ALMUSTAQBAL UNIVERSITY

College of Health and Medical Techniques
Medical Laboratory Techniques Department

Stage : Fourth year students
Subject : Research Methods - Lecture 2

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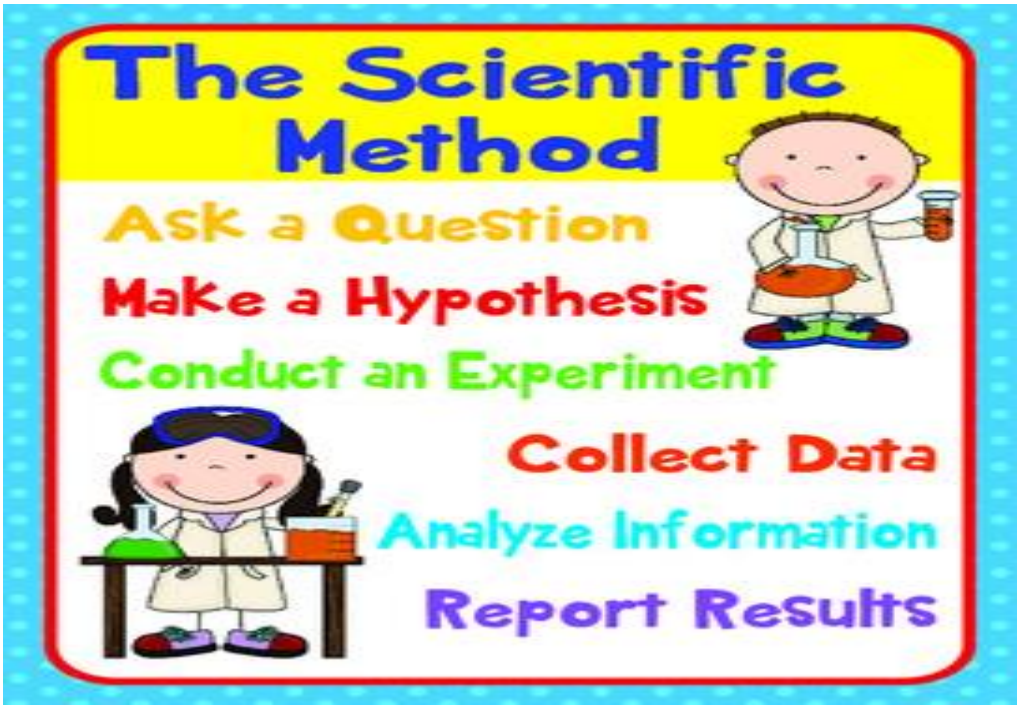
SCIENTIFIC METHOD



The scientific method is the systematic framework through which researchers investigate phenomena, acquire new knowledge, and validate hypotheses. It serves as the backbone for rigorous, reproducible, and objective inquiry across natural sciences, social sciences, and interdisciplinary fields

The scientific method In the research is one of the most essential approaches to gaining new knowledge. It is a systematic, step-by-step process used by researchers to explore, investigate, and draw conclusions from observations and experiments.

To answer these questions, most scientists carry out investigations using The Scientific Method.

Understanding how the scientific method works is crucial on studying natural sciences, social sciences, or humanities

The scientific method is a structured approach to discovering knowledge. It's a way of investigating questions and solving problems through careful observation, experimentation, and logical reasoning. The method allows researchers to develop reliable, repeatable results that others in the scientific community can trust.

The scientific method is used in a variety of researches, including social sciences like psychology, sociology, and economics. In fact, the strength of the scientific method lies in its objectivity. It allows researchers to arrive at conclusions based on evidence, rather than personal beliefs or assumptions. It provides a roadmap for conducting research in an organized, transparent way.

It includes asking a Testable Question which can be answered by designing and conducting an experiment, Form a Hypothesis , Design an Experiment to Test the Hypothesis Using Independent and Dependent Variables and Controls then Draw Conclusions

Core Principles of Scientific Research

The scientific method rests on several foundational principles:

1. **Empiricism(تجريبي)**:
   Knowledge is derived from sensory (محسوسه) experience, observation and experimentation.

2. **Replicability/Reproducibility**:
   Research findings must be confirmable by independent investigators.

3. **Falsifiability**:

Hypotheses and theories must be testable and capable of being proven right or wrong.

4. **Objectivity**:

Observations and interpretations are related to objects.

5. **Systematic Inquiry**:

Research is conducted in a structured, rational, and logical manner

Steps in the scientific method

The scientific method isn't just a one-size-fits-all approach; it's more of a flexible framework. Researchers can adjust the steps depending on their study's specific needs,

Generally the core steps involve:

1. Problem identification

Every research project begins with identifying a problem or a question that needs answering. This is the foundation of the entire study. The problem could arise from a gap in existing knowledge, an observation that doesn't fit the current understanding, or an issue that requires a deeper examination.

For example In natural sciences, a question might be, "What causes certain plant species to survive in extreme climates while others do not?" Whatever the question, it needs to be clear, focused, and researchable.

2. Hypothesis formation

Once the problem has been identified, the next step is to formulate a hypothesis. A **hypothesis** is a proposed explanation based on known theoretical frameworks and prior evidence. Key qualities include:

Testability and Specificity to allow precise experimentation. A good hypothesis is testable and falsifiable, meaning it can be proven to be right or wrong through experimentation or observation.

3. Research Design and Methodology

The methodology section operationalizes how the hypothesis will be tested It involves:

A. **Choice of research type**:
   Experimental, observational, correlational, or qualitative.
B. **Selection of variables**:
   Independent, dependent, and controlled variables.
C. **Sampling strategy**:
   How data subjects or observations are selected.
D. **Planning data collection tools**:
   Surveys , lab instruments , sensors , or archival sources.
E. **Ensuring ethical compliance**:
   Consent (الموافقه), confidentiality, and safety protocols.

4. Data collection

After the hypothesis is in place, the next step is gathering data. This can be done in several ways depending on the research method.

The independent variable can be changed to see what is the effect on another thing that is a dependent variable

A good experiment should has only one independent variable test at one time

Data must be collected systematically to ensure validity and reliability.

Methods of data collection

1. Controlled laboratory experiments.
2. Field research and observation.
3. Surveys and questionnaires.
4. Secondary data analysis from existing datasets or literature.

Regardless of the method, the goal is to collect accurate and reliable data that will provide insight into the hypothesis.

In experimental research, data might come from controlled experiments.

In observational studies, data could be gathered from fieldwork or surveys.

In social sciences, data collection often involves qualitative methods like interviews, case studies, or ethnography, where researchers interact directly with participants.

It could also include quantitative methods such as statistical analysis, which involve collecting numerical data that can be analyzed mathematically.

5.Data analysis

Once the data has been collected, it's time to analyze it. Data analysis involves organizing and interpreting the data to determine whether it supports or contradicts the hypothesis.

In quantitative research, this might involve using statistical tests to find patterns or correlations.

In qualitative research, it could mean identifying themes or trends in the data.

It's important to note that data analysis should be objective. Researchers must approach the data without bias (تحيز او انتقاء) choosing all the get results. This ensures the findings are trustworthy and valid.

6. Conclusion

After analyzing the data, the researcher draws conclusions. This is where the results are put into context, and the original hypothesis is either accepted or rejected. If the data supports the hypothesis, the researcher might confirm that their prediction was correct. If the data doesn't support the hypothesis, the researcher might reject or revise it and possibly conduct further research.

The conclusion often leads to new questions, as the research might reveal additional problems that require further investigation. The process doesn't necessarily end here. In fact, many research studies open up new avenues of inquiry, creating a cycle of ongoing learning and discovery.

The most important thing is that the research is done systematically, transparently, and with objectivity to ensure the best possible results.