

THE STUDY AND THE USE OF THE COMBINATION OF ICT TOOLS OF E-COMMUNICATION AT THE PEDAGOGICAL UNIVERSITY

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***Abstract:** The paper presents preliminary results of the research regarding information needs and educational requests of young scientists as to ICT tools for their educational and research activities. The first part of the article includes a consideration of the notion of scientific and educational communication, inspection of the classifications of ICT tools of e-communication. The second part of the article describes the results of the research conducted at the Volodymyr Hnatiuk Ternopil National Pedagogical University, Ukraine. The research examined some categories of ICT tools of e-communication in the field of the higher pedagogical education, which are used at the stages of the research process and are studied during an electronic «ICT tools for teaching and research» course.*

Keywords: e-communication, ICT Tools, research process, electronic course, graduate students, Pedagogical University.

INTRODUCTION

The introduction of e-learning is a complex process that requires considerable resources and demands solving complex organizational, technological, methodological and other issues. One of the important principles of e-learning is the exposure of knowledge.

Nowadays knowledge is an important source of social development, and the main issue concerning building the knowledge society is not a process of informatization as such, but increasing access to information and reducing the digital inequality, especially in education and science.

The digital revolution is transforming research to become more open, interconnected, and global. Many of these changes are caused by new digital infrastructure.

Improvement of educational and scientific communication, as one of the components of e-learning is not only technical, but also a complex social issue. The advancement of electronic communication in teachers', students', researchers' and scientists' daily practice, the extension of international educational and scientific relations, the expansion of informal electronic communication need to be analysed taking into account the potential of ICT tools and the real world interaction of their participants.

1. ELECTRONIC EDUCATIONAL AND SCIENTIFIC COMMUNICATION — CURRENT POSSIBILITIES

Nowadays the educational and scientific communication is the main mechanism of functioning and development of education and science, one of the most important means of public relations, as well as a necessary condition for the formation and development of the individual researcher and scientist. The system of educational and scientific communication is an information space in which knowledge emerges and spreads. The basis of communication is a professional interaction of its participants.

Educational and scientific communication is understood as a series of processes of introduction, transmission and reception of educational and scientific information (Online space of scientific communication, <http://cyberleninka.ru/article/n/onlaynovoe-prostranstvo-nauchnyh-kommunikatsiy>). Structurally, educational and scientific communication includes:

- direct contacts — personal conversations, classroom training and scientific discussions, oral presentations;
- contacts mediated by technical means of information distribution — publications (books, scientific and abstract journals, collections of treaties, conference materials, research archives, blogs, social networks, etc.), preprints, unpublished materials (reports, experimental data, etc.);
- mixed contacts — seminars, conferences, symposia, exhibitions, etc.

Such tools of electronic scientific and educational communication are distinguished (Morze, Varchenko-Trotzenko 2014; Kolodziejczak, Roszak, Ren-Kurc, Kowalewski, Poljanowicz 2015): web-forums; online meetings; chat rooms; blogs; wiki; mental maps; white board; institutional repositories; e-libraries; Internet (video-, audio-) conferences; scientometric databases; social networks.

The use of basic possibilities of electronic communication includes especially e-mail and searching for information online. The main goals of the use of scientific and educational communication are searching for information, communication and coordination of projects. To a lesser extent, electronic communication is used for publications and simultaneous group work (Information technology and scientific communication: tools and model of implementation into the university environment, http://ifets.ieee.org/russian/depository/v17_i1/pdf/8.pdf).

New forms of communication give an opportunity to create an international network of academic groups of different time duration, improve the quality of research and publications, and establish new contacts between science, business and the public.

Many researchers (Morze, Makhachashvili, Smyrnova-Trybulska 2016; Shorley, Jubb 2013) consider Internet and a variety of e-communication as a new modern environment for scientific and educational research. The reason for this view point is that today it happens that on the Internet digital versions of traditional sources and their digital forms are created, stored and made available. This is reflected in the creation of modern digital tools for research, among which there are such groups (Digital tools for researchers, <http://connectedresearchers.com/online-tools-for-researchers/>):

Explore the literature

- Search engines and curators: ContentMine, Google Scholar, Microsoft Academic Search, MyScienceWork, BibSonomy etc;
- Article visualization tools: eLife Lens, Mendeley, ReadCube, Interactive Science Publishing;

Find and share data and code: Open Science Framework, DataHub, GitHub, SlideShare

Connect with others

- Connect with experts and researchers: Academia, AcademicJoy, LabRoots, Linkedin, Mendeley, SocialScienceSpace;
- Outreach: AcademicJoy, AcaWiki, DrawScience, I Am Scientist, SciVee, Useful Science;
- Citizen **science**: InnoCentive, SciStarter, Zooniverse.

Write

- Reference managers: Citavi, EndNote, Paperpile, Zotero, F1000 workspace,

- Collaborative **writing tools**: Atlas, Authorea, Quip, ShareLaTeX.

Publish

- Open access platforms: eLife, F1000, ScienceOpen;
- Paper repositories: ArXiv, F1000, Figshare, SlideShare;
- Support to publication: Google Charts, ORCID, Exec&Share.

Evaluate research

- Peer-review: Hypothes.is, Peerage of Science, ScienceOpen, The Winnower;
- Altmetrics: Altmetric, ImpactStory, PlumAnalytics, Profeza.

Some researchers (Kramer, Bosman 2016) examine the classification of e-communication in terms of the main stages of the research process: discovery, analysis, writing, publication, outreach, assessment. The paper (F1000 Research. Open for Science, <http://f1000research.com/articles/5-692/v1>) states the basic trends of using the scientific e-communication: social discovery tools, data driven & crowdsourced science, collaborative online, writing, open access and data, publication, scholarly social media article level (alt) metrics.

Authors present their projection of how innovations in ICT branch are changing scientific research processes, analyzing them from different points of view:

- **Expectations** — growing importance of data discovery, more online analysis tools, more integration with publication & assessment tools, more use of “publish first, judge later”.

- **Uncertainties** — support for full-text search and text mining, willingness to share in analysis stage, acceptance of collaborative online writing, effect of journal/publisher status, requirements of funders & institutions.

- **Opportunities** — discovery based on aggregated OA full text, open labnotes, semantic tagging while writing/citing, reader-side paper formatting, using repositories for institutional visibility, using author-publication- and affiliation-IDs.

- **Challenges** — real semantic search (concepts & relations), reproducibility safety/privacy of online writing, globalization of publishing/access standards, making outreach a two-way discussion, quality of measuring tools.

- **Most important longterm development** — multidisciplinary & citation-enhanced databases, collaboration & data driven, online writing platforms, Open Access, more & better connected researcher profiles, importance of societal relevance & nonpublication contributions.

- **Potentially most disruptive development** — semantic/concept search & contextual/social recommendations, open science, collaborative writing &

integration with publishing, circumventing traditional publishers, public access to research findings, also for agenda setting, moving away from simple quantitative indicators.

Now science and education are in transition. Communication is very important for science and education due to their transition to an open format. Scientists distinguish different ICT tools of e-communication based on a typology of the workflows. We are of the opinion that a systematic approach to the study and the use of ICT tools of e-communication in groups, united depending on the stage of the research process is promising for young scientists of Pedagogical University to all practical purposes.

2. STUDY ON USING ICT TOOLS IN EDUCATIONAL AND SCIENTIFIC COMMUNICATION IN E-LEARNING

The methodology of e-learning implementation in the Ternopil National Pedagogical Hnatiuk University during the 2010-2016 years was based on the following tasks:

- development of the technological infrastructure of the university, mainly oriented on cloud technologies (Oleksiuk 2014) and Web 2.0 technologies (Balyk, Shmyger 2011);
- determination of organizational structure (Distance Learning Center), responsible for implementation of the e-learning system at university;
- organizational support and preparation of the participants of the educational process; training of e-learning users; creating a system of professional training for teachers to develop and use digital educational resources;
- effective integration of ICT in the educational process; development of new educational techniques, integrated with ICT; development of various digital educational resources, e-courses, which implement different types of e-communication.

In this regard, the use of ICT tools of e-communication in educational and research activities require additional training of graduate and postgraduate students.

The study of information needs and educational requests of young scientists as to ICT tools for their research activities, of regularities and forms of educational and scientific communication was conducted at the Department of computer science and teaching techniques during the period of 2014 – 2015 as part of «ICT tools for teaching and research» course majors for graduate and postgraduate students.

We also intended to clear a question of what innovations in ICT field would change research processes and promote better educational and scientific achievement. In addition, we aimed to define how graduate and postgraduate students form their

workflow, which ICT tools they choose at every stage of the research to do their work more effective.

Peculiarities of teaching methodology of the «ICT tools for teaching and research» course include:

- blended learning is carried out, where e-learning technologies combine with traditional instruction, training in university classrooms and individual work, based on materials of the electronic «ICT tools for education and research» course located in the LMS Moodle;

- orientation on the development of 21st century skills (creativity and innovation, critical thinking and the ability to solve problems, communication and cooperation skills, ability to work with information, media and computer skills, life and career skills, social skills);

- orientation on practical tasks for the development of mini-projects of educational and research, social research and scientific focus based on the use of electronic environment.

2.1. Research methods

In order to examine a group of ICT tools graduate and postgraduate students choose at every stage of the educational and scientific research, the following methods were used: diagnostic survey; interview; qualitative analysis of the text (documents); observation; questionnaire.

The study was conducted via an online questionnaire created in Google-form. Certain questions are taken as a basis of the questionnaire. (Kramer, Bosman, 2016). We have adapted materials of the research to the working conditions of Ukrainian Pedagogical University.

The questionnaire included questions on sociology and questions about using various ICT tools during the six stages of the research process in different types of educational and scientific activities.

For each of the activities in the questionnaire five ICT tools were offered. In most cases, we included 2-3 best-known ICT tools, and two lesser-known, experimental tools to encourage respondents to examine them.

237 respondents took part in the survey, of which 215 — graduate students, 22 — postgraduate students. Among the respondents, 62% were female, 28% — male (Figure 1).

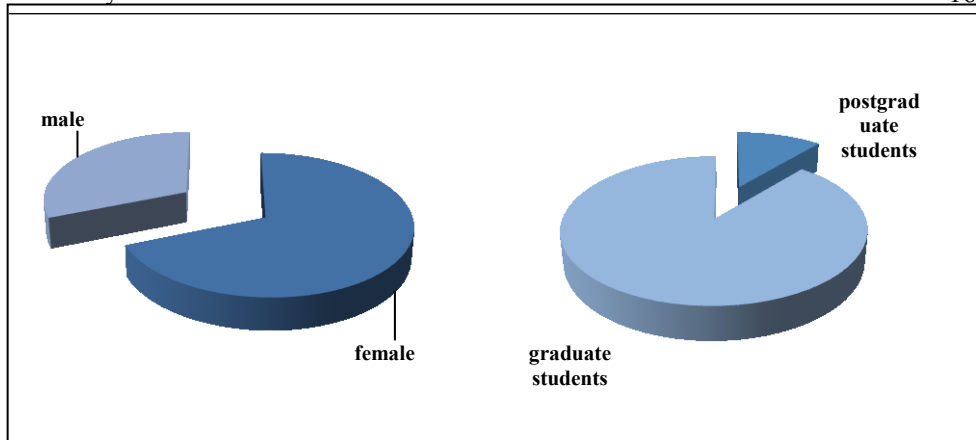


Figure 1. Sociological survey

Source: Own research

Another criterion that we took into account during the research is the area of expertise of young researchers (Figure 2).

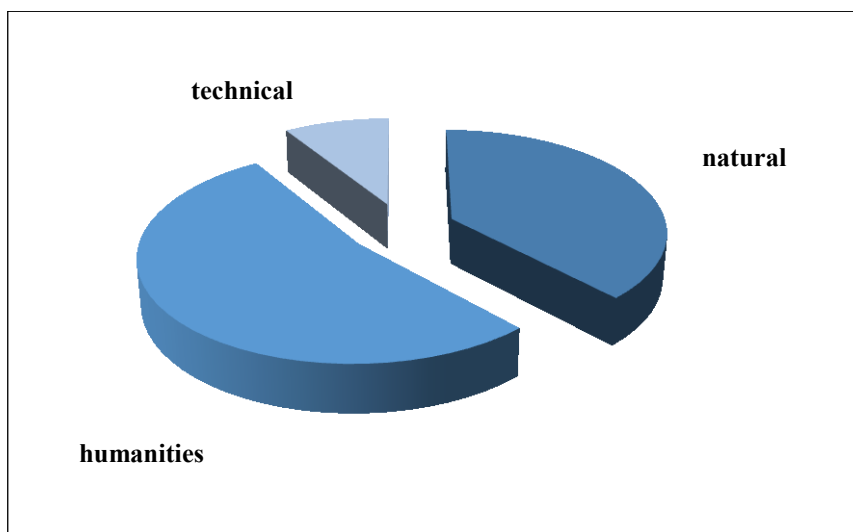


Figure 2. A survey on areas of expertise

Source: Own research

Most respondents at the Ternopil National Pedagogical University are humanitarians. At the first stage of the research — discovery, researchers, as a rule, search literature, read, annotate and tag during / after reading. In the course of a survey of graduate and postgraduate students of all majors, the following information regarding programs and websites that they use to read / annotate during the study the following data were received (Figure 3):

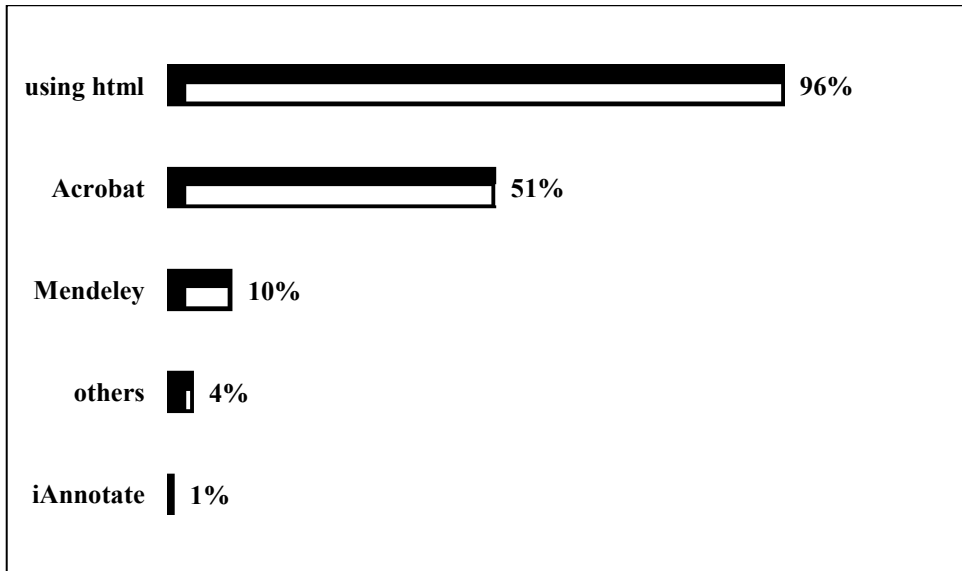


Figure 3. Discovery. Tools, sites for reading / annotation

Source: Own research

The survey results suggest that survey respondents most commonly use web browsers (96%) for reading necessary materials online. In addition, the vast majority of young scientists often use free software Adobe Acrobat Reader for viewing documents. About 1% of respondents said they use iAnnotate program. This shows that in general this program is little known.

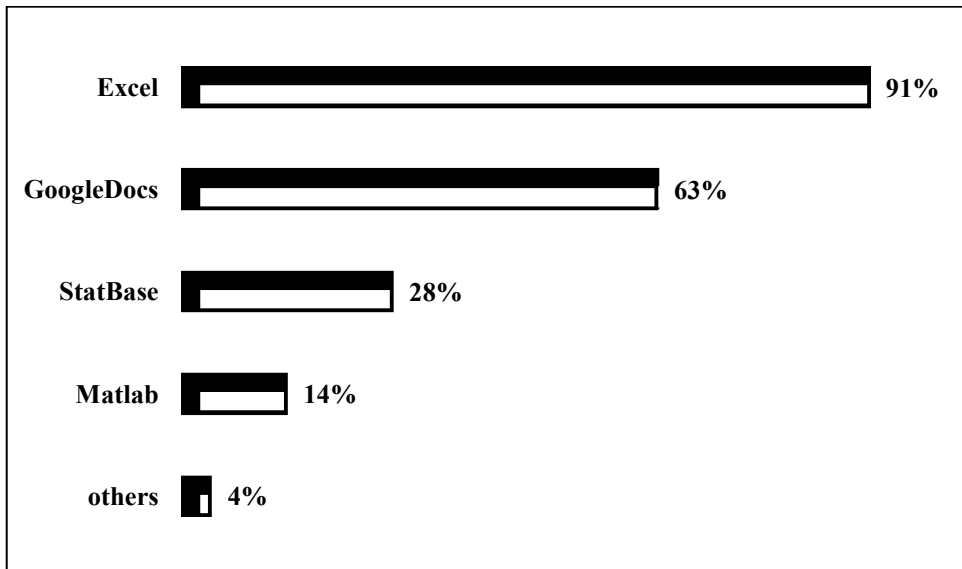


Figure 4. Analysis. ICT tools for data analysis

Source: Own research

The second stage of research is data analysis. In the course of a survey of graduate and postgraduate students of all majors, the following data about ICT tools that they use to analyse data during research were received (Figure 4, Figure 5):

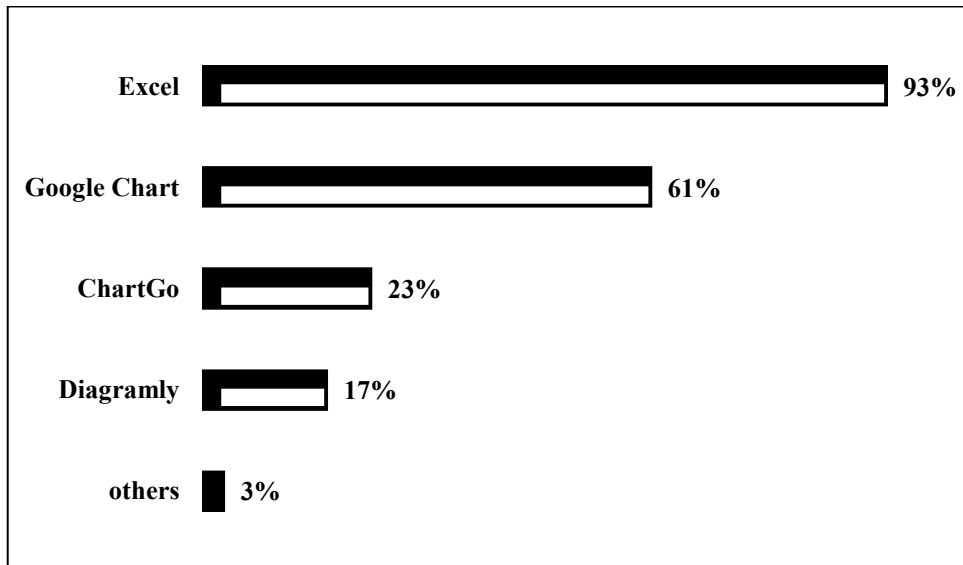


Figure 5. Analysis. ICT tools for graphical analysis and presentation of data

Source: Own research

At this stage, the most popular ICT tools for graphical analysis and data presentation are Excel (91%), GoogleDocs (63%), GoogleChart (61%).

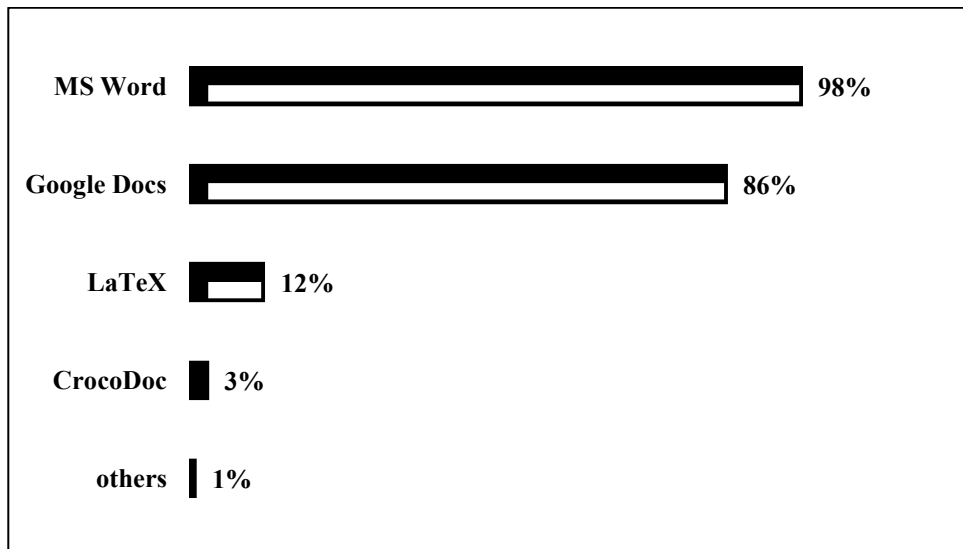


Figure 6. Writing. ICT tools for preparing and writing materials

Source: Own research

Writing is the third stage of research (Figure 6), during which the writing, translation and citation of materials are realized.

The analysis of the questionnaires shows that the vast majority of graduate and postgraduate students use MS Word (98%) and Google Docs (86%) for preparing and writing materials (Figure 6).

An important condition of the held research is its publication stage. At this stage, researchers usually: archive / share data; archive / share publication; archive / share posters; publish etc.

In particular, most respondents use Google Drive (72%) and institutional repository (54%) for data storing and sharing, Google Scholar (23%) (Figure 7). A high percentage of the use of institutional repository is caused by functioning of the advanced electronic environment in Volodymyr Hnatiuk Ternopil National Pedagogical University.

There is an eLearning environment at the university, in which institutional repository is integrated and organized on the basis of DSpace, with systems for educational purposes (LMS MOODLE, CMS Joomla!, UFD library) and support systems research (based on Microsoft Sharepoint). The integration of these tools is implemented at the level of content and unifying of access, which provides efficient use of DSpace in research work and the training of future scientists.

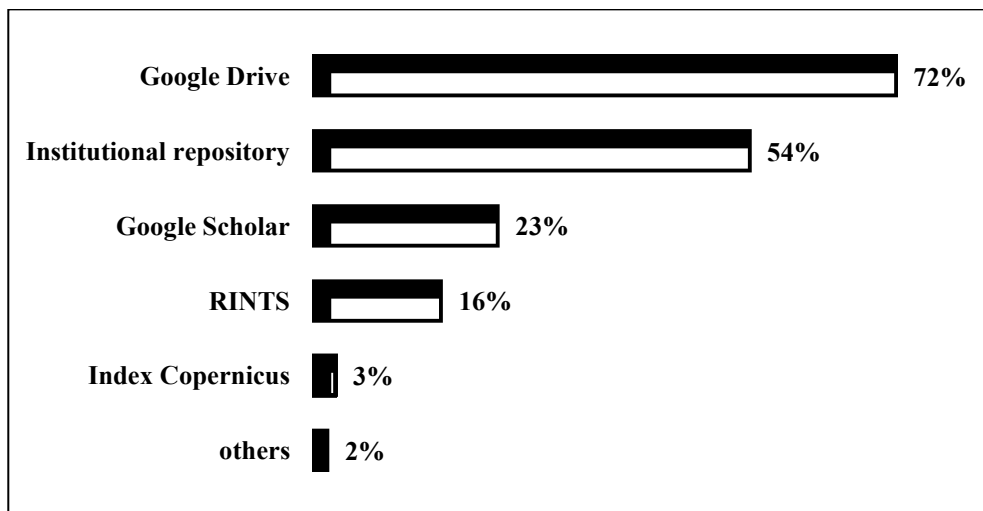


Figure 7. Publication. ICT tools for storing and publication

Source: Own research

Taking into account practical experience and observation, we may note that among the popular ICT tools young scientists use when posting study data, there are programs for creating knowledge maps and infographics (Figure 8, Figure 9).

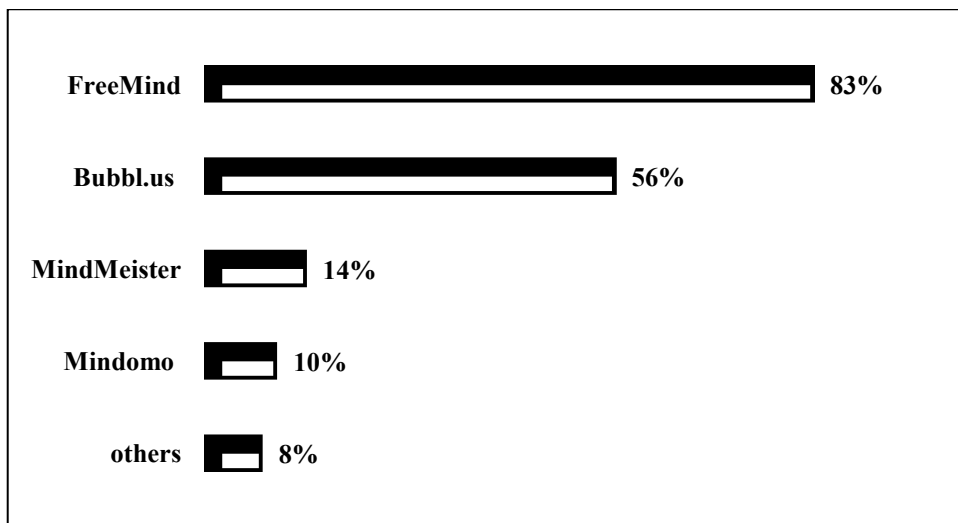


Figure 8. Publication. ICT Tools for graphical representation of data in the form of mental maps

Source: Own research

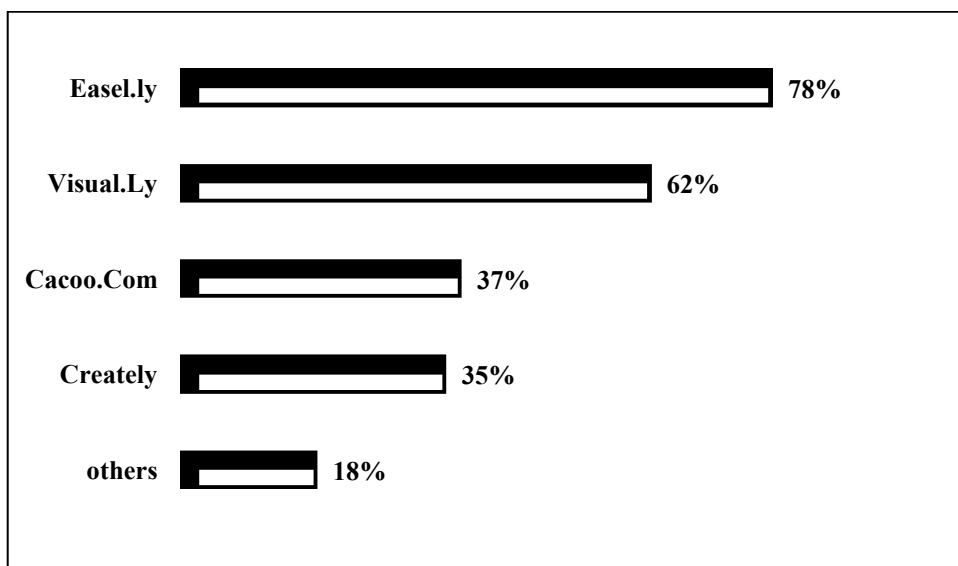


Figure 9. Publication. ICT tools for graphical representation of data as infographics

Source: Own research

Public information about the achievements, important results of scientific, technical and innovation activity of researchers, searching for new, sophisticated forms for maintaining and deepening ties between the university community and society takes place at the stage of outreach.

During the presentation of the results of our research, we pay particular attention to the ability to present them professionally using different ICT tools (Figure 10).

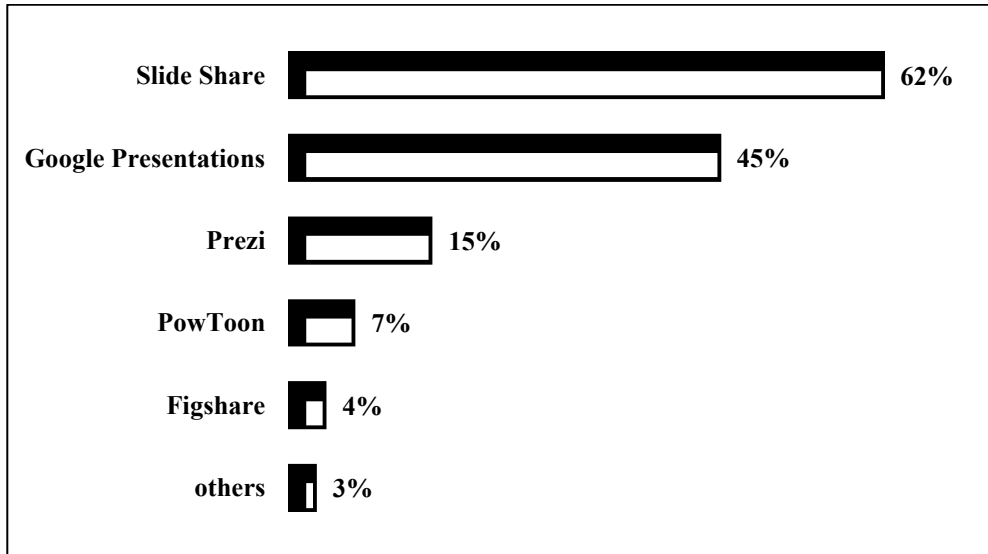


Figure 10. Outreach. ICT tools for archiving and sharing posters and presentations

Source: Own research

Popular ICT tools for creating presentations among young scholars are traditional, as well as innovative, like Slide Share, Google Slides, Prezi, Slides.

The last stage of any study is its evaluation. The basis of determining the effectiveness of research is a purpose of specific public interest, and evaluation criteria should be developed in accordance with this purpose. An important issue in this case is to ensure a professional evaluation.

Given the growing importance of producing knowledge for social development, valuation activities should be carried out collectively, including using ICT tools. Therefore, during the evaluation stage the attention has been focused on the ability of young scientists cooperate and evaluate each other (Figure 11).

In this study, during the evaluation stage we focused on ICT cooperation instruments. They enable carrying out the evaluation of educational and scientific projects due to high-tech information environment implemented in Ternopil National Pedagogical University.

For example, collections of digital electronic resources, joint projects, mandatory evaluations and comments from teachers and peers are the results of network cooperation of graduate and postgraduate students as part of the University's wiki portal.

In addition, young researchers place the materials of scientific and educational research on blogs (Google Blogger). This enables discussions, active sharing experience between colleagues to improve their own professional skills. Thus, we evaluate criteria such as organization of interactivity, feedback, the number of collaborators and blog readers, visiting statistics, citation, a reference to the original source, self-assessment and more.

To determine the scientific productivity, the number of citations of articles in academic literature young scientists create profiles in Google Scholar. In this context, Google Scholar Metrics tool is used to evaluate research results and to achieve greater openness of university education and science.

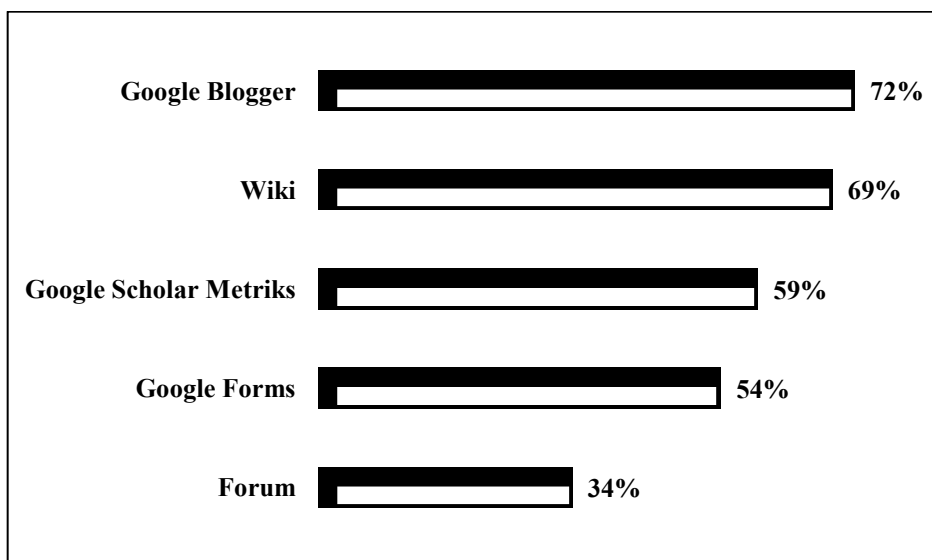


Figure 11. Assessment. ICT tools for collaboration

Source: Own research

The survey revealed that for collaboration and assessment most respondents use Web 2.0 technology, including blogs (72%) and Wiki (69%).

When analysing the survey results, it should be noted that, almost on all stages of the educational and scientific research young scientists of Volodymyr Hnatiuk Ternopil National Pedagogical University use Google services, because Google Apps cloud services are seamlessly integrated into the e-learning environment of the university (Figure 4 – Figure 7, Figure 10).

In terms of scientific communication at the University, the use of Google Apps helps to optimize performance of current tasks, such as preparing publications and projects. A group of researchers or graduate students can work together in Google Docs and observe changes in the real time, collaborate effectively, fulfilling collaborative work.

CONCLUSION

The use of ICT tools of e-communication in educational and research activities require additional training of graduate and postgraduate students. One way to achieve it is the development of special electronic «ICT tools for teaching and research» course. The content of the course was built according to the main stages of the research. Additionally, the results of the research regarding information needs and educational requests of young scientists of the University as to ICT tools for their research activities were taken into account.

A modern electronic informational and educational space is created at the Volodymyr Hnatiuk Ternopil National Pedagogical University, an important component of which is electronic tools of scientific and educational communications based on cloud technology and Web 2.0 technology. Google Apps Services are the universal tools for e-communication, covering all stages of the project or research in the pedagogical university.

The prospect for further research is emphasizing the criteria for selecting appropriate ICT tools for teaching and scientific communication, creating of practical recommendations for the effective use of innovative forms of e-communication within the information educational environment of the University. For this purpose, different levels of activity - from the individual strategies of communication of graduate and postgraduate students to implementation of educational and scientific policy of the university in general should be taken into account.

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