

Review research paper

INTELLECTUAL OPERATIONS DEVELOPMENT THROUGH LANGUAGE ACQUISITION AT A TECHNICAL UNIVERSITY

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Abstract. *This paper deals with the idea of efficient intellectual operations development required for students to be successful at acquiring information via IT tools and learning a foreign language. The authors provide a list of functional soft skills referred as cogitative abilities. These operations ensure critical data selection during relevant engineering information search contained in digital engineering environment. Intellectual skills are rated in the course of instruction of graduates and undergraduates. Suggestions on skills formation and their further improvement on the basis of IT tools and functional approach are given.*

Key words: *intellectual operations, cogitative abilities, information flows, technical university, IT tools, functional approach*

1. INTRODUCTION

For successful professional activity, students should be taught to critically analyze incoming information and formulate reasoned conclusions on this basis. The quality of training depends on the ability of students to operate with information and to use information resources in cognitive activity. Development of cogitative abilities takes place throughout a person's life, but the most productive period is the student age (17-23 years). According to the age psychology (Vygotsky 1978; Klychnikova 1983; Korniyenko 1996; etc.) at this age, there is a rise in mental activity, the need to establish cause-and-effect relationships and involvement in creative types of cognitive activity. The level of student thinking abilities shaped at university is significant for their future career and social adaptation in modern society.

The subject of this paper is intellectual (cogitative) skills and abilities development. Intelligence is a system of mental mechanisms that makes it possible to build a subjective picture of what is happening 'inside' an individual (Kholodnaya 2002). It is also the thinking ability of a person and it represents a set of cognitive processes.

Intellectual skills show:

- the level of cogitative instincts;
- the ability to identify the challenge and anticipate the ways to settle it;
- the ability to make presuppositions on causes and consequences of phenomena;

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- how to hold multiple meanings of complex phenomena and statements at the
- same time.

As noted by Smirnov (2014) only a little more than half of students increase their intellectual capacity from the first year to the fifth, and, as a rule, this increase is observed in weak and average students, and the best students show no progress. For the most students, the level of intellectual operations such as comparison, classification, and definition is very low.

The purpose of our research is to get some understanding on the impact of IT educational resources and technologies on intellectual skills development. We share the idea that evolution of the digital educational environment at a technical university is aimed at the improvement of a student intellectual level by the potential of IT tools (Martynova 2008) and that the result of learning digitalization is rational intellectual activity (Nazarenko 2010, 114). Personal reserve opportunities and pedagogical grounds to develop intellectual skills should be identified.

2. RESEARCH METHODS AND APPROACH

To achieve the purpose the following research methods and approaches were adopted:

- thorough examination of syllabus and curricula regarding the specified skills development;
- definition of the phenomenon ‘intellectual skills’;
- drawing up the list of intellectual skills necessary both for language acquisition and engineering activity;
- investigation of psychological and pedagogical IT fundamentals in assignments design;
- selection of the appropriate IT tools to develop intellectual skills and abilities;
- demonstration of efficient skills development by means of ESP assignments.

2.1. Intellectual skills

Intellectual skills are associated with cognition, intelligence and thinking with some focus on other mental operations. Intellectual skills refer to critical, analytical, synthesizing and problem-solving skills, and are defined as methods an individual can use to evaluate or organize information and data. They are formed in the course of active instruction. The development of abilities are results of mastering operational mechanisms (Aebersold, Field 2002; Achard; Niemeier 2004; Nattal 2005; Derewianka 2016), and information transformation based on cognitive operations. Intellectual skills include: assimilation of new knowledge; development of critical analysis concerning studied information; application of basic knowledge in wider contexts. Shaping of general intellectual skills at a technical university such as skills of self-education and self-development was investigated by Russian and foreign researchers (Goncharuk 2006; Grishko 2007; Rudenko 2016; Inozemtseva 2017; Ivanova et al. 2018; Repkina 2018).

According to Jean Piaget there are four stages of intelligence development regarding the age-specific periods. The fourth period of intelligence development is the period of formal operations. It begins from the age of 12 and lasts further throughout life. (Piaget 2003). But instruction could speed up the completion of these stages. For example, P. Ya. Halperin states that with targeted training formal operations appear earlier (Halperin 2011).

Intellectual skills ensure the development of productive thinking and contribute to a shift in mental development and increase the level of cognitive activity. Intellectual skill is the awareness of a rational way to implement a particular mental operation and its use in solving various problems (Rumzytseva 2004; Yegorova 2005; Kupriyanycheva 2006). Intellectual skills are: the ability to think, perceive, remember, be attentive, and have intuition. Thus, most authors relate them as mental or logical operations. But by now there is no complete classification of intellectual skills.

2.2. Taxonomy of Learning Domains: the Cognitive Domain

Bloom's taxonomy of learning domains was created in 1956 under the leadership of educational psychologist Dr. Benjamin Bloom to promote higher forms of thinking in education (Bloom 1956), for example: analyzing and evaluating concepts, processes, procedures, and principles, rather than just remembering facts (rote learning). The following is shown in the order of learning domains importance:

- create: produce new or original work (design, assemble, construct, develop, formulate, investigate, conjecture);
- evaluate: justify a stand or decision (appraise, argue, defend, judge, select, support, value, critique, weigh);
- analyze: draw connections among ideas (differentiate, organize, relate, compare, contrast, distinguish, examine, experiment, question, test);
- apply: use information in new situations (execute, implement, solve, use, demonstrate, interpret, operate, schedule, sketch);
- understand: explain ideas or concepts (classify, describe, discuss, explain, identify, locate, recognize, report, select, translate);
- remember: recall facts and basic concepts (define, duplicate, memorize, repeat, state).

In accordance with the conditions of learning by Robert Mills Gagné (1984) intellectual skills are subdivided into different levels of learning: discrimination, concrete concept, defined concept, rule, and problem-solving (Gagne 1985). For example, discrimination is the ability to differentiate objects based on one or more of their physical characteristics, features or dimensions. Robert Gagné suggests that learning tasks for intellectual skills can be organized in a hierarchy according to complexity:

- stimulus recognition,
- response generation,
- procedure following,
- use of terminology,
- discriminations,
- concept formation,
- rule application,
- problem solving.

In pedagogy intellectual development is reduced to the development of the mind. Intellectual skills are the subject of a special shaping. Six components of intelligence are stated (Field 2004; Buzzetto-More, Sweat-Guy, Elobaid 2007; Lightbown, Spada 2013):

- the ability to perform digital operations;
- vocabulary;
- the ability to perceive similarities or differences between geometric shape;
- fluency of speech;

- the ability to reasoning;
- memory.

It is rational to develop cross-subject and specifics for individual subjects academic and intellectual skills on the basis of classification made by Y. K. Babanskiy (Babanskiy 1982):

- definition of object analysis and synthesis and their components;
- identification of significant object features;
- reaction rate and attention to detail;
- focus on problem solving;
- distributed attention;
- spatial perception;
- working memory and rational memory;
- logical comprehension of training material;
- solution of cognitive issues;
- comparison of objects and phenomena in order to find similarities and differences;
- establishment of cause-and-effect relationships;
- acquisition and classification of information;
- thinking (speed, creativity, logics);
- problem statement and the ways to solve it;
- performance of cogitative operations.

2.3. Intellectual competencies

In recent decades, there has been a shift to the development of key competencies in the educational content. On the formation of key intellectual skills of self-education, self-development (Crow, Dabars 2015; Bastedo et al. 2016) intellectual competencies reveal:

- maturity of cogitative instincts and research activity;
- the ability to find out challenges and problems and speculate on as to their settlement;
- the ability to speculate on the probable cause of different phenomena and their implications;
- keeping in mind at a time various ideas, complicated phenomena, issues and texts.

3. THE WAYS OF INTELLECTUAL SKILLS DEVELOPMENT

The following stages are involved in intellectual skills shaping:

- designation of the efficient thinking;
- undertaking of cognitive and creative assignments;
- development of skills required in modern society;
- shaping of reasoning skills;
- syllabi and methods of instruction design;
- options for skills formation are to be integrated in the content of ESP course.

Intellectual skills include abilities to:

- identify the problem;
- analyze critically;
- generalize;
- compare and classify the information under study;
- state cause-effect relations.

3.1. Academic skills development – the way to student functional literacy

Educational skills	Intellectual skills
set a goal	be able to select information
define and implement objectives, make up procedures	mine new knowledge
correlate the result with the goal	be able to process information
evaluate the result	be able to transform information

Unfortunately, students have lost the ability to ‘grasp’ the integrated knowledge for assimilation. The current pace of technology, creation and processing of information have significantly exceeded the ability of a person to consciously learn and apply knowledge. Perception of the world around us through an entertainment and reference model, rather than through science and education as before, formed a ‘clip thinking’, which resulted in a superficial and unappreciated perception of information. The ‘telegraph’ style of writing and thinking becomes the only one available to a person. The user often only has time to run through a couple of sentences of text with a glance at the image. Clip thinking corresponds to our time. It allows you to snatch the necessary information from the rapidly changing content, but at the same time the whole picture of the world is lost. Therefore, the problem of shaping critical thinking and reading skills becomes relevant.

Students have to be taught to give reasons, to prove, to make conclusions, and read productively only on the basis of mental operations. These operations are: analysis and synthesis; comparison, generalization and concretization; abstraction; classification; argumentation and reasoning (inductive and deductive). This is consistent with the concept of universal educational actions (Asmolov 1999). The required skills shaping necessary for foreign language acquisition are considered to be: critical thinking, information skills, skills of reasoning, predictive skills, etc.

3.2. Critical thinking

Critical thinking is the ability to analyze and interpret information to assess its context and validity. It is the kind of mental activity allowing a person to make up reasoning about proposed considerations. Critical thinking refers to a diverse range of intellectual skills concerned with information evaluation. It is necessary for having strong analytical skills. This can include multiple specific skills:

- asking questions about information;
- comparison of material with known information;
- drawing the context analysis of information.

Critical thinking comprises such logical operations as: analysis, synthesis, comparison, summarizing, and reflection concerning personal mental activity. All statements are evaluated in accordance with the adopted standards, canons and code of ethics. Inconsistent details and material are detected.

The content significant for earning critical thinking includes the items necessary for cognitive student activity in the digital environment (Bednenko 2010). Intellectual skills peculiar to critical thinking are:

- search for information;
- making sense of received data in comparison with acquired before;
- analyzing information and drawing reasoned conclusion;
- planning and predicting;
- making comparison and analogy;
- correlating information from different sources;
- organizing information;
- considering and evaluating different points of view;
- generalizing and differentiating received data and summing up;
- stating cause-effect relations;
- applying outcome for defined task decision;
- evaluating acquired knowledge and information.

Critical thinking capability was considered by numerous scholars as background for improvement in mental activity. It was regarded as the background for cutting edge knowledge and personal development. Four-stage development of critical thinking:

1. motivation for determination the problems;
2. understanding and stating the ways for their decision;
3. personal attitude towards the data under study;
4. application of the obtained results in non-standard situation.

All the above-mentioned provisions that reveal the features of critical thinking formation by means of ICT can be implemented in the course English for Specific Purposes (ESP) for students of the technical University.

Teaching students critical thinking in a modern university by means of information technologies is shown in the review of Russian authors (Popkov, Korzhuev 2004; Khutorskoy, Krayevskiy 2008; Ivanova 2018, etc.) and works of foreign authors (Craig 2015; Christesen, Eyring 2011; Ackerman, Goldsmith 2011; Bastedo 2016, etc.). It is advisable to form within a separate ESP course the assignments for critical skills shaping. Critical thinking skills include: reasoning, analyzing, decision making, problem solving, evaluation.

3.3. Information skills

One of the general qualification requirements of engineering specialist areas is the awareness of rational methods for searching and rational application of scientific and technical information. General qualification requirements for engineering occupations are:

- rational information search and usage;
- ability to find multiple sources and choose the best one.

Previously, the main and the only object of linguistic research was the text (its analysis, comprehension, etc.). However, in order to feel free in the information society, a person must process a huge amount of information. The avalanche of information contained in information flows cannot be fully perceived and analyzed due to psychophysiological limitations. A new information object 'information flow' requires the use of new technologies to be the means for extracting sense by the addressee. Information flow is meant, first of all, as a set of texts that act as a single object: the recipients are interested in the meaning contained in hundreds or even thousands of texts at once.

The psychologists Zhinkin (1998), Sokolov (2013), Zimnaya (2004), etc., began to discuss the role of semantic milestones at text comprehension. According to computer science they are 'keywords', which carry a semantic load in the text when searching for information. Keywords refer to the logical-factual chain (Dridze 2009). The text is divided into parts based on its semantic content - semantic grouping occurs. And in each semantic part a 'semantic point' is made. It is the extract of the main meaning. By semantic milestones, you can restore the content of the entire text using paraphrasing. The result is text-invariant which is equal to comprehension.

A set of keywords (SKW) is a mental substratum of internal speech. Semantic milestones are equal to the language of thought quanta. The SKW is characterized by integrity and coherence. Inner speech takes place. SKW is related to mental operations of a person during speech comprehension. The composition of SKW should not exceed the volume of human operational memory (7+-2). Key words are mostly localized in 1-2 sentences of paragraphs initiating the thematic chains in the text.

For information skills shaping some exercises can be proposed. Materials were selected from authentic specific professional fields for on-screen reading and computer-based learning.

Ex. №1. *Think of the following specialist areas: Machine Tools, Tool Engineering, Industrial Processes, Metal-Forming Technologies, Rolling Technologies, Casting Technologies, Welding Technologies, Materials Science, Electronic Technologies, Laser Technologies, Material Processing Technologies. Which of them correspond to the extract below?*

"The global demand for aluminum and aluminum products is increasing because aluminum alloys can offer excellent corrosion resistance with good strength and low density compared with steel. Aluminum, when being used in mobile applications, saves much more energy and greenhouse gas (GHG) emissions over lifetime of the product. It was reported that 1 kg of aluminum in a car reduces CO₂(eq) emissions by 19 kg during its whole life-cycle. In addition, 5%-7% fuel savings can be realized for every 10% weight reduction by substituting aluminum for heavier steel through appropriate design. The application of aluminum in passenger vehicles and light trucks manufactured in 2006 will lead to potential savings of approximately 140 million tonnes of CO₂(eq) emissions and to energy savings of equivalent to 55 billion liters of crude oil over the lifecycle of these vehicles."

(Jurang CUI, Hans J. Roven. Recycling of automotive aluminum. *Transactions of Nonferrous Metals Society of China*, 20 (2010): 2057-2063.
<https://www.sciencedirect.com/science/article/abs/pii/S1003632609604179>)

Ex. № 2. *Match the sentences below (1 – 9) with functions (a – g). Some phrases in bold will help you. a) warning; b) evaluating; c) inviting; d) complaining; e) instructing; f) suggesting; g) apologizing.*

1. **Let us** now proceed to a description of the scale.
2. **It would be wrong** to consider these as rival theories and they certainly do not **have to** be seen to be mutually exclusive.
3. **Consider** two separable aspects of an everyday understanding of mind.
4. This is **especially important** for time-lapse imaging, for instance when looking at the propagation of damage in a sample previously subjected to impact (e.g. compression or fatigue after impact).

5. **It possible to** undertake laminography using laboratory X-ray CT systems by positioning the sample inclined with respect to the principal ray of the X-ray cone-beam (known as the rotary scan geometry).

6. **Due to** the interactions, the features **become** distorted, for example some faces are removed.

7. **Unfortunately**, nearly all research works on feature recognition ignore the fact that manufacturing experience plays important role in feature recognition.

Ex. № 3. Match the groups of markers (1 – 8) and appropriate functions (a – h). a) markers sequencing; b) markers re-expressing; c) markers specifying; d) markers referring; e) markers resuming; f) markers exemplifying; g) markers summarizing; h) markers focusing.

- 1) to illustrate this, thus, for example;
- 2) let us consider, we must now turn to, I shall begin by;
- 3) first of all, next, at this point, in conclusion;
- 4) that is to say, or rather, to put it another way, i.e.;
- 5) to sum up, in short;
- 6) to resume, to return to the previous point, getting back to the argument;
- 7) in this respect, in that connection, as we said, apart from this;
- 8) namely, that is to say, viz, to wit.

3.4. Exercises aimed at the development of inner speech by means of IT

Types of interactive exercises in LMS Moodle 3.2. are: Match, Cards, Cloze, Drag and Drop and etc. As evidenced by our practice of learning in Moodle the time required to undertake interactive assignments is saved by 30% on average, and the acquired knowledge is stored in the memory much longer. Modern students mainly use the right-hemisphere, since the information about the world is obtained from the screens perceptually in the form of images. So when the educational materials are created for a new generation, the neurophysiological features of information processing must correspond to and be taken into account. In the result these materials should be interactive multimedia. Content selection should be done in accordance with the criteria of authenticity, integrity, and consistency. They should possess all features of electronic engineering discourse. Texts should also include examples of argumentation, and IT tools should be integrated into the ESP course.

Ex. 1. (Cloze), Guess the meaning from the context and do not consult a dictionary. There are logical prompts on the right. Mental activity and insight should take place to guess the meaning through the right context.

1. The tank and boosters are jettisoned (.....) *during ascent, only the orbiter goes into orbit.*
2. The Shuttle was originally conceived (.....) *to operate like an airliner.*
3. He also put forward the revolutionary idea that space was pervaded (.....) *by various kinds of force: magnetic, electric, radiant, thermal, and gravitational.*
4. Faraday enhanced the theoretical understanding of electricity and magnetism.

Ex. 2. Argumentation skills

Skills are part of the ESP course content. Argumentation skills belong to the category of intellectual skills, and they cannot be developed automatically. The ESP course is an opportunity to master these skills. The list of skills for engineering students should be

expanded, since the range of issues that they must analyze and discuss is wide, for example the ability to:

- justify the purpose of the statement;
- appeal to the arguments of the opponent;
- sum up and draw conclusions;
- respect of the opposite of point of view;
- provide clear and concise evidence;
- adhere to the issue under discussion;
- compare or contrast your own judgment with the opposite point of view;
- listen to the partner, hear and understand what is being discussed, etc.

The principle of situational learning are instances that require students to find heuristic solutions involved in the ESP course content. For example, to answer the question

‘Why is the external fuel tank orange?’ students have to consult the Internet to find the facts and explain why such an engineering decision was made during the Shuttle project (professional competence), and present some reasoned statements (communicative competence).

Ex. 3. Explain why such an engineering decision was made during the implementation of the Shuttle program (professional competence), and present a reasoned statement (communicative competence).

1. Why was the external tank of the orbiter of orange color?

- *reason 1*
- Shuttle delivered into GTO payload. One pound of payload costs much.
- *reason 2.*
- First the external tank was painted. But then it became unpainted to increase the payload by 500 kg (the weight of paint).

The following computer programs are used to facilitate student work with information flows and resources:

1. Visual World <http://www.visualworld.ru>
2. TextAnalyst 2.0
3. Text compactor (TC) <http://textcompactor.com>

For example, an automatic summariser “Visual World”. It is free.

The file size must not exceed 500 Kб (doc, docx, rtf, pdf), 100 Kб (txt, html).

Abbreviated text of the abstract = text volume 17% from the original.

= text volume 61% from the original.

Text “Self-driving Car”

1. A shortened summary - the text Volume 17% of the original text of 1770 marks.

Car events such as the Frankfurt Motor Show have showcased even more advanced technologies such as Bosch's emergency autonomous braking system and Ford's obstacle avoidance system that automatically steers around obstacles in the road. Still, major automakers such as Nissan have suggested they could have autonomous cars ready for dealerships by 2020.

2. Abbreviated text of the abstract - text size 61% of the original:

Federal officials apparently like what they see in self-driving cars: their potential to operate more safely and fuel-efficiently than the vast majority of human drivers.

Nevada, Florida, California and the District of Columbia have already begun setting ground rules for the operation of self-driving cars. Self-driving cars offer more than added convenience during a driver's work commute. Widespread use of fully autonomous vehicles could slash annual costs related to road accidents by \$488 billion and save \$158 billion in fuel costs.

Ron Medford, director of safety for Google's autonomous car project, told that the auto industry should prepare to deal with fallout from accidents involving autonomous cars.

Car events such as the Frankfurt Motor Show have showcased even more advanced technologies such as emergency autonomous braking system and obstacle avoidance system that automatically steers around obstacles in the road. But self-driving cars won't hit the road anytime soon, except for test drives. Still, major automakers such as Nissan have suggested they could have autonomous cars ready for dealerships by 2022. The time is needed to road-test each technology before unveiling the full autonomous car package.

3.5. Degrees of informational literacy development

Low degree

Students are able to:

- to find international words slowly;
- to give a wrong text content prediction, using special characteristics and text structure inertly (such as its title, subtitles, running titles, different references, including tables, graphs, etc.);
- to compare the text title with the key words concerning the suggested topic;
- to differentiate relevant and irrelevant ideas;
- to misapprehend the word order.

Students are not able to:

- to refer to the background knowledge concerning the subject;
- to generalize the key ideas of the text for communicative purposes;
- to be aware that the same sound and letter combinations may have different meanings;
- to make use of dictionaries and reference books properly.

Average degree

Students are able to:

- to identify international words promptly and guess the meanings with pronunciation and spelling;
- to predict the text content promptly by text features and structure;
- to make use of the background knowledge promptly concerning the suggested subject;
- to examine the whole text to identify the important and required information;
- to look through the information and to note only the relevant points;
- to be aware of words derivation, sentence patterns, paragraph structure and text structure;
- to be aware of polysemy and make the right choice of the word meaning in a given context.

Students are not able to:

- to generalize the main points, to evaluate the significance of the obtained information to be used later on;
- to employ analysis and synthesis gradually;
- to achieve insight by getting together details (words, word combinations, sentences) to aggregate the whole;
- to evaluate information from the text by means of intellectual (cognitive) skills.

High degree

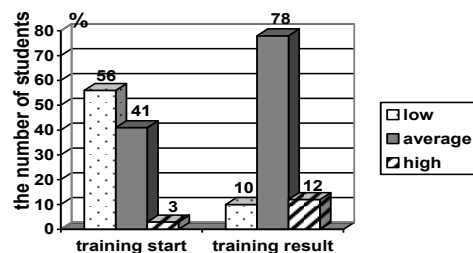
Students are able to:

- to derive the meaning from the text structure and wording;
- to develop assumptions and predictions;
- to sum up the key points and evaluate the obtained information for further usage;
- to use experience and background knowledge related to the topic;
- the proper use of dictionaries and reference books;
- to distinguish facts from opinions;
- to understand the logic of the author's material presentation;
- to reject or accept the information provided by the source;
- to make a conclusion, charts, abstracts, summaries, and etc.;
- to comprehend and discuss the implicit information.

3.5. Variations in informational parameter of functional literacy formation

The dynamics of functional literacy reflects the degree of intellectual skills formation by the end of laboratory teaching. The results of the laboratory study demonstrate the positive dynamics of intellectual skills formation to read and understand professionally marked texts.

The undergraduates studying at Bauman Moscow State Technical University (or BMSTU) were tested in 2018-19 and 2019-20 academic year. The involved students studied the following specialist areas as Machine Tools, Tool Engineering, Industrial Processes, Metal-Forming Technologies, Rolling Technologies, Casting Technologies, Welding Technologies, Materials Science, Electronic Technologies, Laser Technologies, Material Processing Technologies. A total of 284 students studying at the Faculty of Mechanical Engineering Technologies took part in the experimental learning. The average data on quality and quantity derived from the empirical data are represented in the following table.



Positive learning dynamics of intellectual operations in the course of experimental training students to understand occupational texts

Table 1 The results of experimental learning

Criterion	Average indicator	Opening section	Intervening section	Final section
Qualitative	range of completeness and accuracy of comprehension (%)	41	58	89
	the amount of time spent on a written task (min)	33	26	21
Quantitative	rate of writing (character/min)	32	38	45

4. CONCLUSION

Teaching students at a technical university on the basis of educational IT technologies ensures adaptation of young specialists to modern conditions on the labor market. Well-shaped cognitive and intellectual skills are to be developed in ESP course. They are necessary for their successful professional activity. IT tools stimulate intellectual activity of students. Multimedia interactive assignments facilitate language acquisition and save time for productive activity in the classroom. The analysis of the laboratory results confirmed our assumptions that teaching engineering students to read and understand professionally-oriented texts will be more effective if the training is based on the basis of a functional approach aimed at mastering information competence and the formation of intellectual skills.

REFERENCES

- Achard, Michel, Niemeier, Susanne, ed. *Cognitive linguistics, second language acquisition, and foreign language teaching*. Berlin; New York: Mouton de Gruyter, 2004.
- Ackerman, R., & Goldsmith, M. Metacognitive Regulation of Text Learning: On Screen Versus on Paper. *Journal of Experimental Psychology: Applied*. Vol. 17, no.1 (2011): 18-32. Doi: 10.1037/a0022086.
- Aebersold J., Field M. *From reader to reading teacher*. Cambridge.: Cambridge university press, 2002.
- Asmolov, A.G. XXI vek: psihologiya v vek psihologii. *Voprosy psihologii*, no.1 (1999):3-12.
- Bednenko, V.G. Teoretico-pedagogicheskiye aspekty razvitiya kriticheskogo myshltniya studentov sredstvami informatsionnykh tekhnologiy. Avtoreferat diss. kand. ped. nauk. Pyatigorsk, 2010. (in Russ.).
- Bastedo Michael N., Altbach Philip G., Gumport Patricia J., ed. *America higher education in the twenty-first century: social, political, and economic challenges*. 4th ed. Baltimore: Johns Hopkins University Press, 2016.
- Bloom, Benjamin S. *Taxonomy of Educational Objectives: The classification of Educational Goals*. New York: Longmans, Green, 1956.
- Bogomaz S.A., and Krasnoyartseva O.M., red. *Intellektualnyy potentsial i innovatsionnaya aktivnost vuzovskoy molodyozhi: kollektivnaya monografiya Tomsk: Izdatelskiy Dom Tomskogo Gosudarstvennogo Universiteta*, 2014. (in Russ.).
- Buzzetto-More, N., Sweat-Guy, R., & Elobaid, M. Reading in a digital age: E-books: Are students ready for this learning object? *Interdisciplinary Journal of Knowledge and Learning Objects*, no. 3(2007): 239–250.
- Crow, Michael M. and Dabars, William B. *Designing the new American university*. Baltimore: Johns Hopkins University Press, 2015.
- Derewianka, B. & Jones, P. *Teaching Language in Context*. (2 ed.). South Melbourne, Australia: Oxford University Press, 2016.
- Dridze T.M. *Yazyk i sotsialnaya psihologiya*. Moskva: URSS, 2009. (in Russ.).
- Field J. *Psycholinguistics: the key concepts*. London, New York: Oxford University press, 2004.
- Gagne, Robert M. *The conditions of learning and theory of instruction*. New York: CBS, 1985.
- Galperin, P.Ya. *Lektsii po psikhologii: uchebnoye posobiye*. Moskva: KDU, 2011. (in Russ.).

- Goncharuk, N.P. Psikhologo-pedagogicheskiye problemy formirovaniya intellektual'nykh struktur. Kazan: Kazanskiy gosudarstvennyy tekhnologicheskiy universitet, 2006. (in Russ.).
- Grishko, N.N. Lingvisticheskiye zadachi v razvitii intellektual'no-kommunikativnykh kompetentsiy studentov. Saratov: Nauch.kn., 2007. (in Russ.).
- Inozemtseva, K.M. Analysis of modern requirements for the level of foreign language proficiency of engineering specialists. Moskva: *The Education and science journal*, 19(6, 2017):71-90. (In Russ.) <https://doi.org/10.17853/1994-5639-2017-6-71-90>.
- Ivanova L.I., Margaryan T.D., Nikolaeva N.S., Borodina T.Yu. Shaping Skills Of Reasoning In Esp Course At Technical University. 18th PCF 2018 Professional Culture of the Specialist of the Future, 28-30 November 2018, Peter the Great St. Petersburg Polytechnic University. St.Petersburg: Peter the Great St. Petersburg Polytechnic University, *The European Proceedings of Social & Behavioural Sciences (EpSBS)*: 1687-1697. <https://www.futureacademy.org.uk/files/images/upload/18thPCSF2018F181.pdf>
doi:<https://dx.doi.org/10.15405/epsbs.2018.12.02.181>
- Kholodnaya, M.A. Psiholohiya intelekta: Paradoksy issled. 2nd ed. St.Peterburg: GPP Pech. Dvor, 2002.
- Klychnikova, Z.I. Psihologicheskiye osobennosti obucheniya chteniyu na inostrannom yazyke. Moskva: Prosveshcheniye, 1983. (in Russ.).
- Korniyenko, E.R. Smyslovoye vospriyatiye i ponimayiye inoyazychnogo teksta. Moskva: GPI "ISKONA", 1996. (in Russ.).
- Krayevskii, V.V., Khutorskoy, A.V. Osnovy obucheniya: Didaktika I metodika. Uchebnoye posobiye dlya studentov vysshih uchebnyh zavedeniy. 2nd ed. Moskva: Izdatelskiy tsentr "Akademiya", 2008. (in Russ.).
- Kupriyanycheva, N.I. Evristicheskaya deyatelnost kak pedagogicheskoye sredstvo razvitiya intellektualno-tvorcheskogo potentsiala studentov v tekhnicheskoye vuzhe: Monografiya. Kazan: Kazanskiy gosudarstvennyy tekhnologicheskiy universitet, 2006. (in Russ.).
- Lightbown, Patsy M., and Nina Spada. How Languages are Learned. 4th ed. Oxford: Oxford University Press, 2013.
- Martynova, O.N. Potentsial samoreaoizatsii budushchih inzhenerov: Monografiya. Samara: Samarskiy gosudarstvennyy aerokosmicheskiy universiten imeni S.P. Korolyova = Samara University, 2008. (in Russ.).
- Nattall, Chr. Teaching reading skills in a foreign language. Oxford.: MACMILLAN, 2005.
- Nazarenko, A.L. "K voprosu ob informatizatsii lingvisticheskogo obrazovaniya." Moskva: *Vesti Moskovskogo universiteta, Ser.19. Lingvistika I mezhkulturnaya kommunikatsiya*, no 1 (2010): 114-121. (in Russ.).
- Piaget, Jean. Psihologiya intelekta. M. [i dr.]: Piter, 2003. (in Russ.).
- Popkov, V.A., Korzhuyev, A.V. Teoriya I praktika vysshego professionalnogo obrazovaniya. Moskva: Akademicheskii Proyekt, 2004. (in Russ.).
- Repkina, L.I. "Globalization influence on the development of students' skills to translate professional guided materials". *Tula: Izvestiya Tula State University = Izvestiya TulGu. Pedagogics*, no 3 (2018): 106-110. (In Russ., abstract in Eng.).
- Rudenko, A.N. Intellektualnyy potencial studenchesnva v sovremennoy Russii. Monografiya. Moskva: RUSAYNS, 2016. (in Russ.).
- Rumyzytseva I. M. Psihologiya rechi i lingvopedagogicheskaya psihologiya: novyye tekhnologii obucheniya inostrannym yazykav. Moskva: PERSE, 2004. (in Russ.).

- Smirnov, S.D. Psihologiya i pedagogika dlya prepodavateley vysshey shkoly: uchebnoye posobiye dlya slushateley sistemy podgotovki i povysheniya kvalifikatsii prepodavateley. Moskva: MGTU im. N. Baumana = Bauman Moscow State Technical University, 2014. (in Russ.). <http://baumanpress.ru/books/483/483.pdf>
- Sokolov E. The psychophysiology of consciousness. Oxford: Oxford University Press, 2013.
- Vygotsky, L. Mind in society. Cambridge, Mass: Harvard University Press, 1978.
- Yegorova, G.I. Intellektualizatsiya professionalnoy podgotovki spetsialista tekhnicheskogo vuza. St.Peterburg: Institut obrazovaniya vzroslyh, Rossiyskaya akademiya obrazovaniya, 2005. (in Russ.).
- Zhinkin, N.I. Yazyk – Rech – Tvorchestvo: Issledovaniye po semuitike, psiholingvistike, poetike. Moskva: Nauka, 1998. (in Russ.).
- Zimnaya I.A. Pedagogicheskaya psihologiya. Moskva: Logos, 2004. (in Russ.).