Program of Scientific Communication Development for Older Age Cohort Scholars

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Abstract: This paper is aimed at studying scientific communication as an integral part of a scientist's activity. The authors of this article analysed the development of informational technologies, which gave rise to a new paradigm of scientific communication Research 2.0. In the present study the analysis of research papers, describing models of scientific communication is done. The findings allow to define the structure and content of a comprehensive program of activities, connected to scientific communication in compliance with the Scientific Communication Life Cycle Model. In order to introduce a program, aimed at lowering scholars' emotional barriers in course of their professional interaction, a target group of older age cohort scholars in the fields of Mathematics and Methods for teaching Mathematics was chosen. The five-stage program of activities encouraged professional interaction of older age cohort scholars and introduced them to the methods of presenting research findings, elements of managing and mechanisms of applying the findings by means of Research 2.0. A constructive description of each module of the program is done, actions and a strategy are described, communication between participants and tutors through the platform Higher School Mathematics Teacher is arranged in this research. In order to assess the efficiency of implementing the program, Researcher Development Framework (RDF) is used. The study also presents the results of the activity of older age cohort researchers, who were engaged in the program. Following the change in the phase of the development of researchers' characteristic features and in compliance with RDF, a conclusion is made about a positive impact of the program on the development of scholars' interaction skills, the awareness of the procedures of actual professional conduct. The impact of the program on the scholar's emotional comfort in course of professional communication is proved as well.

1 INTRODUCTION

The scholars' effective performance is an attribute of sustainable development of the society. Factors, contributing to effective scientific activity. The development of intellectual and psychological qualities of a scientist, correlation between the process of thinking and creativity, phenomena of scientific discovery and genious were always of high interest for psychologists, educators, science historians. Numerous researches were done into specific attributes of a scientist, considering them from different theoretical perspectives. Attempts to identify personal qualities, which are central to the professional activity of a scientist, were made in classical research by Bogoyavlenskaya (Bogoyavlenskaya, 2021), Cox

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(Cox, 1926), Guilford (Guilford, 1959), Hollingworth (Hollingworth, 1926), Roe (Roe, 1961), (Terman, 1922), stated, that scientific communication (a complex of processes and mechanisms of transmitting scientific ideas inside a scientific community) is an integral part of a scientist's activity. Fast-paced development of modern science and the level of scientific achievements prompted scientists to search for new means of scientific communication.

The first aspect meant integrating skills of scientific communication into a basic set, which is identified by sociologists, employers and scientists (Brownell et al., 2013; Gray et al., 2005; West, 2012; Vlasenko et al., 2019) as critical for any scientist. Hence, courses in communication are introduced into curricula for postgraduate students in many countries, among which are the following: Great Britain (Quality Assurance Agency, 2019), the USA (American Association for the Advancement of Science, 2009, 2023), Canada (Ontario Universities Council on Quality Assurance, 2023) and Australia (Australian Qualifications Framework, 2014). In turn, in educational literature there are numerous papers (Levine, 2001; Mulnix, 2003; Gillen, 2006; Kozeracki et al., 2006; Jones et al., 2011; Cameron et al., 2020), which state, that such components of scientific communication as reading scientific papers by other scientists and promoting own scientific concepts can help budding researchers to develop core skills of a scientist and boost their confidence in scientific thinking. So, inspired by this idea, the authors in the present paper did an overall review of the history of communication in science. A paper by Vickery (Vickery, 2000) presents detailed means and attributes of oral and written communication in pre-digital era and shows a picture of prerequisites for modern methods of scientific communication. Special attention is given to the development of scientific communication in the 20th century. It's result from industrial research, occurrence of Big Data, computer networks and Internet communication. Early in the 21st century, Hurd (Hurd, 2000, 2004) offers a new paradigm of communication in science and shows that digital media offer new roles and functional opportunities to the participants. Thus, the development of information technologies changed the mode of scientific communication. The conventional system based on printing, which relied on a referred scientific journal as a key mechanism for presenting scientific findings, underwent transformation and turned into a system, dependent on digital means of transmitting information. As Hurd (Hurd, 2000) stated, scientometrics bases replaced conventional libraries and publications turned to electronic formats; communication in science evolves to the process, which counts more on on-line resources. This transition from printed to digital format changed the roles of all the participants of the scientific communication system. Transformation of contemporary science, namely its digital aspect, has a specific impact on older age cohort scholars. In many cases a well-established ethos of scientific activity contradicts new rules: lack of skills for searching digital information puts under threat relevance and timeliness of a research; absence of experience in disseminating scientific findings by means of digital resources obstructs partners' interest in those findings.

Though new policy of scientific communication, as well as academic rules, cannot be formally labelled as norms, they start dominating science universally. Non-compliance forces older age cohort scholars and researchers feel uneasy, to adapt, to find ways of internal and external solutions to the conflict. Recently the issue of adapting older age cohort scholars to new rules of scientific communication has become a pressing one.

1.1 Analysis of Scientific Papers

In educational literature, dedicated to academic education, scientific communication is considered from a point of view of positive impact on the process of developing scientist's core skills of a. In papers by Levine (Levine, 2001), Mulnix (Mulnix, 2003), a correlation between the skills level of processing scientific literature and efficient scientific activity is stated. Research by Gillen (Gillen, 2006) proves that though a majority of scientists are able to understand and absorb informative aspects of scientific articles, they often face difficulties interpreting the findings and analyzing them critically. As researchers might lack in strategies, necessary for building up credible criticism, then developing the skills of scientific communication becomes critical for engaging them into active scientific process. Research paper by Kozeracki et al. (Kozeracki et al., 2006) highlight, that designing courses, aimed at the critical analysis of articles in scientific journals and presentation of own research increases scientific literacy and self-confidence of researchers.

Researching the problem of developing a skill in scientific communication, Cameron et al. (Cameron et al., 2020) came to a conclusion, that behavior and attitude to scientific writing, speaking and presenting findings contribute to scientific identity. As the main factor of this process is its fulfillment in all the academic stages from a postgraduate student to a scientific advisor, it is indicative of a potential for engaging means of scientific communication for enhancing career perseverance. Research papers by Smyrnova-Trybulska et al. (Smyrnova-Trybulska et al., 2019), Kuzminska (Kuzminska, 2021), look into this issue. These works allow to state that introducing the scientific communication program into educational process ensures development and improvement in researchers such a skill as undertaking scientific communication; contributes to developing digital competencies and building up an image of a scientist, thus integrating into a single scientific community. The researchers confirmed that digital competencies concerning scientific competencies allow researchers to search for scientific and professional information more efficiently, to work with open systems of scientific research support, to analyse data and visualize them with the help of up-to-date informational computer technologies, to create and manage personal educational environment, a portfolio, etc.

Studying the problems, connected to developing professional skills in a scientist, experts emphasized the necessity to build models of scientific communication. One of the earliest models of scientific communication is the UNISIST model (UNESCO, 1971) (the United Nations Information System in Science and Technology), offered by the United Nations Educational, Scientific and Cultural Organization (UNESCO) with the aim to improve scientific and technical communications. Taking into account ever-growing impact of the Internet technologies on communication between scientists, Søndergaard et al. (Søndergaard et al., 1972) presented an extended and revised UNISIST model. One more model by Garvey and Griffith (Garvey and Griffith, 1972) means to describe the communication process in science, but it lacks informational technologies support. In studies by Hurd (Hurd, 2000, 2004) this model is revised in order to consider the impact of digital technologies, such as electronic publications, self-publications and electronic libraries.

Kling et al. (Kling et al., 2003) offer a model of scientific collaboration STIN (Socio-Technical Interaction Network), which allows to understand better the character of professional relationships inside scientific communities. Swisher (Swisher, 2003) offer a linear step-by-step model which defines the stages that a new concept goes through in the system of scientific communication. In a cycle of research by Björk and Hedlund (Björk and Hedlund, 2003, 2004; Björk, 2007a,b) a model of SCLC (Scientific Communication Life Cycle) is presented. It describes the process of communication from the beginning of a research up to using the findings for the benefit of the society. This model covers both, formal and informal communication, but the main focus is on the life cycle of publications as well as readers' activity aimed at getting access to those publications. A systematized review of the characteristics of these and other models of scientific communication can be found in a study by Lugović et al. (Lugović et al., 2015). The scientists put focus on the development of technological innovations of Web 2.0 that resulted in occurrence of a new paradigm of scientific communication Research 2.0.

The analysis of papers by Luzón (Luzón, 2009), Ullmann et al. (Ullmann et al., 2010), Procter et al. (Procter et al., 2010), Koltay et al. (Koltay et al., 2015) shows, that the term "Scientific communication Research 2.0" determines new approaches in creating scientific knowledge, based on the notions of unity and collaboration. The scientists describe how generating and managing collective knowledge brings about new structures and systems of scientific communication. Kuzminska (Kuzminska, 2021) consider that scientific blogs, social networking sites for the collaboration of scientists ResearchGate and Academia.edu, applications for managing and sharing publications (Mendeley, Qiqqa, EndNote), services Open Peer Review, international and national bibliometric systems (in Ukraine – Open Ukrainian Citation Index, "Bibliometrics of Ukrainian science") and other make part of such structures. Though the main channel for publishing the research findings is still an article in a journal with a peer review, Research 2.0 provides wide opportunities for the improvement of research processes and can lead to changing the principles of research activity in future.

The research is dedicated to the development of a comprehensive program of activities, linked to scientific communication in compliance with SCLC Model and principles of Research 2.0. There is evidence among the objectives of the research, that introduction of the program in place into the process of the professional development of older age cohort scholars contributes to enhancing digital scientific communication skills and validates the role thereof as a catalyst for building up confidence and stabilizing scholars' personal comfort.

2 METHOD

2.1 Participants

During 2019-2020 the comprehensive program of activities, aimed at developing scholars' digital scientific communication skills was introduced into the educational process of professional development of older age cohort scholars at Ukrainian universities. 52

scholars aged 50+ participated in the experiment (figures 1, 2).

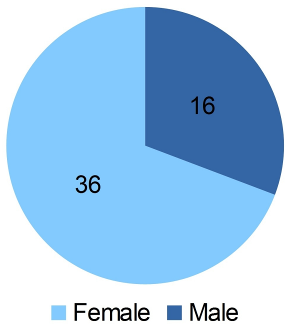

Figure 1: Gender sampling frame, % of the total number of participants.

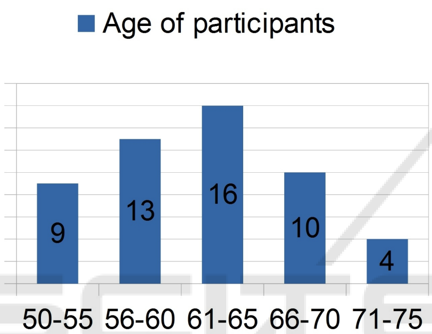

Figure 2: Age sampling frame, % of the total number of participants.

According to targeted selection, the sampling frame must comprise researchers working in the same area of knowledge. It was done, taking into account the specifics of the scientific communication system for different disciplines. The experiment was done at scientific schools, where the researchers work in the domain of Mathematics and Teaching Methods. The quality composition of the program participants in accordance with specialization and professional attributes is presented in figures 3–5.

Development of a comprehensive program of activities in scientific communication in compliance with SCLC Model. In the first stage of the program development with the help of the deductive content analysis of the research papers (Søndergaard et al., 1972; Kling et al., 2003; Swisher, 2003; Björk, 2007a,b), dedicated to the models of scientific communication, the authors of this study defined the structure of the program and the key aspects of the content, designed to provide its compliance with the paradigm of Research 2.0. Compared to other models, the SCLC Model Björk (Björk, 2007a,b) is more comprehensive, detailed and contains more constituents that reflect activity, findings, elements of governance,

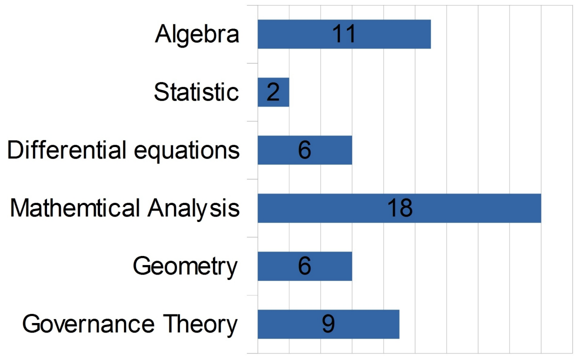

Figure 3: Specialisation of the participants of the experiment, % of the total number.

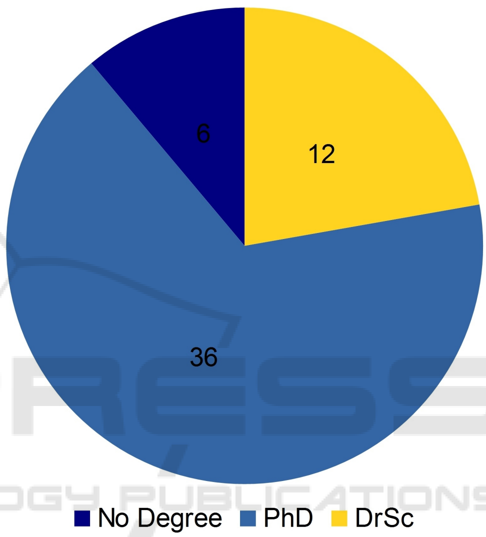

Figure 4: Qualitative composition of the participants of the experiment in accordance with professional attributes, % of the total number.

mechanisms, etc. when developing the program of activities, connected to scientific communication, the SCLC Model serves as a roadmap for positioning all the components of the system of scientific collaboration as a global interconnected informational system. The developed comprehensive program consists of five stages of different duration from 0.5 to 2 credits ECTS, each of them contains 2–5 modules (tables 1, 2).

In the second stage, when doing analysis concerning the nature of Research 2.0, Koltay et al. (Koltay et al., 2015), Sheombar (Sheombar, 2019) gave a constructive description of activities and projects, as well as actions and strategies which contribute to developing scientific research skills in young scientists and which are based on the principles of openness, collaboration, conversation and connectedness.

Communication between the program participants and tutors took place on the platform Higher School

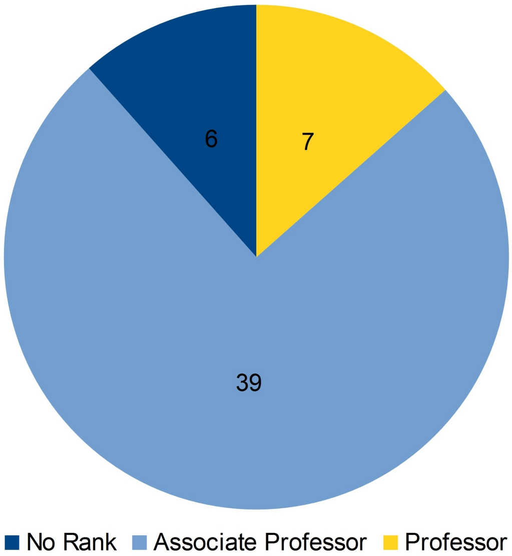

Figure 5: Qualitative composition of the participants of the experiment in accordance with professional attributes, % of the total number.

Mathematics Teacher (Vlasenko and Sitak, 2023). Forum, on-line chatting and electronic mailing were chosen as the means of communication. Through their personal accounts the participants got access to the description of events, activities and strategies for each of the stages of the program, listed below.

2.2 Developing Topics for the Informational Environment

Most of the older age cohort researchers have no proper information basis regarding digital scientific communication, which is connected to the fact that digital scientific communication is a rather specific activity, avoided by older people in everyday life. As a rule, even scholars, who are active in doing scientific research, have fragmented knowledge of scientific communication basics. The main goal of this stage is developing in researchers a systematic knowledge concerning scientific communication, its key components, new trends and technologies, basics of efficient work with information, research data management. Watching video-lectures allows the participants to understand how digital scientific communication happens nowadays, how open access, open science and licenses, research data management impact the life cycle of a research. Participation in seminars, trainings means applying best updated practices and search techniques in order to work with scientific sources, to use universal and specialized information resources, new web-applications for various types of research, etc.

Table 1: The structure of the comprehensive program of activities, concerning scientific communication in compliance with the SCLC Model. Stages 1, 2.

Creating the information environment	
Activities concerning scientific communication	Content of the activity
An on-line course in scientific communication	Watching video lectures, chatting
Practical assignments	Doing practical assignments on searching information, quoting, preparing presentations, designing a manuscript, etc.
Presentation of University programs, events by the Ministry for Education and Science and businesses, aimed at supporting scientists	Electronic mailing of video materials and samples of documents; meetings with management, representatives of the Ministry for Education and Science representatives of business, program alumni
Doing the research	
Searching for ideas, defining a topic for research	Getting acquainted with social networking web-sites for scientists; creating profiles and micro-networks.
Searching the information resources	Searching publications in databases, archives, bookmarks, getting (saving) the publications, paid and free subscriptions
Reading publications	Reading summaries, full texts
Doing the research itself	Communication in collaborations
Integrating the results into the context of a general problem	Work with references, quoting

The authors of the present study believe, that in the informational environment, dedicated to the problem of digital scientific communication, it makes sound sense to highlight the following topics:

1. General overview of key components and strategies of digital scientific communication, usage of new web-applications in all the stages of the research life cycle, especially when searching for information and spreading the findings. Social networks for scientists ResearchGate, Mendeley, Academia.edu.
2. Scientific information: main types of sources.

Table 2: The structure of the comprehensive program of activities, concerning scientific communication in compliance with the SCLC Model. Stages 3–5.

Presenting the findings	
Non-formal communication	Seminars, conferences, mailing colleagues, microblogs, subscriptions to the projects in social networking web-sites
Publication in a reviewed edition	Preparing a manuscript, searching publishing houses. Designing the manuscript, communication with an editor and a reviewer
Promoting sharing and search	Promotion in blogs, social networks for scientists, open libraries, University resources
Tracking the publication	Indexing, bookmarks, tags
Secondary publications	Monographs, publishing in mass media
Applying the findings	
Promoting the improvement of the standard of living (application in industry, IT, healthcare)	Getting acquainted with the process of standartisation, filing an author certificate/a patent
Education	Passing on knowledge through workshops, educational videos, one-to-one counselling
Feedback for science	Forecasting benefits for the future of science
Contests for scientists, grant programs	
Contests for young scientists by Universities and the Ministry for Education and Science	Filing documents
Contests organized by businesses	Preparing presentations, participation in startup-schools

Specialized search systems such as Google Scholar, ScienceDirect, DOAJ and databases (Web of Science, Scopus, ZbMATH, MathSciNet), strategies for efficient search on the Internet.

3. Tools for monitoring new publications on the research problems. Subscriptions (Mendeley Groups, ResearchGate). Scientist's profiles (Scopus Author ID, ResearherID, ORCID iD).
4. A scientific article in a reviewed journal as the main element of scientific communication. Academic publishing houses (Springer, Elsevier, Pleiades Publishing).
5. Studying various aspects of scientific papers and publication strategies. OJS/PKP journal systems.
6. Management of bibliographic references (applications Mendeley Web Importer, EndNote, BibTex, Zotero).
7. Key notions of scientometrics. Scientometric indices Web of Science, Scopus, Google Scholar, Open Ukrainian Citation Index et al.
8. Copyright. Creative Commons license.
9. Archiving the research data. Repositories DOAJ and ArXiv.

When creating the informational environment, educational materials published on the platforms Prometheus (Prometheus, 2020), EdEra (EdEra, 2019, 2018), YouTube channel (PC Technology Center, 2019; Research HUB, 2019) and own materials by the authors of this study were used (Vlasenko et al., 2021). As an illustrative basis for scientometric and bibliometric techniques, a cycle of research by Rovenska and Novikov (Rovenska, 2019; Rovenska and Novikov, 2020; Novikov and Rovenska, 2017a,b) was used.

As the main indicator of the efficiency of scientific work is receiving accolades and financial rewards, the authors of this paper believe it pertinent to share relevant links to grant programs and awards with the program participants, announced by university management, businesses and professional unions. Receiving an accolade by a researcher can serve as one of the criteria of developed skills in digital scientific communication and core skills in general.

2.3 Doing Research

The first module, which is to define the topic, initiates the research. Review of ideas is the main function of this module. Social media offer useful communication channel for finding new ideas and communicating with the world. Participants register and create own accounts in the main social networks for scientists, such as ResearchGate, Academia.edu and Mendeley. According to a research by Nentwich and König (Nentwich and König, 2014) on academic use of social networks, the function "Profile" comes top among eight most popular functions of social media for scientific purposes. The profiles created can be filled with publications that the participants already have. In this module the participants also create micro-networks with the representatives of a certain scientific school. When the topic is defined, social networking sites for scientists become an additional tool for searching partners for collaboration.

Since the research process is based on the competencies, related to searching, assessing and applying information, the second module is dedicated to developing skills in searching information resources. The development of Web 2.0 brought about easy and accessible means of receiving information. Still, access to information does not necessarily mean expanding knowledge. Research 2.0 resources allow to make changes in the methods of assessing information sources on their topic. The participants are offered to focus on the assessment of the accessible information, based on bibliometric indicators. The module gives an opportunity to master the specifics of work with both, interdisciplinary (Scopus, Web of Science, Google Scholar), and specialised (ZbMATH, MathSciNet) scientometric databases.

It is necessary to draw the participants' attention to the opportunities which subscriptions (both, free and paid) give as well as risks arising out of it. Not only using social media for private purposes, but also for academic ones requires preventive measures from spam and harassment from unscrupulous communities. Participants can also face challenges when receiving publications, for instance, if the publication is not accessible any more, or the publication was not digitalized. When such situations happen, it prompts finding alternative ways of receiving the publication, such as buying a hard copy, search in archives or among colleagues.

The third module is dedicated to the development of practical skills in reading publications. The participants work on the constructive methods for reviewing the content of a publication with the help of key words, summaries, reading full texts, creating bookmarks, comments and annotations in Mendeley, applications for tracking quotes EndNote, BibTex.

When doing own research, the need for expanding own scientific horizon through communication with single-minded scientists increases, and most of the older age cohort scholars scientists enhance live communication etiquette. However, the challenges of the time require mastering on-line modes of communication with colleagues. According to a recent research by the Ministry for Education and Science of Ukraine (MESU, 2020) the most common reasons that hamper the development of scientific communication among scientists are: psychological unpreparedness for new types, modes of scientific communications and underdeveloped network of personal connections and communication channels. For remote communication the participants are recommended (but not limited by) such means of communication as Zoom, e-mail, Viber, Facebook (Messenger), Telegram, Skype, WhatsApp. As the survey shows (MESU, 2020), these channels are the most widely used in professional communication among scientists.

The final module of this stage is dedicated to improving the practical skills in working with reference-messengers, such as Mendeley Web (functions Web Importer and Citation Plugin), EndNote (adding information about sources from Web of Science, from on-line libraries, websites of publishing houses, and own notes), Zotero and others.

2.4 Presentation of Findings

This stage comprises five modules, which are – informal communication, presentation of findings through publishing, sharing promotion, tracking and secondary publications. The main difference from communication within the first module is that an author has a complete control over those who become the receivers of the information about the findings. On top of conventional presentations at conferences, seminars, the participants also learn about informal communication channels which are accessible tools of Research 2.0, such as blogs, subscriptions for ResearchGate projects, tags and opportunities for joint work in Mendeley Groups. Using the resources of Research 2.0 increases the efficiency of scientific communication, as researchers receive a feedback (on-line comments) much earlier and can fix the errors, complete the article and send it for publication.

In the module, dedicated to presenting the findings through publication in a reviewed journal, the participants can learn about the proper formats of articles for academic publishing houses Springer, Elsevier, Pleiades Publishing (mastering AMS-LaTex is an obligatory prerequisite) and acquire the practices for communication with the editor and reviewers through Open Journal Systems. An important nuance of the module is that some participants experience communication with predaceous publishing houses and for the first time face academic plagiarism. Taking it into account, maintaining academic reputation becomes profoundly valuable.

Modules, dedicated to sharing, promoting search and tracking publications, encompass the whole spectrum of practical skills in using bibliometric means – from identifying the indices universal decimal classification (UDC) and Mathematics Subject Classification (MSC) to using descriptors (DOI, ISSN).

The basics of information search and scientometrics, which the participants learnt during lectures and seminars in the first stage, are now acquired through personal experience in using scientometric databases (Scopus, Web of Science, Google Scholar), archives (ArXiv), etc. The participants are recommended not only to create formal profiles Scopus Author ID, ResearcherID and ORCID, but also de-facto analysis of absolute and normalized indicators, namely h-index and impact-factor of the publication.

The final module of this stage concerns secondary publications of scientific findings. This module significantly falls behind the previous ones and is optional. Secondary publications make sense in terms of sustainable impact on the development of science, when they give other scientists or external experts an opportunity to learn more about the findings in solving a certain problem. Among the communication norms, which are also mastered in this stage are copyright for scientists, open access and research ethics.

2.5 Application of Findings

This stage highlights practical skills in transferring scientific knowledge in several directions in parallel – improving the quality of life through its application in industry, IT, healthcare; integration of the knowledge into education and learning; feedback in science. The participants are recommended to select a direction of application, depending on the kind of scientific research. Thus, in order to commercialize scientific knowledge, the participants are advised to register a patent or an author certificate. Application in education and learning means running classes and workshops for students, one-to-one counselling, creating educational videos, etc.

The specifics of scientific communication in Mathematics is to use the findings broadly in order to amass theoretical knowledge. The research findings, as well as the methods of receiving them can be used for further studying various issues of Mathematics, including Applied Mathematics, prognostication, hypothesizing and other. Secondary publications, for instance sections of monographs or a popular science article allow the participants to acquire the skills in digital communication with the audience outside their own scientific school.

2.6 Contests for Scientists and Participation in Grant Programs

According to Björk (Björk, 2007b), the global system of scientific communications performs two functions – the first is to pass on scientific knowledge, the second is to contribute to decision-making in supporting research from the side of University leadership, business, non-governmental organisations. This stage must be introduces into the program, as lack of understanding concerning the mechanisms of grant participation is a strong communication barrier in the general system of science and innovations support. Participation in contests is not obligatory, but is recommended to all the program participants. This stage allows to develop skills in preparing contest papers, presentations, startup projects.

2.7 Method of Assessing the Findings During the experiment

The assessment of the program implementation was done with the help of Domain B (Personal effectiveness), Domain D (Engagement, influence and impact) of Researcher Development Framework (RDF) (The Careers Research and Advisory Centre (CRAC) Limited, 2023), offered by a world leader in supporting professional development of researchers, the Research and Advisory Centre “Vitae”, Cambridge, UK. RDF is made of the empiric data, collected through surveying experts in order to identify characteristic features of researchers, defined in RDF as descriptors. Descriptors are structured into four domains and twelve subdomains that cover knowledge, intellectual abilities, methods and professional standards of doing a research, as well as personal qualities, knowledge and ability to ensure efficient collaboration with others, and a wider impact of research (figure 6). Each of sixty three descriptors contains three to five phases, that are separate development stages or the efficiency level within the descriptor (The Careers Research and Advisory Centre (CRAC) Limited, 2023).

2.8 Findings

In this work, we offer an overview of the developed program and the results of its implementation. Our study does not involve in-depth statistical analysis of the obtained results.

The comprehensive program of the activities, which is aimed at developing core skills of a scientist with the help of scientific communication means, was introduced into the process of advanced training of scientists in 9 scientific schools of and Teaching Methods of Donbas State Engineering Academy, Kryvyi Rih State Pedagogical University, Sumy State Pedagogical University, Berdiansk State Pedagogical University.

The assessment of the results of the program implementation was done through surveying partici-

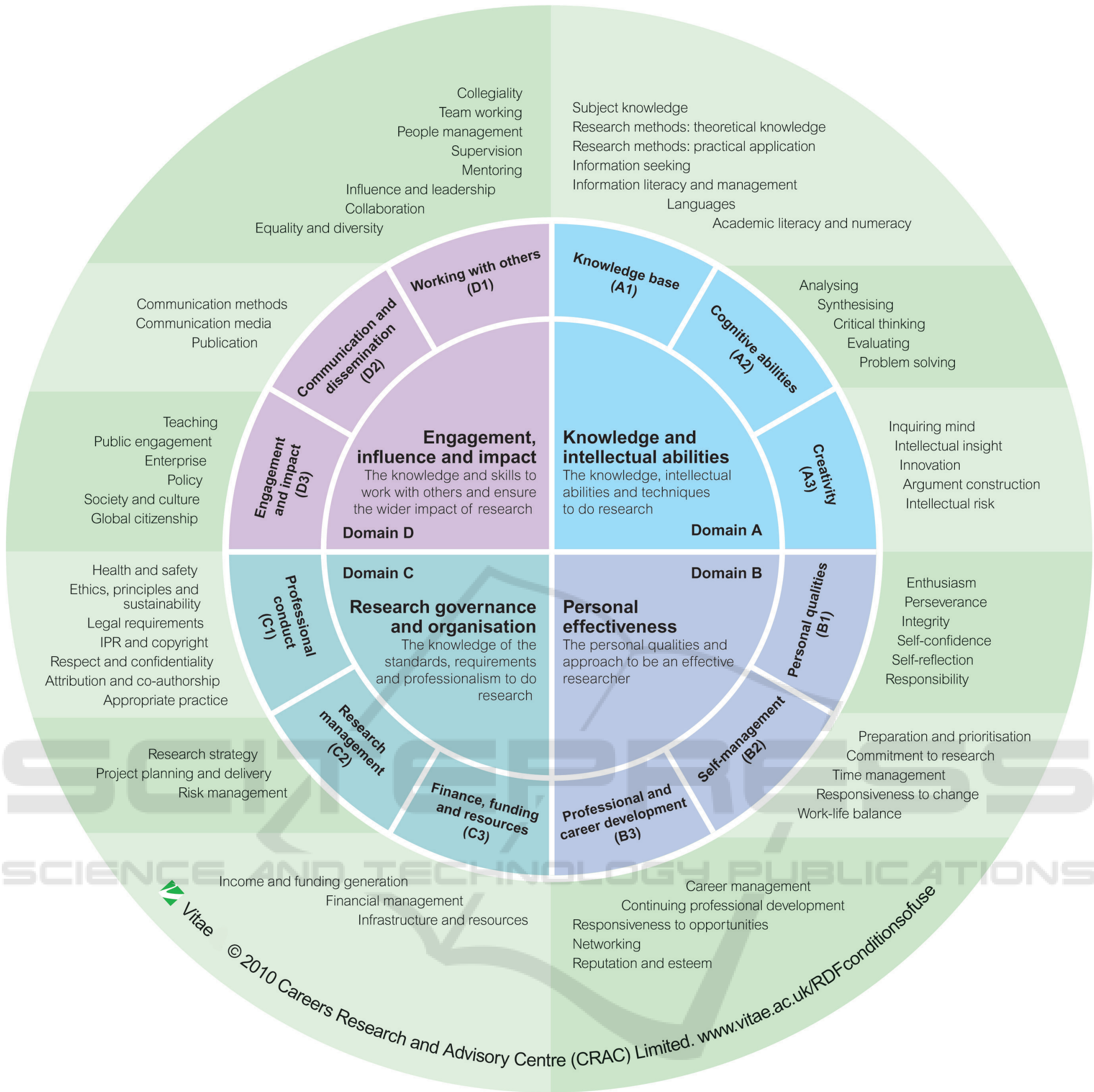

Figure 6: The Researcher Development Framework by Vitae (The Careers Research and Advisory Centre (CRAC) Limited, 2023).

pants. Every participant of the program was assessed by at least 2 stakeholders through an on-line surveying. The goal of the survey was to identify the skills level in the participant attributes that personal communication skills that prompt the progress in scientific activity and academic career.

The data concerning changes in the descriptor development or the level of efficiency within the descriptor in the program participants can be found in tables 3, 4.

Positive results of implementing the program (marked as "+") are confirmed by deepening of the development phase or the level of efficiency within 4 descriptors in 30–50% of the participants, 11 descriptors in 50–75% of the participants and 14 descriptors in more than 75% of the participants of the program. The program has the most significant impact on the development of career skills, necessary for responsibility and control over professional development; awareness of the standards, requirements and procedures of professional behavior; skills, necessary for interaction, management and influence on academic, social, cultural and economic context.

In course of detecting communication competence it is appropriate to test emotional difficulties in professional communication. For this reason, a method

Table 3: Changing the development phase of a descriptor or the level of efficiency inside a descriptor in the program participants (Domain: Personal effectiveness).

Descriptor/Subdomain	in 30-50% of the participants	in 50-75% of the participants	in more than 75% of the participants
Personal qualities			
Enthusiasm			+
Perseverance		+	
Integrity		+	
Self-confidence			+
Self-reflection	+		
Responsibility			
Self management			
Preparation and prioritisation			
Commitment to research			+
Time management		+	
Responsiveness to change			+
Work-life balance	+		
Professional and career development			
Career management			+
Continuing professional development			+
Responsiveness to opportunities		+	
Networking			+
Reputation and esteem		+	

"Diagnostics of emotional barriers" (Fetiskin et al., 2002, p. 166–167) was applied by the authors of this paper. After doing the course, based on the program in place, a number of persons who define their emotions as 'hindering interaction with partners' (N_1) or 'complicating establishing contacts' (N_2) decreased, as it was anticipated. The diagnostics findings are presented on figure 7.

Forming such skills as financial management of research, understanding of academic and commercial systems of financial support becomes an additional factor for the impact that the program has, which is proved by the data concerning the program participants' involvement in contests and grant programs for researchers (figure 8).

3 DISCUSSION

In connection with the present research it makes sound sense to mention the papers, dedicated to

Table 4: Changing the development phase of a descriptor or the level of efficiency inside a descriptor in the program participants (Domain: Engagement, influence and impact).

Descriptor/Subdomain	in 30-50% of the participants	in 50-75% of the participants	in more than 75% of the participants
Working with others			
Collegiality			+
Team working		+	
People management		+	
Supervision			
Mentoring			+
Influence and leadership			+
Collaboration			+
Equality and diversity		+	
Communication and dissemination			
Communication methods			+
Communication media			+
Publication			+
Engagement and impact			
Teaching		+	
Public engagement		+	
Enterprise		+	
Policy			
Society and culture	+		
Global citizenship	+		

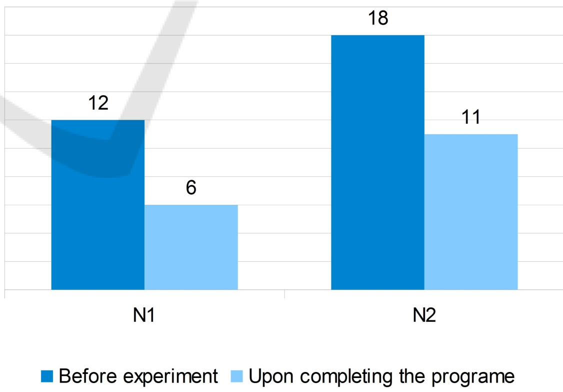

Figure 7: The findings of emotional barriers diagnostics of the program participants.

defining skills of researchers that characterize them as scientists in a volatile informational environment. Davies et al. (Davies et al., 2011) define a set of central skills of an efficient researcher that are linked to the adaptive nature of thinking. These authors consider that scientists do cognitive activity filtering information according to its importance, using various

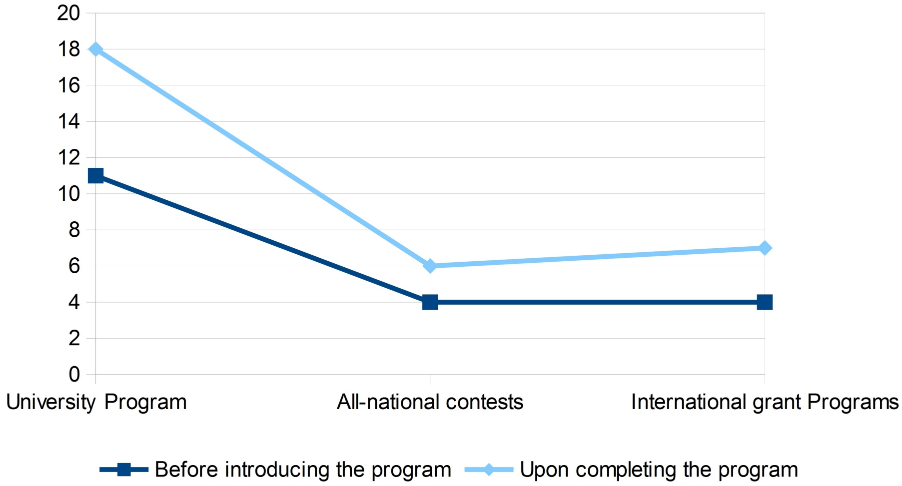

Figure 8: The number of co-participation in contests for researchers among the program participants.

tools and methods for it. Such an activity is defined by a certain type of thinking, which allows to use these tools and methods in the working processes, aimed at achieving the desired outcome. As Koltay et al. (Koltay et al., 2015) mention, researchers have to acquire skills, linked to innovative thinking and problem-solving. They also believe that the research process nowadays is defined by comprehending and justifying data, as the ability to find deeper meanings is more important than formal reading. Moreover, due to globalization and increased international cooperation a practical skill of working in social networks as well as cross-cultural communication skills are becoming more and more vital.

Comprehension, justifying, adaptive thinking, problem-solving and innovative activity depend on the information and define the circle of skills, necessary for a modern scientist. Contemporary resources of Research 2.0 have an impact on all the stages of the life cycle of a research, which are connected to information, starting with identifying an idea to spreading the results. Thus, Research 2.0 gives a wide spectrum of opportunities for personal growth of scientists, who nevertheless are reluctant to use these opportunities and excuse themselves by lack of time or experience. According to conclusions by the Social media and research workflow, Nicholas and Rowlands (Nicholas and Rowlands, 2011), Sheombar (Sheombar, 2019), Vlasenko et al. (Vlasenko et al., 2020b) only a few researchers make the most of all the tools that social media provide.

The authors of this paper believe that creating in researchers a quality experience of using Research 2.0 resources in professional communication could become a solution to this problem. As Mogull (Mogull, 2017) states, scientists often follow bad communication practices, reiterating typical mistakes. The most typical problems are: lack of ideas because the content is inadequate when the information is processed (inability to read summaries, incorrect application of search techniques); lack of clearly defined conclusions because of inability to integrate the findings into the structure of the general problem; poor choice of the edition for publications; ignoring the process of managing the publication, etc. By the present research the authors join such experts as Mogull (Mogull, 2017), Albert (Albert, 2000), Szklo (Szklo, 2006), Vlasenko et al. (Vlasenko et al., 2020a) who consider, that clear and transparent digital communication practices can make a difference to scientific thinking and improve the quality of scientific advancement. Thus, the suggested program of activities is based on acquiring by scientists some personal experience in research work through the usage of the means of digital communication.

The constituents of the program are aimed at improving core skills of scientists through their scientific communication. Each stage of their activity (from developing topics for the informational environment to presenting the research findings) is ensured by a program of activities, divided into several modules. Every module focuses on developing certain skills. The program means, that older age cohort scholars, who advance their qualifications, will master the basics of efficient work with information, research data management, and will get an insight into digital scientific communication, its components, new trends and technologies of scientific communication; they will learn how to use contemporary practices and search techniques when working with information resources. The attendees also master constructive means of reviewing the publications content, acquire the skills of creating bookmarks, comments and summaries as well as communicating with editors and reviewers through open journal systems. Communication between the program participants and tutors takes place on the forum and via an on-line chat on the platform Higher School Mathematics Teacher (Vlasenko and Sitak, 2023).

This assessment showed that combining means of digital scientific communication on a certain system and ensuring personal experience in using those means contributes to the development of skills of older age cohort scholars, necessary for responsibility and control over professional development; awareness of the standards, requirements and procedures of professional behavior, necessary for the efficient research management; development of the skills, central to interaction, management and influence on academic, social, cultural and economic context, for instance, skills in financial management of research, understanding of academic and commercial system of the financial support of science.

4 CONCLUSIONS

Fast-paced development of informational environment, opportunities for researchers to communicate with their colleagues and the whole scientific world via the Internet ensured new opportunities in strengthening the global system of scientific communication. This fact made it possible for researchers to improve their core skills through promoting scientific knowledge ensuring mechanisms of participation in contests, interaction, collaboration, personal development and justified the timeliness of developing the program of activities in digital scientific communication for older age cohort scholars, based on the principles of Research 2.0.

Analysing the research into the models of scientific communication and considering the experience of mature scientists, working in Mathematics and Teaching Methods, allowed the authors of the present paper to define the structure of a comprehensive program of activities, aimed at developing skills in scientific communication and core skills of researchers, as well as to devise educational and methodological materials for its implementation in compliance with the SCLC Model, which ensures acquiring personal user experience through the practice of using the means of digital scientific communication.

The above mentioned program of activities was structured in accordance with certain stages of a researcher's activity and involves scientific communication through the means of digital learning environment. Among such activities were: on-line courses in scientific communication, presentations of programs for supporting researchers, workshops, educational videos, one-to-one counselling.

The above mentioned activities encouraged the researchers to seek sources of information and integrate their findings into the context of the overall problem by digital means; to introduce scholars to social networks; to create accounts and micro-networks; to maintain informal communication at seminars, conferences, e-mailing colleagues; to submit publications through open journal systems.

Hence, those activities were aimed at forming communication skills and presenting research findings remotely; practical skills in using bibliometric means; skills in applying contemporary practices and searching techniques when working with sources of information; practical skills in imparting scientific knowledge; skills in preparing start-up projects. All in all, the participants' activity was focused on developing systemic understanding of the nature of Research 2.0, which is based around openness, collaboration, conversation and connectedness.

The participants evaluated the findings of the program introduction by means of Researcher Development Framework, which allows to detect the level of formation of researchers' specific features in such domains as Personal effectiveness and Engagement, influence and impact. Positive changes in the stages of the descriptor development or changes in the level of its efficiency prove the efficiency of implementing the program and its influence on the development of researchers' skills in scientific communication. It was also confirmed, that the latter became a significant catalyst for lowering emotional barriers in course of professional interaction. The analysis of the information on the participants' involvement in contests and grant programs for scientists proved the skills level of in financial management of research and understanding of the system of financial support.

The findings of this research allow to develop trainings for developing specific communication skills of the academia. Courses, developed on the basis of such a program, contribute to quality and speedy increase in communication competence, thus, to a scholar's personal emotional comfort. Communication competence along with emotional comfort, in turn, become instrumental to scholars' competitiveness in the ever changing environment.

The authors of this paper consider a vector of further study to be the detection of scientific activity of the program participants and correcting the model in accordance with the specific features of age cohorts.

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