EPISTEMOLOGICAL ADVANTAGES OF SCIENTIFIC EXPERIMENTS' COMPUTER SIMULATIONS IN COMPARISON WITH TRADITIONAL TYPES OF EXPERIMENTS

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Abstract

Purpose. The author devotes this study to the epistemology of scientific experiments and the epistemic advantages of computer simulations that become available to scientists conducting experiments.

Design/methodology/approach. Among the main advantages are:

1) syntactic and semantic flexibility in designing and creating simulations;
2) quantitative enhancement of cognitive abilities
    - multiple superiority of computational abilities of high-performance clusters over human cognitive abilities;
    - visualization of experimental data in a form in which they are usually not accessible to humans in any of the other types of experiment;
3) quality enhancement of cognitive abilities
    - epistemic opacity - the absence of any opportunity for the researcher as the subject of the experiment to follow every process taking place in the hardware-software complex at any of its levels (hardware, digital, mathematical and logical);
    - working with models and mathematical equations that cannot be decomposed and solved by analytic or other methods accessible to human thinking that are directly related to rational activity;
4) epistemic unique experimental facility that are based on multi-level simulation, the basis of each level of which is laid down a separate theoretical concept or hypothesis.

Findings. *Simulations are the quintessence of structuring syntax (in the case of computer simulations, machine-computational syntax) according to the most relevant semantic forms of theoretical concepts and hypotheses about the object of the experiment.* An optimally working customized system for converting machine syntactic structures through semantic forms of mathematical models, which in turn express the semantics of theoretical concepts and hypotheses, allows simulations to perform the following important experimental functions:

- optimal selection of theories and hypotheses to describe the object of the experiment;
- verification of theories for semantic-syntactic consistency;
- explanation of the semantic essence of the theory;
- accurate and adaptive forecasting;
- obtaining heuristic data and an increase in the number of scientific discoveries.

Originality/value. The author, analyzing the heuristic nature of the experimental data, introduces a special criterion of representativeness, which defines simulations from the point of view of the transition of experimental traces from graphematical space to experimental data that already belong to the representative space. According to this author's criterion, the novelty of an experiment is determined by building new syntactic relationships between various experimental data to expand the existing semantics of theoretical concepts and models in relation to the study of phenomena subjected to experimental research. With this approach, according to the author, the novelty of data or heuristics is possible only in the case of computer simulations, in which the construction of multi-level simulators based on various semantics can be implemented.

Research/ Practical/ Social/ Environment implications. Today computer simulations based on high performance computing clusters have become commonplace in research practice. More and more often, scientists prefer to conduct experiments using computer simulations not only in terms of their technical convenience, but those cognitive advantages that traditional types of experiment cannot provide researchers with: laboratory, natural and mental (including mathematical modeling). Some philosophers, imbued with the technological capabilities of computing systems, dare to pose fundamental questions about the nature of knowledge, mind and ontology. This work will be useful to scientists in terms of constructing the methodology of a scientific experiment using computing technologies and computer simulations.

Research is limited: 1) to those computer simulations that are used in scientific experiments; 2) to the methods of the philosophy of experiment; 3) by the methodological scheme of the experiment: the target system - the object of the experiment - the subject of the experiment.

Keywords: computer simulations, computer science, philosophy of experiment, philosophy of science.