

## DEVELOPMENT OF PROSPECTIVE AGRICULTURAL ENGINEERS' TECHNICAL WRITING SKILLS USING ONLINE WRITING LAB

**Olha Chaikovska,<sup>1</sup>**

Associate Professor, PhD in Philology,  
Department of Foreign Languages  
Higher Educational Institution "Podillia State University"

olgachaikovskaya@ukr.net  
ORCID: 0000-0001-9161-4574

**Iryna Humeniuk,<sup>2</sup>**

Associate Professor, PhD in Philology,  
Head of the Department of Foreign Languages  
Higher Educational Institution "Podillia State University"

irynahumenyuk79@gmail.com  
ORCID: 0000-0002-7905-9771

**Anastasiia Trofymenko,<sup>3</sup>**

Associate Professor, PhD in Education,  
Head of the Department of Foreign Languages  
Kamianets-Podilskyi Ivan Ohienko National University

trofimenko2006@gmail.com  
ORCID: 0000-0003-3347-4635

**Abstract.** *Technical writing skills allow prospective professionals to be competitive engineers, be effective at the workplace, reach high positions, and gain self-confidence in Agricultural Engineering. Therefore, technical writing is an integral part of English for Specific Purposes communication of prospective agricultural engineers. The current study aims to examine the influence of Online Writing Lab (OWL) resources on the development of students' technical writing skills. To achieve the outlined aim, a mixed research design was employed, which involved 58 Masters of Podillia State University. Two groups were formed based on students' preferences: experimental (n=28) and control (n=30). The Pearson criterion was used to process the results, which indicated that there was a statistically significant difference between the experimental and control groups in terms of their technical writing performances. The study has shown that using OWL resources positively influences the development of Master's technical writing skills. OWL can be considered an effective tool for teaching students technical writing. It engages and motivates the students in technical writing skills and further self-study. Additionally, the*

---

<sup>1</sup> Corresponding author, responsible for responsible for conceptualization, methodology, validation, investigation, resources, data curation, writing an original draft, review and editing, supervision, project administration.

<sup>2</sup> Co-author, responsible for conceptualization, methodology, validation, formal analysis, investigation, resources, data curation, writing an original draft, review and editing, visualization.

<sup>3</sup> Co-author, responsible for conceptualization, methodology, validation, investigation, resources, data curation, writing an original draft, review and editing, visualization.

*study revealed that the majority of the students have positive attitudes toward the use of OWL resources in the learning process.*

**Keywords:** *technical writing skills; agricultural engineers, Online Writing Lab; Business English Course; the field of Agricultural Engineering.*

## 1. INTRODUCTION

Business activity of prospective professionals in agricultural engineering requires skills and abilities in foreign language writing. Technical writing skills are necessary for clear communication, knowledge transfer, accuracy, and compliance in engineering. Teaching the students verbal and non-verbal communication in a professional context is the primary goal of ESP for Masters. Both oral and written engineering communication skills belong to soft skills and are in high demand by employers. According to Rus (2015), technical writing activities “are not engineering students’ favourite activities” (Rus, 2015, p.1110). The students often underrate the importance of writing skills (Lievens, 2012) and prefer to focus on mathematical and practical work instead of on written work (Beer & McMurrey, 2009).

Language instructors also state that “developing writing skills is not one of the easiest tasks”. The reasons lie in the nature of the technical writing process, which is a complex and elaborate one” (Rus, 2015, p. 1114). However, there could be some other reasons that can influence engineering students’ poor writing. In the local context, poor writing skills can be associated with the lack of academic hours for ESP learning, appropriate materials, and resources for acquiring technical writing skills. Language instructors often prefer other skills, such as reading, speaking, and listening.

Technical writing should be popularized among engineering students for several reasons: to be a competitive engineer and be productive at the workplace, to attain high positions, and to obtain self-assurance. It should be noted that the coronavirus also became a factor that shifted the focus from reading, speaking, and listening to technical writing skills.

New approaches should be applied to improve engineering students’ technical writing skills. One of the ways to optimize the process of acquiring writing competencies is the use of various online resources, such as the Online Writing Lab (OWL). This paper attempts to overcome this gap by integrating online technical writing resources.

The scholars admit that teaching and learning technical writing is very important and challenging for teachers and students. For example, Evangeline and Ganesh (2016) found out that apart from grammatical errors, syntax, and cohesive devices, the trainees’ major constraint was a need for more vocabulary to present their ideas in technical writing. Only 30% of the students could appropriately use phrasal verbs and other technical expressions. The authors admit that only 48% of the students could interpret the graphs, tables, and pictures into paragraphs, though the engineering students learned this during the first semester.

Technical writing was examined from multiple perspectives: industry’s needs (Barnum, 1982), students’ needs (Kelley, 2006; Evangeline, & Ganesh, 2016; Desjardins et al., 2019), and the students’ expectations (Barnum, 1982). Several approaches and strategies were recommended for use in the ESP classroom to develop technical writing

skills with the engineering students. In research from Barnum (1982), the case method was used in one technical writing course. Such an approach changed some students' minds about the importance of a technical writing course for their future careers. Writer-centered, genre-centered, and reader-centered approaches are all seen as necessary ways to help students get the most out of their writing, for themselves and their readers, and to inspire students to improve their writing throughout the four years of their degree course and beyond, according to research conducted in large engineering classes (Robinson & Blair, 1995).

The studies at the beginning of the 21st century are marked by using self-reflection (Selwyn & Renaud-Assemat, 2020). Selwyn and Renaud-Assemat (2020) applied the new approach to improve students' writing skills. The approach aimed to clarify student understanding of what "good" writing looks like and encourage students to reflect on how their work compares to this ideal before submission by completing a 'Reflective comments' section.

Gao's findings are consistent with that of earlier research. The author described the design, implementation, and assessment of a technical writing course for engineering graduate students based on a project-based instruction (PBI) method. The course was designed according to the following principles: matching objectives with program outcomes, incorporating both soft knowledge and hard skills, including both group work and individual deliberation, and providing differentiated instruction. The most important principle for designing and implementing this PBI course was to make all the designed tasks for the final project procedural, consistent, and connected. The implementation of the course showed its teaching effectiveness.

American researchers attempted to improve technical writing skills through lab reports (Gravé, 2019; Wiebe et al., 2005). Students in Polytechnique Montréal programs had one-course credit devoted to written and oral communication. However, they had difficulty employing good technical writing practices, such as capstone projects, lab reports, and hands-on assignments (Desjardins et al., 2019). A common approach was applied to the civil engineering program at Polytechnique Montréal. This approach was successful; student response was positive, and improvement was observed in the courses where writing was required (Desjardins et al., 2019).

Mehlenbacher et al. (2018) examined two asynchronous online courses on science and technical communication to learn more about how college students perceive and use cloud technology for collaborative writing. Students used Google Docs to complete a group project with three to four people per group, and they also wrote personal reflections on the process of writing collaboratively. The research examines leadership and its relationships to group knowledge creation and collaborative writing. The guidelines for implementing collaborative, cloud-based assignments are provided, and the conflict between giving student teams explicit instructional direction and letting them enjoy the equivocality and messiness of virtual collaboration is highlighted (Mehlenbacher et al., 2018).

The literature review showed that only some studies focused on teaching and learning technical writing through ICT tools, online applications, and platforms. Nilavu (2019), for example, used Google Classroom to enhance engineering students' writing skills. The author states that the students obtained enhancement in technical writing because of the following reasons: YouTube videos were used with subtitles; the images

complemented the text, enabling the students to imbibe the content for writing checklists; using models for transcoding bar charts, pie charts, graphs with diagrams and texts; reading and transcoding of graphs through Wolfram Alpha Widgets. Nilavu (2019) concluded that the ICT-based multimodal approach through Google Classroom to enhance writing skills claimed positive results (p. 3247).

Madhyastha (2002) described the experiences of using a variety of Web-based functions to teach Technical Writing to Computer Engineers. The scientist used the document editing features of Adobe Acrobat and Microsoft Word to create a new authentic peer editing system called COLLAGE (COLLaborative Approach to Global Education).

Despite the existing studies, the level of research related to using online technical writing resources in ESP teaching and learning is still constrained.

In this paper, we have tried to estimate the effects of online writing lab resources on engineering students' writing skills.

The purpose of the article is to examine the influence of online writing lab resources (Purdue OWL) on the technical writing skills of Masters in agricultural engineering.

The hypothesis is that using online technical writing lab resources at Business English for agricultural engineers' classes will improve students' technical writing skills and, consequently, enhance their learning performance.

## 2. METHODS

*Research Design.* To conduct the present research and obtain objective results, a mixed-methods approach was applied. Quantitative methods such as an experiment and a survey were used. The experiment was aimed at finding out the efficacy of regularly using online writing lab resources in acquiring technical writing skills. The survey in the form of a written questionnaire was applied to confirm a hypothesis of technology-based technical writing efficacy. The qualitative method was used to collect and analyze quantitative data.

*Participants.* The research was carried out at the Higher Educational Institution "Podillia State University" in Ukraine. The experimental learning lasted for five months (spring semester 2022). The online Moodle-based educational experiment was represented by 58 full-time Masters majoring in Agricultural Engineering. Fifty-eight students volunteered to participate in an experiment. Based on students' preferences, two groups were formed: experimental (n=28) and control groups (n=30).

*Instruments and Procedure.* Due to the university syllabus, the Master had a mandatory Business English course (2 academic hours a week). The correlation between classwork and self-study due to the syllabus was 1 to 2. Both groups had an equal number of Business English classes. All the students passed the unified entrance test. The Business English course in Moodle Learning Management System consisted of four topics (8 academic hours for each topic): "The role of science in the development of society", "International cooperation", "Sociocultural norms of business communication", "Job search and documentation" as shown in Table 1. Writing engineering reports, proposals, case studies, memos, and specification documents were included. To improve students' technical writing skills, we decided to conduct a pedagogical experiment. The experiment contained the following stages: division of students into two groups, introduction of the Business English courses in Moodle (Chaikovska, 2020) to the students of experimental

and control groups (we added Purdue Online Writing Lab resources to the course for the students of experimental group as shown in Table 1), student testing, conducting a survey.

**Table 1.** Topics in Moodle Business English for experimental and control groups

№	Topic	Type of text	
		Control group	Experimental group
1.	The role of science in the development of society	What is science? (Moodle); How to get a Master's degree in Ukraine and abroad? (Moodle); Writing reports, proposals, and technical documents (Moodle); Sentence structure in technical documents (Moodle); Project work: Engineering report. "Structural and technological parameter optimization of agricultural machinery car parts".	What is science? (Moodle); How to get a Master's degree in Ukraine and abroad? (Moodle); <i>Writing reports, proposals, and technical documents (OWL);</i> <i>OWL writing assignments: Sentence structure (sentence clauses, sentence fragments, and subject-verb agreement) (OWL);</i> <i>Project work: Engineering report. "Structural and technological parameter optimization of agricultural machinery car parts".</i>
2.	International cooperation	International cooperation in the field of Science and record keeping. (Moodle); International scientific seminar. (Moodle); Memo Writing (Moodle); Correct English usage for effective technical writing (Moodle); Project work: Memo writing.	International cooperation in the field of Science and record keeping (Moodle); International scientific seminar (Moodle); <i>Memo Writing (OWL);</i> <i>OWL writing assignments: Grammar exercises (adjectives, adverbs, appositives, articles, count and noncount nouns, prepositions, and tense consistency);</i> <i>Project work: Memo writing.</i>
3.	Sociocultural Norms of Business Communication	Types of contacts: interpersonal, corporate, intercultural, and business (Moodle); Ethics of business communication (Moodle); The tone in business writing (Moodle); Correct English usage for effective technical writing (Moodle); Project work: Business letters for the workplace	Types of contacts: interpersonal, corporate, intercultural, business (Moodle); Ethics of business communication (Moodle); <i>The tone in business writing (OWL);</i> <i>OWL writing assignments: Eliminating Wordiness;</i> <i>Project work: Business letters for the workplace</i>
4.	Job search and documentation	Job search. Interview (Moodle); Resume. CV (Moodle); Correct English usage for effective technical writing (Moodle); Project work: Resume design. Agricultural Engineer.	Job search. Interview (Moodle); Resume. CV (Moodle); <i>Resume design (OWL).</i> <i>OWL writing assignments: Project work: Resume design. Agricultural Engineer.</i>

It should be noted that the Purdue Online Writing Lab (OWL) web page also incorporates assignments that help to use appropriate grammar, spelling, and punctuation in technical documents and build students' confidence in their ability to utilize technical

content. After covering general topics in Moodle, the students of experimental groups were proposed to explore the procedure of writing technical documents with the help of Purdue Online Writing Lab (OWL) in the format of videos and PowerPoint presentations (OWL Reports, Proposals, and Technical Papers, 2012). Then the students were provided with links to OWL writing assignments with a focus on peculiarities of spelling, grammar, and punctuation in writing technical documents.

The final stage of OWL-based activities was students' project work: Writing the report, Memo writing, and Resume writing. The students consulted with subject-area specialists and their scientific supervisors about their chosen topics. The students accompanied their research work with slides, transparencies, and videotapes on relevant aspects of the topic. The role of the teacher at this stage is to guide the students with comments on the coherence of content, appropriate technical writing style, and manner of delivery.

At the end of the semester, the students of both groups were asked to write a resume. We used the following criteria for evaluating the resumes: the structure, the content, vocabulary and grammatical accuracy. To get students' feedback, a questionnaire analysis was performed (Table 2) at the final stage of the experiment. The experimental group students were given several multiple-choice questions to express their ideas about using online technical writing resources in Business English for engineering students' courses.

### 3. RESULTS

The research hypothesizes that utilizing online writing lab tools in Business English for engineering programs helps the students to become more adept at technical writing. After the studying period and the final check, the students of the experimental and control groups got their scores for writing the resume. The maximum score was 5. The Pearson criterion was used to identify whether the level of writing performance significantly differed in both groups. To check the hypothesis:

$H_0$ : The difference in technical writing performance between the students of experimental and control groups is not significant;

$H_1$ : The technical writing performance in experimental and control groups differs significantly.

The statistical program MS Excel was used to calculate the obtained data. The screenshot of the data obtained is given in Fig. 1.

	A	B	C	D	E	F	G	H
1	Score	n/c	n/exp	f/c	f/exp.	n/c+n/exp	$(f/c-f/exp)^2/(n/c+n/exp)$	
2		2	4	1	0,133333	0,035714	5	0,001905896
3		3	16	7	0,533333	0,25	23	0,003490338
4		4	8	16	0,266667	0,571429	24	0,003869992
5		5	2	4	0,066667	0,142857	6	0,000967498
6			30	28	1	1	58	0,010233724
7	v=3	$(x^2)cr=$	7,815			$p < 0,05$		
8		$(x^2)exp=$	8,596329					
9								
10								
11								

Figure 1. Screenshot of Pearson criteria calculation in MS Excel

At a given number of gradations ( $g = 4$ ), the number of degrees of freedom ( $\nu = 3$ ) for significance  $p \leq 0,05$  equals  $\chi_{2cr} = 7,815$ . Therefore, concerning the assimilation of the theory, hypothesis  $H_1$  is accepted. The technical writing performance in experimental and control groups differs significantly. The scores in column C show that the experimental group had better results after treatment than the students in the control group.

The post-experiment questionnaire aimed to clarify students' opinions and attitudes to technical writing online resources implemented in Business English for engineering students' courses and ensure students' appreciation of the technical writing content and form. After confirming the hypothesis, we aim to finalize the experiment by seeking feedback from the respondents. The results of the questionnaire are presented in Table 2 below.

**Table 2.** Questionnaire results about students' opinions on using OWL resources

Statement	Highly agree	Agree	Not sure	Disagree	Highly disagree
Using OWL resources in the technical writing section of the course is engaging and motivating	13%	49%	20%	11%	7%
OWL videos benefit my technical writing	9%	61%	19%	6%	5%
OWL PP presentations benefit my technical writing	10%	55%	21%	7%	7%
OWL handouts on technical documentation benefit my technical writing	12%	60%	18%	6%	4%
I will use OWL materials in my self-study	14%	64%	20%	16%	10%
Moodle Learning Management System is convenient for incorporating Purdue Online Writing Lab (OWL)-resources	40%	37%	14%	6%	3%

The majority of respondents (62%) testified that using OWL resources in the technical writing section of the course is engaging and motivating. Nonetheless, a significant number of students continue to find technical writing both challenging and boring: 18% disagree that OWL resources benefit students' performance in technical writing. The students of the experimental group consider OWL videos (70%), technical writing handouts (72%), and PowerPoint presentations (65%) helpful in obtaining writing skills in a profession-based context. The key question of the questionnaire for the further usage of OWL materials was answered positively (78%). According to the students, they consider Moodle Learning Management System to be convenient for incorporating Purdue Online Writing Lab resources (77%). We still think that the limited number of learning hours and a lack of experience in providing resources for advanced engineering courses are related to motivating students to present the results of their research in English.

#### 4. DISCUSSION

Numerous research studies have investigated the challenges and benefits of technical writing for engineering students. Unfortunately, we also admit the low level of technical writing skills among engineering students. Language instructors try to overcome this gap using different approaches to technical writing teaching, providing workshops in writing methods, report structure, tables and figures, writing tools, grammar, and resume

writing for civil engineering students (Desjardins et al., 2019). Our research aligns with Nilavu's (2019) and Madhyastha (2002) surveys. Scientists claim that ICT tools such as Google Classroom, Adobe Acrobat, and Microsoft Word applications can enhance writing skills and show positive results. Inadequate investigations about the efficiency of applications and online resources in improving writing skills make it a promising area for further research.

OWL activities in technical writing, based on using authentic videos, PowerPoint presentations, and technical writing grammar exercises, showed positive results. The students in the experimental group outperformed the students from the control group. The results of the students' questionnaire demonstrated that using Online Writing Lab resources in Business English for engineering students' courses makes learning more interesting and engaging. Most students (78%) will use these resources in self-study. In addition, the experiment participants prefer video resources to handouts on writing technical documentation in Moodle Learning Management System.

In this study, we focused on improving students' technical writing skills through Online Writing Lab resources and demonstrated how they can be implemented into the Moodle Learning Management System. However, our research has potential limitations. Firstly, the participants of our study were first-year Masters majoring in Agricultural Engineering. Due to the university syllabus, the students take the Business English course only during the second semester. A longitudinal study might be necessary to investigate changes in students' progress.

Based on the study, we suggest establishing a mandatory or elective course in the basics of technical writing in the first semester to obtain more accurate results.

## **5. CONCLUSIONS**

Considering the current attention to the development of virtual education space and the necessity of digitalization of teaching and learning processes, the importance of developing technical writing skills should be implemented with the help of writing lab resources.

To provide an accurate estimation of the effects of online writing lab materials on the writing abilities of engineering students, we performed the current research with the application of quantitative and statistical techniques to accomplish the goal and produce more objective results. Additionally, an effort was made to generalize the research results of contemporary experts in the field.

Therefore, the formation of foreign language skills in technical writing requires special attention from the teacher in English language classes and involves several stages, including teaching writing techniques and written communication. The permanent motivation of students to study, activation of their imagination and creative potential, and communicative and social significance are integral factors contributing to the effective acquisition of these skills. The use of OWL resources is an inexhaustible source for pedagogical creativity. It engages and motivates the students in technical writing skills and further self-study. The implementation of OWL resources contributed to the better performance of projects with the students of the experimental group. This indicates that the experimental group students made better progress in developing discipline-specific

Chaikovska, O. et al. (2023). Development of prospective agricultural engineers' technical writing using online writing lab. *Advanced Education*, 23, 42-51. DOI: 10.20535/2410-8286.274944

writing skills (knowledge of content and structure of engineering documents, clear and concise writing, and appropriate lexical and grammatical constructions).

The answers in the questionnaire suggest that Moodle Learning Management System helps acquire technical writing skills.

The research carried out also revealed the omissions. We did not consider the principle "from simple to complex" and started with such a complicated issue as writing engineering reports. We should admit that this kind of document is rather complicated, mainly when we deal with issues such as the optimization of technical parameters of agricultural machinery units. In addition, the order of the OWL resources should be changed: Tone in business writing, Memo writing, Writing the report, and Resume writing. Besides, it would be appropriate to devote more learning hours to more complicated topics such as report writing and memo writing. The improvements mentioned above will enable the enhancement of agricultural engineers' academic performance in the context of developing technical writing skills.

## REFERENCES

- Barnum, C. M. (1982). Teaching technical writing to the engineering student: Industry's needs, the student's expectations. *IEEE Transactions on Professional Communication*, PC-25(3), 136–139. <https://doi.org/10.1109/tpc.1982.6447778>
- Beer, D. F., & McMurrey, D. A. (2009). *A Guide to Writing as an Engineer* (3rd ed.). Wiley.
- Chaikovska, O. (2020). Business English [Business English course for Masters in Agricultural Engineering]. Moodle. Retrieved from: <http://pdatu.net.ua/course/view.php?id=1332>
- Desjardins, A., Doré, E., & Desjardins, R. (2019). Development and integration of technical skills oriented toward engineers' needs. *Proceedings of the Canadian Engineering Education Association (CEEA)*, 1-6. <https://doi.org/10.24908/orbotpceea.vi0.13782>
- Evangeline, J., & Ganesh, K. (2016). A need analysis of technical writing skills of engineering students in India. *SHS Web of Conferences*, 26, 01090. <https://doi.org/10.1051/shsconf/20162601090>
- Gao, Y. (2019). Teaching Technical Communication to Engineering Students: Design, Implementation, and Assessment for Project-based Instruction. *Proceedings of the Interdisciplinary STEM Teaching and Learning Conference*, 3(1). <https://doi.org/10.20429/stem.2019.030106>
- Gravé, I. (2019, June). Improving technical writing skills through lab reports. *In 2019 ASEE Annual Conference & Exposition*. <https://doi.org/10.18260/1-2--32951>
- Kelley, N. (2006). *Sentence structure of technical writing*. Retrieved 23 November 2023 from <https://www.studocu.com/row/document/air-university/technical-writing/technical-writing/5555971>
- Lievens, J. (2012). Debunking the 'Nerd' Myth: Doing Action Research with First-year Engineering Students in the Academic Writing Class. *Journal of Academic Writing*, 74–84. <https://doi.org/10.18552/joaw.v2i1.66>
- Madhyastha, T. M. (2002). Teaching technical writing to computer engineers using the Web. *32nd Annual Frontiers in Education*, 3, S2E-S2E.
- Mehlenbacher, B., Kelly, A. R., Kampe, C., & Kittle Autry, M. (2018). Instructional Design for Online Learning Environments and the Problem of Collaboration in the Cloud. *Journal of Technical Writing and Communication*, 48(2), 199–221. <https://doi.org/10.1177/0047281616679112>

- Nilavu, R. (2019). Enhancing writing skills in engineering students: An ICT based multimodal approach through Google Classroom. *International Journal of Scientific & Technology Research*, 8(12), 3244-3247. Retrieved from [jstr.org/final-print/dec2019/Enhancing-Writing-Skills-In-Engineering-Students-An-Ict-Based-Multimodal-Approach-Through-Google-Classroom.pdf](http://jstr.org/final-print/dec2019/Enhancing-Writing-Skills-In-Engineering-Students-An-Ict-Based-Multimodal-Approach-Through-Google-Classroom.pdf)
- Purdue OWL: Cover Letters*. (2011, December 14). YouTube. Retrieved 03 December 2022 from <https://www.youtube.com/watch?v=uSLGa2bRU-g>
- Purdue OWL: Writing Numbers Introduction*. (2011, December 14). Retrieved 03 December 2022 from [https://owl.purdue.edu/owl\\_exercises/writing\\_numbers/index.html](https://owl.purdue.edu/owl_exercises/writing_numbers/index.html)
- Reports, Proposals, and Technical Papers*. (2012). [Power point presentation]. [https://owl.purdue.edu/owl/subject\\_specific\\_writing/professional\\_technical\\_writing/technical\\_reports\\_and\\_report\\_abstracts/reports\\_proposals\\_and\\_technical\\_papers.html](https://owl.purdue.edu/owl/subject_specific_writing/professional_technical_writing/technical_reports_and_report_abstracts/reports_proposals_and_technical_papers.html)
- Robinson, C. M., & Blair, G. M. (1995). Writing skills training for engineering students in large classes. *Higher Education*, 30(1), 99–114. <https://doi.org/10.1007/bf01384055>
- Rus, D. (2015). Developing Technical Writing Skills for Engineering Students. *Procedia Technology*, 19, 1109–1114. <https://doi.org/10.1016/j.protcy.2015.02.158>
- Selwyn, R., & Renaud-Assemat, I. (2020). Developing technical report writing skills in first- and second-year engineering students: a case study using self-reflection. *Higher Education Pedagogies*, 5(1), 19–29. <https://doi.org/10.1080/23752696.2019.1710550>
- Wiebe, E., Brawner, C., Carter, M., & Ferzli, M. (2005, June). The LabWrite Project: Experiences reforming lab report writing practice in undergraduate lab courses. In *Undergraduate Lab Courses Paper presented at 2005 Annual Conference*. Portland, Oregon. <https://doi.org/10.18260/1-2--15583>

#### **Conflict of interest**

The authors declare no conflicts of interest.

#### **Funding**

This research received no specific grant from any funding agency.

Received: March 3, 2023  
Accepted: November 27, 2023