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MODERN KNOWLEDGE MANAGEMENT CHALLENGES: IMPLEMENTING AND MODELING

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Abstract. At the present stage of development of society, intellectual resources, information and knowledge are facing the challenges of transforming the economy, which is changing under the influence of technologies of the 4th industrial revolution. These challenges throw the existing education system back and require it to adapt to new realities. As a result of the analysis of scientific literature, the authors showed a stable model-scheme of the knowledge base in a changing world. As a result, the model of interconnection between branches of the knowledge industry can be implemented as a basis in the education system and the labor market. Correlation-regression linear dependence of R&D and economic development indicators was built. The implementation of the goals can increase the adaptation of the education system to the changing labor market, provide a basis for the reproduction of knowledge, which will further turn the education sector into one of the leading sectors of the new type of economy. Scientific novelty consists in an attempt to implement education in other sectors of the economy in order to ensure the uninterrupted reproduction of knowledge and its dissemination. Practical application will improve the efficiency of knowledge management. The objectives of the study are to show the relevance of the research topic and the lack of a single solution in this direction today. The digital economy, artificial intelligence and new technologies are changing all spheres of human life. Understanding knowledge management requires new solutions, new methods and behaviors.

Keywords: knowledge, knowledge management, information, knowledge base, model.

JEL Classification: D83.

Introduction

A feature of the current stage of socio-economic development of all mankind is the entry into a new, post-industrial period. A distinctive feature of that stage is the strengthening of the role of knowledge, intelligence and information, as the main factors of having advantages in intense competition in real market conditions. Revolutionary changes in computer and information technologies, liberalization and globalization of the economy have only intensified this process.

The current pace of economic development requires from its participants a flexible management system capable of adapting. Industry 4.0 environment creates new conditions for the development of society and economy, where knowledge management systems play one of the key roles.

Since ancient times, it was believed that the main source for their creation and use is capital, raw materials and labor. At present, knowledge is considered as an exclusive fund of economic resources and a factor of long-term advantage in all areas, because it provides the potential for economic and social development, as well as increasing competitiveness.

In the modern world, the main trend is that knowledge is turning into a key resource for development, the actual globalization of competition based on the creation of knowledge-intensive products and services. An important skill is the ability of both individuals and entire organizations to accumulate, create and rationally use knowledge, constantly self-learn and improve themselves. Only those organizations that do this most quickly and effectively are able to outmaneuver their competitors. One of the main tools in achieving the above is the formation of an effective knowledge management system in an organization capable of continuous self-improvement and increasing the economic and social value of the organization by developing its internal

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potential based on innovative development in the context of the digitalization of the economy. In our society, knowledge and transferability play an important role in building a competitive and efficient company (Tangaraja et al., 2016).

The role of education and educational institutions in the formation of the intellectual and social capital of society can hardly be overestimated. Education has always developed and will continue to develop for the society in which it exists.

Foreign and domestic scientists believe that the dual nature of education is not only a public good, but in a market economy it turns educational services into a subject of competition.

1. Theoretical background

Managing our stock of knowledge or intellectual assets has become a popular topic among scientists and practitioners. It is not surprising that most modern organizations have realized the importance of using such a resource as knowledge in order to increase their competitiveness and innovation, and therefore have shifted their focus to knowledge-based systems.

Knowledge is an intangible asset that can increase employees' and organisation's effectiveness (Gupta et al., 2022).

According to Dalkir, in modern conditions, knowledge is considered as a commodity or an intellectual asset, but it has characteristics that are significantly different from ordinary goods, for example, when a person shares knowledge, his stock of knowledge does not deplete, but expands (Dalkir, 2019). The acceptance that information and knowledge in general have become recognized as the true assets of an organization has led these organizations to invest a lot of energy in managing them (Pinelli & Barclay, 2019). Knowledge is the result of experience, and knowledge is regarded as the sum of human cognitive experience (Kakabadse et al., 2003). Omotayo pointed out that knowledge management remains the key to gaining a competitive advantage among companies in the same industry because it enhances acquired knowledge, increasing the ability of organizations to be creative, thereby placing them in a favorable market position relative to existing competitors (Omotayo, 2015). Thus, innovative and creative organizations will remain successful and competitive organizations in their dynamic environment (Serenko et al., 2010). For this reason, a lot of research is currently being done to find out why the acquisition, exchange and application of knowledge in organizational settings is becoming such an important aspect of management (Wilson, 2002). At the same time, the knowledge acquired today may become obsolete tomorrow, which, therefore, requires a new accumulation of intellectual capital. Therefore, it involves the application of various strategies, policies and tools for the effective management of knowledge as an asset of the organization. Knowledge has come to be seen as an organizational resource that needs to be managed effectively if an organization desires to keep up with the pace of competition.

The essence of knowledge management lies in managing the information that an organization has accumulated and effectively using the experience of employees (dos Santos & Sampaio, 2023). All formalized and measured data should be accumulated in databases to ensure the continuity of the formation of internal information flows and reduce the cost of its repeated search and systematization. According to studies, employees spend up to 50% of their working time every day searching for information previously found and processed by other employees (Lin, 2008). The reason for this is obvious and lies primarily in the lack of effective technologies for internal knowledge sharing with the company.

Knowledge management can be considered in the technological and organizational aspect. In the first case, we are talking about the creation of databases, knowledge maps, the introduction of information technology. However, the source of all knowledge is man. Creating a corporate culture that encourages employees to share knowledge is an organizational component of a knowledge management system. Knowledge management should promote cooperation, exchange of experience between employees. In addition, knowledge management depends on the classification of knowledge into explicit and implicit. In the case of explicit knowledge, we are talking about database management, document management, and the educational level of employees. Implicit knowledge implies such a management system that would ensure the exchange of experience between employees.

New research shows that both foundation and innovation of business model rely mainly on human capital, followed by relational and structural capital (Elia et al., 2022).

Findings suggest that top management support, development of knowledge management strategy, knowledge friendly culture, creation and maintenance of digital infrastructure, and employees training are the major drivers for developing a KM system in Industry 4.0 environment (Gupta et al., 2022). Modern companies should take the necessary steps to keep up with the current pace of development, which includes the use of a knowledge management system.

Martín Rojas believes that knowledge sharing will become a reality when a climate of trust is created in the company: "It is difficult to expect employees to be ready to exchange and share their knowledge in a general climate of mistrust and lack of mutual assistance" (Martín-Rojas & García-Morales, 2020). It is necessary to focus on the implementation of three tasks for the formation of an organizational culture that contributes to the development of a knowledge management system:

- the formation of an organizational culture in which all employees recognize knowledge as a key resource;

– creation of effective intra-corporate social communications and elimination of communication barriers;
– formation of a motivation system for employees to create and share knowledge with colleagues, in which the exchange of corporate knowledge is beneficial not only for the company, but also for employees.

2. Results

2.1. The analysis of barriers to knowledge management in the organization

The formation of a knowledge management system is not always carried out smoothly and without obstacles. It should be noted certain obstacles that organizations may encounter in the process of forming a knowledge management system. Among the difficulties faced in the process of company knowledge management, participants in the Knowledge Management Index study identified (Lavrov, 2019):

1. Resistance to change and lack of motivation to share knowledge among employees;
2. The complex structure of the company, in which the interests of various departments do not coincide;
3. Lack of resources: temporary, material, human (lack of specialists with deep expert knowledge);
4. Lack of knowledge management support from company leaders;
5. Poor knowledge of the organization's management in the field of modern technologies and personnel management tools;
6. Lack of a formalized, systematic approach to knowledge management;
7. Weak corporate culture that is not capable of sharing knowledge;

In addition to organizational barriers, there are also subjective factors that negatively affect the process of creating and disseminating knowledge in an organization (see Table 1).

Table 1. Subjective factors hindering the formation of knowledge (source: Husted & Michailova, 2002)

Factors that hinder the process of sharing knowledge in an organization	Description
Unwillingness of workers to share knowledge with others	Unwillingness to spend time disseminating knowledge. Unwillingness to help "intellectual" parasites. Respect for hierarchy and formal authority. Fear that knowledge may be misinterpreted.
Unwillingness of employees to perceive the knowledge of their colleagues / managers	Preference to develop own ideas and knowledge. Doubt about the suitability and validity of knowledge. Very strong connection with the group (team members get used to each other and do not want to take information from others employees). Groupthink (the team believes that it has a monopoly on knowledge, and knowledge that comes from outside is bad).
Unwillingness of employees to share their failures and mistakes with other employees	Uncertainty in the reaction of colleagues. Prevention of possible damage to a career. Lack of activity / initiative (there is a slogan in the organization that if you do nothing, you will not make a mistake).

2.2. Specifics of human capital

The modern total workforce, having professional knowledge, skills, experience, innovative potential and capable of further intellectual development, is becoming an even more important factor in the development of production than advanced equipment and technology, which are expensive and become morally obsolete relatively quickly. There are three main components in the structure of human capital – education capital, health capital and culture capital. But the leading institution that ensures the production of human capital is the educational services market.

The unit of "human capital" is not the employee himself, but his knowledge, skills and abilities. Another thing is that this capital does not exist outside of its carrier – a person. And this is the fundamental difference between human capital and physical capital (machinery and equipment). There is also an analogy between depreciation of fixed and human capital. The physical depreciation of human capital, as already mentioned, is associated mainly with the "depreciation" of its carrier – the aging of the worker, the age-related decrease in his working capacity. The process of "forgetting" also plays a certain role – the loss of previously acquired, but not used knowledge for a long time. However, there is a difference: in the course of labor activity without any investment, a process takes place that is opposite to physical wear and tear, namely, new knowledge, new skills are acquired that increase the value of the employee (Panahi et al., 2013). The obsolescence of human capital is associated primarily with scientific and technological progress, which devalues certain blocks of knowledge and skills. This process is inevitable, but predictable. Ideas of modern designs, products and technologies appear long before they are introduced into production. Therefore, forecasting innovations in the national economy makes it possible not only to predict the emergence of new unemployed, but also to determine the directions of investments intended for the reproduction of human resources. Education is the main form of reproduction of lost knowledge and skills.

2.3. Interaction between branches of the knowledge industry

If we talk about the production of knowledge as a catalyst for the development of the state and the whole world as a whole, then we can single out branches of the knowledge industry: science is the branch of generating new knowledge; culture – a branch of humanization of knowledge, preparation of the consciousness of people and society for the perception and application of new knowledge; education branch of dissemination of knowledge; innovation is a branch of the practical use of knowledge. These industries do not exist independently of each other. They are in constant interaction and mutual influence. Knowledge is a connecting element between them and at the same time a product of their activity and a development factor.

Education is the leading industry in the knowledge industry. On the one hand, it involves the transfer of already existing, accumulated knowledge from generation to generation through the dissemination of existing knowledge from one individual or place of storage to another, and on the other hand, the formation of abilities to create new knowledge. In modern conditions, the processes of the emergence of new knowledge and the transfer of existing ones are closely connected with the development of higher education.

Thus, in the new economy, knowledge simultaneously acts not only as a resource and factor of production, but also as a product of scientific work, an element of infrastructure and human potential. The institute of education (primarily higher education) and science occupies a priority place among institutions producing and reproducing certain types of knowledge. In addition, the economic and social significance of knowledge as a resource is of particular relevance and usefulness in modern conditions.

If we talk about the production of knowledge as a catalyst for the development of the state and the whole world as a whole, then we can single out branches of the knowledge industry (see Figure 1): science is the branch of generating new knowledge; culture – a branch of humanization of knowledge, preparation of the consciousness of people and society for the perception and application of new knowledge; education is a branch of dissemination of knowledge; innovation is a branch of the practical use of knowledge. These industries do not exist independently of each other. They are in constant interaction and mutual influence. Knowledge is a connecting element between them and at the same time is a product of their activity and a factor of development.

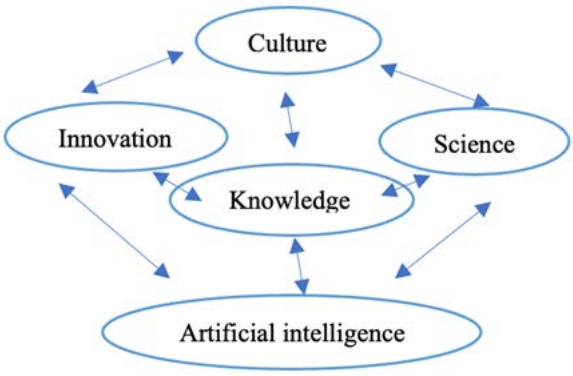

Figure 1. Model of interconnection between branches of the knowledge industry (source: Author, 2023)

Education is the leading industry in the knowledge industry. On the one hand, it involves the transfer of already existing, accumulated knowledge from generation to generation in the form of the spread of existing knowledge from one individual or place of storage to another, and on the other hand, the formation of abilities to create new knowledge. In modern conditions, the processes of the emergence of new knowledge and the transfer of existing ones are closely connected with the development of, above all, higher education.

2.4. Education as a generator of knowledge

In fact, knowledge industries are the life cycle of knowledge and correspond to the stages of its development. In general, the life cycle of knowledge is a certain period of time during which knowledge is created, developed and used, bringing real benefits to the user and society (intellectual, economic, social, etc.). Knowledge corresponds to the generally accepted scheme of any life cycle: introduction – growth – maturity – decline. Each segment of the life cycle of knowledge corresponds to a branch of the knowledge industry. Education here is at the peak of the life cycle and corresponds to the stage of maturity and obtaining the greatest social and personal benefits. Thus, the basis of the process of creating the economic resource "knowledge" is intellectual work and the knowledge industry, through which knowledge acquires the form necessary to meet the needs of society for new knowledge. The initial information is the subject of production of such an economic resource as "knowledge".

The traditional model of education is going through a real crisis: half of his life a person studies what is already known to science, and only for a short period can he act productively and create new knowledge. In an effort to provide students with the most up-to-date information, universities constantly modify their curricula, but the preparation of their graduates corresponds to knowledge that is several years outdated. Therefore, the learning process is increasingly transformed into an active exchange of knowledge in the form of seminars, discussions, conferences. Students should not just acquire knowledge, they should be ready for self-education, rapid acquisition of new professional knowledge and skills (Sang et al., 2010).

More and more we need not performers who have mastered a certain amount of knowledge, but socially active people who are ready for a constant change in economic and production technologies, capable of innovative activity, ready for retraining and professional retraining. In modern conditions, education must take into

account the needs of the global economy. At the same time, the main task facing educational institutions is to prepare the next generation of specialists to manage not just a changing world, but the changes taking place in this world, or changes in the future.

2.5. Benefits of knowledge management system in education

The development of parameters for the competitiveness of an educational institution implies taking into account the following factors: changing needs and expectations of consumers of educational services, increased use of information technology, new requirements for personal development. The knowledge management system of the university can be considered as the following processes:

1) academic knowledge management system;
2) employee knowledge management system;
3) knowledge management system about the educational institution (Orlova & Sazonkina, 2015).

The basis of employee knowledge management is the formation of a corporate culture and corporate space based on a systematic exchange of experience, mentoring and training, the use of various tools for the development and training of personnel (corporate blog, employee testing) (Tsoukas & Mylonopoulos, 2003). The academic knowledge management system is the knowledge management of teachers and students. Faculty knowledge management implies virtual and real participation in the activities of professional associations, advanced training, participation in international cooperation programs, regular master classes by specialists from leading domestic and foreign companies. The process of formation of students' knowledge is carried out: through the management of knowledge flows; using modern teaching aids; implementation of student projects based on teamwork; implementation of research projects commissioned by companies; constant participation of practitioners in the educational process; conducting internships for students in leading companies; the opportunity to study additional educational programs. The introduction of these principles into the management system of an educational institution allows the formation of extra-competences of graduates due to their innovative nature, focus on international standards, flexibility and individual approach.

Improving the efficiency and quality of the educational process, more fully using the available intellectual, material and production resources to achieve the goals of creating a university complex are the goals of knowledge management in education. A successful knowledge management process enables organizations to achieve the following benefits:

– improving the quality of curricula;
– implementing innovation by encouraging the free flow of ideas;
– the possibility of introducing an interdisciplinary approach to the development of curricula;
– use of existing knowledge with the prospect of eliminating unnecessary processes;
– improvement of working conditions for teaching staff;
– reducing staff turnover by recognizing the value of employees' knowledge and paying adequate remuneration;
– improvement of services related to teaching and learning with the use of modern technologies;
– creation of a database of collective and organizational knowledge of the organization;
– reduction of time spent on research.

New methods and forms of management of an educational institution require an integrated approach to knowledge management, including the methodological, organizational, project-based nature of management. It is possible to propose the creation of a knowledge base for the implementation of such an integrated approach in educational institutions.

The goals of creating a knowledge base:

– to provide effective access of employees of the institution to all information and knowledge functioning in the organization;
– establish the types of knowledge required by users for their work;
– develop methods for obtaining knowledge;
– study the processes of movement and exchange of knowledge between users of the base within the educational organization;
– build an effective procedure for documenting processes;
– develop a methodology for corporate training;
– training employees of the organization to work with the knowledge base.

2.6. Analysis of knowledge indicators of the leading countries of the world

The methodological basis for analyzing the knowledge indicators of the world's leading economies was the reports "Research and Development: Trends in the United States and International Comparisons" (Research and Development, 2022) and the report on indicators "Academic Research and Development" (Science and Engineering Indicators, 2022). According to these documents, global research and development is concentrated in a few countries. The United States leads the world in R&D efficiency with a share of 28% in the world in 2019, followed by China (22%). However, China's current CAGR (2010–2019) is nearly double that of the US. These two countries alone account for about half of the world's total R&D.

US research and experimental development (R&D) metrics reached $667 billion in 2019 and an estimated $708 billion in 2020, reflecting growth across all sectors (business, higher education, federal government, nonprofits, and others), but mostly in the business sector).

Adjusted for inflation, growth in total US R&D averaged 3.8% per year from 2010 to 2019, well above the 2.2% growth in US gross domestic product (GDP) over the same period.

The U.S. national R&D intensity (R&D-to-GDP ratio), a key indicator of R&D investment, also increased from recent highs of 2.79% in 2016 and 2.95% in 2018 to 3.12% in 2019 and is estimated at 3.39% in 2020.

Scientific discoveries, new technologies and the inventive application of cutting-edge knowledge are essential to succeed in a competitive global economy and to meet challenges and seize opportunities in various societal areas such as health, the environment and national security. Therefore, the overall strength of R&D in a country (both in the public and private sectors) is an important indicator of current and future national economic advantages and prospects for social improvements at the national and global levels (see Figures 2 and 3).

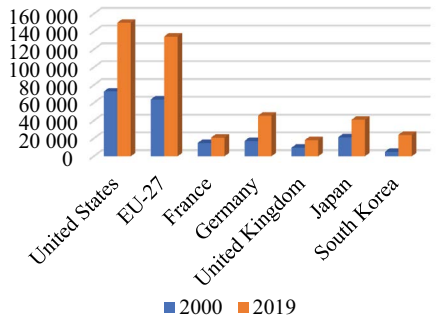

Figure 2. Government budget al.ocations for R&D; PPP = purchasing power parity (Millions of U.S. dollars) (source: Organisation for Economic Co-operation and Development, 2021)

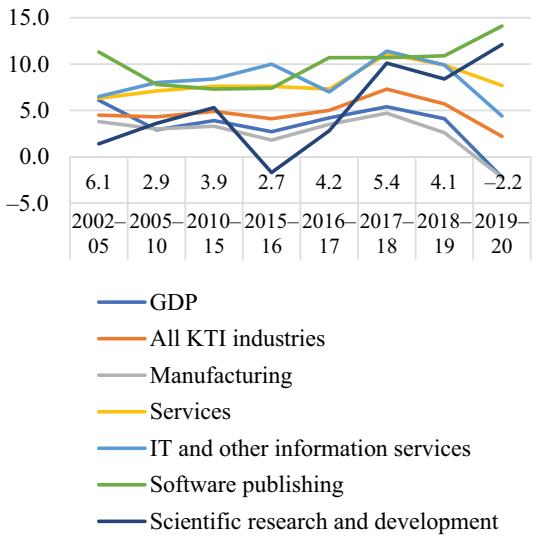

Figure 3. Annual rates of change in U.S. KTI value added and GDP: 2002–2020

A correlation-regression linear dependence of R&D and economic development indicators was built. Regression models for the US, France, Germany and Korea were built using the Least Squares method. The simulation used annual data from 1993 to 2020 (see Table 2).

Table 2. Correlation-regression linear dependence of R&D and economic development indicators (1993–2020) (source: Author (2023) made in Rstudio; The World Bank, n.d.)

Country	Indicators			
	GDP per capita (constant 2015 US$), y	Patent applications, residents, x	Determination coefficient R^2	Correlation coefficient r_{xy}
USA	^y = 3,36e+04 + 0,0841*x (1,02e+03) (0,00459)	0.084 ***	0.93	0.96
France	^y = –8,91e+03 + 3,13*x (5,82e+03) (0,419)	3.12 ***	0.68	0.83
South Korea	^y = 7,26e+03 + 0,133*x (617) (0,00507)	0.13 ***	0.96	0.98
Germany	^yg = 2,05e+04 + 0,382*x_5 (6,76e+03) (0,146)	0.38 **	0.38	0.62

According to the correlation analysis, the correlation between GDP per capita and the number of patents was determined, a direct strong direct linear dependence on new knowledge that is applied (patents) in the USA, France and South Korea was determined. A notable correlation was found in Germany.

The coefficient of determination shows that in the US and Korea, 93% and 96% of the formation and growth of GDP per capita depends on the number of innovations and patents.

Innovation accounts for 68% of GDP per capita in France, and a weak dependence of GDP on innovation is observed in Germany. Since innovation and patents are directly dependent on investment in R&D, an increase in investment in R&D will lead to an increase in GDP per capita and economic development.

Enterprises are the top performers (75% in 2019) and sponsors (72%) of research and development in the US. The sector performs most of the R&D in the US classified as experimental development, more than half of applied research, and a significant (and growing) share of basic research (32% in 2019).

Higher education institutions (12% in 2019) and the federal government (9%) are the second and third largest R&D performers in the US. Higher education institutions are the largest performers of fundamental research. Both companies have seen a decline in their share of total US productivity since 2010.

It is proposed to use the following indicators of knowledge management in educational institutions:

- satisfaction with working conditions;
- satisfaction with the organization's activities on the part of staff, customers, partner organizations, government authorities;
- increasing competitiveness.

Within the framework of this approach, indicators of knowledge management in educational institutions of higher professional education should use such indicators as:

- the number of business initiatives for the interaction of an educational institution with scientific organizations and commercial enterprises;
- the number of types of Internet communication used for the interaction of an educational institution with scientific organizations and commercial enterprises;
- the number of internships, dissertation defences, advanced training courses for the teaching staff;
- the number of information materials used by teachers in their educational activities after advanced training;
- the number of implemented innovative projects in a certain period of time;
- the amount of time used by staff for knowledge management;
- the amount of material support for activities in the field of knowledge management implemented in the organization;
- the number of concluded cooperation agreements, taking into account their qualitative characteristics and the effectiveness of cooperation;
- satisfaction of employers with the competence of graduates of educational institutions;
- the level of corporate trust in the organization.

This approach allows you to take into account the corporate culture of the organization and control its change, but requires a highly professional approach in identifying problems in the knowledge management of a particular organization.

Conclusions

Thus, in the new economy, knowledge simultaneously acts not only as a resource and factor of production, but also as a product of scientific work, an element of infrastructure and human potential, and scientific knowledge is a priority, and among institutions that produce and reproduce certain types and types of knowledge, there is no doubt, the priority place is occupied by the institute of education (primarily higher education) and science.

The results obtained on the basis of the analysis of scientific literature make it possible to identify trends in the development of the knowledge industry in the world, which determines the relevance and significance of the research topic. Based on these data, a model for the reproduction of new knowledge was built on the basis of existing knowledge.

Education carries out the reproduction of the intellectual capital of society. The realization of this goal is possible through the development of new standards and training programs, new forms of interaction with other participants in socio-economic processes. This will ensure a guaranteed set oriented to the real sector of the economy.

Regression models were built for GDP per capita of the leading developed countries. The authors also proposed a theoretical model of knowledge management at the present stage of development

It has been established that since innovations and patents are directly dependent on investment in R&D, an increase in investment in R&D will lead to an increase in GDP per capita and economic development.

The use of a knowledge management system in education as an integral component of management can significantly improve the quality of educational services and provide modern education. For knowledge that is not used and does not increase eventually becomes obsolete and useless, just as money that is stored without being converted into circulating capital eventually depreciates. Knowledge that is distributed, acquired and exchanged, on the contrary, generates new knowledge.

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