DOI:10.59787/2413-5488-2024-47-3-61-69

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THE ROLE OF SCIENTIFIC AND TECHNICAL DISCOURSE IN THE IMPLEMENTATION OF SCIENTIFIC LANGUAGE TRAINING OF ENGINEERS

Abstract: In this article the content analysis of the concept “scientific and technical discourse” is carried out and various aspects of this concept are systematized. Based on foreign and domestic practices, the main components that characterize scientific and technical discourse as a separate category have been revealed. The key characteristics and properties of scientific and technical discourse are identified, the knowledge and use of which will ensure successful communication in the scientific and technical environment. The specific influence of the identified characteristics on the effectiveness of scientific training has been clarified, since their correct use can significantly increase the quality of language education and training of technical specialists as a whole, improve their professional knowledge and language skills, as well as make them more competitive in the labor market.

This scientific work is the result of research obtained in the process of project implementation “Intensification of scientific and professional language training of technical specialists in the context of digital transformation of education” (IRN AP19678460) by the grant funding of Science Committee of the Ministry of Science and Higher Education of the Republic of Kazakhstan.

Keywords: scientific and technical discourse, characteristics of scientific and technical discourse, scientific and linguistic training, technical specialists.

Introduction

The President Kassym-Jomart Tokayev highlighted technical education and vocational training as critical components of Kazakhstan's future workforce development. The President emphasized the need for educational institutions to align with labor market demands, particularly in technical fields, as part of the country's broader economic strategy (Tokayev, 2024). The demand of the technical language is becoming an urgent task of engineering education. This study examines the role of scientific and technical discourse in improving the scientific language education of engineers. As engineering increasingly relies on accurate scientific communication, understanding this discourse is critical for effective professional development. This study aims to explore the specific characteristics and roles of scientific and technical discourse, thereby contributing to the improvement of language training technical specialists in an evolving digital education landscape.

The appeal to discourse is not new; it is associated with its depth in different spectrums of education. There are different types of discourse: linguistic, foreign language, scientific and technical, medical, etc. In our study we are talking about scientific and technical discourse, in which technical and scientific information is dominant. Many scientists expressed different points of view in defining the concept and features of scientific and technical discourse. However, research conducted in this direction does not fully meet the requirements for the concept of scientific and technical discourse. Problems associated with the analysis of the characteristics of scientific and technical discourse of engineering communication represent a vast field of activity for researchers. The problem actualized in this study, which involves finding an answer to the question of what key aspects characterize scientific and technical discourse of communication in engineering fields, becomes obvious. The objective of the

research is with the great variety of characteristics of scientific and technical discourse too identify exactly those aspects that have an impact on the scientific language training of technical specialists.

The novelty of our research lies in the identification and analysis of the key properties and characteristics of scientific and technical discourse of engineering communication, its role in the scientific language training of technical specialists.

Materials and methods

To conduct the research, a combination of the following methods was used: 1) content analysis to examine the concept "scientific and technical discourse"; 2) practices analysis reviewing both the domestic and international practices related to the problem of the research; 4) interpretation and categorization generalizing the characteristics of scientific and technical discourse.

Within the framework of this methodology, the study aims to find out how scientific and technical discourse plays an important role in the teaching of scientific language for engineers. Through a comprehensive analysis of relevant domestic and international literature, the study focused on explicit consideration of the characteristics of scientific and technical discourse. Source selection criteria included relevance to scientific language education, relevance of publications, and journal authority. Interpretation involves linking the analyzed characteristics of scientific and technical discourse to their role in effective communication.

The study emphasizes the importance of specific language features of scientific and technical discourse, such as specialized language and academic citation, in enhancing communication skills among engineers. The impact of the identified discourse features on improving the quality of language education of engineering professionals is interpreted. Understanding and applying these features can improve communication skills, make engineers more competitive and enhance their overall proficiency.

Categorizing the findings from the analysis, the study identified and generalized the key characteristics of scientific and technical discourse that impact engineering language education. Specifically, features like specialized language, academic citation, and data visualization enhance communication skills and improve technical professionals' competitiveness in the market place.

Results and discussion

The importance of scientific information in modern society is great. It is conditioned by the pace of scientific thought development, its growing influence on all aspects of human activity. Therefore, interest in the problem of scientific and technical discourse remains high.

There is no universal definition of the term *"scientific and technical discourse"* in science, since discourses satisfy different conceptual needs. In this regard, the processes of its definition and assimilation, as well as its use in practice, are complicated. The need for this work becomes obvious, since during scientific training it is important to summarize the material available in modern science about scientific and technical discourse and, to a certain extent, adapt the process of studying and recognizing scientific discourse for technical specialists.

Let us turn to the works of foreign scientists. Representatives of the French school formed different ideas about discourse. The works of M. Pecheux and P. Serio play an important role. According to Pecheux (1975), "discourse is the point where language and ideology meet". Pecheux, M. (1975). Serio (2001) defines discourse as the speech appropriated by the speaker and believes that "discourse is an utterance considered from the point of view of the discursive mechanism that controls it. Fuko (1996) defined discourse as "a set of speech acts united by one problematization". Thus, Habermas (2001) considers the concept of discourse

interdisciplinary. The described concepts of discourse and the directions developed on their basis allow to get closer to understanding discourse in the professional communication of engineers due to their dynamic development, determined by the rapid development of technology, and also begins to attract attention of linguists (Kurkan et al., 2020).

We suppose that scientific discourse is a special form of communication, characterized by the use of special language, logical structure, desire for objectivity and accuracy, orientation toward academic research and discussion of scientific topics. It is a way for scientists to exchange opinions, present research results, confirm conclusions, and discuss various aspects of scientific problems.

Scientific discourse is a type of institutionally oriented discourse, the purpose of which is the process of acquiring new knowledge about the world around us, presented in linguistic form and conditioned by the communicative norms of scientific communication, the participants of which are scientific researchers, the method of implementation is scientific dialogue, the values are key concepts of truth, knowledge and research (Dmitrichenkova & Dolzhich, 2017).

In contrast to the general concept of discourse, scientific and technical discourse is characterized by certain ways of organizing, selecting and using linguistic units, which makes it possible to transmit scientific and technical information effectively. In other words, a certain use of the language of science initiates the implementation of linguistic phenomena characteristic of a given discourse, that is, a specific grammar and corresponding vocabulary. Discourse is formed depending on academic goals; some discursive strategies can be individual (Sandoval, et al., 1999). Let's consider the key characteristics of scientific and technical discourse (Table 1):

- features of scientific and technical terminology;
- visualization and visibility of scientific and technical discourse;
- features of scientific and technical text;
- scientific data analysis;
- design and modeling of technological processes;
- collection and analysis of scientific and technical information;
- academic citation.

Table 1

Key characteristics of scientific and technical discourse

	Scientific and technical discourse	
No	**Characteristics**	**Distinctive features**
1	Scientific and technical terminology	accuracy, brevity, consistency; neutrality, clarity, unambiguity
2	Visualization and visibility of scientific and technical discourse	flow charts, graphs, diagrams, mental maps
3	Scientific and technical text	structuring, clear logic, accuracy, clarity, large number of terms
4	Scientific data analysis	transforming, cleaning, interpreting and modeling data
5	Design and modeling of technological processes	developing plans, concepts for creation of new products, systems, or technologies
6	Collection and analysis of scientific and technical information	process of studying the assessment and interpretation of data
7	Academic citation	assessment of the significance and contribution of individual scientific articles, authors, journals, research groups

Technical discourse as a practice is ahead of theory, since its practical aspects are more accessible and efficient, and the processes are more dynamic (Rubannikova, 2023).

Features of scientific and technical terminology (accuracy, brevity, consistency; emotionally expressive neutrality, absence of synonyms and homonyms, clarity, unambiguity, presence of professionalism, transition of terms into professional slang). Scientific and technical terminology differs from ordinary speech in its accuracy, structuring and specificity. Let's consider the features of scientific and technical terminology:

- precision and exactness: terms must be defined so that their meanings are unambiguous and do not leave room for different interpretations;
- structuring: terms are organized into a system where they can be classified according to various criteria and related to each other;
- uniqueness: each term represents a specific notion or concept, and it is unique within a given field of knowledge;
- derivative forms: in scientific terminology, derivative forms of words are often used to denote different aspects of a concept. For example, a noun can be converted into a verb, adjective, or adverb to describe various properties or actions;
- use of specific concepts: some terms may have a specific meaning within a particular scientific field, which may differ from their generally accepted meaning;
- internationalisms and Latin terms: many scientific fields use terms originating from Latin or Greek languages, as well as international terms, to provide universal vocabulary regardless of language;
- acronyms and abbreviations: in some cases, abbreviations or acronyms are used to denote complex or long terms;
- evolution and updating: terminology of science and technology is constantly evolving and updating in accordance with new discoveries and technological advances.

These features make scientific and technical terminology an important tool for accurate communication and knowledge transfer in scientific and technical fields. The listed parameters allow to consider scientific and technical discourse as a separate type of professional discourse (Kurkan et al., 2020).

Visualization or visibility of scientific and technical discourse - graphic and digital representation of scientific and technical information. Logical visualizations: flow charts, graphs, diagrams, mental maps. Mixed visualizations: infographics, visual notes.

The reason for using visualization in science is the increasing amount of data (Iļjinska & Smirnova, 2014).

Visualization of scientific and technical discourse can be carried out in various ways depending on the goals of the analysis and the available data.

Some approaches for visualization of scientific and technical discourse are: network analysis, topic modeling, term map, frequency analysis, timing charts, graphs and diagrams.

These approaches can be combined or adapted in accordance with the specific goals and characteristics of the scientific and technical discourse being analyzed.

Didactic requirements for modern visual (graphic) materials: reliability, authenticity, information richness, educational relevance, clarity.

Features of scientific and technical text: structuring, clear logic, accuracy, clarity, great richness of terms.

The corpus of scientific and technical text differs from ordinary text in its specificity and features, which ensure its clarity, accuracy and understandability for the target audience.

Here are some features of a scientific and technical text:

- accuracy and clarity;
- objectivity;
- structuring;

- use of terminology and specialized language;
- presenting data in the form of tables, graphs, charts and other illustrations to clearly present results and conclusions;
- extensive use of citations and references to support statements, justify conclusions and point to previous research;
- formal style and vocabulary characteristic of the academic and scientific environment;
- compliance with standards and conventions for data presentation, text formatting, design of tables and graphs, etc.

Scientific and technical text as a communicative value is not limited to the language component (Dmitrichenkova & Dolzhich, 2017). It is believed that the corpus of scientific and technical texts significantly expands research potential (Butenko, 2022).

The highlighted features make scientific and technical text an effective tool for transmitting information and research results in the scientific and technical community.

Scientific data analysis is of particular importance and research interest - the process of transforming, cleaning, interpreting and modeling data to extract useful information, identify patterns, detect trends and make informed decisions. Scientific data analysis includes collecting necessary data from various sources, data cleaning, preliminary analysis, feature extraction, application of analysis methods, interpretation of results, visualization and presentation, decision making. Scientific data analysis is conditioned by the possibility of creating scientific services - a set of processes and resources for servicing research and applied projects by providing the consumer (researchers, specialists) with the products of intellectual scientific activity (Suchkov, 2020).

Therefore, it can be confidently stated that the listed factors form a general process of data analysis, which can be adapted depending on the specific requirements and characteristics of the research.

Design and modeling of technological processes represent not only ways to create scientific and technical discourse, but also tools for the development and knowledge transmission in scientific and engineering fields.

Design involves developing plans, concepts, and specifications to create new products, systems, or technologies. In modern scientific and technical discourse, design plays a key role in the innovation process, contributing to the development of new technologies and scientific discoveries.

Modeling is used to abstract real-life phenomena and create formalized models that can be explored and analyzed; to clarify the understanding of complex systems, identify relationships and understand their dynamics; to formulate hypotheses, test theories, and predict experimental results.

In modern scientific and technical discourse, simulation is widely used to test hypotheses, evaluate the efficiency of processes and predict the behavior of complex systems; it provides the opportunity to simulate the operation of real systems in a virtual environment, which allows experiments to be carried out under controlled conditions.

Design engineering is the process of creating real objects, devices or systems based on theoretical and practical knowledge. In scientific and technical discourse, design plays an important role in the creation of new technologies, devices and tools for research and applied purposes (Perez-Llantada, 2024).

All of these processes interact with each other, creating a cycle of iterations in which the results of one stage can be used as input to the next stage. This approach stimulates the development of scientific and technical discourse, promoting the growth of knowledge and innovation.

Collection and analysis of scientific and technical information - important stages in the research and development process in scientific and engineering fields. In the process of

collecting scientific and technical information, it is necessary to determine the purposes of collecting information and the requirements for it in order to know exactly what information needs to be collected; correctly organize and carry out analysis of scientific and technical information; develop knowledge and practical skills necessary for processing and analyzing information; identify sources of scientific and technical information (scientific articles, journals, books, reports, conferences, Internet, databases, etc.); carry out a systematic search for information in selected sources using keywords, phrases and terms; evaluate the quality and reliability of the collected information, taking into account the authority of the sources, the relevance of the data, the scientific reputation of the authors, etc.; organize the storage of collected information using structured storage methods, such as databases, abstract cards, electronic notes, etc.

Scientific and technical information analysis is the process of studying the assessment and interpretation of data obtained from various sources in scientific and technical fields. This process may be aimed at identifying patterns, trends, new ideas or problems, and making recommendations for the development of further research or practical solutions. Digital communication encourages critical thinking (Rubannikova, 2023).

These steps help ensure an efficient and systematic process for collecting and analyzing scientific and technical information that can be used to support research, development, and decision making in scientific and engineering fields.

Academic citation – an important characteristic of scientific and technical discourse, reflecting the level of influence of the work on the scientific community. In the context of scientific and technical discourse, academic citations are often used to evaluate the significance and contribution of individual scientific articles, authors, journals, research groups, etc. Here are some key aspects related to academic citations:

- Citation Index, such as Hirsch Index (h-index), Gard Citation Index, etc., is used to assess academic citations. It reflects the number of articles and the number of citations to those articles. For example, the h-index is equal to h if the author has h articles, each of which has been cited at least h times;

- Citation in publications. How often an article or research is cited by other researchers in their own work may indicate how significant the results of that work are considered to be by the scientific community;

- Journal Impact Factor is a measure of a journal's citation rate, calculated on the basis of the average number of citations to articles published in that journal over a certain period of time. The higher the impact factor of a journal, the greater its influence and prestige in the scientific community;

- in scientific and technical discourse, it is also important to take into account citations not only in scientific articles, but also in patents, technical reports, conference reports and other scientific and technical documents;

- network analysis of citations allows to study the relationships between various scientific works and research groups, identify scientific directions and key players in a certain field.

Academic citations are an important tool for assessing scientific contribution and influence in the scientific community, however it is important to remember that it is not the only or comprehensive criterion for assessing scientific discourse, other factors can also be important in assessing the quality of scientific work.

Thus, scientific and technical discourse is characterized by these seven characteristics, which facilitate effective communication within the scientific and engineering communities. The dynamic nature of this discourse is driven by continuous evolution and adaptation to new discoveries, necessitating the use of visualizations and data analysis to manage the increasing complexity of information. Key features such as accuracy, clarity, and the systematic

organization of terms contribute to the uniqueness of scientific texts, making them vital for knowledge transfer and research dissemination.

Moreover, the design and modeling of technological processes play a crucial role in fostering innovation, allowing for the simulation and testing of hypotheses in controlled environments. The systematic collection and analysis of scientific information are essential for identifying trends and making informed decisions, while academic citations serve as a benchmark for evaluating the impact and relevance of research within the scientific community. Overall, the interplay of these elements promotes a robust framework for advancing knowledge and driving progress in scientific and technical fields.

It should be noted that the study of scientific and technical discourse within the framework of teaching the scientific language to engineers may face a number of potential problems and limitations. First, scientific and technical discourse is saturated with specialized terminology, which is often incomprehensible to non-specialists. This creates a barrier to analyzing and interpreting texts. For example, terms may have a narrowly focused meaning in one context and be used differently in another. Second, scientific fields may have their own rules, methods, and language, making it difficult to compare and unify discourses between them. For example, physics and biology use different approaches to data presentation and conclusions, making it difficult to analyze them in a unified context. Third, scientific language can change over time. New discoveries, technologies, and research lead to updated and refined terms, which creates the challenge of analyzing scientific texts in their historical development. For example, what was considered an axiom 50 years ago may be disproved today. In addition, scientific and technical discourse often uses formalized language such as mathematical equations, graphs, and tables. This creates difficulties for textual analysis as it requires not only linguistic skills but also specialized knowledge in the field. Thus, all the above-mentioned problems and limitations bring their own specificity to the process of studying the role of scientific and technical discourse.

Conclusions

The study showed that scientific and technical discourse has integrity, logic, consistency, and is a synthesis of communicative, cognitive and linguistic means that structure and actualize the scientific and technical field of activity.

The identified and described characteristics of scientific and technical discourse represent a special type of communication, which is characterized by the use of specialized language focused on the transmission and discussion of scientific information and technical concepts. Using the characteristics of scientific and technical discourse in scientific language training technical specialists provides a deeper understanding of the subject, develops critical thinking, improves problem-solving skills and preparation for working with modern technologies, develops research skills. Thus, the characteristics of scientific and technical discourse help future engineers not only structure their knowledge, make it more accessible to other specialists, but also develop important skills and competencies, and successfully adapt to the requirements of their professional activities.

Here are some recommendations for enhancing the teaching of scientific language for engineers:

1. Integration of scientific and technical discourse in the curriculum: Scientific and technical discourse should be integrated into the curriculum to help students understand specialized terminology and visual data representation. This integration creates a unique "mental environment" that influences how researchers perceive and interpret data, conduct research, and communicate with each other.

2. Practical exercises in analyzing scientific texts: Engage students in practical exercises that involve analyzing real-world scientific texts and creating structured technical documents.

This will enhance students' language proficiency and help them apply theoretical knowledge in practical contexts.

3. Use of digital tools for discourse analysis: Promote the use of digital tools for discourse analysis to ensure that future engineers are well-versed in the communication tools they will encounter in their professional environments. Digital tools can facilitate the analysis of scientific and technical discourse more efficiently.

4. Focus on interdisciplinary approach: Emphasize an interdisciplinary approach to teaching scientific language to engineers. This approach will help students understand the interconnectedness of various fields of science and technology, improving their overall comprehension and problem-solving skills.

5. Teaching critical thinking: Develop students' critical thinking skills by engaging them in activities that require the analysis and interpretation of scientific information. Encourage students to evaluate data, identify patterns, and critically evaluate the results of experiments.

6. Development of scientific literacy: Focus on developing students' scientific literacy by teaching them how to read, interpret, and communicate scientific information effectively. This includes understanding scientific terminology, data visualization, and academic citation practices.

7. Emphasis on specialized terminology: Ensure that students have a thorough understanding of specialized scientific and technical terminology. This will help them accurately communicate and transfer knowledge within their field of study.

8. Use of modern tools and software: Incorporate the use of modern tools and data analysis software in teaching scientific language to engineers. This will familiarize students with industry-standard tools and practices used in scientific research and communication.

9. Promote research skills: Develop students' research skills by involving them in the process of writing scientific articles, preparing technical reports, and analyzing scientific information. This hands-on experience will enhance their research capabilities and prepare them for future professional activities.

10. Encourage adaptation to new discoveries: Teach students how to adapt to new discoveries and advancements in science and technology by discussing how scientific language evolves over time. Help students understand the importance of staying updated with the latest terminology and trends in their field.

By implementing these recommendations, educators can effectively enhance the teaching of scientific language for engineers, enabling them to become proficient communicators, critical thinkers, and competitive professionals in the modern digital education landscape.

In order to develop an effective methodology for studying the role of scientific and technical discourse in the scientific language training process, the following aspects are worth paying attention to: emphasis on interdisciplinary approach, teaching critical thinking, developing scientific literacy, emphasis on specialized terminology, use of modern tools such as data analysis programs, specialized scientific platforms. These recommendations will allow future engineers to develop a deeper understanding of scientific and technical discourse during scientific and linguistic training, and future research can focus on the application of scientific and technical discourse in other specialized fields such as medical or legal engineering. Thus, this research can evaluate how integrating such discourse into the curriculum affects long-term professional development.

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