



Politechnika  
Wroclawska

# Methodology and conducting scientific research

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# Science

The definition of science:

***„Science is one of the types of human knowledge. In terms of cognition, it seems to be the best knowledge that describes reality most adequately. Science owes this high cognitive status to the methods it uses and the language it uses”***

***„Scientific research is the work undertaken by a researcher or team of researchers to advance scientific knowledge, establish new scientific theses, theses, axioms, generalizations and definitions”***

Source: <https://pl.wikipedia.org/wiki/Nauka>

# Scientific research

**Research can only be undertaken when the aim is to do so:**

- discovering so far undetermined new dependencies that have not been studied before,
- questioning the existing material and proving other dependencies,
- extending existing studies that have already been published
- updating (or confirming that they are still operational) existing studies and their results due to the significant passage of time and the possibility of their obsolescence.

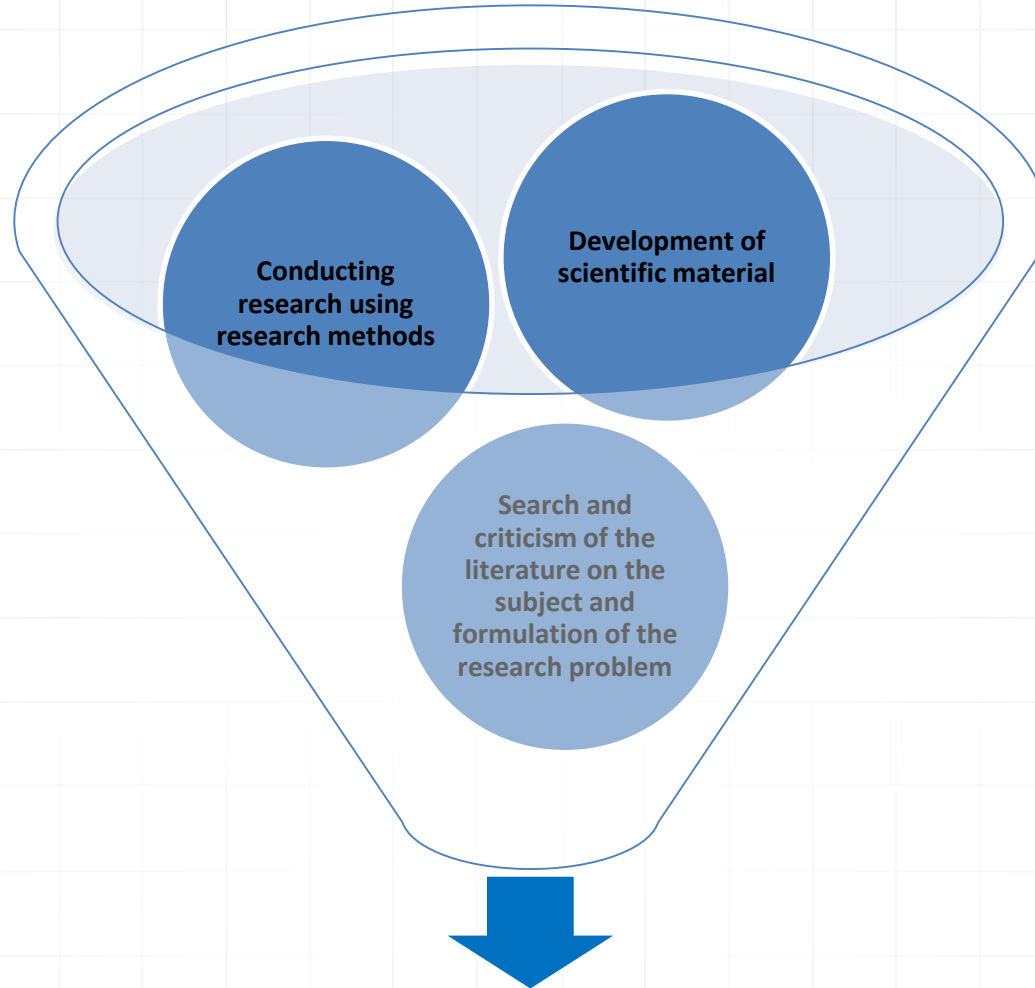
Źródło: [https://pl.wikipedia.org/wiki/Badania\\_naukowe](https://pl.wikipedia.org/wiki/Badania_naukowe)

# Typology of scientific research

Typology of scientific research according to its purpose:

- **basic** - explaining phenomena not yet explored and discovering new scientific (not practical) laws,
- **applied** - using the results of basic research in practice,
- **implementation** - they consist in developing methods and techniques for applying research results in production (they are the final stage of the research cycle; the results of these studies are called innovations).

# Scientific research process



**Scientific research results**

# Search and criticism of the subject literature

## Knowledge sources:

- See the content of the lecture "Searching for scientific knowledge",
- Consultations with the supervisor and other team members,
- Cooperation with other centers in the country and abroad,
- Research internships,
- Training.

**Only a proper mastery of the literature on the subject is the ground for specifying the research problem.**

# Formulation of the research problem

## Formulation of the research problem:

- The formulation of the research problem begins scientific research,
- A scientific problem does not have to be precise and unshakable. This is the general direction of research,
- The problem during the research is constantly being clarified and can even be quite significantly transformed,
- The research should also be justified due to the research gaps in the existing research,
- The subject matter should be up-to-date and innovative,
- Research objectives should be formulated.

**Then the appropriate working method or methods are selected.**

# Conducting research

## Conducting research:

- It consists in performing a series of similar activities, the purpose of which is to obtain scientific material for further study. **It is important that the researcher performs them reliably and accurately,**
- It should be recorded on an ongoing basis in order to reliably assess the course of the phenomenon under study,
- It constitutes a whole in terms of methodology and logic,
- It allows for a rational determination of the beginning and end of the research.

The researcher can determine the end of the research on the basis that the obtained information does not add anything new. Certain observations repeat themselves in the course of the experiment, observation, or partial statistical elaboration.

**Then the research should be completed.**



# Conducting research

## Resources needed to conduct research:

- Scientific research equipment,
- Software and licenses,
- Small laboratory equipment,
- Test materials (e.g. reagents, sample materials).

## Ways of obtaining resources needed to conduct research:

- From the resources of the parent unit (Department),
- From faculty and university resources,
- From resources / laboratories of other entities outside Wrocław University of Science and Technology.

The purchase of missing resources can be realized with external funds (e.g. research grants).

# Acquisition of research skills

## Skills necessary to conduct research:

- Service of research equipment / software / devices,
- Proper conduct of experiments,
- Correct analysis of the obtained test results,
- Presentation of the obtained research results.

## Ways of acquiring research skills:

- From the supervisor,
- From other people on the research team,
- From scientific publications,
- Thanks to cooperation with other centers,
- Thanks to participation in trainings, internships and schools,
- By reading online forums, tutorials, guides, etc.

# Preparation of scientific material

## Preparation of scientific material:

- Comes after the end of scientific research,
- Collects data in the form of tables, figures and charts,
- It consists in determining the partial and final results,
- It is a selection of necessary information and a generalization of observations,
- It is the process of extracting scientific facts, confirming scientific truths, searching for relationships and dependencies, explaining phenomena, carrying out evidence and confirming the correctness of hypotheses.

In the phase of developing the scientific material, the scientific material is prepared for the development of a scientific publication.

# Management of the doctorate process

- Project management methodologies can be used (e.g. PRINCE 2 methodology),
- Determine the rules of cooperation with the supervisor,
- Establish rules for using the necessary resources,
- Develop an implementation and implementation plan,
- Develop an implementation schedule (e.g. Gantt chart),
- Develop a strategy for publishing research results,
- Plan a quality management system,
- Identify risks on an ongoing basis,
- Plan a risk management system.

# Tasks to be performed for the next class

1. To formulate a research problem in one sentence.
2. Determine the resources needed to conduct your research and how to obtain them.
3. Develop a list of literature sources showing how to conduct research and analyze data in the field of your research.
4. Develop a schedule for carrying out your research.
5. Develop a list of possible risks in carrying out your research.