Digital transformation of academic writing

Sara Slamić Tarade[1], Lidija Tepeš Golubić[1], Miroslav Slamić[1]

[1]Zagreb University of Applied Sciences
sara.slamic@tvz.hr

Abstract

Scientific and professional research and writing academic papers have always been a challenge for people with experience and for those who are just starting with these activities. Nowadays, when the digital transformation in this field has reached its full bloom, we have various digital tools at our disposal to help us in research and writing academic papers in an organized way. Digital technologies have created a new ecosystem for research, both for searching and accessing information as well as for writing with the possibility of mutual collaboration among authors. The paper highlights the major categories of digital tools and describes the most important ones in more detail. Digital tools help authors throughout the research process and in writing academic papers. These include thinking about an idea, taking notes from the literature, citing, adding graphical elements, and collaborating with colleagues in real time. A new paradigm in writing academic papers with the help of artificial intelligence was briefly discussed, which includes the use of language models of natural language, and text processing with a critical review of the ethics of using these tools was briefly discussed.

The research was conducted on the use of digital tools in two populations: teachers and students. The obtained research results were presented and discussed, after which appropriate conclusions were drawn.

Keywords: writing an academic paper, digital tools, mind map, citing, artificial intelligence.

1. INTRODUCTION

Writing academic papers (articles, doctoral theses, graduate and final theses, seminars) is a method of communication where the author or authors address the public through the written word, which carries a lot of weight. They must be well written, understandable, and grammatically correct, and they must be the author's own work since once they are published, they become unremovable information that is a reflection of the author. Writing a good academic paper requires skills in research, comprehension, and presentation. The presented facts must be relevant and understandable and supported by references to relevant literature in order to be able to give arguments for the author's own research, whereby the quality depends on the reputation of the references published in renowned journals or conferences.

In today's times of digital transformation which is omnipresent in all fields and has enabled the extensive development of digital literacy, researchers and authors have access to a variety of digital tools that enable them to write academic papers in a highly organized manner.

Digital tools have enabled a new set of possibilities for collaboration and communication, mapping and citing information, and accessing and utilizing information in databases, websites, and other authors' published works. [1]. When we compare the writing of academic papers 30 to 35 years

ago, when in order to browse the literature, it was necessary to sit in libraries and search specialized databases on microfilm and take notes on paper, with the writing of academic papers today, when we can effectively access all the necessary content practically from the comfort of our homes, a huge step forward is visible that was made possible by the digital transformation [2].

The process of writing academic papers has been completely changed as a result of digital technologies, particularly because digital technologies have simplified the search for relevant literature by using specialized search engines. Through the use of specialized programs, authors can create their own bibliographic database. More effective control of the research and writing processes is made possible by the use of appropriate tools for the visual mapping of information and ideas related to writing a paper. Today, the process of text editing and formatting is completely based on word processing programs, and translation from other languages is made possible by very powerful translators based on the application of artificial intelligence (AI – Artificial Intelligence) [2].

In point 2 are shown the main categories of digital tools and briefly listed some of them

from each category. In point 3 is briefly described the role of artificial intelligence as a new paradigm that is starting to be used more frequently in writing papers. Research of the digital tool application in the target population of teachers and students is described in point 4. The presentation of results and discussions is detailed in point 5. Finally, in point 6 is given a conclusion with some recommendations for the application of digital tools in the student population as well as for further research.

2. CATEGORIES OF DIGITAL TOOLS FOR ACADEMIC WRITING

Although there are many software applications for writing academic papers, which we call digital tools, in this paper we have classified them into eight categories (Figure 1) and briefly described each category, and highlighted the most commonly used digital tools.

By using the Internet, with digital search tools, we can search a large number of scientific and professional databases that contain various articles, doctoral theses, or research results from any scientific field. As a rule, specialized databases enable access to academic papers to the registered users, usually with payment or via the electronic resources portal of the
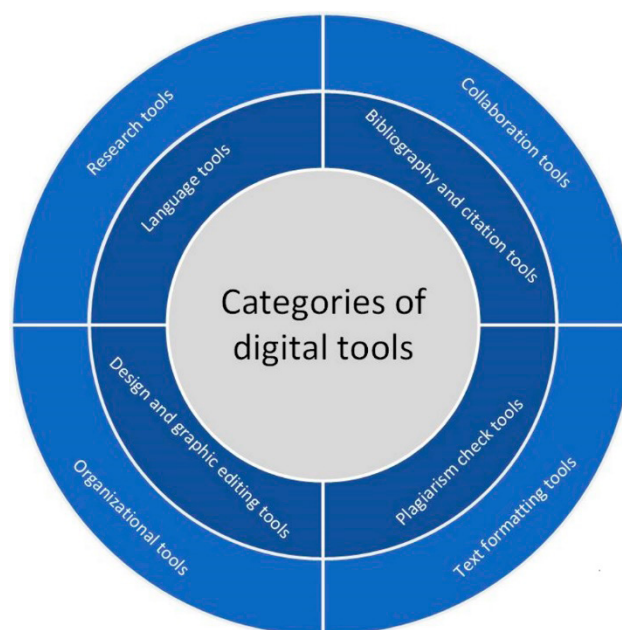

Figure 1 Categories of digital tools (source: authors)

National and University Library in Zagreb. (http://baze.nsk.hr/). In addition to specialized databases by field, Google Scholar and arXiv have the widest application in the academic community, especially for students, because they are open type, and the standard search engines Google or Bing are very often used.

The categories of digital tools for author collaboration in writing academic papers and research reports are very important because research and paper writing takes place in teams, and they allow document sharing on cloud storage platforms or document editing in real-time [1]. The most accessible tools for author collaboration have both free and commercial use options. We point out the example of widely available tools in the academic community such as Google Drive and Google Doc, Microsoft OneDrive and Sharepoint, and web applications within Office365 and Dropbox and Dropbox Paper.

Language tools are used during text writing to check the grammar and syntax of sentences and they can be integrated within a text processor (MS Word, Google Doc) or be standalone, such as the popular free web application Ispravi. me (powered by Hašek) for the Croatian language, which is maintained by the Faculty of Electrical Engineering and Computing in

Zagreb, and for the English language we point out the Grammarly application, which in the paid version allows correcting grammatical and syntax errors, and it also gives suggestions related to modifying sentences to make the text as understandable as possible.

Considering that in most cases academic papers have a prescribed form, text formatting tools are especially important, which define the document style, size, and font type, automatic numbering of titles and subtitles, generation of content, and automatic creation of lists of images and tables. These tools are always integrated within the word processing application, and we especially emphasize the most commonly used tools such as Microsoft Word, Google Doc, or LaTeX.

From the category of organizational tools, we emphasize mind maps (conceptual maps) whose purpose is to develop ideas (brainstorming), which allows us to visually describe a specific problem with different ideas. The presentation of the mind map is more successful if we visualize it in the right way to create a big picture of the ideas that we want to describe in the paper as a result of our research. A mind map allows us to display the hierarchy and relationships between individual ideas. When creating a mind map, we use

Figure 2 Example of a mind map (source: authors)

mind triggers such as images, icons, colours, mutual connections, and similar, which enable a better mind perception of the entirety of our ideas (Figure 2). There are many different commercial or free applications for creating mind maps, such as MindJet Mind Manager, Xmind, and FreeMind. In this category, we also classify the Microsoft OneNote Office365 application, available to everyone in the academic community, which enables the efficient organization of ideas and notes in notebooks that can be divided into sections and pages.

Effective management of the literature used in writing academic papers requires a lot of attention and good organization is needed to avoid mistakes or unnecessary revision of work. For this reason, digital tools are used to organize a library of literature that will be used when writing academic papers. There are various digital tools with which we can successfully organize reference management and use them effectively in citations, such as Mendeley or Zotero. Both tools are excellent and each of them allows you to install a desktop version, and they can also be installed as an add-on to MS Word and a web browser. By integrating it with the MS Word text processor, we can refer to the literature in accordance with the selected citation style, with automatic editing of the order of references and the creation of a literature list.

Editing academic papers often also requires the use of appropriate digital tools for the design and graphic editing of diagrams, graphs, images, and other graphic elements. These tools belong to the design and graphic editing category. Programs for editing images (Photoshop, Gimp), programs for creating diagrams and flow charts (Microsoft Visio), and programs for creating infographics are most commonly used. For the presentation of academic papers at conferences, it is common to create posters. Since a relatively large amount of information needs to be presented on the poster, the best option is to utilize visual interpretation of knowledge, data, and information by using an infographic creation program. Digital tools of this type are based on vector graphics that allows reducing and enlarging images without losing quality and the most commonly used are Adobe Spark, Canva, and Google Charts and can be freely used, unlike Adobe Illustrator which is a commercial tool.

Given that each academic paper must be the author's own work, a special place belongs to the category of digital tools for checking plagiarism. It should be emphasized that plagiarism is not allowed in the academic community and considering that almost all academic papers are published publicly today, plagiarism is very easily detected because these works are accessible via the Internet. Faculties around the world, including Croatia, pay great attention to this and use various software solutions to check plagiarism. Although today there are also free web tools for checking plagiarism, they usually give a relatively poor results, so commercial versions are used more frequently.

In Croatia, SRCE has ensured all interested faculties use of the Turnitin application, which has a large database of content that it searches to determine plagiarism. Students are encouraged to avoid plagiarism and encouraged to use these tools to ensure that the academic paper they have written is their own work and not someone else's description.

3. THE ROLE OF ARTIFICIAL INTELLIGENCE IN ACADEMIC WRITING

Although artificial intelligence (AI - Artificial Intelligence) is not included in the list of categories, we will explain briefly, as a completely new paradigm, its role in writing academic papers. This is specifically referring to a specific subset of artificial intelligence known as Natural Language Processing (NLP). The most significant application of NLP is in language translation, supplementing the text with words or sentences, creating summaries of articles and books, asking questions and giving answers, and in its most complex form, automatic writing of entire chapters. To

perform these tasks, very powerful language models have been developed by applying deep machine learning based on the processing of a large amount of text content, such as Google BERT [3] and OpenAI GPT-3 [4]. The capabilities of the GPT-3 model range from the automatic generating of text such as articles to writing songs, poems, and essays. The deep neural network of the strongest language model GPT-3 was trained on 45 TB of textual content from almost the entire web, the content of forums such as Reddit, the entire Wikipedia as well as almost all online book databases. This huge language model has 175 billion parameters, and its application is developing rapidly.

We highlight one example in which artificial intelligence wrote an article about itself without any intervention from the author [5].

In the context of this article, the most interesting application for us is related to paraphrasing [6], [7] to avoid plagiarism, which is made possible by such language models. Both commercial and completely free paraphrasing tools are available. We highlight one example of a web tool for paraphrasing https://quillbot.com/:

Original text

„*With NLG (Natural Language Generation), the user must first define the content they want and the format required, such as a social media post, a poem, or a research paper. These designs are the template that the software provider offers and are becoming increasingly sophisticated. In fact, many media outlets are replacing human-written pieces with NLG output*".

Paraphrased text

„*The user must first identify the material they wish to create and the format they need, such as a social media post, a poem, or a research paper, before using NLG. These are the software provider's templates, and they're getting more advanced all the time. Many news organizations are now using NLG output to replace human-written content.*"

A more thorough consideration of the ethics of utilizing such tools is a topic for another article, but as artificial intelligence penetrates more deeply into all areas of life, we highlight that, when used properly, it may be very helpful for authors to avoid plagiarism. Possible ethical dilemmas of applying AI in education and academic writing should be channelled appropriately and teachers should advise students in the coming years on how to use the potential of AI.

4. RESEARCH STUDY

The research was conducted on the use of digital tools in two populations, teachers and students, using a survey consisting of 10 questions. The questions are related to the use of digital tools in 7 categories for students and 8 for teachers. The target populations are teachers (140 teachers) and students in the final semester of undergraduate studies in Computing and Informatics at the Zagreb University of Applied Sciences. To answer the questions about the use of several types of digital tools, we used a Likert scale (Always-Often-Sometimes-Rarely-Never). The survey included only students who attended the courses "Professional and Research Methodology" or "Text Processing" (a total of 215 students). 46 teachers (33%) and 46 students (21%) responded to the survey. Given that the target population in both groups is not very large, the size of the samples obtained in the survey is acceptable for drawing appropriate conclusions without generalization.

5. RESULTS DISCUSSION

The results of answers to questions related to the categories of language tools, bibliography and citation tools, graphic tools, and plagiarism check tools are displayed in comparison for teachers and students (Table 1). Among teachers, given their research and experience in writing academic papers, we notice a much greater use of the mentioned categories of digital tools than among students. In both groups, tools for language correction and tools for checking plagiarism are most frequently

Table 1 Comparative analysis of results for teachers and students (source: authors)

	Language tools [%]	Bibliography and citation tools [%]	Design and graphic editing tools [%]	Plagiarism check tools [%]
Teachers				
Always	41.3	23.9	8.7	47.8
Often	30.4	17.4	17.4	19.6
Sometimes	17.4	13.0	30.4	10.9
Rarely	8.7	32.6	28.3	13.0
Never	2.2	13.0	15.2	8.7
Students				
Always	15.2	10.9	4.3	17.4
Often	21.7	10.9	4.3	15.2
Sometimes	28.3	26.1	41.3	28.3
Rarely	21.7	10.9	23.9	13.0
Never	13.0	41.3	26.1	26.1

used. Teachers and students should pay greater attention to bibliography and citation tools because they allow much better management of the literature used in research and writing academic papers.

According to the graphs (Figure 3), we can see that organizational tools are used considerably less frequently than anticipated, and if we look at the answers Never and Rarely, 65% of teachers and 76% of students normally do not use them. We believe that much more emphasis should be dedicated to this issue given that in the literature concerned with the writing of academic papers [2], organizational tools are given quite a lot of importance for the sake of systematic research and writing.
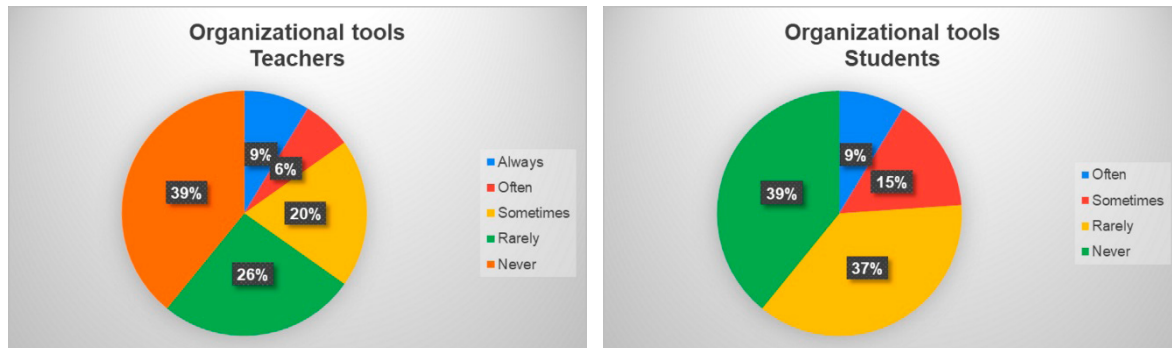

Figure 3 Using organizational digital tools (source: authors)

Considering that text processing programs that contain various options for editing and formatting the document are most often used for writing academic papers, tools from that category are used to the greatest extent (answers Always and Often), which is about 95% for teachers, and for students approximately 71% (Figure 4). Since these tools are increasingly becoming more advanced thanks to the application of artificial intelligence, they are characterized by significant automation of various tasks while utilizing text processing programs.
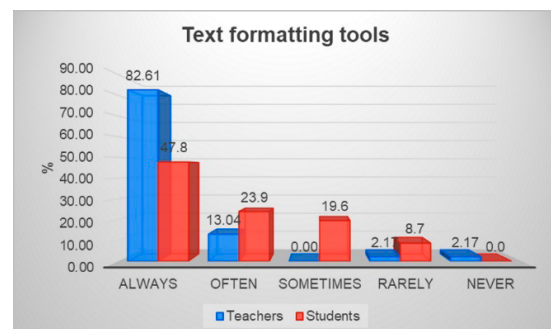

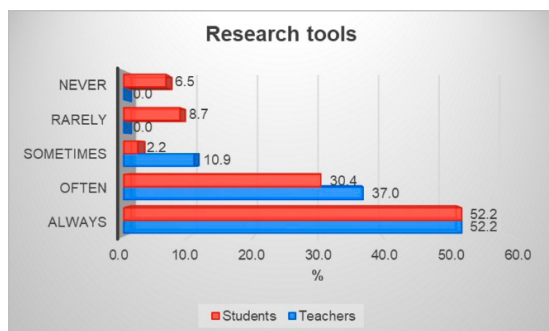**Figure 4 Using text formatting digital tools (source: authors)**

Figure 5 Using digital search tools
(source: authors)

Figure 6 Using collaboration tools
(source: authors)

Search tools are also frequently used by all respondents (Figure 5), which is understandable given that they are widely available online. Both groups use them in more than 80% of cases (answers Always and Often) because they are mostly of open type (Google Scholar, arXiv, and Google). Probably, the results would be even better if more effort were put into educating people, especially students, on how to use the database portal of the National and University Library in Zagreb.

The teachers were the only ones asked the question related to the use of collaboration tools considering that undergraduate students perform very little collaborative research and write most of their academic papers individually (seminars, final paper). In their research and writing of academic papers (scientific and expert articles), teachers are usually joint authors, and collaboration tools enable them to work more efficiently, so they place a high value on using these tools, in total around 70% of the answers Always, Often and Sometimes (Figure 6). Although the students were not asked this question, we believe that they should receive additional education about using digital collaboration tools and students should be included in team research and writing seminars during their studies.

6. CONCLUSION

The academic community must undergo a digital transformation based on digital technology, both in Europe and in our country,
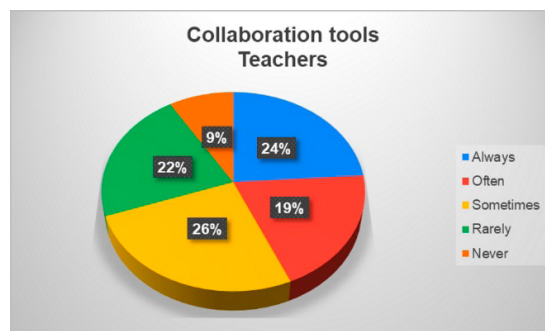
for an entirely new advancement in the field of education and is the focus of many documents addressing concerns related to the digitization of society. One significant area is the writing of academic papers, which concerns both teachers and students equally, provided that teachers have a dual role, as both users of these tools in their scientific and professional research and also as educators of students who are just entering the field of research and writing. of his works. Students begin writing papers with seminars, end with their final papers and graduate theses and continue with scientific and professional papers. Given the enormous potential of digital technologies, we stressed the significance of using different digital tools for that purpose as a subset for developing digital literacy. From the eight categories stated above, the most commonly used digital tools are singled out, which are constantly being improved, particularly by adding new options based on artificial intelligence algorithms. It should be underlined that artificial intelligence contributes to the automation of activities carried out with digital tools, such as suggestions for completing sentences, correcting misspelt words, paraphrasing, and similar. It is important to note that the use of artificial intelligence in writing and paraphrasing still has some limitations, which require a careful application from the user. For example, the language model GPT-3, which was also trained on websites with "toxic" content, in the initial generation of content in some areas displayed a significant bias (religious, gender, age, race and similar). To prevent these undesirable effects, the model is constantly

taught with the aim of blocking the generation of the aforementioned inappropriate content.

We are aware that the research was made with certain limitations, most of which are due to the choice of a particular target student population. The analysed results show that both teachers and students use digital tools from the aforementioned categories to a greater or lesser extent.

We believe that there is still a great deal of space for improvement in this area, particularly among the student population. One possibility is that all students of the Zagreb University of Applied Sciences take a specialized course that would educate them in the use of digital tools for research and writing academic papers. Teachers should also encourage students in other courses to use certain digital tools, particularly when writing seminars or research descriptions related to some student projects. Continuing research in the field of digital transformation of the academic community can contribute to its more systematic and effective implementation.

7. REFERENCES

1. M. C. Pennington, "Trends in Writing and Technology," *Writ. Pedagog.*, vol. 5, no. 2, pp. 155–179, 2014, doi: 10.1558/wap.v5i2.155.

2. M. Schcolnik, "Digital Tools in Academic Writing?," *J. Acad. Writ.*, vol. 8, no. 1, pp. 121–130, 2018, doi: 10.18552/joaw.v8i1.360.

3. J. Devlin, M. W. Chang, K. Lee, and K. Toutanova, "BERT: Pre-training of deep bidirectional transformers for language understanding," *NAACL HLT 2019 - 2019 Conf. North Am. Chapter Assoc. Comput. Linguist. Hum. Lang. Technol. - Proc. Conf.*, vol. 1, no. Mlm, pp. 4171–4186, 2019, doi: https://doi.org/10.48550/arXiv.1810.04805.

4. T. B. Brown *et al.*, "Language models are few-shot learners," *Adv. Neural Inf. Process. Syst.*, vol. 2020-Decem, 2020 arXivID 2005.14165, ISSN 10495258.

5. B. M. Cagri, "This Article is Written Completely by GPT-3, A Top-Notch Artificial Intelligence Algorithm - and It Tells Us Not to Worry About the Rise of Artificial Intelligence!," *Web*, 2022. [Online]. Available: https://evrimagaci.org/this-article-is-written-completely-by-gpt3-a-topnotch-artificial-intelligence-algorithm-and-it-tells-us-not-to-worry-about-the-rise-of-artificial-intelligence-11394, [retrived 2.4.2022].

6. S. Witteveen and M. Andrews, "Paraphrasing with large language models," *EMNLP-IJCNLP 2019 - Proc. 3rd Work. Neural Gener. Transl.*, pp. 215–220, 2019, doi: 10.18653/v1/d19-5623.

7. H. Palivela, "Optimization of paraphrase generation and identification using language models in natural language processing," *Int. J. Inf. Manag. Data Insights*, vol. 1, no. 2, p. 100025, 2021, doi: 10.1016/j.jjimei.2021.100025.