **Valid for me** **Opinions**

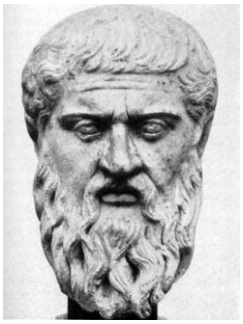
Perspectives

Intersubjectivism

Paradigms

What does it mean to know something?, II

Different ideas and vision has existed in parallel, and thus is a categorization difficult, yet few samples:



Plato (ca. 300 BC):

- Plato's theory of ideas: What we observe are "manifestations" of "patterns" of things, e.g. a tree that we observe is manifestation of the "idea tree". The ideas have, in a sense, a self-will which recurs in every instance. Ideas are in their own world, which we cannot observe.
    - cf. the concept of numbers
    - class and object concept.
    - dualistic worldview:
        - forms / world of ideas, ideal and unchanging
        - the material world, perceptible and changeable
    - how can we know that what we think we observe is the "truth"?
- Cave parable: think of prisoners chained in a cave can only observe the true reality through the shadows in an opening in the cave. The real world, the idea world is hidden to us, the sensible world is only a pale shade.
- Others: Socrate, Aristotle.

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Enlightenment (1700s)

- science, mechanical worldview, secularism science
- cause and effect, it's not that things "have their own will"
- we can place ourselves outside the observational material, make neutral observations
- two directions
    - rationalists (knowledge based on rational deduction from logical principles), including René Descartes, Cogito, ergo sum
    - empirists (can only get knowledge through observation and generalization thereof), for example. John Locke.
- Immanuel Kant (pictured), the end of the Enlightenment, sought to unite directions.
    - Knowledge can be

Analytical apriori: Saying nothing more than the statement itself, e.g.: The circle is round, determined by the meaning of words.	*Synthetic a priori:* Our assumptions that precede experience such as space, time
	Synthetic posterior: Learning from experience

    - The "categorical imperative" in ethics.
    - The difference between " Daβ Ding an Sich " and "Daβ Ding für Mich"

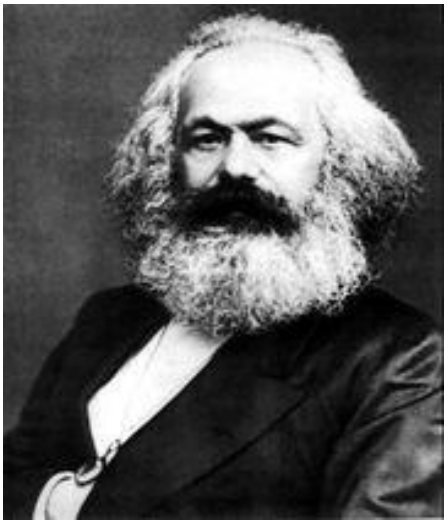
What does it mean to know something?, III

Romanticism (ca. 1800-1850-'s)

- want not only a mechanical worldview, but also emphasis on emotion, beauty, nature in our understanding of the world
    - Example: What is the purpose of a garden?
- overall understanding of reality
- Jean-Jacques Rousseau, "Emil", was in the Romantics even if he timely belonged to Enlightenment.
- Friederich Schleiermacher, including "The hermeneutic circle"

"Scientific era", scientific modernism.

- technical innovations (eg. electricity, telegraphy), evolution theory, social analysis, etc. as the basis
- posivism: the only thing we can know (and the only thing that exists?) is what we can positively observe and infer from this
- sectorization, for example. art, religion, politics, science
- Modernism in culture, marked by rebellion against the traditional
- development optimism, largely broken by 1st World War.
- Charles Darwin, Karl Marx, Max Weber and others as important persons



What does it mean to know something?, IV

Post-modernism (many different divisions, including time-frames)

- Human understanding is only possible through language; any understanding will be dependent on social, historical and cultural context.
- Post Modernists will often be based on textual representations, rather than in traditional empirism (it is however important to realize that a post-modern definition of "text" will be much broader than the traditional).
- Postmodernism rejects all essentialism and all totalization.
- In practice, postmodernism often exceeding the 1900s established disciplinary boundaries. (http://no.wikipedia.org/wiki/Postmodernisme)

- Forerunners:
  - Heidegger (including existential philosophy)
  - Wittgenstein (including philosophy of language, eg., "Die Grenze meiner Sprache ist die Grenze meiner Welt")
  - Friedrich Wilhelm Nietzsche (including no generalizations are possible, Nihilism, the individual must fight for himself ¸ "Wille zur Macht". "Übermench mentality" etc.)

- Key people:
  - Jacques Derrida (including deconstruction - also applies to others)
  - Michel Foucault (e.g. do not ask "do things exist, what are their properties) but "what have the terms done with us".
  - Richard Rorty (including non-realist, non-essentialists and non-representationalist, anti- foundationalist. The question to be asked is "Does it work?", not "It is true?".
  - Hans-Georg von Gadamer (eg reinterpretation)

However: postmodernism is not as hot today as it has been before... ..

What does it mean to know something?, V

So: where does our knowledge come from?

Often given answer:

- Logic basis (but where we get it from)? and
    - Other axioms (but where do we get it from)?
    - Mathematics (but it is based also on the assumptions)?
- Axioms as a whole (but who have decided them)?
- Empirical observations, via the senses (but are they safe)?
    - Moreover, many findings build upon advanced instruments, we don't actually see the objects.
- Other's knowledge (but is it safe)?
    - and: we know that it is transmitted "unchanged"?
- We do not observe natural and other laws, we only use the laws to explain the observations. Laws ≠ observations.
- We don't observe concepts. We can observe a particular horse, but not the concept horse, nor the concept of animals.
- Inherited knowledge, instincts, it is knowledge? Knowledge? Science?
- What is / how our consciousness?
- Are there other sources to knowledge? to Science?

However:

Are we "locked in the iron cage of rationality" ?? (Max Weber)

What does it mean to know something?, VI

Some elements in today's science debate:

- Carl Popper: **Falsification:** A scientific theory cannot be proven, but it must be falsifiable. It is strengthened by not being able to falsify it. Thus in stark contrast to the post-modernist thinking.
    - NB! Parallel to software testing.
- The falsification criterion has been criticized, among other things, because of the lack of symmetry: Should we have stricter criteria to accept a hypothesis than to reject it? We cannot demand absolutely certain knowledge, but rather what is the most likely, the strongest explanatory power. Such thinking is often called abduction.
- **Thomas Kuhn:** Our perceptions are influenced by a set of concepts, thinking, understanding etc. that we take for granted, our **paradigms.** These understandings are sometimes challenged, e.g. based on new scientific discoveries, hence there will, from time to time be paradigm shift ("scientific revolutions").

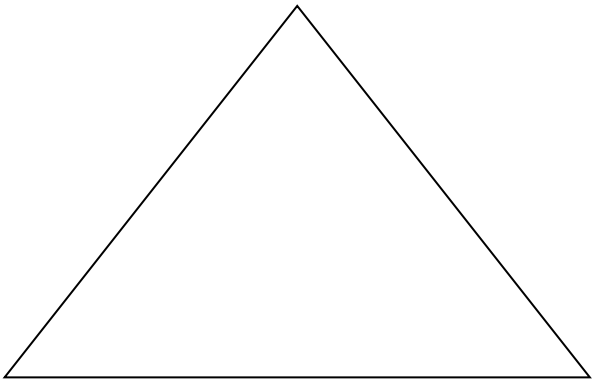
  Note: Does this apply to other fields as well, e.g. politics?
- Many have **given up on the idea of objective truth,** relativism is therefore philosophically more viable. "Reality" is just a social construct (Peter Berger). The best we can hope for is an intersubjectivism, but that may, also, an illusion ....
- Others, e.g. **Ayn Rand's** objectivism claims the importance of distinguishing between individual and objective reality. She thus believes that things must either be right or wrong, nothing in between may apply. Simultaneously, it is pure rationalism, and becomes very black and white.

- A newer concept is foundationalism: is it that all must build on a foundation, a foundation and a reality outside us in some sense, or is it more appropriate to rely on a non-foundationalistic mindset?

What does it mean to know something?, VI

Ogden's triangle

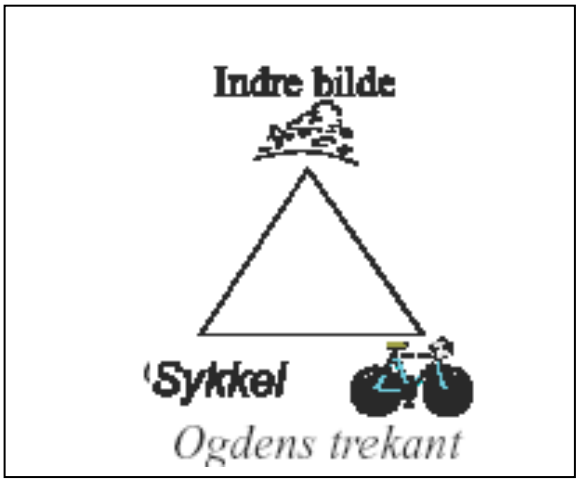
concept (notion, idea) - abstract



term
(word)

phenomenon
(reference)

example:

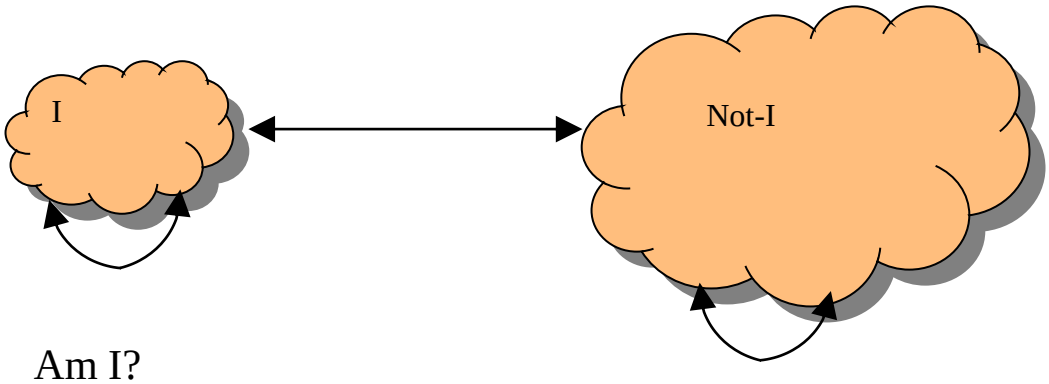


The figure is over-simplifyed. What is missing in the triangle, include reference to other concepts, underlying background, culture, blurring etc.

The plea is: Our knowledge is not directly, but through that we create an idea and try to match that with, or create, language.

What does it mean to know something?, VII

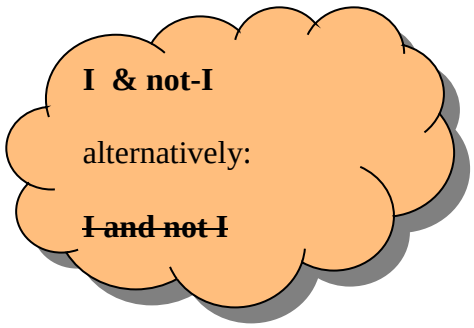
Basic questions - which man always had:



- Am I?
- Is not-I?
- Rene Descartes claims, "I think, therefore I am"

If yes:

- Can **I** know somehing about **non-I,** if so, how?
- Can **I** know something about **I/me,** if so, how?
- Can **not-I** know something about **me,** if so, how?
- Can **not-I** know something about **non-I** (is it possible for me to know ??)
- Am I different from not-I?



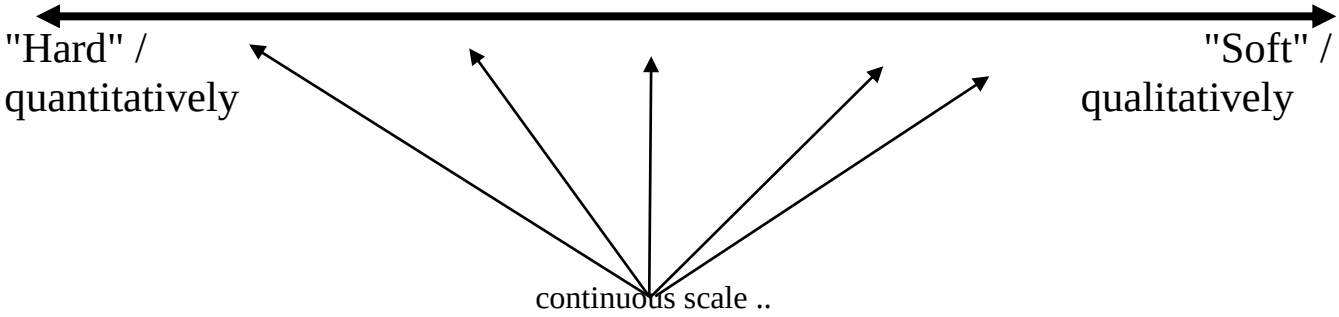
- Can anything be exist, although I cannot observe it? Are observations credible?
- What is truth (at different levels or fields) – or is there no truth?
- Is the truth important?

Different views on research

"Real" research:

Exists only in natural Science	Only if quantify - tative or natural - Science methods	The use of qualitative methods is also research	Interpretation, for example.hermeneutric methods can be used	"Everything" is research

Corresponds to a large extent:



- **Science** in English means **the natural sciences,** others are something else, for example. social science, educational science.
- Some scientists claim that everything other than research based on mathematical-scientific methods are quasi-research.
- Do all social sciences tend to be "mathematizing"?
  (Johan Galtung, 1967: "Those who currently teach sociology without being able to do mathematics, will 20 years from now be unable to read sosiological journals")

  But: he was wrong!

Claim:

Many disciplines have both hard and soft sides

Geography:

Geophysics
mineralogy

Human/Social Geography

Philosophy:

logic

history of philosophy,
epistemology,
metaphysics

Medicine:

molecular biology,
Surgery

Social Medicine,
Psychiatry (in part)

Informatics:

numerical analysis,
digital technique

social sides of computing
systems development (to some extent)
"information science"

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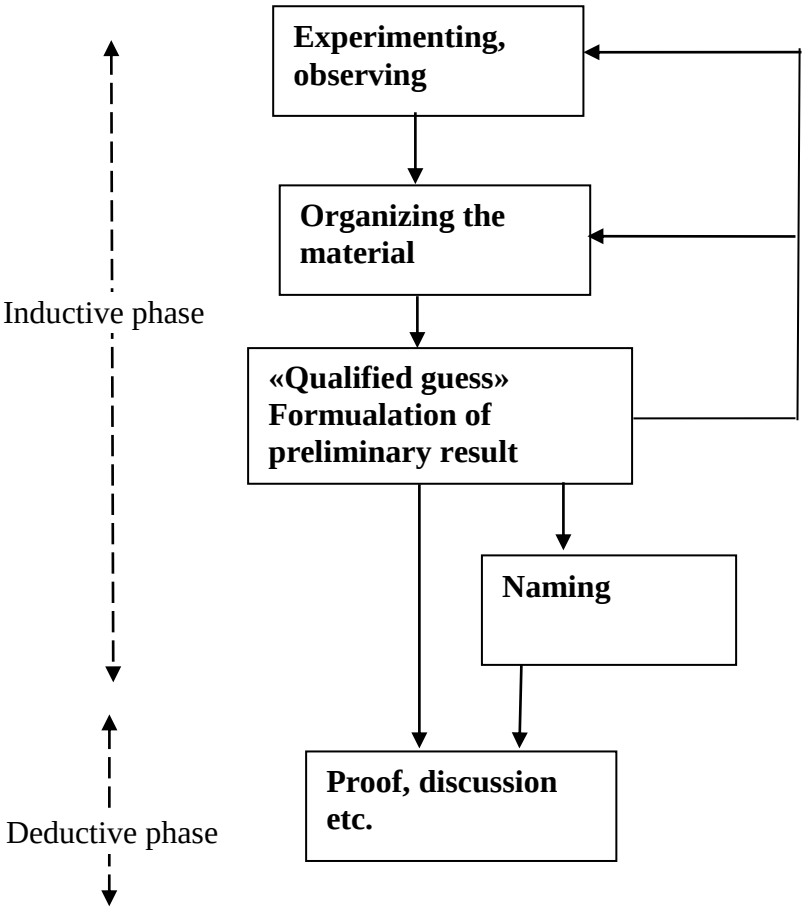
- Research methods, then, vary **within each subject,** not only between the different subjects
- At the same time: the more **"hard" parts** have often **had status** in professional circles, to some extent because it is based on logic / mathematics and / or repeatable experiments - thus be provable (or lack falsification).

Discussion: *Other examples of subjects with hard and a soft sides?*

Even mathematics has softer sides!

Also in mathematical research and education, qualitative elements, intuition, conceptualization, discussion of categorization is central. The following is taken from a textbook of mathematics didactics (Ragnar Solvang: Mathematikkdidaktikk).

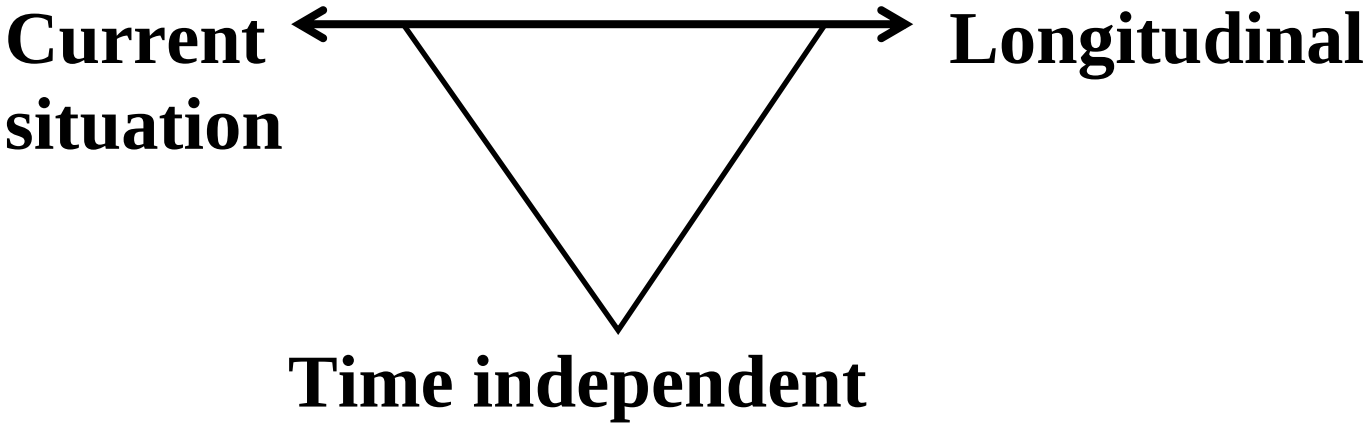


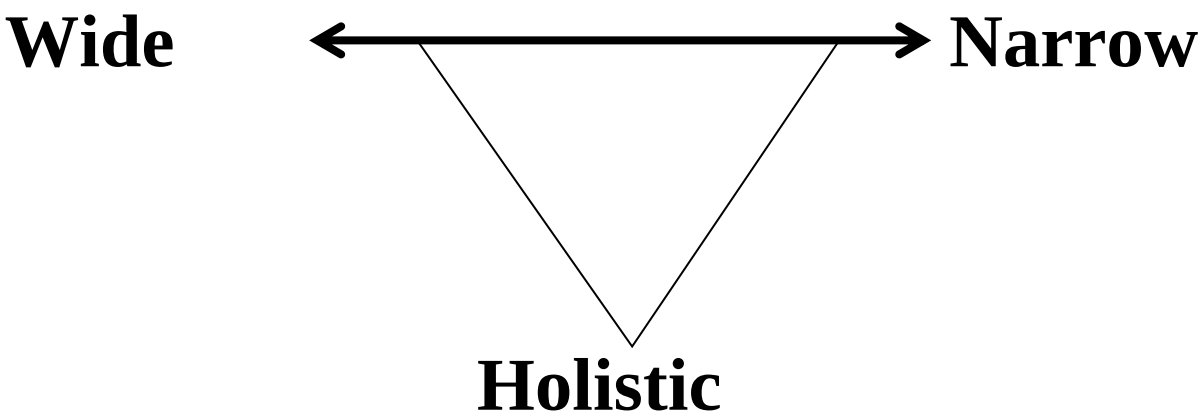
George Pólya, in his classics **"How to solve it: a new aspect of mathematical method", distinguishes** between

- to find - the creative / explorative, "presumably it so"
- to prove - the formal proof to check that intuition was not wrong.

"That sometimes clear ... .. and sometimes vague stuff .... which is .... mathematics "
(Imre Lakatos, 1922 - 1974, after Davis / Hersh: The Mathematical Experience).

Different focus





Discuss: **Is time independent and/or holistic achievable? ToE??**

Development / design / engineering vs. research

What about development of new ideas, products (a bridge, a toy, an electronic device……), software etc. - should that be called research?

Stop / think!

Some thoughts:

- **Development:** constructing things that do not yet exist.
  Research: finding out more about things that already exists.

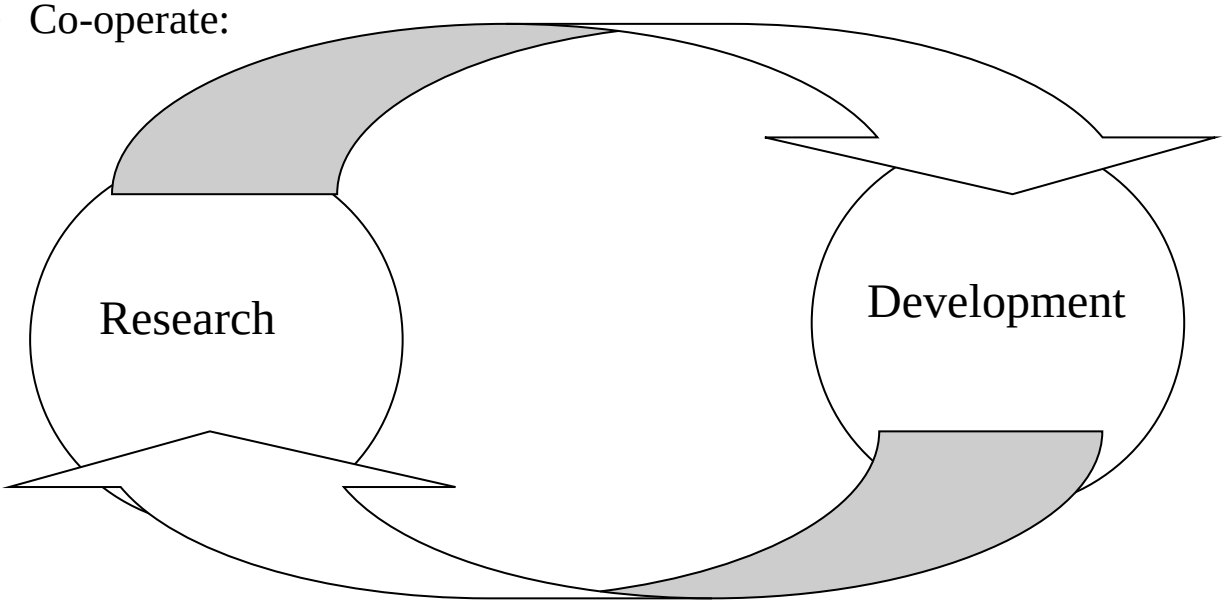
- May some parts of or some aspects of development / design / engineering should be called research, others should not?

- Development / design / engineering is, more often than not, based upon research in some way or another.

- In many's mind: the word research means it must be "clever", "advanced" and so on – **having status**
  i.e. that's why we like to call "everything" research.

- On the other side: both development (and research in the traditional meaning) often try to give us new insight – shouldn't that be enough to call is research?

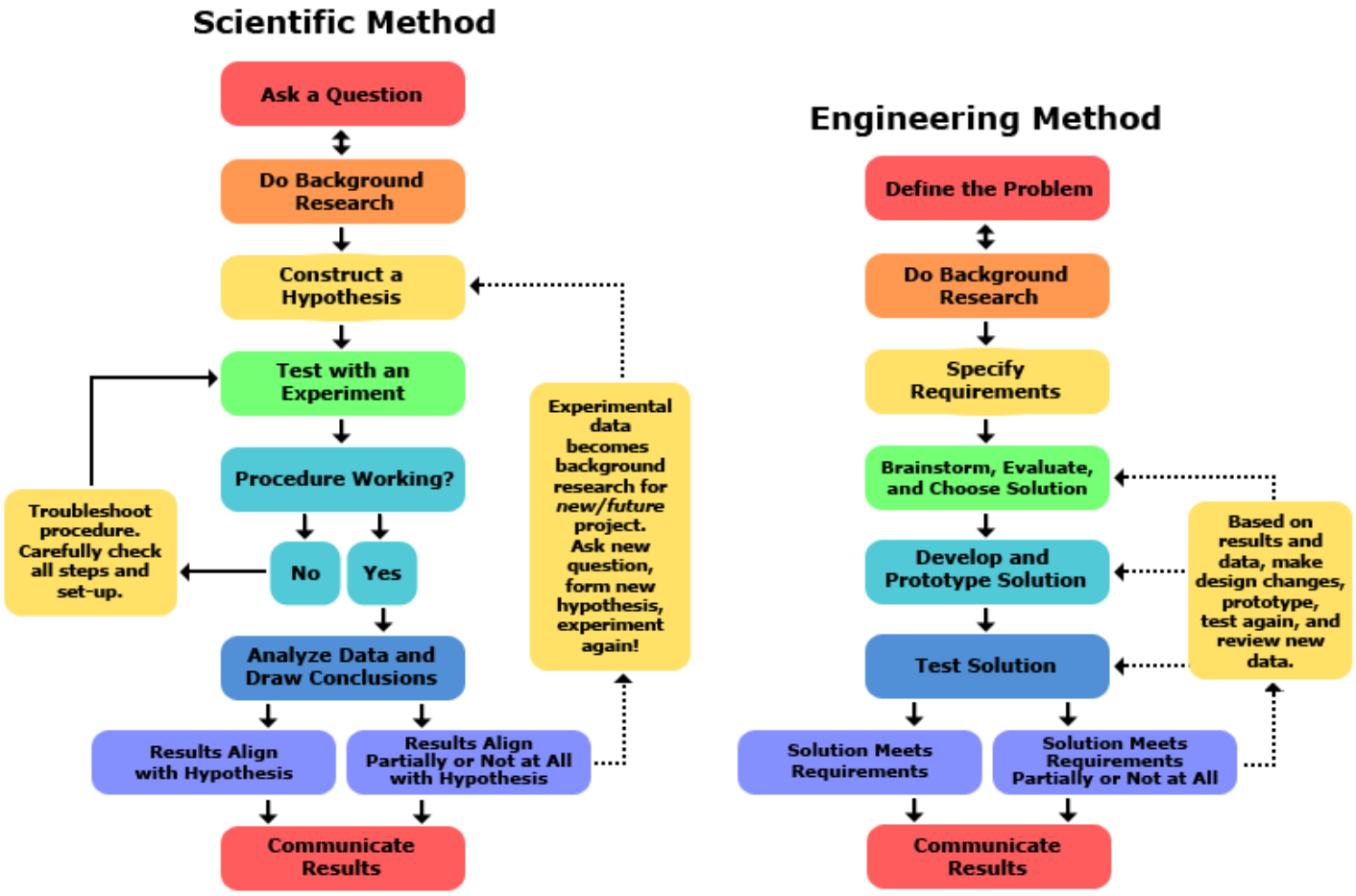
- Co-operate:



Comparing the Engineering Design Process and the Scientific Method

While scientists study how nature works, engineers create new things, such as products, websites, environments, and experiences. Because engineers and scientists have different objectives, they follow different processes in their work. Scientists perform experiments using the **scientific method**; whereas, engine follow the creativity-based **engineering design process**.

Both processes can be broken down into a series of steps, as seen in the diagram and table.



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