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SCIENCE AND SCIENTIFIC METHOD AS PART OF URBAN CULTURE TAUGHT ON SERBIAN UNIVERSITIES**

Summary: This paper analyses definition, meaning and significance of science, methodology and scientific method. Through presentation of general categorical definitions and certain conceptual discrepancies, several perspectives present at Serbian universities have been pointed out. The first of those discrepancies relates to the quintessential relation between science and social reality. Additionally, due to society being dynamic, it has been pointed out that scientific truth may prove to be relative and that it is of utmost importance to know and constantly improve methodology of scientific research as such. This significantly enhances the progress of entire well-being and urban culture.

Key words: higher education; scientific method; science; positivism; urban culture

Introduction

In its beginnings, philosophy represented the entirety of human knowledge and encompassed all scientific findings of those days. Over time, philosophy divided into three main branches: natural sciences (logics), humanistic sciences (ethics) and arts (esthetics) (Folić & Kurtović-Folić, 2009). The development of schools and universities as a precursor to research centers in their present form was catalyzed by religion and until XIX and XX century they remain closely connected with theology. The church patronage over scientific activity in Europe dates back from the period of establishment of the first university in Bologna (Carić, 2008). Only during the last century, scientific practice provides autonomy with regards to religious institutions. However, its significance conditions the interest of real social power holders with respect to science achievements and their application in reality (Nikolić & Baker, 2011). High intensity of developmental changes especially in the information society at the threshold of the 21st century has been largely based on the development of

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science and educational institutions (Carić & Carić, 2011). By progress of society and modern information systems, being the most dynamic factor of changes at present, the market needs have continuously been changing creating, as a result, the demand for diversification in higher education. The awareness that the process of generating knowledge for the sake of economic as well as society development is of importance has been significantly enhanced. The aforementioned is perceivable from statistical data which shows that „throughout the history of higher education the other half of the XX century represents the period of the most spectacular expansion in the number of enrolled students“ (Carić, 2008, p.3). Latest technology developments nowadays are affecting millions of Free and Open Source Software users in the world in a way that the latest information and communication technologies are available to everyone (Oreški & Šimović, 2012). Following these ICT developments, the notion of computer literacy and information literacy which is considered as a foundation for developing the modern society is increasingly present (Soleša & Soleša-Grijak, 2011). In this sense, the quality of education and acquirement represent the foundation of competitiveness not only in the labor market but in the domain of what we colloquially call - mundane life match. Therefore, successful functional complementarities of work at institutions of higher education and scientific research conditions both efficacy of educational process as well as the necessary competencies of highly educated persons.

Different perceptions of common definitions of science

When analyzing scholarly literature, one can notice that among scientists there is no consensus regarding the perception of science. However, prior to dealing with the problem of defining science, the subject, method and objectives of science are cited as its three constituent factors as well as immediate assumptions from which scientific activity springs out (Gud & Het, 1966). Scientific research and knowledge need to have the following elements: 1. to be organized and planned, 2. to be founded in empirics and verified theoretical knowledge, 3. rational choice of methods and to be in compliance with the rules of methodological procedures, 4. formulating laws as groundwork for explanation and anticipation, 5. synthesis of theoretical-epistemological and practical-experiential (Nikolić, 2005). Scientific paper describes the used methods, processes and means, in order to enable comparison with other similar researches as well as their repetition (Carić et al., 2013). Definition of science needs to encompass the following two aspects: (1) the statistical aspect of science characterized by the following elements: system of accumulated knowledge and experience from the earlier epochs; facts probity and the possibility of facts reproduction and (2) the dynamic aspect of science that is exhibited through the following: science as a dynamic system, research as an activity of human spirit to promote science, and scientific finding as a result or research product.

Subotić states that the main purpose of science is learning about the world around us in order to cope with it more easily. This author goes on to explain that science primarily represents “a systematized codex of knowledge” (Subotić, 2009, p.346). Zugaj believes that science represents a systematized and proven body of knowledge in a certain historical context and referring to objective reality, while this

body of knowledge has been compiled by purposeful usage of some objective research methods, aimed at comprehension of natural and societal laws in order to anticipate future events and do things most effectively (Žugaj, 1997, Žugaj et al., 1999). Šamić defines science as an orderly, systematized and tested knowledge, achieved by methodical, careful and conscientious research and analysis (Šamić, 1988). Ratković offers a simple and successful science definition: “Science is a systematized knowledge derived conceptually via certain methods, which can be verified“ (Ratković, 1979, p.7). Nikolić trying to constitute the definition which could structurally situate all the important components of scientific activity concludes: “Science is a systematized conceptual knowledge of a clearly specified object, method, cognitive goals, which starting from methodological postulates are systematically exploring experiential facts, establishing synthesis of cognitive and practical, as well as its results probity“ (Nikolić, 2010, p.20). Miljević claims that science is a human and social, essentially intellectual and rational activity. At the same time, science is also the result of scientific work. Hence, it is without doubt that in part science represents all the acquired and tested scientific findings, while it is also a logical, purposeful and targeted activity of acquiring new knowledge. From here we can conclude that science is at the same time both a complex process of acquiring new scientific knowledge and a developed structure of already acquired, tested, proven and verifiable scientific findings regarding the scientific subject and scientific method (Miljević, 2007).

Lukić (1995) states that science is the most precise and concrete intellectual creation that helps one discover reality as such (in Vuković & Živković, 2005). However, Mc Lelland emphasizes that most scientists do not agree that science leads to the comprehension of truth and adds that science implies the process of determining the things that will most probably be accurate at present given the currently available evidence (Mc Lelland, 2008).

A common denominator can be found in all of the previously mentioned definitions of science: systematized knowledge and methodological and systematic approach to acquiring new knowledge. This points out to some key differences regarding the ways in which scientists and those who are not involved in any scientific work perceive the process of acquiring new knowledge (Marczyk et al., 2005). In line with that, Lukić explains that science presents a group of empirical statements of a kind, being differentiated from others by its systematic and in-depth nature, and special methods used to arrive at those statements. Everyday experiential findings or learning statements of other kind are not systematic enough and are obtained along the way using other practical activities. However, science presents a group of systematically obtained and organized empirical knowledge statements (Lukić, 2003). It could be stated that systemised and tested knowledge, acquired through thorough research and logical analysis is called science.

Article 3 of the current Law on scientific and research work defines research as a systematic and creative work undertaken with the purpose of discovering new knowledge and raising the overall level of contemporary civilization development and using that knowledge to develop all aspects of society (Zakon o naučno-istraživačkoj delatnosti, 2005).

Hence, scientific research is free and open for scientific criticism which represents a constructive element of any scientific and research activity, since “there is no

refuting which is not followed by an even better theory” (Lakatos, 1978, p.6). In other words, Popper stated that the development and improvement of knowledge cannot start from nothing, from *tabula rasa* – nor even from pure observation. The improvement of knowledge consists mainly in the modification of previous knowledge (Popper, 2002).

Methodology and method

Methodology is a specific logical discipline, regardless whether general, special or single methodologies are in question or any other typological methodology. The given perception is shared by most sociologists, philosophers and members of other academic circles, which from the aspect of their science deal with the research of social and natural data. Milić in a well known monograph *Sociological Method* explains his standpoint, pointing out that ”it is impossible to extract general methodology from logic” (Milić, 1965, p.11) appropos, the branch of philosophy that deals with the establishment of the rule of true thinking and deduction. Radenović (1995) provides a simple definition according to which methodology is a branch of logics dealing with scientific method (in Vuković & Živković, 2005, p.8). Zaječaranović defines methodology as a science which deals with logical forms of learning and their application in scientific research (Zaječaranović, 1987). In other words, it is a science dealing with methods applied in scientific research and presentation of research results, emphasizing two processes: research as the process of scientific discovery and arriving at new findings, and education as the process of research results dissemination. Šešić states that methodology is a science whose object of study focuses on methods of scientific knowledge. ”The task of methodology is to discover, describe and explain the methods of scientific knowledge that is to show and explain the ways of obtaining the scientific knowledge” (Šešić, 1982, p.1). In describing their tasks, there is a very important area of improvement of the existing methods as well as education of researchers. As a scientific discipline, it examines all forms and ways of research with which it arrives at systematic and objective scientific knowledge (Carić & Carić, 2011).

Miletić (1978) states that methodology consists of three parts: logical, epistemological and scientific-strategic (in Vuković & Živković, 2005), while Nikolić adds technical to the previously mentioned scientific and strategic parts, constituting methodology as a whole. Starting from the aforementioned, it is possible to conclude that methodology as a specific logical discipline deals with finding and perfecting methods, research tools and procedures, development of logical frames of scientific knowledge, systematizing and evaluating scientific experiences as well as education of researchers (Nikolić, 2010).

Methodology has continuously been growing over time, adjusting and shaping scientific methods to fit the needs of modern society.

Scientific method (Greek methods – path, research manner) is called ”a set of various procedures and processes via which scientific knowledge and truths are obtained” (Šamić, 1988, p.12). Method is a way, a path to accessing the object of research, a way in which its truth is revealed (Nikolić, 2010). However, different theoretical – methodological approaches to a certain extent differently determine the signi-

ficance of scientific method. Positivists under the term method imply only "logical principles and technical means that are applied in scientific research practices." This type of method understanding which is reduced to logical rules of cognition and research technique is incomplete and unilateral (Pešić, 1999, p.12). Gud and Het are of the opinion that the usage of universal scientific principles quintessentially constitutes a method. Dialectical approach understands method more completely, and that viewpoint is widely accepted in contemporary science. Method is structured from logical rules and principles, theoretical knowledge and technical means (Nikolić, 2008). Each of these aspects of scientific methods has a concrete role in the research process and formulation of scientific notifications.

Scientific method represents a process of data collection and systematic data organization, as well as determining and explaining facts (their relationships and observed regularities), data analysis, arriving at conclusions and testing them (Plavšić, 2008). In short, scientific method represents a systematic unity of concepts and way of dealing with the chosen research subject (Miljević, 2007). When performing research into a specific research matter, it is possible and methodologically correct to use several different research methods (Nikolić, 2010).

Miljević explains that by scientific methods we do not always imply the same. When using the term "scientific methods", we sometimes want to refer to the logical way of thinking, and sometimes we refer to general scientific theories, so we speak of functional method, dialectic- materialistic method, structural method etc. Other times scientific methods might imply methods of data collection, such as: observing, survey, content analysis (Miljević, 2007, p.12).

Most authors classify scientific methods differently. These different ways of classification are presented in Figures 1 and 2.

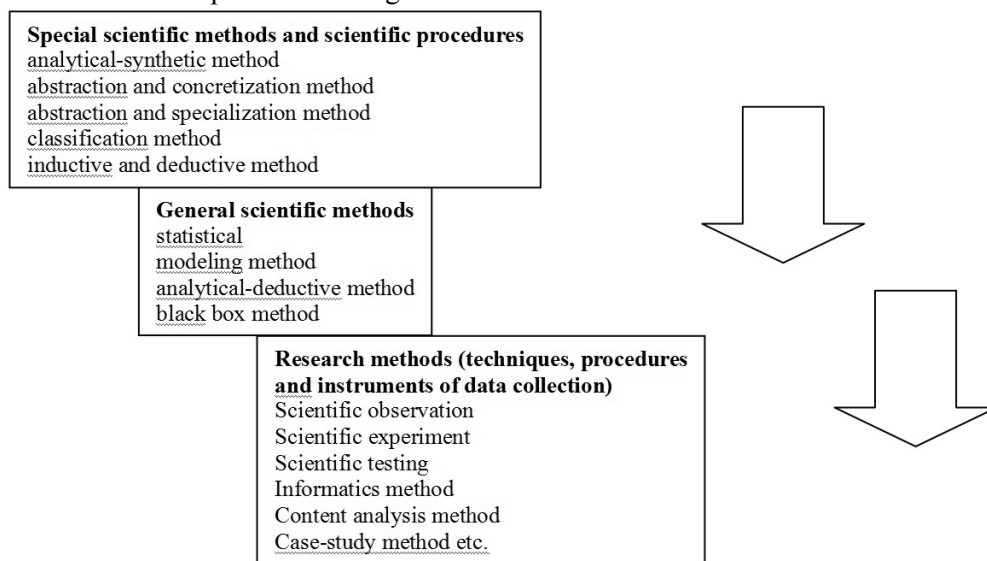


Figure 1.

Classification of scientific methods according to different levels of generality - Šešić (in Sotirović & Adamović, 2002, p.28)

Scientific methods are classified according to different generality levels, beginning with special scientific methods and ending with research methods.

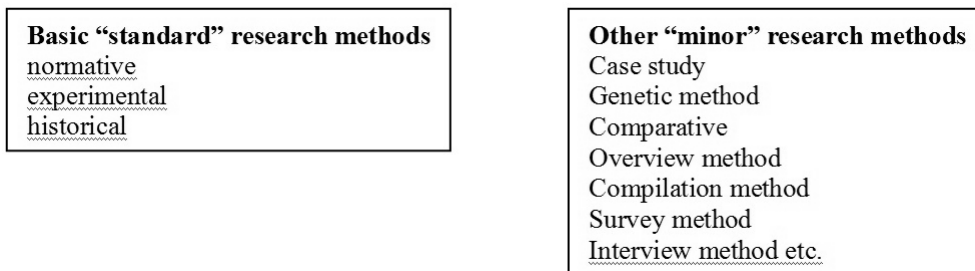


Figure 2.

Classification of research methods – Adapted according to Šamić, 1988, p.12-13.

Scientific methods are classified according to different generality levels, beginning with special scientific methods and ending with research methods. Šamić states that some methodologists make a distinction between methods and techniques and explains that his division was not influenced by this distinction (Šamić, 1988).

Nikolić (2010) classified scientific methods according to: (1) generality criteria, (2) paradigmatic formulation, vision, theoretic-methodological approach, and (3) research stages. Basic methods present a matrix for all other methods. General scientific methods are those which are used in all scientific branches (Nikolić, 2010).

Adhering to certain generally accepted "conclusion rules" (deduction rules) is necessary in order to abstract personal, social and irrational influences or at least reduce their impact and ensure that the process of acquiring new knowledge happens with minimum inconsistencies in drawing conclusions. Although world scientists observe and examine based on the evidence which can be tested and verified, the way or research method can take different forms, with creative flexibility as the key characteristic of scientific thinking. We cannot say that there is a single unique method that all scientist use or should use. Nevertheless, each research work should result in a conclusion which is verifiable and thus prove or refute. Scientific method is often presented as a set of procedures and steps to follow with variable scope (Mc Lillard, 2008).

Conclusion

As conceptually systematized knowledge derived from certain methods, which can be verified, science has long since become the driving force of the progressive development of society. The scientific way of thinking is built on a rational relation towards the empiric as well as the things that present empiric projection in the future. However not all knowledge founded in reason is at the same time a scientific one. It needs methodology. It can develop on speculation grounds, hypothetical thinking which tries to construct a projection of the reality without the proper practical proof, perhaps of indirect indicators only. That too is possible in natural physical world, the world of organic and inorganic reality as well as in social reality. Nonet-

heless, even then it must be connected to empiric via methodological support; it must find it and state it in space and time. Science does not deal with speculations, that is, it does not come down to them. Greatness of human mind, a rich fancy of philosophical reflections is just speculation about the truth. Hence, the postulates of classical positivism and later logical operationalism, independent of any dispute, survive to this day as guides to answer a question: What can we actually research? That approach is not really a unique methodological and epistemological concept. And that is the general place. Modern researchers of this provenance in particular have become aware that researcher sometimes has to seek help from its imagination, sometimes intuition too. Yes, but scientific research must not be reduced to them. To doubt and think through about what awaits us in the empiric, to project into awareness. However, devoid of methodological manner of collecting, sorting, displaying, analyzing and interpreting experiential facts, a research does not have the status of scientific. Methodology is like society, a dynamic category, the same goes for methods – they are given for all times. To be able to properly respond to their task, they need to be improved, adjusted and adapted; as the research itself after all. Conceptual differences are largely a matter of constant cognitive trendiness. Theorists know how to cast anchor behind the rigid canons of conceptual directions or schools to which they belong. Immediately empirical (or theoretical and empirical study) itself is destined to the convenience and efficiency. As such, it composes the use of methods, instruments and procedures in a manner the subject and goals of knowledge demand it. Paradigms are refracted. First and foremost, they are more oppositional in theoretical debates than in reality. This does not mean that the difference between paradigms and theoretical-methodological approach is banal. The differences are undoubtable. Moreover, the question is when does a topic and/or cognitive goal demand one, when the second, third and at what point it demands a proper combination of different theoretical-methodological perspectives. Human creation, among other things, is perceivable on the methodological horizon. How to expect science's progressive development without improvement of scientific research methodology? Educational system is firstly and foremostly based on manifestation of science value and incorporation of scientific information into all spheres of social life, as well as into educational structures. Even here, functional interdependance of vital social areas is perceivable. Strategic development of entire urban society in countries of developed world is based on complementarity of science and education quality.

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НАУКА И НАУЧНИ МЕТОД КАО ДЕО УРБАНЕ КУЛТУРЕ У НАСТАВИ НА УНИВЕРЗИТЕТИМА У СРБИЈИ

Сажетак: Овај рад се бави одређењем, значењем и значајем методологије и научног метода. Упоредо са представљањем општих места у категоријалним одређењима и извесним појмовним несагласностима, приказано је и неколико перспектива заступљених на универзитетима у Србији. Прва од поменутих несагласности тиче се суштинске релације науке и друштвене стварности. Такође, узимајући у обзир да је друштво динамично, у раду се истиче да се научна истина може показати као релативна, те да је изузетно важно познавати и перманентно развијати и унапређивати методологију научноистраживачког рада као такву. Тиме се значајно повећава прогрес целокупног благостања и урбане културе.

Кључне речи: високо образовање, научни метод, наука, позитивизам, урбана култура