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The Formation of System Thinking of Bachelors of Technical University by Means of Instrumental Didactics in the Discipline "Energy Saving"

La Formación del Sistema Pensamiento de Bachilleres de la Universidad Técnica por Medios Instrumentales de Didáctica en la Disciplina "Ahorro de Energía"

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ABSTRACT:
The purpose of this article is to identify pedagogical conditions of formation of system thinking in bachelors. The authors note the use of didactic multidimensional technology of Professor V. E. Steinberg as the teaching condition of performing the above activities of students. Namely, the expansion of substantial parts due to the multidimensional presentation of information on energy saving and the organization of the deductive-synthetic logic of the educational process based on a visual frame of cognitive maps with multicode reporting. Under these conditions, multi-dimensional organization of the information on updating of energy saving, supported by visual (graphical) frame of the cognitive map allows a fuller and deeper revealing of the continuity, interrelation and complementarity of scientific information, and easier demonstration of it to bachelors. It is a pedagogical condition of formation of their system thinking. In the framework of presenting

RESUMEN:
El propósito de este artículo es identificar las condiciones pedagógicas de formación del pensamiento sistémico en los solteros. Los autores señalan el uso de la tecnología didáctica multidimensional del profesor V. E. Steinberg como la condición de enseñanza de la realización de las actividades anteriores de los estudiantes. Es decir, la expansión de partes sustanciales debido a la presentación multidimensional de información sobre ahorro energético y la organización de la lógica deductiva-sintética del proceso educativo a partir de un marco visual de mapas cognitivos con reporte multicódigo. En estas condiciones, la organización multidimensional de la información sobre la actualización del ahorro de energía, apoyada por el marco visual (gráfico) del mapa cognitivo permite una revelación más completa y profunda de la continuidad, interrelación y complementariedad de la información científica y una

graphic information of the cognitive map, the author raises the problems of the current state of energy saving in Russia: the rapid progress of the domestic electricity industry of the twentieth century, where the electrification plan and its implementation have proved high efficiency of the system of state planning in the context of highly centralized power and determined the development of this system for decades. The article presents the principles of Russian state policy in the field of energy saving at home and at the workplace, and the low level of development of Russia's energy sector at the global level. The practical possibility of applying the didactic multidimensional technology is shown on the example of uptake of a particular systemic information on energy saving. The authors explain support of the activity approach in the design of the uptake situations and thus, the psychological conditions of obtaining a specified learning outcome.
Keywords Didactic multidimensional technology; cognitive map with multicode information presentation "Energy saving"; system thinking; multi-activity approach; approximate action bases.

demostración más fácil de la misma A solteros. Es una condición pedagógica de formación de su sistema de pensamiento. En el marco de la presentación de información gráfica del mapa cognitivo, el autor plantea los problemas del estado actual del ahorro de energía en Rusia: el rápido progreso de la industria eléctrica nacional del siglo XX, donde el plan de electrificación y su implementación han demostrado ser altos Eficiencia del sistema de planificación estatal en el contexto del poder altamente centralizado y determinó el desarrollo de este sistema durante décadas. El artículo presenta los principios de la política estatal de Rusia en el ámbito del ahorro de energía en el hogar y en el lugar de trabajo y el bajo nivel de desarrollo del sector energético de Rusia a nivel mundial. La posibilidad práctica de aplicar la tecnología didáctica multidimensional se muestra en el ejemplo de la captación de una información sistémica particular sobre el ahorro de energía. Los autores explican el apoyo al enfoque de actividad en el diseño de las situaciones de captación y, por lo tanto, las condiciones psicológicas para obtener un resultado de aprendizaje especificado.
Palabras clave: Tecnología didáctica multidimensional; Mapa cognitivo con presentación de información multicódigo "Ahorro de energía"; pensamiento sistémico; Enfoque multiactividad; Bases de acción aproximadas.

1. Introduction

Socio-economic changes in the country has exposed the crisis of higher education, resulting in a decline in the intellectual level of youth and, consequently, training. The necessity of rapprochement of Russian and Western models of education led to the reform of the education system, one of the effective ways which the transition to two-tier education system and the use of innovative technologies. Our research is developing in the direction of use of means of instrumental didactics engineering pedagogy to improve the quality of preparation of bachelors of technical universities. Its value and practical value is the creation of pedagogically adapted the content of the discipline. Considering similar concepts in the literature, we see that a number of authors (Grigorash, 2016; Pavlova et al., 2014) draw attention to the fact that engineering education should teach people to systems thinking that such specialists should have a high intellectual potential and able to quickly learn to work in other areas. For us, this position is a positive development improving the quality of preparation of bachelors of technical universities, but she has not received proper consideration in terms of the formation of systemic thinking of students – engineers.

Specify the position in this matter. Electricity is a core infrastructure sector of the national economy of any state. How reliable and efficient will operate power generation, uninterrupted be electricity supply for economic entities and the population depends on the progressive and sustainable development of national economy and energy security of the state. We agree with the position of the famous academician, Nobel prize winner in physics, P. L. Kapitsa, who set in the twentieth century, a rigid correlation between the specific power of the state, on the one hand, and the level of socio-economic development or human development index, on the other hand. Currently, according to Yu. N. Kucherov(2002), a Russian joint stock company "unified energy system of Russia" (RJSC "UES of Russia") is, first and foremost, a huge scale creation of science, engineering and technology, is to embrace the whole country, from Kaliningrad to Vladivostok, an industrial giant, supplying our homes, businesses and factories with electricity and heat. In this regard, on the one hand, legally attributed RJSC "UES of Russia" to the real organization of energy of Russia, the functioning of which depends on the rational use of natural, human and technical resources.

On the other hand, to creatively solve problems within designated system, in accordance with

Federal state educational standards of higher professional education (FSES HPE), the student should not only deeply comprehend the complex interactions of scientific and technological progress, but also to understand the inevitable problems of its functioning, in particular energy saving. A similar conclusion quotes the Director of the Department of state policy and normative legal regulation in the sphere of education Ministry of education and science Igor Remorenko (2010). He noted that the number of branches and types of activities engineers are so complicated that the necessity of teaching students not only high technology, but also the most reasonable use of natural, human and technical resources – this will be our contribution to world science.

Thus, the relevance of this study due to the existing contradictions:

- between the social order of modern higher education on preparation of bachelors in the framework of the Federal state educational standards (FSES) and the scarcity of theoretical and experimental studies of their preparation;

between the fundamental theoretical training of bachelors and practical orientation of the educational program, because the amount of theoretical training is reduced, at the request of the Ministry of education and should not be more than 50% of the time allocated for practical training.

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2. Methodology

To achieve this goal, we offer a deepening of the theory of developmental education for today's reality. Moreover, according to D. I. Feldstein (Electricity ranking, 2016): "you Can be proud of the fact that in the domestic psycho-pedagogical science has long embarked on developing learning, believing and understanding; the ascent from the abstract to the concrete, based on the principles of theoretical thinking". This statement from a methodological point of view involves the deepening of the theory of developmental education through the joint application of multivariate-active approach and teachings on approximate basis of actions proposed by P. Ya. Galperin.

The novelty of the research lies in the fact that we changed the subject of previous investigations of the formation of the system of cognitive abilities of students of engineering specialties of technical universities on the example of teaching of structural materials (Prikhodko and Soloviev, 2015), for example the teaching of energy saving for the formation of system thinking of bachelors of direction of preparation 13.03.02 "power engineering and electrical engineering."

Pedagogical prerequisite that the above-mentioned activities we offer students the use of didactic multidimensional technology Professor V. E. Steinberg (Revin and Chervonaya, 2015), namely the expansion of substantial parts of due to the multidimensional representation of information for updating of energy saving and the organization of the deductive-synthetic logic of the educational process based on a visual frame of cognitive maps with multicode reporting. Here mental operations are not isolated, they are interrelated and dependent on each other, but among them allocated to the comparison, analysis, synthesis, classification, abstraction and concretization.

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3. Results

Practical significance of the research is to develop cognitive maps with multicode reporting on mainstreaming of energy efficiency, below, will focus on its description in more detail.

Next, consider the system of RJSC "UES of Russia", so to deploy the centrifugal ("solar"), using the cognitive maps (See Figure 1). Each coordinate defines its features (or cluster of nodes in a group), making cognitive map becomes multivariate. Then, agreeing with the definition of I. Nikitko, (Nikitko, 2014), where the energy system is a set of power plants, energy networks and consumers connected by common process of production, transmission and use of electricity, we accept the above structuring of the energy system from the point of view of rational energy saving. In parallel, miscoordinate sectors of the cognitive map, we place with multicode presentation of information typical images of the energy efficiency of modern Russia. Thus, removing the focus of the consideration of an object or bringing it closer, turning to the past, present and future, we visually present the elements of the picture of RJSC "UES of Russia".

First coordinate axis (C1), we dedicate the emergence and rapid progress of domestic power industry. In the first phase, we focus on student's analytical ability, namely the ability to select from a variety of events relevant to the phenomenon; the ability to find and identify the problem, the ability of comparison of events and the execution of the sentence.

Therefore, we will note that the widespread penetration of electricity into our lives has occurred incredibly fast, since the first light bulb, there have been only 130 years ago. Historically, the birth of the power supply system of Russia is connected with events lighting Foundry Bridge in St. Petersburg. Electric lights, it was established in 1879 (the first reference node C1, See figure 1). This, according to O. N. Veselovsky (Veselovskiy and Shneyberg, 1993), contributed a random event, due to the fact that at the time of opening Liteyny bridge, the existing lighting firms did not manage to conclude a contract for its coverage. They were ahead of the "Association of electric lighting P. N. Yablochkov the inventor and Co", which introduced electric street light. However, the above-mentioned random event, it was well prepared by the preceding history of the development of the science of electricity. Domestic electrical school at that time was one of the best in the world. According to research of I. A. Glebov, M. I. Shumilova (Glebovv, 1999; Sychev, 2015), its activity is coordinated by VI (electrical engineering) Department of the Russian technical society and the Russian electro-technical Congress, which from 1900 to 1913 was held seven. In these conventions was seen as a technical and purely strategic challenge. Under these conditions, despite the fact that the beginning of the development of capitalism in Russia was delayed for decades, the gap in the commercial use of world achievements of science and technology of that time the Russian capital market was minimal, for the production of electricity in 1913, Russia ranked eighth in the world. Thus, V. L. Gvozdetskiy (Givozdetsky, 2001) shows that the level of Russia's energy development in the XIX-XX centuries was quite high and there were real conditions of continuity of its development in economic and scientific sense.

Under these conditions, the emergence of the Soviet period energy associated with the electrification plan (the second reference node C1, See figure 1). As you know, history does not tolerate subjunctive mood, and therefore to say that it would be if, instead of the GOELRO plan, the country received the opportunity to develop normally without wars and revolutions – is meaningless. Therefore, the economic goal of the electrification plan was the restoration and development of destroyed during the Civil war the economy of Soviet Russia, since the generation of electricity in the country in 1920 was only 26% from level of 1913 The whole of Russia sounded the words of Lenin: "Communism - is Soviet power plus electrification of the whole country." Only electrification made it possible to equip the industry with modern technology. However, Lenin saw in the electrification of not only economic, social but also highly political task, and it hoped to win the peasantry. Because the light in Russia since pre-Christian times has always been associated with truth and order, and clear as light received in a remote village had to treat the one who brought it.

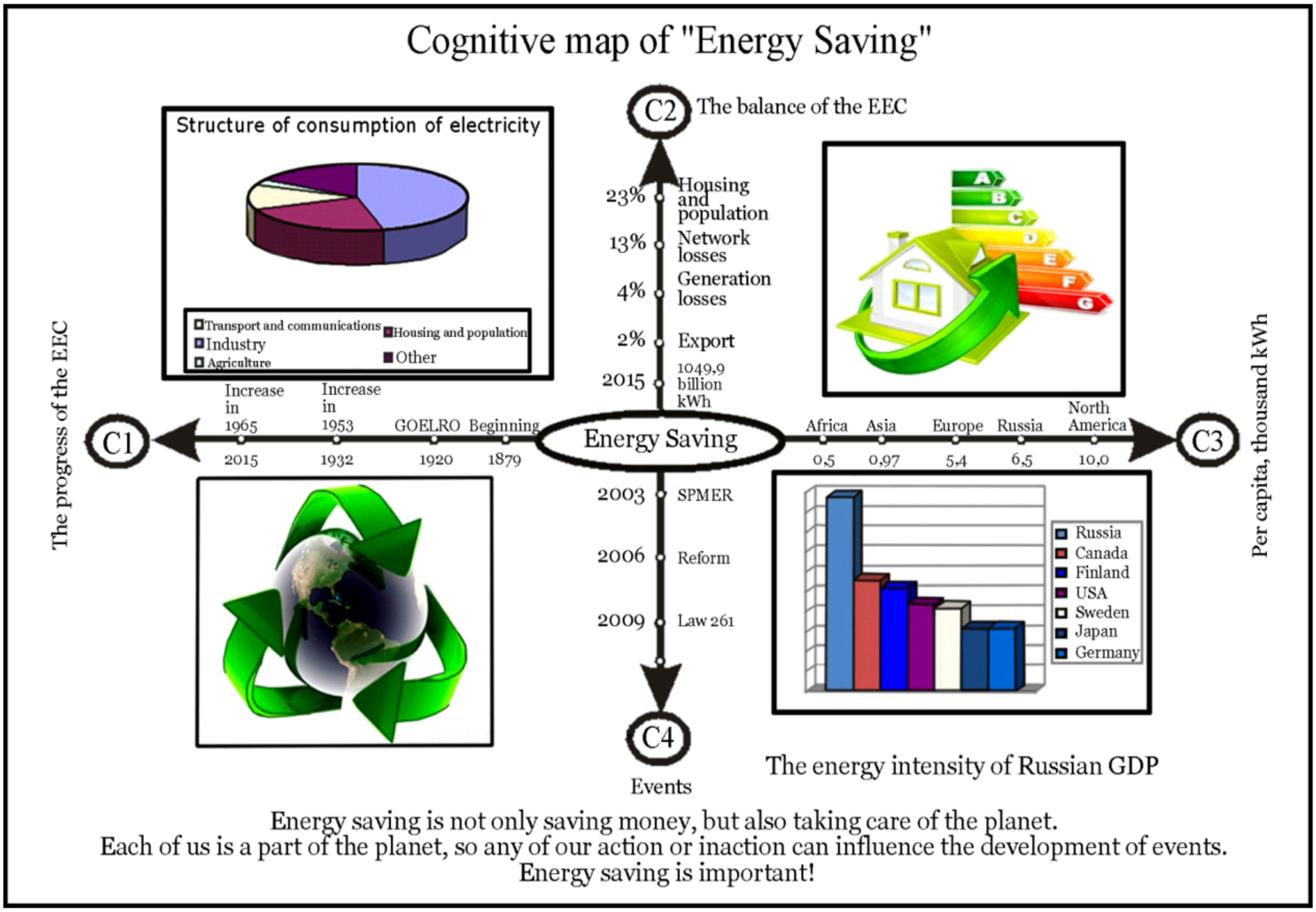

Figure 1. Cognitive map of "Energy Saving"

Lenin's instructions determined the direction of work on the plan of electrification of Russia. In the work of the Commission under the chairmanship of G. M. Krzhizhanovsky worked extensively prominent figures of science and technology of Russia: Professor G. O. Traftio, ing. A. G. Kogan, Professor E. J. Shulgin, Professor A. A. Gorev, Professor I. G. Alexandrov, Professor L. K. Ramzin, Professor K. A. Krug, Professor M. A. Chatelain; Professor G. D. Dubellir, Professor B. I. Ugrimov, Professor A. I. Ugrimov, ing. M. Ya. Lapirov-Skoblo, ing. Stunkel B. E., M. A. Smirnov, and many others (Givozdetsky, 2001). More than 200 leading experts were brought to develop a specific state plan for revival of economy and industry of Russia on the basis of electrification. In a very short time, in the not simple conditions of Russia 1920 professional team organized and executed a huge amount of work. We collected, processed, studied and deeply analyzed the statistical, technical, economical, geological and hydrological, mineralogical and mining, pedological, ethnographic, transport, industrial and agricultural data on the vast territories of the Russian Federation. In the works of the Commission, these data are grouped by major regions: Southern region, Central industrial region, Volga region, Caucasus region, Northern region, Ural region, Western Siberia and Turkestan. Analytical materials are synthesized and summarized in the overall summary.

In December 1920 VIII all-Russian Congress of Soviets adopted a plan of electrification, according to which for 15 years, the power grid was planned to increase to 1750 MW. Provided radical reconstruction on the basis of electrification of all sectors of the national economy and mainly growth of heavy industry, rational distribution of industry throughout the country. For the first time in Russia, the authors of the GOELRO plan proposed economic zoning on the basis of considerations of proximity to sources of raw materials (including energy), the current territorial division and specialization of labor, as well as convenient and well-organized transport. Overall, the plan was a uniform program of revival and development of the country and its specific industries, primarily heavy industry and the main means thought possible the rise of labor productivity not only due to the intensification and rationalisation, but also due to the replacement of the muscular effort of humans and animals to mechanical energy. From the outset it was assumed that the electrification plan will be introduced in the legislative procedure and contribute to its successful implementation was centralized management of the economy.

The method of implementation of the GOELRO plan was adopted mobilization, relying only on their own people. The whole country turned into a huge construction site. The construction itself was an unprecedented pace. Moreover, the reason was not only the enthusiasm of the people, but the number of shady aspects of the implementation of the GOELRO plan. Most of the builders were prisoners. N. With. Khrushchev cites a Memorandum from G. 01.02.1954 the following data (Givozdetsky, 2001) that in the period from 1921 to 1954, for counterrevolutionary crimes convicted 3 777 380 people, have passed through the camp of about 20 million, killed 10 million. Every megawatt, the first Volga hydroelectric power station has a cost of 40 human lives. In addition to funding for the program was widely sold off the treasures of Russian culture, the grain - and this at a time when in many regions of the country was famine-stricken. For many years, all social sectors funded only as a residual, causing the people to live extremely difficult. Without this, the GOELRO plan was unlikely to be met. Forget about the bread for the coming day - that was the pathos of the system that gave birth to this plan and ensure its implementation. Therefore, the contents of the GOELRO plan was laid down not only the exact calculation, quality organization, intelligence and painstaking work of domestic scientists, economists, engineers and builders, but also the mobilization of cheap labor of the people.

Ultimately, under this plan, Russia for a fantastically short time from an agrarian country into a very industrial power. Currently, the new round of historic twists again from the start of the crisis the current state of the economy of the XXI century. The experience of generations shows that a modern student to focus in the present and anticipating the future, you should first know the past well. Therefore, the program of the modern acceleration of innovative development of domestic electrical industry and power industry can remain a slogan if not will be analyzed and used years of domestic experience of electrification for developing a new strategy to ensure the preservation of the Russian Federation as integrity, economically independent state. After 95 years, we can attempt to estimate the full scale of the electrification plan. Appreciate and admire the fact that the plan was implemented. Because in fact, according to B. I. Kudrin (Kudrin, 2009), a program for the electrification of Russia was a unique macroeconomic experiment. Was carried out huge work, both scientific and practical, and made at a time when the country lay in ruins. Moreover, that can only be admired. Electrification plan can serve as a model of using limited state resources to the effort precisely where it will give the desired result. Exactly electrification became the core of all branches of the national economy; the GOELRO plan and its implementation have proved high efficiency of the system of state planning in the context of highly centralized power and determined the development of this system for decades. Therefore, already by 1932 (the third reference node C1, as shown in figure 1), that is, in just 12 years, the production of electricity in Russia grew by 53 times! Last year (fourth reference node C1, as shown in figure 1) of electricity produced 65 times more and almost the same received the Russian consumers. We will add here some of the main figures: the country has more than 600 power plants with a total installed capacity of 215 million kW, including 56 large 1,000 MW or more. Almost 80% of all these stations is included in the system of RJSC "UES of Russia".

Second coordinate axis (C2), we have been consumers of electricity. In the second phase, we distinguish the ability to determine the structure of the problem, to foresee the result, to choose the optimum method of solution. According to the Official website of the Ministry of energy of the Russian Federation (Key indicators, 2016), in 2015, electricity generation by power plants of Russia 1049,9 billion kWh (first support unit C2, see figure 1), of which 2%

(the second reference node C2, see figure 1) is the export share. Here is also indicated that 3 to 4% (the third reference node C2, see figure 1) is spent on the inevitable losses in energy production and 13% (fourth reference node C2, see figure 1) - for losses during transportation. In the first quarter of the center space of the cognitive map, we placed a diagram of the structure of energy consumption where the share of industry (46%), housing and population (23%), transport and communication (12 %). Below we will analyze these numbers.

First, we explain the word "inevitable." On the one hand, energy is lost not because someone stole many processes, such as the current movement in the wires or the rotation axes of the bearings, by their physical nature are accompanied by losses (heat, friction, work accessories, etc.). In power engineering, since ancient times, there is a veritable cult of loss control, it is thrown a strong force of scientists, designers, technologists, the victory is considered a loss reduction even for a small fraction of a percent.

Second, as noted above, the share of consumption of the electric power industry maximum (46%). In this regard, the example is the result of energy audit of machine-building enterprise (Key indicators, 2016), where all energy consumed, according to experts, about 30% is spent on purely technological processes and 70% in CHP plants, boiler houses, ventilation, lighting, production of compressed air, internal transport and other miscellaneous needs. Energy-intensive industries in the engineering are: forging, foundry, heat and electroplating. The complexity of the energy efficiency at machine building enterprises is a large range of products, making it difficult to determine specific rates of energy consumption for the production of this product. Therefore, the indicators of efficiency of use of energy resources for the enterprises of machine-building complex, according to experts, can become the following: reduction of allowances change in the form of blanks approaching them to form the finished product; change ways of processing products, such as replacement turning disembarkation, transfer processing of products from planing speed milling; the use of multi-spindle machines instead of one-spindle for drilling; milling work with a setting on one machine several milling cutters; load growth or replacement of underloaded motors with smaller motor power; changing cutting parameters. It is clear that the principle of the state policy of Russia in the field of energy saving involves the use of energy to the maximum extent on the productive activities of consumers.

Thirdly, we analyze the set above, the share of consumption of housing and population (23%). In the second quarter the center space of the cognitive map, we placed a diagram of the structure of electricity consumption in the apartment, where the share of the fridge (27%), electric (21%), lighting (13%), Laundry (15%) and so on. Currently, it is planned to install a certain amount of the consumption of utility resource is based on one person was in a residential area – the so-called social norm of consumption of municipal resources (Key indicators, 2016),. It is also planned to approve two tariffs of utilities, for payment of volumes of consumption of municipal resources within the social norms of housing and communal services and to pay for the volume of utilities consumed more than the prescribed amount. Naturally, the rate for utility resource in excess of this norm will be much higher. Note here the wisdom of the Russian proverb: "do Not the money wealth and thrift, but the mind" or otherwise rational electricity consumption at home will be effective if initiated by the increase in the cognitive activity and independence in the conduct of accounting, control and analysis of energy consumption of each family member, for "thrift - wealth sister."

Next, we give a simple example of calculation: in the apartment was two people, a social norm of electricity is 75 kWh per person per month, therefore, in General, for apartment the size of norm of electricity consumption is 150 kWh Consumption per month in the apartment, according to the counter reading was 190 kWh. Thus, the limits of social norms has been consumed 150 kW.h, over – 40 kWh electricity tariff within social norm is 2.80 RUB per kW·h, super – 3,50 RUB for kW·h. As a result, electricity should be paid in the following amount: the Cost of electricity for the month = 150·2,80 + 40·3,50 = 420 + 140 = 560 rubles. If people want to take advantage of additional benefits, for example, a dishwasher, a boiler, put the warm flooring, light consumption will increase dramatically - "for the income and expense keep". It is pertinent to recall General recommendations for the rational use of electricity: when choosing appliances, look for labeling from A to G, which indicates the degree of energy saving; replace incandescent bulbs with energy saving; turn the air conditioner only when tightly closed Windows and doors in the room; be sure to scale the appliances were removed in a timely manner, it's hard to believe, but this way we can reduce the cost of electricity for water heating to 30%; place the refrigerator away from the sun and heating devices. Ultimately, as noted above, electricity consumption in the home and housing is not a small fraction (23%) of the total figure, but "a penny saved is a penny gained".

Let us change the focus of the review of RJSC "UES of Russia" upward to the state level of thinking, namely the third coordinate axis (C3) we dedicate to the indicator, determining the comparative level of development of the electricity industry on a global level is the annual amount of energy consumed per capita in the country (Posiagina, 2009). In this part of Russia occupied a good place, for every Russian there is 6500 kW.h. In other CIS countries the specific consumption of electricity, unfortunately, is much lower. Per capita, North America consumes 10 thousand kW.hours of electricity per year, Europe - 5.4 million kW.h, Asia - 0,97 MW.h Africa - 0,5 thousand kW.h. The world average electricity consumption is 2000 kW.hours per person per year. Meanwhile, in addition to specific energy consumption, there are other important measures of human prosperity, including energy. The basis of one of these indicators - gross domestic product (GDP), which determines the value of everything produced within a country in a year, and usually also per person. The capacitance allows making a conclusion about how effectively electricity is used. It's one thing if the manufacture of the meat grinder or ice cream leaving banks 10 kW.h electricity, and quite another if 1 kW.h. Therefore, in the third quarter of the center space of the cognitive maps we publish a chart of the GDP of Russia. Unfortunately, currently, every dollar invested in production in our country is spent 2.5 times more electricity than in the United States, about 3.5 times more than in Germany and France, 5 times more than in Japan. It is extremely important figures, they have cause to reflect on the development of domestic energy inquiring minds of students and talking about many things: about the technical condition of the industry, about the business organization, level of technology, including and the reasons for the critical state of the industry. Thus, the margin of safety inherent in the Soviet years, to the end of the last decade came to an extreme level, and as energy began to pose a serious threat to the economic security of the country. In this case, it is necessary to consider that according to experts (Tkachenko et al., 2016), 76.8% of capacity hydroelectric power station of Russia, 59% of the capacity of GDP in Russia over 30 years old, 79.6% of the nuclear capacity of Russia is older than 20 years. High degree of deterioration of generating capacities also leads to low efficiency of processing fuel into electricity. Moreover, the efficiency of thermal power plant Russia is only 36.6 per cent, with 45% in foreign countries. Thus, about 10% of the consumed thermal power plant fuel in Russia is burned to waste. Ways out of the crisis have been proposed at the state level. It is to them we dedicate the fourth coordinate axis (C4) of our cognitive maps. Will focus below on three key aspects of energy development of Russia in XXI century.

First, in 2003 was adopted the State plan of market electrification of Russia – SPMER (the first reference node C4, See figure 1). One of the conceptual provisions of this plan is to implement energy (and other) construction based on the unity Federal laws and regulations, based on the decentralization of distributed systems. While not denying the achievements of the power industry of the twentieth century, let us think what we actually have with electrification in the early twenty-first century, if from space shows that 2/3 of territory of Russia – with the lights out? Note that 80 years was ignored, which in 1920 was adopted by the most radical of the above-mentioned variant of the electrification plan: a complete monopoly, that is all in the hands of the state, guided by the principle of centralized supply of consumers of the total electric network. It is appropriate to allocate three stages of electrification. The first is the establishment of a state power plant (GRES) and the elimination of the kulaks (1929 destroyed up to 1 million mills and private sources of electricity with a total capacity of 10 million kW).

Second - with the construction of large power plants, the formation of the EES, connecting the farms to the public networks, the organization of each regional Committee of the Communist party's own power system. This has led to the destruction of up to 6.6 thousand plants from 100 to 10 000 kW (at the country - up to 5 million kW), the elimination of the rural intelligentsia. According to statistics, in 1926 there was 405 thousand rural settlements, in 1985, left 153 thousand and for the last 20 years of the twentieth century had disappeared more than 20 thousand settlements. Under the obligation to supply electricity to each outlet, engine, barn energy systems received the right to give every consumer the technical conditions for connection, to prevent customers building their own generating capacity. As a result, by the end of the twentieth century had a complete monopoly of the electricity industry that are incompatible with market conditions, and therefore inevitably led to restructuring.

Currently, there is one key (hard not to be solved in the country), the problem reduces to the following. If the citizen of the Russian Federation - resident of the province - has put its own wind turbines, with a capacity of 5 kW, and stretched along the village line voltage of 380 V, why: a supply organization does not give permission to connect the wind facility to the grid; at night, the grid buys electricity? While the practice is straightforward, the grid opposed to struggling to connect such generating capacity. Here it is imperative that a legislative solution because the non-electrified heartland makes it desolate – this is a province with no future; and without a hinterland, without the electrified territory development and no future for the whole of Russia.

Secondly, in the 2006 administrative reform, the concept of which was simple: the part of energy that allow competition, the generation and distribution had to be separated from the "monopoly" part and privatized. The driving force in the industry was supposed to be private strategic investors, Western companies of the corresponding profile and Russian big capital. They were offered thermal power plants, United in the one and a half more than a dozen generating companies. The implication was that by buying thermal generation, private owners will increase the efficiency of its assets and on this basis will enter into price competition with each other. The price of electricity will be exempt from state regulation and under pressure from the increased supply will decrease. Thus, RJSC UES was liquidated; the industry has attracted effective owners and large-scale investments. However, it soon became clear that the government does not intend to let prices of electricity, leaving himself the option to enter in case of need manual adjustment. In the end, the capacity market, which was hoping the new owners of the assets, and not earned. Additional detail - in the course of the reform of RJSC UES and very inconsistent with her logic one of the largest buyers of energy assets became the state "Gazprom". In addition, those assets that remained unsold, was consolidated state company "inter RJSC UES". These two structures have become the two poles of a new concentration of forces in the Russian energy sector. Everything was back to normal. Power in Russia was once again under government.

Thirdly, in 2009 was adopted the Federal law from 23.11.1009 year № 261-FZ "On energy saving and increasing energy efficiency" has introduced a mandatory energy audits for most legal entities. The energy audit is a feasibility analysis and inspections of the plant to determine the energy efficiency of production, identify options to reduce energy costs and opportunities for their implementation. Russia embarked on the path of bridging the technology gap with developed countries in energy efficiency and 2016. It may be a turning point in the acceleration of technological modernization of the Russian economy.

In the last quarter of the center space of the cognitive map, we placed the image of our planet, because energy saving is not only saving money, but also taking care of her. Danger to the atmosphere and climate on our Earth affects us all. Thus, the participants of the climate conference in Paris 13.12.2015 presented the final draft of the outcome document, which will replace the Kyoto Protocol to the UN framework Convention on climate change. According to the Minister of foreign Affairs of France Laurent Fabius, the document provides for allocation by 2020 to developing countries 100 billion dollars in the fight against harmful emissions into the atmosphere. Fabius said that the adoption of the document would significantly reduce the rate of global warming. In particular, the document puts before the States the task to keep the end of the century warming relative to pre-industrial era within two or even one and a half degrees. At this point, insisted many island States. The purpose of the Paris summit was the conclusion of the first global agreement to reduce greenhouse gas emissions. The conference was attended by representatives of 190 States. The special representative of the Russian President on climate Alexander Bedritsky said that Russia is committed to the agreement and will continue to strengthen its actions to reduce the anthropogenic load on the climate for the future. Energy saving is very important.

This leads to the conclusion that this form of cognitive maps with multicode representation of such a large-scale information contains a significant degree of uncertainty operation "semantic granularity" the reference node, for the curious students creates the opportunity to reflect on the key issues of energy saving, personalizing the process. In addition, in the conditions of modern scientific and technological revolution of unusually increased social responsibility of the engineer and scientist in the consequences of their activities. Therefore, the design and operation of engineering facilities requires a comprehensive system approach, taking into account not only economic indicators but also social and environmental criteria.

Thus, it is possible with adequate certainty to say that the multidimensional organization of a system of energy efficiency, supported by visual (graphical) frame the cognitive map allows for a fuller and deeper to reveal the continuity, interrelation and complementarity of scientific information user friendly and easier to Express her bachelors and is a pedagogical condition of formation of their system of thinking.

4. Conclusions

In recent years, an increasing interest among domestic and foreign scientists is systemic thinking, as well as issues associated with its formation in the learning process (Revin and Chervonaya, 2015; Tkachenko et al., 2016; Cayaleri et al., 2005; Waldman, 2007). One of the main national papers on this issue, Z. A. Reshetova indicates that systems thinking considers the real object as a multidimensional whole, including numerous determining factors (Pavlova et al., 2014). We agree with the opinion of the author that systems thinking, first and foremost, is an understanding of the systemic nature of things, which is expressed in the totality of related phenomena, a component of the organized whole. In the second place, it is impossible not to agree with the definition in the work of I. A. Sychev (Sychev, 2015), who devoted to formation of system thinking of students of information specialties, under a system thinking here is the ability to synthetic perception of objects of reality and conscious understanding of the diversity of information inherent in the holistic picture of the world.

Especially important to systems thinking is becoming in engineering where the complexity of objects subject to the design, construction, production, management of its operation, requires new structures of knowledge, scale and method of their integration (Saarinen and Hamalainen, 2004; Thornton et al., 2004). During the process of system thinking is formed by the reflection of the object in a holistic multi-dimensional view of him as a system consisting of subsystems with multiple relationships. In this process, cognitive activity develops the ability to predict state changes of object in different conditions, as in the natural course of events and the intervention of human activity.

The attention attracted by the problem of formation of system thinking in teaching foreign researchers dealing with the role of system thinking in the work of managers, economists, engineers, doctors, teachers and other professionals (Fordyvem 1988; Frank, 2000; Holger, 2006; Maani and Maharaj, 2004). Therefore, in many foreign works systems thinking is often contrasted with mechanistic thinking, with which we disagree. The close relationship between systems thinking and practical thinking are given in the work of the German psychologist D. Dörner. K. Fridtjof systemic thinking understands the ability to identify the quality system that is performed by using logical operations (comparison, generalization, abstraction, etc.) (Mulej et al., 2003). John O'Connor and I. McDermott mean a system thinking approach to understand the meaning and regularity in the observed sequences (Saarinen and Hamalainen, 2004). Thus, for us is a positive thing that many researchers thought about the problem of creation of pedagogical conditions of formation of system thinking of students. However, she has not received proper consideration in terms of visual graphical representations of system knowledge.

Here Tony Buzan proposes to solve this problem using the so-called "mindmaps" - mental maps, and the method which is offered by Tony Buzan originally called "mindmapping" (Mulej et al., 2003). According to the method of Tony Buzan, the efficiency of thought processes can be improved by connecting to the process the right hemisphere and diluted monotonic logical perception of visual images and associations. Tony Buzan proposed to abandon linear writing in favor of the radial. To do this, Tony, Buzan uses mind maps – a visual picture of the problem that needs to be solved or the subject that you want to remember. Says Tony Buzan, mental maps you have to draw on A4 sheets or A3 depending on the amount of information. In the center of the mind map – -, the subject of the problem. From him the colored lines diverged "branches" - the various aspects of this subject. On each branch are 3-4 word Association with every aspect, also connected with branches of different colors. The result is a "thinking map" - visual representation of their own ideas about the subject or problem. Such mental map visible all the main aspects of the problem, gaps in understanding of the issue, associative links, and most importantly – it shows not the result, but the thinking process itself. Undoubtedly, noting a contribution of Tony Buzan, we note that this approach can guarantee the formation of systemic thinking of students if pedagogical conditions are presented above instructor developed cognitive maps of a particular discipline, particularly "energy Saving". This study is not an exhaustive resolution contained therein aspects of formation of system thinking of students of technical universities. The results of the study showed prospects of further development of the problem, in particular, the use of hypertext and multimedia technologies in cognitive maps as navigators of knowledge, adaptation of research results for different categories of students etc.

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