Challenges of scientific knowledge visualization in publication productivity of the university academic staff

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Abstract. It has recently been shown that a person, an author particularly, faces the challenges of visualization in the cognitive process. The aim of this study is to consider the forms of thinking process and the changes happened in education process and in scientific activity. It was noted that the challenges connected with information perceiving during the work with the text occur in the process of creating academic papers as well. We conclude that the topical field of visualization covers not only the educative process assuming information transfer from person to person (model "teacher-student"), but the process of scientific activity. Applying the methods of visualization in publication activity is the factor for effective communication in social and cultural space that provides the opportunity for academic society to recognize results. We offer possible ways to promote scientific papers via online resources such as scientific social networks and tools of media corporations. The scientific social network ResearchGate and Thomson Reuters media corporation product as an online tool "Researcher ID" placed at the bibliographic database Web of Science TM Core Collection are used as the examples. We state that information technology allows authors to promote the results of their studies around the world.

Introduction

The problem of scientific knowledge visualization is one of the most topical in the modern world. Indeed, the contemporary level of science development, computer technologies and the Internet allow us to study the achievements of contemporary science newly and to speak of the excellence of abstract knowledge [1].

The thinking can be actualized in various ways – by means of the people practice, in the way of theoretical cognition, and in a sign and figurative form. Up to the present day in the educative process and scientific activity the conceptual thinking was more involved. These days more and more researchers address to a sign and figurative form of cognitive activity, confirming with that the well-known statement that "Everything new is actually well-forgotten old".

Actually, at the earliest stages of development people fixed information graphically (the first drawings, rock painting). By means of drawings there was a process of information transforming from the inward man outwardly. In fact, people learned to fix their thought in time and in space [2]. Later symbols provided the basis for writing. Exactly in such way a person started learning how to communicate with other people and with him/herself.

Thinking is a two-level model consisting of sensory perception divided into sense, perception and representation, and of the abstract thinking presented by such constructs as notion, statement and inference. According to that, even at a representation stage we start operating with images of subjects abstracting from the subject itself. Precisely at this stage we deal with the object visualization keeping in the memory the image earlier seen or a combination of images which will be presented as a notion afterwards.

It is impossible to transmit thoughts to each other without using these constructs. At the stage of representation it becomes impossible to connect the value and the meaning of the notion together.

It should be noted that each person is the subject of culture. The consciousness of the person is developed within the cultural unity where the experience of activity, communication and world perception are connected. The person is necessary not only to take in this experience, to make senses, but also to modify her/himself on it so to "reborn" - to appear the unique and inherently valued personality.

However, all these abilities do not appear in a person "naturally", cultural experience assumption cannot be spontaneous. It demands certain efforts and organized activity. A person cannot simply "take" knowledge composed a scientific paradigm - s/he has to rediscover

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them for him/herself, an in-personal meeting has to be done to this knowledge [3].

Mastering these values, norms and meanings occur in the process of education and scientific work. Education assumes a collaborative work of a trainee and a trainer. It characterizes the process of life experience, knowledge and skills transferring via language constructs. Thus, it is formed the social and cultural space weaved of scientific concepts, symbols and meanings.

Moreover, recent decades show that information technology, modern devices and Internet technology in particular, play a key role in publication productivity of scientists. Using scientific databases and social scientific networks is of growing interest. The importance of using these powerful tools is doubtless. Nowadays, scientists from different part of our world have opportunity to communicate with each other in order to exchange their experience, find solutions in knotty issues, carry out research and publish the results of collaborative studies.

Materials and methods

Several researchers believe that a personality is formed under the influence of the components such as social intercourse where a person exists and his/her individual characteristics can be enriched during education process [4]. According to this it is possible to state that educating a person - personality's formation happens in two ways – in the course of developing values, meanings and norms of contemporary society, in the process of self-improvement, development of dowries and aptitudes as well as in scientific work.

Scientific activity intends constant communication, dedication to integrate creative and leadership potential, skills to listen and to hear others. The process of making scientific texts, i.e. the results of scientific creativity supposing collaboration in analyzing, understanding and discussing the result presented in the form of a scientific article or a report, especially, if this work is devoted to the analysis of a complex interdisciplinary question, happen to be very problematic. Modern authors are "like birds sitting on far twigs of the same "human culture" tree, they are far from the earth and hardly hear and understand each other. But the majority has to take their discoveries on trust and use fruits of their mind "[4, 5].

Human society and its history, natural language, literature and art, creative work results and the creative process itself can be the objects of cognition. The specific subject under human cognition is a text as a semiotic exponent of human phenomenon within the system of humanitarian culture.

In texts the peculiarities of cognizable objects are reflected but the reflection always mediated by the text creators' subjective activity. The researcher relying on principles of scientific methodology must be able to find in texts the answers to the points of interest.

There are three the most common ways of making notes that people use. They are a narrative style, a reader-oriented text and an exposition in the form of compound (multilevel) list. The narrative text is a coherent expression of an idea. The reader-oriented text is a list or range where the ideas are arranged in order, for instance, as they appear.

The third way is the list where ideas are set hierarchically [6]. It should be emphasized that the main feature of the narrative style is a linear structure of the text, the peculiarity of the list is the use of graphics characters (figures or letters), and the multilevel list is characterized by logic and sequence.

In scientific article (linear record traditionally) the text is divided by the titles and subtitles, it also contains lists and tables, which the author seems to be simple and logical. However, it is to make efforts to make author's idea understandable in right way. That is the first difficulty of working with text.

From our point of view it is connected with a variety of causes. One of them can be illustrated by the myth of the cave (The Allegory of the Cave), which was presented in Plato's work "The Republic"[5]. Sir Francis Bacon considers that there is an additory difficulty which means that every person has his/her own "cave", weaved from meanings, symbols, life experience and prejudice". The cave idols are the core of a person's mistake". Inborn features of everyone, is the personal cave which "absorbs the beam of truth" [6].

The other difficulty is that sometimes it is hard to capture the correctly understood information and after a while to reproduce it from our memory. We suggest that this process is connected with the lack of any emotion which can color new information for us. Visually a record looks monotonous; the same things are constantly repeated. The reader stops focusing his attention, diverts and the information "goes by" [7].

If we imagine the process of work with text as a process of collaborative creative work, using the hermeneutical method, the result will be quite different [10]. Thus, for instance, according to Wilhelm Dilthey understanding is a reconstruction [11]. We must consider text in both as a cultural system that frames legal issues in universal terms and as an external organization of society that examines them in terms of the positive laws of particular institutions. The text has an inner content, a reader as an interpreter has to reconstruct it, being in other position, slightly at a distance. The considerable time gap that may result in the interpretation of all factors of the text complicates the task.

According to Hans-Georg Gadamer, understanding is an interrelation between author and reader, and a historical process [7]. When interpreting a text we change its contents, it does not exist out and irrespective of understanding the subject. That is why an interpreter can expose its content better than its author. The language environment (cultural tradition), where the subject of cognition of a knower from his/her birth, is being a subject as well as a condition of human understanding at the same time.

Self-realization interlinks with culture interpretation, the content of which is scattered in texts. The reader's understanding of spoken or written language may change according to the historical situation in which we find ourselves. He also asserts that an understanding of the meaning of language may be an event or experience rather than an act of mind. A condition of understanding

is that in order for it to occur, it must have a historical background.

The other difficulty concerning the linear record is to put forward the central idea in the familiar text. Frequently the reader points out a main idea using key words, but it is hard to separate these semantic constructs from the master file.

The absence of visual objects, images, color peculiar to the scientific text, makes the process of working with text makes the process monotonous and less productive.

According to research, it is necessary to separate such notions as "knowledge visualization" and "information visualization". "Knowledge visualization" means the aims of information and data transfer, which stimulate cognitive procedures. This process facilitates the mutual transfer of facts, insights, experiences, values, expectations, perspectives, opinions and predictions. "Information visualization" means graphical data representation which is abstract. The information visualization is focused on the use of digital and computer-based tools to explore large data sets for conceptualization. Knowledge visualization has to explain the goals of described elements connections. Using associations, analogies, intelligence, these explanations help the recipient to use the gain knowledge and to make his own decision, not imposed by someone else.

Results and discussion

The process of creating a scientific text as a result of scientific creativity in the form of a report or scientific article should be arranged in a certain manner. As the reflection of cognizable object features is mediated by subjective activity of texts, it is necessary to use the best efforts in order to the author's plan to be interpreted correctly so it is understood by the reader.

The published article/work should lead to recognition of the scientist in the scientific environment, his works, leading to future citations of his work by other researchers in their publications. This increased attention will promote the citation index of the author and to form a recognized field of research and study of the scientist. His/her achievements in scientific activity and results of studies will be the basis of this brand.

The opportunity of using modern ways of communication promotes transferring scientific knowledge and distributing the results of scientific research. These results can be used in the system of higher education. The use of visualization tools in the process of creating a scientific article or conducting a scientific project makes it possible. [13].

For a long time Russian scientists had no possibility to collaborate with foreign researches and publish their scientific manuscripts in foreign journals. The list of journals where they could present the results of their scientific research was limited to Russian periodicals only. Proceedings in international and Russian conferences as well as publishing articles in Russian scientific periodicals were the only opportunity to promote scientific ideas and results.

There was a number of examples in the history when researchers from non-English countries published their discoveries only in their country periodicals and in their mother tongue. For instance, the case with the discovery of Claude Shannon's sampling theorem [14]. It was published in 1948 [15]. But in 1933 one Russian scientist Vladimir Kotelnikov presented his theorem (the same theorem) in the 1st All-Union congress on technical reconstruction of communication and development of weak-current industry development [16]. The report was written in Russian that is why only Russian scientists and scientists in the USSR could read, heard, and known it. Consequently, nobody in other countries knew about that as well as Claude Shannon, at that time he was at the age of 17 only. Kotelnikov's theorem was the basis for the further research. Later C. Shannon presented his theory but it was with some additions. It occurred that this theorem was discovered by several scientists independently nearly at the same time. Now this theorem has several names Nyquist–Shannon, Nyquist–Shannon,–Kotelnikov, Whittaker–Shannon–Kotelnikov, Whittaker –Nyquist–Kotelnikov–Shannon, and cardinal theorem of interpolation. Nevertheless, in the USA it is usually named as Shannon's sampling theorem, while in Russia it is known as Kotelnikov's theorem. Such situation could happen because in the first half of the XXth century scientists did not have technical opportunity to collaborate and to exchange their experience.

The World Wide Web broke these barriers; it became possible to promote research and development to the academic space [17]. Appearing the virtual databases which are accessible to any user whenever and wherever has changed the situation of isolation. Nowadays modern scholars have the opportunity to use online resources, social networks and databases as a mean of social, cultural and scientific communication.

The authoritative publishing houses Elsevier and Thomson Reuters are the owners of multidisciplinary research platforms as Web of Science and Scopus which contain various bibliographic databases covering the highest impact journals and conference proceedings [18, 19, 20, 21]. These resources make possible to form author's own articles catalogue, make list of cited references, determine citation index and define whether the research area is pressing or not.

Every database has its tools helping the scientists to carry out research as well as to promote the results of their studying. For instance, Thomson Reuters Corporation, being the owner of the Web of Science platform suggests researchers around the world using in the scientific purposes such constructive tool as a Researcher ID [22]. The Researcher ID system allows creating "a personal site of a scientist". Every author gets his/her unique identification number to operate his publications and keep them online and up to date, because on this website authors can link their ResearcherIDs to their works.

In turn, Elsevier's Scopus has its own tools as Author's ID, which is similar to the ResearcherID and has something in different. These tools help to identify colleagues, to find collaborators and partners in the same

research field. Nowadays the majority of leading researchers in academic world has such unique identification numbers and the ability for collaborative research.

Recently the scientific social networks have become widespread among researchers where they can communicate to exchange their experience, organize scientific seminars, participate in network scientific projects and find collaborators. A scientific social network is a kind of a platform where any researcher can deposit information including his/her scientific interests, achievements, skills and expertise, add publications and even ask questions to colleagues. ResearchGate is an excellent example of such scientific social network [23]. The given network is one of the most widespread and sought-after among researchers all over the world, it is free for users. ResearchGate is a tool of international scientists' collaboration from all research areas that helps to do the research elaborately from exchanging any scientific information, full texts, discussing arguable points in blogs up to collaboration. Researchers from all over the world can collaborate with each other, communicate, exchange experience and present the results of the studies. Each of the registered authors has an opportunity to download any manuscript; even it has not been published yet. Real-world communication allows authors to find a better solution.

Table 1. Number of researchers from Tomsk Polytechnic University(TPU) been registered in the social scientific network ResearchGate 2012- early 2016 year.

Year	2012	2016
Registered members from TPU	180	927

Table 1 presents the information how the number of researchers from Tomsk Polytechnic University has been changed in social network ResearchGate since 2012 by the early 2016. According to the data in the table 1 it can be clearly seen that the number of the registered researchers has been increased over fivefold from 180 up to 927 registered members [22]. We can suppose that this number will grow further.

With the aim of promoting themselves as authors the registered members have downloaded 1338 manuscripts [22]. As described in Institution Statistics overview these papers are read not only by Russian scholars but preferably by American and Chinese scholars [22].

The data mentioned previously illustrates the tendency in the scientific world. Scientists wish to communicate and exchange experience with each other. In order to be recognized, they use technological innovations that allow to promote the results of research work as well as to find colleagues-associates from other countries.

Conclusion

The results of this study provide insight into the challenges of scientific knowledge visualization in publication productivity of the university academic staff.

In summary, we confirm that in social, cultural and academic space, efficient communication and a common research platform make the results of scientific activity be recognized. It is very important especially when a researcher is on the way to his/her discovery.

The publication productivity of university academic staff and all procedures connected with the process of publishing should be organized specifically in the way when researchers understand what publishers require. A common procedure, guidelines for authors would prevent problems and get to the readers new research and findings quickly. Authors would then have fewer problems creating articles and be able to expand their use visualization tools which in turn excite scientific text for readers.

It was predicted that modern technologies help researchers from all over the world promote their manuscripts and results of their scientific activity as well as break barriers among scientists. It helps to avoid the situation when the same discovery can be made by different scientists independently.

The authorship of this article is one such example of international collaboration of researchers in across the globe. Just a decade ago such collaborative exercises could not be imagined. Nevertheless, such tools as scientific social network ResearchGate and ResearcherID make this process possible. Our example proves the idea of the efficient collaboration. It can be used by other scientists to get better results in their studies.

Nowadays it is vitally important for scientists to be involved in the Internet technologies in order to be abreast of the times, to be recognizable, to prevent such cases when somebody has already discovered that you are trying to find. Thanks to Scopus and Web of Science databases we have an opportunity to read any of the manuscripts we interested in. It destroyed barriers, which existed half a century ago in scientific society.

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