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CATEGORIAL STRATIFICATION OF ACADEMIC NOTIONS IN THE DOMAINS OF NANOTECHNOLOGY, POLITICAL SCIENCE AND ECOLOGY

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Abstract

The article is devoted to the study of the categorial stratification of academic notions in the spheres of Nanotechnology, Political Science and Ecology. The authors analyze the Russian-language nanotechnology, political and ecological terms and their definitions taken from specialized (terminological) dictionaries. The authors consider the structure of definition of each term from the selected corpus of 350 units in the domains of Nanotechnology, Political Science and Ecology, model the corresponding term definitions and determine its constituents (main and additional information blocks). While considering the selected terms, the categories of academic notions (Locus, Construction, Mechanism, Instrument, Process, Characteristic, Ideal phenomenon, etc.) are taken into account. As a result of the analysis the most and least frequent categories of notions (categories of mental constructs) in each sphere are identified. The authors come to the conclusion that the specificity of each sphere in question (Nanotechnology, Ecology and Political Science) is characterized by a special correlation of the categories of notions / mental constructs. Nanotechnology is presented by several frequently used categories of mental constructs, namely: Artificial locus / construction, Ideal phenomenon, Process, Characteristic, Object, Material, etc. Political Science, in its turn, is distinguished by the presence of such categories of notions, as Ideal phenomenon, Doer, Locus, Process, Situation, Characteristic, etc. Ecology contains terminological units with such categories of mental constructs, as Ideal phenomenon, Process, Characteristic, Doer, Artificial locus / Construction, Locus, Natural phenomenon, etc. The category of Process is productive for all fields of knowledge, including Nanotechnology, Political Science and Ecology.

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Keywords: Definition, ecology, information block, nanotechnology, political science, term.



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1. Introduction

Scientific and professional texts are characterized by the presence of specialized lexis, in particular, terminology. The definitive function of the term is an indispensable condition of its existence that involves the expression of a special concept restricted in its boundaries by definition. This function allows referring a concept to a corresponding category (Golovin & Kobrin, 1987; Grinyov-Grinevich, 2008; Popova, 2011). All terminological units that comprise the terminology corpus of a certain field of knowledge can be attributed to a certain prototypic category of academic concepts (among which are Natural object, Locus, Mechanism, Instrument, Process, Characteristic, etc. (see: Latu 2016, 2018a, 2018b) on the basis of the analysis of their definitions. A term is understood as a lexical unit that requires academic definition (Leychik, 2007). The latter is made by specialists for specialists and specialists to be; it can be modelled and examined in detail (see: Lewis, 1970).

In the research we focus our attention on the terminologies of Nanotechnology, Political Science and Ecology which represent different domains of modern science that are important for the modern society. Nanotechnology is a field of science that deals with the manipulation and manufacture of materials and devices on the scale of atoms or small groups of atoms, on the nanoscale (prefix nano- is based on the Greek word “nanos” with the meaning “dwarf”) measured in nanometers (Britannica, n.d.). A nanometer is a unit of length equal to one billionth of a meter (<https://www.calculateme.com/>). The materials built at nanoscale often exhibit distinctive physical and chemical properties due to quantum mechanical effects. The achievements of Nanotechnology are used in many products we came across every day, such as aerogels, lithium ion batteries, piezoelectric fibers, fishing rods, tennis racquets, fitting clothing (<https://www.understandingnano.com/>), etc. (Razduev, Latu, & Mironenko, 2015). Political Science is a field of knowledge which deals with politics, laws of structure, functioning and development of the political life of state and society, reflecting the process of involvement of a person in the activity of expressing political interests and political power (Konovalov, 2010). In turn, Ecology is the study of the relationships between organisms and their environment. Some of the most pressing problems in human affairs – expanding populations, food scarcities, environmental pollution including global warming, extinctions of plants and animals, and all the attendant sociological and political problems – are to a great degree ecological (Britannica, n.d.).

2. Problem Statement

Nanotechnology, Political Science and Ecology terms as verbalizers of the corresponding academic notions have not yet been studied in detail from the viewpoint of their categorial stratification. The most and least frequent categories of notions / mental constructs of the terms in the domains of Nanotechnology, Political Science and Ecology have not yet been analyzed and described drawing on the material of the term definitions.

3. Research Questions

The first question is to analyze definitions of the selected Nanotechnology, Political Science and Ecology terms and in some cases determine their constituent parts – main and additional information

blocks. The second question is to find out the categories of notions / mental constructs of the terms in Nanotechnology, Political Science and Ecology and identify the most productive categories for each sphere in question, name the reasons for this or that correlation.

4. Purpose of the Study

The article is devoted to the study of the categorial stratification of academic notions in the spheres of Nanotechnology, Political Science and Ecology drawing on the example of the Russian-language nanotechnology, political and ecological terms and their definitions taken from specialized (terminological) dictionaries. The authors try to determine the most and least frequent categories of notion / mental constructs in the domains of Nanotechnology, Political Science and Ecology.

5. Research Methods

The research methods that are used to study the terminological material include, first of all, the method of random selection of terms and their definitions aimed at the specialists taken from various specialized sources including text and electronic terminological dictionaries and Internet sites. The next step implied the use of definition analysis to reveal the defining features of concepts reflected in the content of their definitions to identify the categories the analyzed technical terms refer to and classify them accordingly. Then the statistical and comparative analyses were carried out to define the differences in the terminologies of the considered domains.

In the research, we follow the classification of scientific notions (see: Latu, 2016, 2018a, 2018b), according to which the referents of terms can be of material and non-material nature due to their peculiarities. The referents of the first type are divided into the referents of natural origin, namely, Natural Object(-s) (“the category that represents elements of nature” (Latu, 2015, p. 95)), Substance (“comprises the notions of natural substances having certain properties, of which physical objects are composed” (Latu, 2015, p. 95)), Locus (“combines the notions of significant elements of space having a number of differential features which are characterized by the length and volume, where something is located” (Latu, 2015, p. 95)), and the referents of artificial origin, namely: Mechanism (“objects of artificial nature, obtained as a result of scientific and industrial human activity, which perform an action independently without human assistance or under human control” (Latu, 2015, p. 100)), Instrument/Man-made Object (“the category represents the community of referents created for specific purposes, which do not perform the work themselves, but are used by a person in his activities” (Latu, 2015, p. 97)), Material/Man-made Substance (“comprises the notions of consumables, as well as substances obtained artificially and used in the process of human production activity” (Latu, 2015, p. 103)), Construction (“the category covers the notions of artificially created structures, constructions or modified by many places in space” (Latu, 2015, p. 103)). The referents of the second type include such categories, as Process (“the category verbalizes the notions of actions and functions related to one or more objects of scientific or professional knowledge and considered as essential for the development of this sphere” (Latu, 2015, p. 106)), Characteristic (“verbalizes notions about characteristic features of referents of a certain field of scientific knowledge” (Latu, 2015, p. 83)), Agent (“includes notions of subjects engaged in the

implementation of tasks in a particular field of scientific or professional knowledge” (Latu, 2015, p. 109)), Situation/Event (“reflects the temporal and spatial correlation, as well as the conditions of interaction and functioning of the referents of a particular field of scientific or professional knowledge” (Latu, 2015, p. 107)), Ideal Phenomenon (“denotes not the elements of the physical world (artificial or natural), but provisionally introduced images, meanings which are necessary for the study and description of the surrounding reality and serving as a superstructure over the elements of the physical world and the development of scientific knowledge in a particular field of knowledge” (this category includes units of measurement, laws, theorems, etc. (Latu, 2015, p. 109)).

6. Findings

Let us consider the distribution of terms in the domains of nanotechnology, politics and ecology in accordance with the categories of academic notions. The analysis helped to reveal that the most productive categories in the sphere of Nanotechnology are:

Instrument/Man-made object (18%). This category involves all man-made nanoobjects and nanostructures, as well as tools and instruments, for example, *nanotrubka* (*nanotube*), *nanoinstrument* (*nanotool*), *nanokonus* (*nanocone*), etc.: **Nanotrubka**, *inache tubulyarnyye nanostrukury; nanotubuleny* (*angl. nanotube*) – *topologicheskaya forma nanochastits v vide pologo nanosterzhnya* (<http://thesaurus.rusnano.com/wiki/article1391>) (Translation: **Nanotube**, or *tubular nanostructures; nanotubules* (*eng. nanotube*) – *topological form of nanoparticles in the form of a hollow nanorods*).

Natural Object (13%). For example, nanokristall (nanocrystal), nanochastitsa (nanoparticle), etc. **Nanokristall** (*angl. nanocrystal*) – **{kristall}**, *razmery kotorogo po odnomu ili neskol'kim izmereniyam lezhat v nanodiapazone* (<http://thesaurus.rusnano.com/wiki/article1293>) (Translation: **nanocrystal** (*eng. nanocrystal*) – a **{crystal}**, the size of which in one or more dimensions is in the nanoscale).

Material (16%). For example, nanokompozit (nanocomposite), nanomaterial (nanomaterial), nanouglerodnyy material (nanocarbon material), etc. **Nanokompozit** (*angl. nanocomposite*) – **{kompozitnyy material}**, *v kotorom khotya by odna iz faz imeyet usrednenny razmer obosoblennykh elementov (chastits, kristallitov, volokon, plastin i t.d.) meneye 100 nm khotya by v odnom izmerenii* (<http://thesaurus.rusnano.com/wiki/article2209>). (Translation: **Nanocomposite** (*eng. nanocomposite*) – **{composite material}**, in which at least one of the phases has an average size of separate elements (particles, crystallites, fibers, plates, etc.) less than 100 nm in at least one dimension).

Process (17%). For example, nanoproduzvodstvo (nanofabrication, nanomanufacturing), osazhdeniye atomnykh sloyev (atomic layer deposition), etc. **Tekhnologiya Lengmyura-Blodzhett**, *inache plenki Lengmyura-Blodzhett; metod Lengmyura-Blodzhett* (*angl. Langmuir-Blodgett method, sokr. LB*) – *tekhnologiya polucheniya mono- i mul'timolekulyarnykh plenok putem perenosy na poverkhnost' tverdogo podlozheniya plenok Lengmyura... Metod formirovaniya mono- i mul'timolekulyarnykh plenok byl razrabotan Irvingom Lengmyurom i ego uchenitsey Katarinoy Blodzhett v 1930-kh gg.* (<http://thesaurus.rusnano.com/wiki/article1797>). (Translation: **Langmuir-Blodgett technology**, otherwise *Langmuir-Blodgett films; Langmuir-Blodgett method* (*eng. Langmuir-Blodgett method, abbr. LB*) – a technology for producing mono- and multi-molecular films by transferring Langmuir films to the surface of a solid substrate... The method of formation of mono- and

multi-molecular films was developed by Irving Langmuir and his student Katarina Blodgett in the 1930s.).

Ideal phenomenon (12%). For example, zakon Mura (Moore's Law), vikhr' Abrikosova (Abrikosov vortex), polevoy effekt (field effect), etc. **(Nano)lekarstvennaya forma** (angl. (nano-) pharmaceutical formulation ili pharmaceutical form, drug formulation) – pridavayemoye lekarstvennomu sredstvu ili lekarstvennomu rastitel'nomu syr'yu udobnoye dlya primeneniya sostoyaniye... Lekarstvennyye formy byvayut tverdymi (naprimer, tabletki, kapsuly), myagkimi (mazi, suppozitorii), zhidkimi (rastvory, suspensii), gazoobraznymi (aerozol') (<http://thesaurus.rusnano.com/wiki/article1071>) (Translation: **(Nano)pharmaceutical form** (eng. (nano-)pharmaceutical formulation or pharmaceutical form, drug formulation) – a form of a drug or medicinal plant raw material convenient for its use... Dosage forms can be solid (e.g. tablets, capsules), soft (ointments, suppositories), liquid (solutions, suspensions), gaseous (aerosol)).

Mechanism (8%). For example, atomno-silovoy mikroskop (atomic force microscope)). **Biosensor** (angl. biosensor) – ustroystvo, ispol'zuyushcheye spetsificheskiye biokhimicheskiye reaktsii dlya detektirovaniya khimicheskikh soyedineniy (<http://thesaurus.rusnano.com/wiki/article589>) (Translation: **Biosensor** (eng. biosensor) – a device using specific biochemical reactions to detect chemical compounds).

Substance (7%). For example, nanochernila (nanoink), poverkhnostno-aktivnoye veshchestvo (surfactant), etc. **Nanochernila** inache chernila dlya struynoy mikropechati (angl. nanoink) – kolloidnyy rastvor nanochastits v dispersionnoy srede (suspensiya), prednaznachennyy dlya sozdaniya nanostrukturirovannykh pokrytiy s zadannoy topologiyey i funktsional'nymi kharakteristikami (<http://thesaurus.rusnano.com/wiki/article1401>). (Translation: **Nanoink**, ink for inkjet micro-printing (eng. nanoink) is a colloidal solution of nanoparticles in a dispersion medium (suspension) developed to create nanostructured coatings with a given topology and functional characteristics).

The terms of the categories **Characteristic** (6%) and **Situation** (2%) are far less productive. Terms that represent the categories **Locus**, **Agent** (*nanotekhnolog* (*nanotechnologist*)) and **Construction** constitute less than 1% and are non-productive for this domain.

The most productive categories in Political Science include:

Ideal phenomenon (28%). For example, federatsiya (federation), gosudarstvo (state), demokratiya (democracy), etc. **Pravovoye gosudarstvo** – {**gosudarstvo**}, vazhneyshimi priznakami kotorogo yavlyayutsya: gospodstvo zakona vo vsekh sferakh obshchestvennoy zhizni... (Sanzharevsky, 2010)(Translation: **Legal state** – a {**state**}, the most important features of which are: the rule of law in all spheres of public life...).

Process (20%). For example, agitatsiya (agitation), reforma (reform), vibory (elections), politicheskaya mobilizatsiya (political mobilization), etc. **Agitatsiya** (ot lat. agitatio – privedeniye v dvizheniye, pobuzhdeniye k chemu-libo) – rasprostraneniye idey dlya vozdeystviya na soznaniye, nastroyeniye, obshchestvennyuyu aktivnost' mass s pomoshch'yu ustnykh vystupleniy, sredstv massovoy informatsii (Sanzharevsky, 2010) (Translation: **Agitation** (from lat. agitatio – actuation, motivation for something) – the dissemination of ideas to influence the consciousness, mood, social activity of the masses with the use of speeches, mass media).

Situation (17%). For example, voyna (war), impichment (impeachment), politicheskii krizis (political crisis), etc. **Politicheskii konflikt** – vid otnosheniy, gde politicheskiye interesy i ikh nositeli protivodeystvuyut. Razlichayut sleduyushchiye tipy konfliktov: mezhlichnostnyye, mezhnatsional’nyye, mezhpartiynyye, mezhblokovyye, mezhklassovyye, mezhgruppovyye, mezhgosudarstvennyye i dr. (Deishle & Lobzhanidze, 2012). (Translation: **Political conflict** – a kind of relationship where political interests and their carriers counteract. There are the following types of conflicts: interpersonal, interethnic, inter-party, inter-block, inter-class, inter-group, inter-state, etc.).

Agent (13%). For example, prezident (president), politicheskii aktor (political actor), elektorat (electorate), etc. **Aktor** (lat. aktor – deyatel’) – sub’yekt konkretnogo politicheskogo protsesssa. V ramkakh rolevykh kontseptsiy politicheskiye yavleniya i protsessy traktuyutsya kak rezul’tat realizatsii razlichnykh rolevykh predpisaniy aktora (http://www.gumer.info/bibliotek_Buks/Polit/Dict/01.php). (Translation: **Actor** (lat. actor – figure) – the subject of a particular political process. Within the framework of the role conceptions, political phenomena and processes are considered as a result of the implementation of various role requirements of the actor).

Locus (11%). For example, demilitarizovannaya zona (demilitarized zone), etc. **Demilitarizovannaya zona** – ustanovlennaya mezhdunarodnym dogovorom ili soglasheniyem {**polosa territorii**}, na kotoroy gosudarstvu ili gruppe gosudarstv zapreshcheno sokhranyat’ staryye i vozvodit’ novyye ukrepleniya, derzhat’ voyska, sozdavat’ voyenno-promyshlennyye ob’yekty (Sanzharevsky, 2010) (Translation: **Demilitarized zone** – a {**strip of territory**} established by an international treaty or agreement, in which it is prohibited for a state or a group of states to keep the old and build new fortifications, keep troops, create military-industrial facilities).

Less frequent categories are:

Characteristic (8%). For example, politicheskaya aktivnost’ (political activity), etc. **Politicheskaya aktivnost’** – ponyatiye, raskryvayushcheye sovokupnost’ deystviy, vykhod energii individov i sotsial’nykh grupp, napravlennyye na izmeneniye svoego politicheskogo statusa i okruzheniya (Konovalov, 2010) (Translation: **Political activity** – a notion that reveals a set of actions, energy output by individuals and social groups, aimed at changing their political status and environment).

Such categories of concepts as **Instrument**, **Natural object**, **Substance**, **Material**, **Construction**, **Mechanism** constitute less than 3% or are not represented in the selection of political terms at all. This is because of the theoretical nature of Political Sciences: it mainly deals with certain abstract socio-political phenomena, not real natural objects, instruments, mechanisms, constructions, substances and materials. Compare it with the mainly practical nature of Ecology.

As for the sphere of Ecology, the most productive categories are:

Natural object (17%). For example, endemic (endemic), populyatsiya (zhivotnykh) (population (of animals)), etc. **Fil’tratory** – vodnyye zhivotnyye, pitayushchiyesya melkimi planktonnymi organizmami ili vzveshennymi chastitsami (detrit), ottsezhivayemyimi iz vody pri pomoshchi osobykh fil’truyushchikh prispособleniy rotovogo apparata (Ibragimova, Rakhimov, & Ziyatdinova, 2012) (Translation: **Filter feeders** – aquatic animals that feed on small planktonic organisms or suspended particles (detritus), filtered from water with the help of special filtering devices of the oral apparatus).

Ideal phenomenon (16%). For example, predel'no dopustimyy vybros (maximum permissible emission), piramida chisel (ecological pyramid), pishchevaya tsep' (food chain), detritnaya pishchevaya tsep' (detrital food chain), pastbishchnaya pishchevaya tsep' (grazing food chain), toksicheskaya doza (toxic dose), etc. **Pastbishchnaya pishchevaya tsep'** – pishchevaya tsep', kotoraya v otlichiye ot **detritnoy pishchevoy tsepi** nachinayetsya s zelenykh rasteniy i idet daleye k pasushchimnya rastitel'noyadnym zhyvotnym, a ot nikh – k plotoyadnym (Ibragimova et al., 2012). (Translation: **Grazing food chain** – a food chain, which is in contrast to the **detrital food chain** begins with green plants and goes on to grazing herbivorous animals, and from them to carnivores).

Substance (14%). For example, parnikovyye gazy (greenhouse gases), uglekislyy gaz (carbon-dioxide gas), zagryaznyayushchee veshchestvo (pollutant), vrednyye khimicheskiye veshchestva (chemicals), etc. **Zagryaznyayushchee veshchestvo** – toksichnoye i/ili opasnoye {veshchestvo}, sposobnoye prichinit' vred zdorov'yu lyudey ili okruzhayushchey i prirodnoy srede (Ibragimova et al., 2012). (Translation: **Pollutant** – a toxic and/or dangerous {substance} that can cause harm to human health or the environment).

Process (14%). For example, akklimatizatsiya (acclimatization), samoochishcheniye (self-purification), ekologizatsiya (ecologization), etc. **Digressiya** – ukhudsheniye sostoyaniya ekosistem pod vozdeystviyem faktorov srede ili chelovecheskoy deyatel'nosti. Digressiya byvayet endodinamicheskaya (naprimer, pri biogennom zasolenii poverkhnosti pochvy), antropodinamicheskaya (pri perevypase pastbishch) i ekzodinamicheskaya (pri vtorichnom zasolenii pochvy, dlitel'nom zatopenii i dr.) (Ibragimova et al., 2012). (Translation: **Digression** – deterioration of the state of ecosystems under the influence of environmental factors or human activity. Digression can be endodynamic (for example, in biogenic salinization of the soil surface), anthropodynamic (in overgrazing) and exodynamic (in secondary salinization of the soil, prolonged flooding, etc.)); **Neorganizovanny vybros** – vybrosy v vide nenapravlennykh potokov gaza, naprimer, v rezul'tate narusheniya germetichnosti oborudovaniya, otsutstviya ili neudovletvoritel'noy raboty oborudovaniya po otsosu gaza v mestakh zagruzki, vygruzki ili khraneniya produkta... (http://peukgroop.ru/ekologicheskie_termini/) (Translation: **Unorganized emissions** – emissions in the form of undirected gas streams, for example, as a result of the equipment leakage, absence or unsatisfactory operation of the equipment for gas suction in the places of loading, unloading or storage of the product...).

Material (13%). For example, penoplast (foam(ed) plastic), penopolistirol (polystyrene foam, cellular polystyrene), plastmassa (plastic), etc. **Penoplast** – lyogkaya plastmassa, imeyushchaya vid zastyvshey peny (Ibragimova et al., 2012). (Translation: **Foam(ed) plastic** – light plastic having the form of hardened foam).

Locus (8%). For example, ekologicheskiy bar'yer (ecological barrier), ekotop (ecotope), pustynya (desert), shel'f (shelf), troposfera (troposphere), etc. **Ekologicheskiy bar'yer** – {**polosa territorii**}, kotoraya sluzhit prepyatstviyem dlya rasprostraneniya tekhnogennykh zagryazneniy ({**sanitarno-zashchitnaya zona**}) (<https://uchebnikfree.com/pochv-agroekologiya-ekologiya/terminyi-ponyatiya-upotreblayemye-25937.html>) (Translation: **Ecological barrier** – {a strip of territory} which serves as an obstacle to the spread of technogenic pollution ({**sanitary protection zone**})).

Situation (7%). For example, *ekologicheskaya situatsiya* (ecological situation), *ekologicheskaya obstanovka* (ecological situation), etc. **Ekologicheskaya obstanovka** – obshcheye sostoyaniye prirodnoy sredy s tochki zreniya usloviy prozhivaniya lyudey i sushchestvovaniya zhivotnykh i rasteniy (Ibragimova et al., 2012) (Translation: **Ecological situation** – a general state of the natural environment in terms of living conditions of people and the existence of animals and plants).

Less productive categories of academic concepts are **Characteristic** (6%) (*bonitet*(quality of locality), *khoming* (*homing*), *smertnost'* (*mortality*), etc.) and **Agent** (4%) (*fil'trator* (*filter feeder*), *ekolog* (*ecologist*), etc.). The categories **Construction**, **Instrument**, **Mechanism** are not characteristic of this domain and constitute less than 1% as categories of notions / mental constructs are not presented in the selection of Ecology terms.

7. Conclusion

The results of the term definition analysis allow us to conclude that Nanotechnology, Ecology and Political Science as different scientific fields of knowledge are characterized by a special correlation of the categories of mental constructs. Nanotechnology is presented by several frequently used categories of mental constructs, namely: **Artificial locus / construction**, **Ideal phenomenon**, **Process**, **Characteristic**, **Object**, **Material**, etc. Political Science, in its turn, is distinguished by the presence of the following categories of mental constructs: **Ideal phenomenon**, **Doer**, **Locus**, **Process**, **Situation**, **Characteristic**, etc. Ecology contains terminological units with such categories of mental constructs, as **Ideal phenomenon**, **Process**, **Characteristic**, **Doer**, **Artificial locus / construction**, **Locus**, **Natural phenomenon**, etc. The difference in the correlation of the categories of notions / mental constructs depends on the object of research in the domain in question. As a rule, such categories of mental constructs, as **Characteristic** and **Doer** in many terminologies are characterized by quite a small amount of terms due to the fact that many various objects have the same properties, and the list these properties is limited. The category of Process is quite productive in all scientific fields of knowledge.

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