DOI:10.59787/2413-5488-2025-50-2-5-17

[1]Damira Jantassova, [1]Daniyel Damiyev

[1] Foreign Languages Department, Abylkas Saginov Karaganda Technical University

DESIGN OF THE FRAMEWORK FOR STEM LANGUAGE TRAINING IN ENGINEERING EDUCATION

Abstract: In the era of digital transformation and globalization of science, the development of scientific and professional language training technical specialists has a particular importance. The present study was carried out in the of implementation of the project "Enhancing scientific and professional language learning for engineering students in Kazakhstan through Digital Technologies" financed by the Science Committee of the Republic of Kazakhstan (Grant No. AP19678460). The research in the article is devoted to the analysis of modern approaches to the formation of scientific language literacy of STEM (Science, Technology, Engineering, Mathematics) students by means of digital technologies. In the research there has been presented the framework of STEM language training aimed at developing scientific literacy, academic writing skills, and effective professional communication among STEM students in the context of digital transformation. Key principles and approaches of STEM language training such as interdisciplinarity, digitization, practical orientation and research-based learning are considered. The study highlights the positive impact of language literacy in the STEM communication on research skills development of future engineers and effectiveness of the digital tools on the development of research language skills and suggests future research directions, including the integration of artificial intelligence into the educational process.

Keywords: STEM language training, research language skills, framework, scientific communication, engineering education, digital transformation.

Introduction

Contemporary advancements in science and technology require technical specialists to combine in-depth professional knowledge with competence in scientific communication. In the context of digital transformation and globalization, the ability to communicate effectively in scientific and professional settings becomes increasingly vital. Under the conditions of digital transformation and globalization, scientific and professional communication takes on a special significance. Modern technical and scientific developments take place in an international context, which makes the mastery of scientific style and terminology an integral part of professional training. This problem is particularly relevant in the light of the introduction of scientific researches and digital technologies into the educational process. The use of electronic learning platforms, automated text analysis systems, data visualization tools and scientific databases opens up new possibilities for the development of scientific and professional language skills. However, along with the benefits of digitization, there are also new challenges associated with the need to adapt research methods to new conditions and to develop approaches that combine technological innovations with scientific principles of professional communication.

Nowadays there is a growing interest in the development of language skills of students of technical universities. Researchers consider various aspects of this problem, including the integration of interdisciplinary learning, the use of digital tools in the development of academic writing, the formation of research skills, and academic ethics. Despite the abundance of studies,

the issues of an integrated approach to academic language training in the conditions of digital transformation, as well as the evaluation of the effectiveness of different techniques and tools, remain unresolved.

The present article is devoted to the development and analysis of the framework of STEM language training of future engineers. The aim of the study is to identify the most effective approaches and methods aimed at the formation of research, academic and communicative skills in STEM disciplines. In order to achieve this goal, we analyzed modern approaches to the formation of scientific literacy of students of STEM disciplines taking into account the use of digital technologies, considered key principles of training such as interdisciplinarity, digitalization, practical orientation and research approach, and analyzed the world best practices and researches in the field of scientific communication. The proposed framework of STEM language training includes conceptual, content, technological and evaluation-result blocks, which provides an integrated approach to the development of scientific and professional language competence for engineering education. The results of the study can be used to improve the educational programs at technical universities and the quality of graduates' preparation for professional communication in the digital economy. Thus, the article examines the theoretical foundations of this problem, analyses domestic and foreign experience, presents methods for assessing the effectiveness of language training, and offers recommendations for its improvement.

Methodology

The methodology of this study is based on an integrated approach to the development of scientific and professional STEM language training for technical specialists in engineering education. It combines several interrelated methods aimed at creating a comprehensive, practice-oriented, and digitally adaptable framework.

The study begins with a literature review focused on the comparative analysis of the best practices and solutions in the field of language training for STEM students. The goal of this review is to identify theoretical foundations and practical strategies for enhancing scientific language literacy and academic communication skills, particularly in the context of digital transformation. There has been identified effective methodologies, tools, and educational models that support the development of research language skills for interdisciplinary communication among future engineers.

The classification method was applied to systematize linguo-didactic techniques used in scientific and professional STEM language training. This classification enables the structuring of key teaching principles and ensures their integration into the proposed training framework. It supports the alignment of instructional strategies with modern requirements of STEM education, including the use of digital technologies and the promotion of academic integrity.

The modeling method was used to design a pedagogical framework of STEM language training engineers. The framework was developed based on the classified linguo-didactic techniques and includes four interconnected blocks: conceptual, content, technological, and evaluation-result. The modeling process ensured the coherence of the framework’s components and their alignment with the objectives of developing linguistic, research, and digital competencies for engineering students.

Literature review

In recent academic literature, there is a growing interest in the development of the language skills of students at technical universities. Researchers consider various aspects of this problem, including critical thinking development, the application of digital technologies in developing academic writing and scholarly communication, and others. The analysis of

scientific sources allowed us to identify the main trends and approaches to the formation of scientific and professional language training of technical specialists.

The authors pay a lot of attention to the integration of digital technologies in the language training of students of STEM disciplines. L. M. Hrynevych, N. V. Morze and V. P. Vember consider the development of critical thinking through digital educational platforms (Hrynevych et al., 2023), and G. Siemens analyses the impact of digital transformation on academic writing and scholarly communication (Siemens,2020). T. Asten emphasizes the need for a structured approach to integrating digital skills in education, where the incorporation of digital tools may enhance students' communicative and collaborative abilities in both technical and academic settings (Asten, 2022).

The growing interdependence between digital competence and academic literacy, particularly within the context of engineering education plays a pivotal role in preparing engineering students to engage with the complex linguistic and communicative demands of their discipline. In the context of language training, academic literacy encompasses a set of core competencies, including the ability to read and interpret technical texts, produce structured and coherent written work, understand disciplinary discourse conventions, and critically evaluate sources of information. For engineering students, this means not only acquiring subject-specific terminology, but also mastering the language functions used to describe processes, interpret data, argue claims, and report research findings. An important place is occupied by the study W. Ye, which studies the methods of improving academic literacy using interactive platforms and artificial intelligence (Ye 2024). A. Y. Bagiyan, T. A. Shiryaeva and E. V. Tikhonova offer a model of pedagogical design aimed at improving the quality of language teaching in technical universities (Bagiyan et al., 2021).

A valuable contribution to the discourse on digital language education is provided by A. Mentsiev, M. Z. Ashakhanova and P. H. Almurzaeva. They emphasize the effective use of digital technologies, which facilitates the development of language skills and enhances students' ability to communicate professionally, collaborate in digital spaces, and access specialized information in multiple formats (Mentsiev et al., 2019).

Understanding, interpreting, and producing complex technical texts in digital formats is becoming essential as engineering curricula depend increasingly on digital platforms, simulation tools, and remote collaboration technologies. This means, teachers need to teach students how to navigate digital communication environments, write collaboratively, and adjust to the changing needs of online academic and professional discourse in addition to linguistic accuracy. The main opportunities and challenges presented by digitalization in the academic setting of engineering are outlined by C. Dell'Era, S. Magistretti, and M. Candi. C. Dell'Era, S. Magistretti, M. Candi highlight that a rethinking of educational models is necessary for the successful integration of digital tools in engineering education, where interdisciplinary integration becomes crucial including language and communication training (Dell'Era et al., 2025).

I. I. Trubina considers the development of soft skills through the integration of terminology in educational programs (Trubina, 2023). V. Tarasova stresses the need to develop students' academic writing and reading skills for successful scientific activity and professional growth (Tarasova,2020).

K.A. Maspul emphasizes the crucial role of scientific and technical language proficiency for prosperous engineering and technology careers. The author stresses that poor language proficiency can cause problems with data interpretation, scientific communication, and results presentation (Maspul, 2023).

Through the use of interactive simulations, collaborative platforms, and multimedia content, students can practice academic writing in digital formats, interact with peers in real-time problem-solving, and be exposed to technical terminology in context. These methods are

in line with contemporary language education objectives, which integrate professional communication, digital fluency, and academic literacy to help develop skilled, future-ready engineering professionals. The research of H.Hubal, A. Siasiev identifies key challenges such as the need for digital infrastructure, teacher readiness, and the adaptation of didactic models, as well as the significant prospects that digital environments offer for enhancing student engagement and interdisciplinary learning (Hubal et al., 2024).

The review thus demonstrates the increasing significance of language proficiency development in STEM education through digital technologies. It draws attention to important topics like encouraging critical thinking through digital platforms, incorporating digital skills into academic literacy, and the necessity of methodical approaches in language instruction. The emphasis is on using AI and interactive tools to improve student collaboration and communication. Along with the need for proficient language skills to support scientific communication and professional success, issues like teacher preparedness and digital infrastructure are mentioned. All things considered, incorporating digital resources into STEM language instruction is crucial to producing qualified engineering professionals.

The Framework for STEM Language Training engineers

The framework has been developed in the context of integrating academic language instruction into engineering education by aligning linguistic competencies with the cognitive and communicative demands of STEM disciplines. The framework seeks to bridge the gap between technical content and language acquisition by promoting disciplinary literacy, digital communication skills, and academic discourse practices. It is intended to improve engineering students' comprehension, interpretation, and production of scientific texts, their ability to work with others to solve problems, and their capacity to express themselves clearly both orally and in writing in both academic and professional contexts. The framework intends to support the development of linguistically competent, communicatively skilled, and globally competitive engineering professionals through the integration of digital technologies, interactive methodologies, and interdisciplinary collaboration. The framework is based on linguo-didactic strategies that assist STEM professionals in developing their scientific and linguistic literacy in order to guarantee both theoretical coherence and practical applicability. Language training has been able to be systematized thanks to this classification, guaranteeing alignment with the changing demands of digital transformation and integration within the suggested framework.

At the core of the proposed framework there are the linguo-didactic techniques, which constitute its theoretical foundation and are strategically integrated into the conceptual and content blocks. These techniques perform several critical functions. Firstly, they provide a set of scientifically grounded principles aimed at the formation and advancement of STEM-specific language competence. Secondly, they inform the pedagogical framework by guiding the selection of teaching methodologies, the incorporation of digital resources, and the reinforcement of academic integrity. Thirdly, they contribute to the systematic organization of language instruction by aligning it with the evolving demands of digital transformation and the internationally recognized norms of scientific discourse. The integration of linguo-didactic techniques thus ensures the internal coherence, contextual relevance, and pedagogical robustness of the framework, supporting its applicability in the training of future technical specialists.

Table 1
Linguo-didactic techniques

No.	Name of linguo-didactic techniques	Features of linguo-didactic techniques
1	Adaptation training materials for teaching scientific and technical terminology to international standards (ISO 704, ISO 1087)	1. Adaptation of terminology training materials with the creation of scientific and technical content in line with international scientific and technical standards. 2. Application of terminology teaching strategies through an interdisciplinary approach through harmonization, standardization and definition of terms. 3. Development of terms in new areas of scientific knowledge, taking into account the seven principles of terminology according to ISO 704. 4. Training in the application of terminological rules and standards of professional scientific and technical communication using modern digital technologies.
2	Focused training in science and technology communication using digital technologies: online dictionaries, electronic glossaries and databases.	1. Focused teaching of scientific and technical terminology through the use of specialized digital technologies: online dictionaries, electronic glossaries and databases. 2. Making scientific language learning accessible and effective through the creation of interactive educational materials using modern digital technologies. 3. Using online tools to check grammar and style when writing scientific and technical texts. 4. 4. Applying AI to analyze and create scientific text to meet the requirements of scientific style.
3	Comprehensive analysis of terms used in science and technology communication training, including identification, definition and comparison of concepts.	1.Introducing integrated term analysis in science and technology communication education, including identification, definition and description of concepts. 2.Teaching integrated analysis of scientific and technical text using critical thinking techniques. 3. Applying rigid syntactic norms for logical presentation of the content of scientific and technical text. 4. Comprehensively analyze terms to identify similarities and differences at all linguistic levels.
4	Interactive learning technologies (case studies, project-based learning) for use in real-life situations of scientific and technical communication	1. Contextualize terms to understand and apply them to specific science and technology communication situations through interactive learning technologies. 2. Use associations and analogies in teaching terminology through comparisons and association maps to facilitate understanding and memorization of new terms. 3. Develop new technologies for the visualization of scientific data to improve the quality of professional communication. 4. Integrating online educational resources in the development of visual-graphic data of linguistic information for better learning and memorization of complex linguistic terms and concepts.

5	Interdisciplinary approach to scientific language teaching through harmonization and standardization of terms	1. Practical teaching of scientific language with the setting of language tasks in real situations of professional-technical communication. 2. Teaching the key features of scientific and technical text: informativeness, logicality, structure and clarity. 3. Unification of linguistic means for clear understanding and interaction of concepts. 4. Introducing methods of processing large amounts of information to ensure data security, identifying patterns, trends and relationships between data.
6	Using modern technologies to teach a scientific language - the language of inquiry	1. Using of AI to analyze and produce scientific text to improve the quality of writing and meet academic standards of scientific style. 2. Applying standardized data analysis techniques to ensure the reliability and validity of scientific and technical information and to provide accurate conclusions and recommendations. 3. Learning to use modern methods of analyzing scientific and technical information, AI and data mining technologies to analyze data effectively, developing their analytical skills and critical thinking in the context of scientific research. 4. Using virtual laboratories to optimize technological processes for experimentation and research, creating a safer and more effective environment for practical mastery of scientific language and methods of scientific presentation.
7	Scientific language in the promotion and accessibility of scientific research	1. Teaching students' effective methods of collecting and analyzing data in scientific language ensures correct interpretation of results and high standards of scientific enquiry. 2. Developing critical thinking and data analysis skills using scientific language promotes sound conclusions and strengthens scientific argumentation. 3. Interacting with colleagues from different disciplines using scientific language enables cross-disciplinary solutions to modern engineering problems and promotes innovation. 4. Knowledge of scientific language facilitates the writing of reports and publications, which increases the visibility and citation of students' work and contributes to their integration into the scientific community.

Linguo-didactic techniques with its features form the methodological foundation of the framework, guiding teaching approaches, defining language skills to be developed, and establishing evaluation criteria for effective learning (Table 1).

Results and discussion

This study aims to create an innovative framework that integrates interdisciplinary, digital and communicative approaches to enhance students' scientific literacy and research

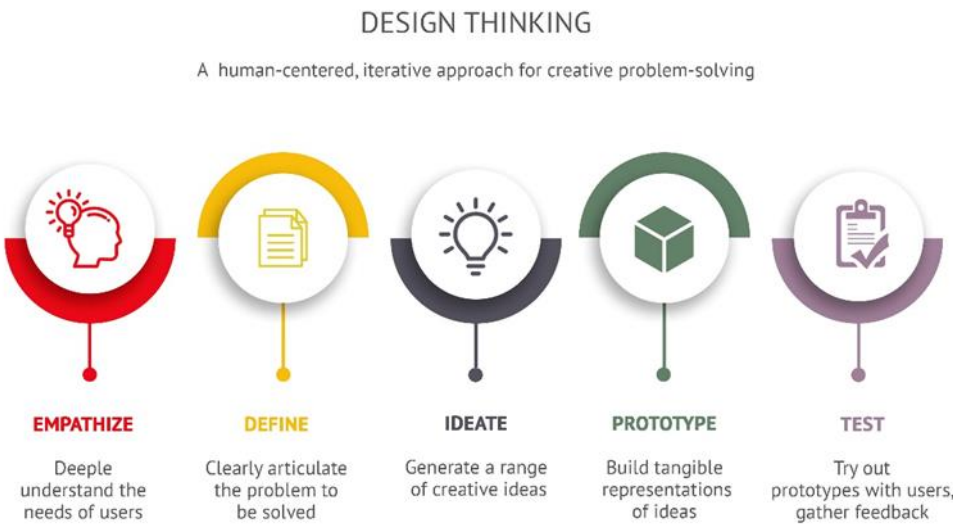
skills. The objectives include usage of contemporary approaches to scientific and professional language training, classifying linguo-didactic techniques that contribute to STEM education, developing a structured framework that includes conceptual, content, technological and evaluation blocks. Important stage is assessing the effectiveness of the proposed framework in improving students' language and research competences, and investigating the role of digital tools in promoting academic writing, terminology acquisition and scientific communication.

To put these theoretical frameworks into practice, the study uses five key methodological approaches, each chosen for their relevance to current educational challenges and their validation in current research and empirical work. These approaches were chosen for their capacity to address the multifaceted nature of language training in STEM education and for their proven effectiveness in fostering interdisciplinary competence, digital literacy, and communicative proficiency.

1. Design Thinking approach fosters critical thinking, creativity, collaboration, and the ability to solve complex engineering problems by mastering scientific concepts through hands-on experience and project activities (Guaman-Quintanilla et al., 2023). In the contemporary landscape of innovation and education, design thinking is emerging not just as a method, but as a fundamental way of thinking that is changing the way problems are framed and solutions are developed. Its collaborative, iterative and human-centered approach helps practitioners to deal with complex, ambiguous and rapidly changing challenges. Design thinking's integrity and efficacy ultimately derive from other approaches, such as interdisciplinary integration, digital and technological methodologies, communication strategies, and socio-cultural models, which provide useful additions. Design thinking ensures that innovation is not only possible and viable, but also appealing and successful, by balancing user needs with technological capabilities and business realities (Figure 1).

Figure 1

Design thinking approach



2. The interdisciplinary approach combines linguistic training with technical disciplines to guarantee contextual relevance, which promotes the use of language skills in practical engineering and scientific scenarios and improves problem-solving skills by fusing domain-specific knowledge with effective communication (Kreps, 2019). The interdisciplinary approach in this framework aims to combine language instruction with STEM subjects, guaranteeing that language learning is firmly rooted in the engineering and scientific fields. By

encouraging contextual relevance and problem-solving skills, this alignment helps students apply their language proficiency to authentic academic and professional situations.

3. The digital and technological approach makes use of AI-based tools, digital platforms, and online research databases for academic writing and analysis (Le et al. 2023. It also ensures continuous access to scientific literature, citation management, and plagiarism detection tools, while encouraging self-directed learning through adaptive and interactive digital learning environments. This method is a key part of the suggested framework, which focusses on integrating contemporary digital tools and platforms to support scientific language learning, academic writing, and research communication. The frame aims to provide engineering students with the language and research competencies they will need in a digitalized academic and professional environment. It illustrates how language instruction must be modified to meet the demands of digital transformation in STEM education.

4. The communicative approach emphasizes the practical application of scientific language in academic and professional settings, fostering peer review, collaborative learning, and structured academic writing exercises while improving students' capacity to engage in research discussions, conferences, and professional communication (Cezzar,2020). The communicative approach is essential for preparing engineering students for academic and professional communication in the real world. It emphasizes the use of scientific language in practice and focusses on building the students' capacity to communicate effectively in a variety of communicative contexts.

5. The sociocultural approach promotes adherence to international academic and publication standards while highlighting linguistic and cultural diversity in scientific communication. It prepares students for successful engagement in global scientific discourse by strengthening their capacity to manage interdisciplinary collaborations in a globalized research environment (Al Siyabi et al. 2022). This method in STEM education responds to the increasing demand for engineers to function well in cross-disciplinary and global settings.

By incorporating these approaches, the study establishes a comprehensive framework that enhances scientific and professional language training within this framework STEM specialists acquire linguistic proficiency, academic integrity, and digital competencies necessary for effective communication in technical and research domains.

The development of an effective pedagogical framework for STEM language training requires a systematic and theoretically grounded approach. In this context, the modeling method has proven to be a durable tool for the conceptualization and design of educational systems. Guided by the principles of pedagogical modeling theory, the selection of components within the proposed framework was carried out with careful attention to coherence, functional integration, and alignment with the target competencies of modern engineering education.

The framework is structured around four fundamental components: the conceptual block, the content block, the technological block, and the evaluation-result block. Each of these components performs a distinct yet interrelated function, collectively ensuring the theoretical coherence, practical applicability, technological integration, and systematic assessment of the framework’s effectiveness.

In contemporary scientific and educational models, particularly within STEM language education, the framework consistently structures around these four foundational components.

The Conceptual Block defines the fundamental principles of the framework, encompassing interdisciplinarity, digitalization, practical orientation, and a research-based approach. It establishes the theoretical foundation of scientific literacy and professional communication in STEM, ensuring that language training objectives align with contemporary challenges in STEM education (Newton et al. 2025). The Conceptual Block serves as the foundational element of the entire pedagogical model. It defines the guiding principles and

theoretical underpinnings that shape the structure, content, and objectives of STEM language training for engineering students.

The Content Block focuses on the core components of language training, including academic writing, research skills, professional terminology, and data visualization. It incorporates interdisciplinary teaching methods that integrate linguistic training into STEM subjects, enhancing students' ability to interpret, analyze, and produce scientific texts in accordance with academic standards (Varianytsia et al 2022). The Content Block of the framework outlines the core educational components necessary for developing scientific and professional language competencies among engineering students, which emphasizes the essential linguistic and cognitive skills required in STEM language training, ensuring that students are equipped to read, write, interpret, and communicate technical and scientific information effectively.

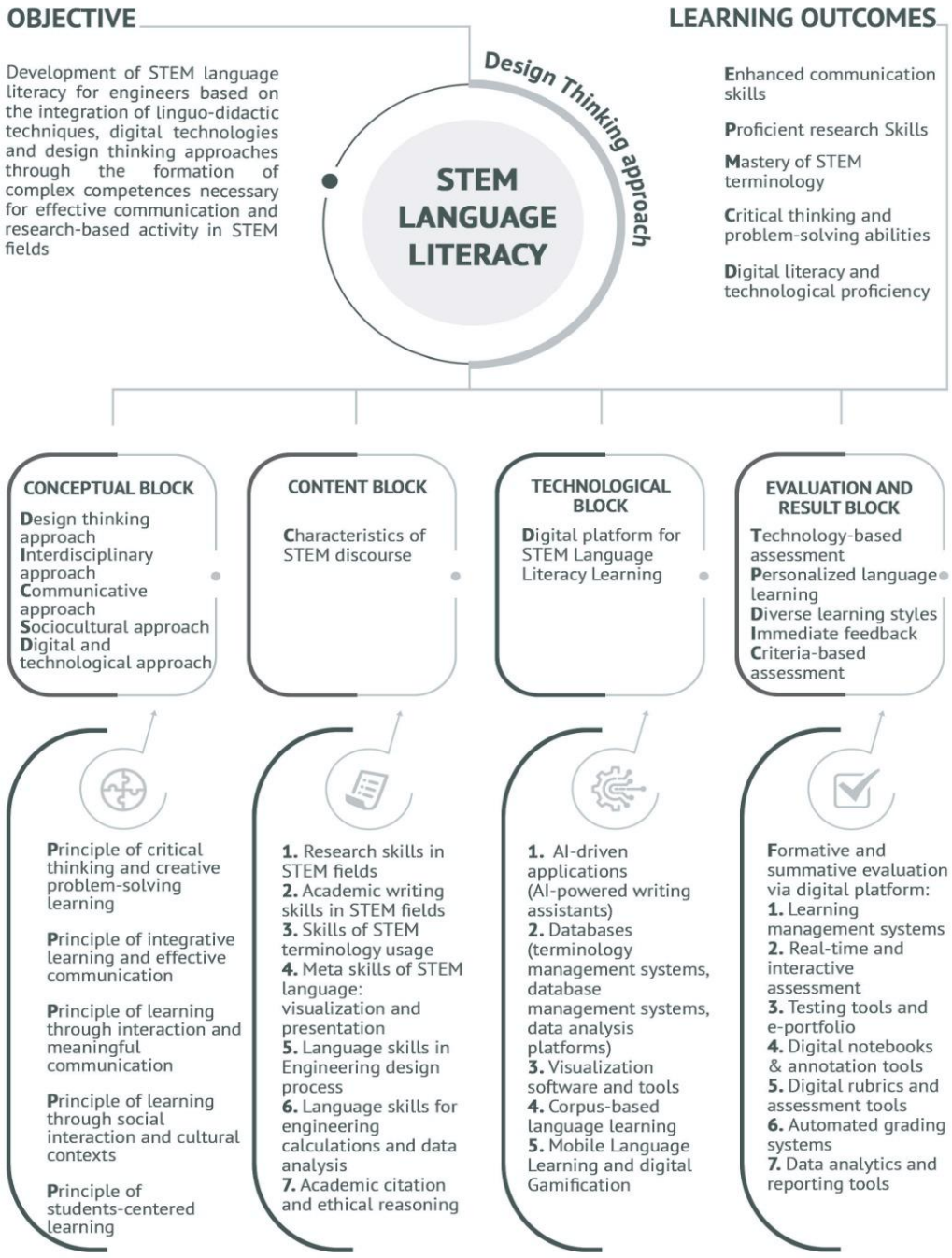
The Technological Block implements digital tools like Grammarly, Mendeley for academic writing and citation management, integrates research platforms such as Google Scholar, Web of Science, and Scopus for information retrieval and analysis, and utilizes data visualization software like Tableau, Python, and R to support the representation of research findings (Pérez et al., 2025). Within the framework, this block integrates modern educational technologies, digital tools, and AI-powered resources into the teaching and learning process and its purpose is to enhance the efficiency, accessibility, and interactivity of scientific and professional language training in STEM fields.

The Evaluation and Result Block assesses the effectiveness of language training by evaluating students' academic writing, research competencies, and use of digital tools, implements formative and summative assessment strategies to track progress in language proficiency, and ensures compliance with academic integrity standards through plagiarism detection and citation accuracy analysis (Ullrich et al.,2023). This block is a crucial component that ensures the systematic assessment and continuous improvement of language training outcomes, which provides a structured approach to evaluate the effectiveness, quality, and impact of scientific and professional language education within STEM.

These components were obtained as a result of an analytical classification of linguo-didactic techniques and methodological approaches, which makes it possible to verify that each element contributes to the holistic development of learners' linguistic, research and digital competences within the framework for STEM language training engineers.

This framework will be piloted in Abylkas Saginov Karaganda Technical university, where its effectiveness will be assessed based on academic writing proficiency, research skills, the ability to utilize scientific databases, engagement with digital tools for citation management, text analysis, and visualization, and adherence to academic integrity standards, with preliminary results indicating that integrating these approaches enhances students' ability to communicate research findings effectively, improves the quality of academic writing, and fosters a deeper understanding of STEM terminology and scientific ethics (Figure 2).

Figure 2
STEM Language Literacy model



Conclusion

The development of a comprehensive framework for STEM language training in engineering education represents a significant advancement in addressing the multifaceted challenges posed by digital transformation and globalization. By integrating linguo-didactic techniques, digital technologies, and interdisciplinary approaches, this framework not only enhances the scientific literacy and communication skills of engineering students but also

equips them with essential competencies for effective participation in a rapidly evolving global landscape.

The research conducted highlights the importance of fostering academic writing skills, research competencies, and professional communication abilities within STEM disciplines, ensuring that future engineers are well-prepared to navigate the complex demands of their profession. Moreover, the incorporation of digital tools and interactive methodologies facilitates a more engaging and effective learning experience, promoting self-directed learning and critical thinking.

The proposed framework, structured around the conceptual, content, technological, and evaluation-result blocks, provides a systematic approach to language training that aligns with contemporary educational requirements. By emphasizing the integration of digital resources and collaborative learning, the framework not only enhances the educational experience but also supports the development of a workforce that is adept at addressing real-world engineering challenges.

Future research directions will focus on the empirical evaluation of the framework's effectiveness in various educational settings, as well as the exploration of innovative digital tools, including artificial intelligence, to further enrich the learning experience. Ultimately, the framework aims to contribute to the preparation of globally competitive engineering professionals who can effectively communicate their ideas, engage in interdisciplinary collaboration, and contribute to advancements in science and technology. Through continuous refinement and adaptation, this approach has the potential to significantly elevate the standards of STEM language training and ensure the success of engineering graduates in a dynamic and interconnected world.

Conflict of Interest Statement

The authors declare no potential conflicts of interest regarding the research, authorship, or publication of this article.

Funding Information

The research has been carried out within the framework of the project funded by the Science Committee of the Ministry of Science and Higher Education of the Republic of Kazakhstan on the topic “Enhancing Scientific and Professional Language Learning for Engineering Students in Kazakhstan through Digital Technologies” (Grant No. AP19678460).

Author Contributions

Damira Jantassova: Conceptualization, Methodology, Validation, Writing-Original Draft, Supervision, Project Administration. Daniyel Damiyev: Formal Analysis, Investigation, Resources, Visualization, Writing -Review And Editing.

References

Asten, T. (2022). Discourse approach in teaching foreign language professional communication. E3S Web of Conferences. P: 1-8. DOI:10.1051/e3sconf/202236303046

Al Siyabi, J., Tuzlukova, V., Al Kaabi, K., etc. (2022). Assistive Technology in the English Language Classroom: Reality and Perspectives. Journal of Language Teaching and Research. 13(6), 1203- 1210. https://doi.org/10.17507/jltr.1306.08

Bagiyan,A.Y., Shiryaeva, T.A., Tikhonova, E.V., etc. (2021). The real value of words: how target language linguistic modelling of foreign language teaching content shapes students’ professional identity. Heliyon. 7, Issue 3,1-8. https://doi.org/10.1016/j.heliyon.2021.e06581

Cezzar, J. (2020). Teaching the Designer of Now: A New Basis for Graphic and Communication Design Education. She Ji: The Journal of Design, Economics, and Innovation. 6 (2), 213-227. ISSN 2405-8726. https://doi.org/10.1016/j.sheji.2020.05.002

Dell'Era, C., Magistretti, S., Candi, M., Bianchi, M., Calabretta, G., Stigliani, I., & Verganti, R. (2025). Design thinking in action: a quantitative study of design thinking practices in innovation projects. Journal of Knowledge Management. 29(11), 32-58. DOI:10.1108/JKM-04-2024-0424

Guaman-Quintanilla, S., Everaert, P., Chiluiza, K., & Valcke, M. (2023). Impact of design thinking in higher education: a multi-actor perspective on problem solving and creativity. International Journal of Technology and Design Education, 33(1), 217-240. DOI:10.1007/s10798-021-09724-z

Hrynevych, L. M., Morze, N. V., Vember, V. P., etc. (2023). Use of digital tools as a component of STEM education ecosystem. Educational Technology Quarterly. P. 1-22. DOI: https://doi.org/10.55056/etq.24

Hubal, H., Siasiev, A., Sipii, V. (2024). Digital Technologies in the Process of Teaching STEM Disciplines: Challenges and Prospects. Cadernos de Educação Tecnologia e Sociedade. DOI:10.14571/brajets.v17.n1.445-458

Kreps, T. V. (2019). Interdisciplinary approach in research and teaching: advantages and problems of application. Scientific bulletin of the Southern Institute of Management. DOI:10.31775/2305-3100-2019-1-115-120

Le, H.C., Nguyen, V.H., Nguyen, T.L. (2023). Integrated STEM Approaches and Associated Outcomes of K-12 Student Learning: A Systematic Review. Educ. Sci. 2023, 13, 297. https://doi.org/10.3390/ educsci13030297

Maspul, K.A. (2023). Enhancing project-based learning in STEM education with integrated technology and coding. Journal of Intelligent Systems and Information Technology. P. 16-24. https://www.researchgate.net/publication/377767708_Enhancing_Project-Based_Learning_in_STEM_Education_with_Integrated_Technology_and_Coding

Mentsiev, A., Ashakhanova, M. Z., Almurzaeva, P. H. (2019). The impact of digital technology on the study of languages and the development of digital education. DOI:10.1088/1742-6596/1399/3/033085

Newton, R., Mutton, J., & Doherty, M. (Eds.) (2025). Transforming higher education with human-centred design. 1st Edition. https://doi.org/10.4324/9781003383161

Pérez, A., McClain, S. K., Roa, A.F., Rosado-Mendinueta, N. (2025). Artificial Intelligence Applications in College Academic Writing and Composition: A Systematic Review. Vol. 30 No. 1 (2025): January-April 2025 Issue / Literature Reviews. https://revistas.udea.edu.co/index.php/ikala/article/view/355878

Siemens, G. (2020). Connectivism: A Learning Theory for the Digital Age. International Journal of Instructional Technology. http://www.itdl.org/Journal/Jan_05/article01.htm

Tarasova, V.V. (2020). Development of academic literacy in foreign language teaching. Pedagogical Sciences. https://cyberleninka.ru/article/n/razvitie-akademicheskoy-gramotnosti-pri-obuchenii-inostrannym-yazykam

Trubina, Z. I. (2023). Development of flexible skills in foreign language teaching on the basis of modern pedagogical technologies. Historical and Pedagogical Journal No. 3. https://cyberleninka.ru/article/n/razvitie-gibkih-navykov-v-obuchenii-inostrannomu-yazyku-na-baze-sovremennyh-pedagogicheskih-tehnologiy

Ullrich, M., Houy, C., Stottrop, T. et al (2023). Automated Assessment of Conceptual Models in Education. Special Issue on Teaching and Learning Conceptual Modeling. https://doi.org/10.18417/emisa.18.2

Varianytsia, L., Kostiuk, O., Prodan, I., etc. (2022). Design Thinking as an Innovative Method of Formation of Creativity Skills in Students of Higher Education. Journal of Curriculum and Teaching 2022, 11 (8), 303-310, https://doi.org/10.5430/jct.v11n8p303

Ye, W. (2024). Enhancing English Language Education in Shenzhen Polytechnic University: Strategies for Effective Teaching and Learning. Creative Education, 15(2). DOI:10.4236/ce.2024.152014

Information about authors

Damira Jantassova – PhD in Pedagogical Sciences, Associate Professor, Head of Foreign Languages Department, Abylkas Saginov Karaganda Technical University, Karaganda, Kazakhstan, e-mail: d.dzhantasova@ktu.edu.kz, ORCID 0000-0003-2595-3249 ***(corresponding author)***

Daniyel Damiyev – M.Tech, Engineer at the Foreign Languages Department, Abylkas Saginov Karaganda Technical University, Karaganda, Kazakhstan, e-mail: damiev.daniel@mail.ru, ORCID 0000-0002-4245-6810