https://doi.org/10.48417/technolang.2024.04.02
Research article

Translanguaging in Engineering Practice

Aleksandra Kazakova (✉)
University of Chinese Academy of Sciences, Beijing, Yuquan Rd, 19A, 100049, China
socphiltech@gmail.com

Abstract

Multilingualism is characteristic to engineering practice. The historical evolution of engineering implies the growing role of scientific knowledge which is explicated through the languages of mathematics, natural sciences and programming. Similarly, the contemporary organizational forms of engineering activity rely on the growing body of formalized rules and quantitative metrics, although the residuals of tacit and practical knowledge are known to persist. On the other side, engineering as collective practice is unfolding both through the formal and informal communication, which contextualizes meanings within the unique constellations of actors, institutional hierarchies, and sociomaterial assemblages. The ensemble of natural and formal languages and visualizations, and switching between different language functions reflect the complexity of engineering activities. Of special interest is the process of translanguaging, which has been studied predominantly in the context of international communication. Following the Vygotsky-Leontiev approach, translanguaging in engineering practice is discussed from the point of view of speech and collective learning. The empirical studies highlight the heuristic aspect of translanguaging. The intertwining of languages in engineering is often not seamless – the collective learning processes become explicit when the languages meet their limitations, revealing both insufficiency and complementarity, and becoming a problem or a subject of reflection themselves. The further implications for epistemology of engineering are discussed: the processes of production and explication of knowledge, the relationship between knowledge and activity, and the status of the cognitive subject.

Keywords: Engineering practice; Engineering knowledge; Activity theory; Philosophy of engineering; Engineering studies

Citation: Kazakova, A. (2024). Translanguaging in Engineering Practice. *Technology and Language*, *5*(4), 12-19. https://doi.org/10.48417/technolang.2024.04.02

УДК 62:811
https://doi.org/10.48417/technolang.2024.04.02
Научнаястатья

Транслингвальность в инженерной практике

Александра Казакова (✉)
Университет Китайской академии наук, Пекин, Юйцюань-роуд, 19А, 100049, Китай
socphiltech@gmail.com

Аннотация
Многоязычие – характерная черта инженерной практики. В исторической перспективе в инженерии возрастает роль научного знания, кодифицированного посредством языков математики, естественных наук и программирования. Аналогичным образом, современная организация инженерной деятельности опирается на растущий массив формализованных правил и количественных показателей, хотя остатки неявного и практического знания, как известно, сохраняются. Вместе с тем коллективная инженерная практика осуществляется как через формальную, так и неформальную коммуникацию, в которой смысл производится в контексте уникальных констелляций акторов, институциональных иерархий и социоматериальных ассамбляжей. Комплексность инженерной деятельности отражается в совокупности естественных и формальных языков и визуализаций, а также переключении между различными функциями языка. Особый интерес представляет феномен транслингвальности, который до сих пор изучался преимущественно в контексте международной коммуникации. В соответствии с подходом Выготского-Леонтьева, транслингвальность в инженерной практике рассматривается с точки зрения речевой деятельности и коллективного обучения. Эмпирические исследования подчеркивают эвристический аспект транслингвальности. Переплетение языков в инженерной практике не всегда бывает бесшовным – процессы коллективного обучения становятся явными, когда языки сталкиваются со своими ограничениями, обнаруживая как собственную недостаточность, так и взаимодополняемость, и сами становятся проблемой или предметом рефлексии. В статье обсуждаются дальнейшие последствия для эпистемологии инженерии: процессы производства и экспликации знания, отношения между знанием и деятельностью, а также статус познающего субъекта.

Ключевые слова: Инженерная практика; Инженерное знание; Деятельностный подход; Философия инженерии

Для цитирования: Kazakova, A. Translanguaging in Engineering Practice.// Technology and Language. 2024. № 5(4). P. 12-19. https://doi.org/10.48417/technolang.2024.04.02

INTRODUCTION

There are few professions that require as much variety of means of communication as does engineering. The combination of natural, formal and visual languages – in varying proportions – constitutes engineering both as a bulk of knowledge (engineering sciences) and as collective practice (engineering projects). As Peter Pelz (2020) argues, "the languages for engineering are spoken and written languages such as German or English, the language of mathematics, programming languages and technical drawing. But also abstract design elements such as bearing, beam, mixer are elements of a further engineering language."

The notion of translanguaging has been developed in linguistics to describe the practices of bilinguals or multilinguals using the repertoire of multiple languages. It may also point at the joint usage of the linguistic and non-linguistic elements, e.g. images. A close concept of code-switching is often used to accentuate the discrete character of languages, or the deliberate and controlled alternation between them. In this work, translanguaging is used in a wider sense – to describe the flow of communication in engineering practice, based on the intertwining of multiple languages. The structure of the paper is as follows. In the first section, the philosophical problematization of engineering languages is presented. A few approaches are discussed with no intention of exhaustive overview. The existing background of engineering studies is discussed in the second section. In the third section, some empirical evidence on translanguaging processes is interpreted from the point of view of cultural-historical activity theory. The last section concludes with the implications for the epistemology of engineering.

A PHILOSOPHICAL INQUIRY INTO LANGUAGES OF ENGINEERING

Comparing the existing approaches in philosophy of engineering, Carl Mitcham and Robert Mackey state that a linguistic one is promising, yet underdeveloped. What they are advocating is not merely linguistic philosophy of engineering, rather the philosophy of engineering language. A Wittgensteinian philosophy of engineering, for example, would study the language game(s), also questioning how many of them are present in engineering. Limiting engineering to one "game of efficiency" (or "problem-solving") seems to undermine the ideological, aesthetical, religious, and other domains of meaning. In line with Ian Hacking's "lingualism," on the other hand, Mitcham and Mackey (2010) suggest examining "engineering language – that is, the technical language of engineering – as its own special phenomenon" (p. 56). However, following the authors' goal "to consider in what ways a reflection on language within a regionalized field of human practice might contribute to advancing a philosophy of that practice" (p. 54), it must be noted that language of engineering practice is not merely *technical*. Instead, the way engineering is practiced requires an ensemble of languages to integrate technical, organizational, political, economic, and other "realities" – which implies translation between these languages.

The neglected domains of philosophy of language with regard to philosophy of engineering are discussed by Bocong Li (2022). He argues that philosophers have mostly overlooked the dramatic rise of linguistic science and its applications after de Saussure.

Nowadays, with the leading role of linguistics both in social sciences and information technologies, this isolation is no more sustainable. Within "linguistic philosophy" itself, its primary logical bias has led to little attention given to the reality of action or event (verbs and adverbs), in favor of objects (nouns) and properties (adjectives), with some exceptions, such as Donald Davidson (2001). The consequences of "neglect of action" in philosophy of language are twofold: either action itself is "dissolving" in the object world, or language is separated from the other modes of human activity, often in the form of logocentricsm. This inhibits philosophy of engineering as philosophy of practice. Bocong Li (2021) applies comparative linguistic analysis to epistemology of science and philosophy of engineering. He reveals the differences in the sentence patterns and the "noun vs. verb" ratios; and a greater amount of determinative, declarative and descriptive sentences in epistemology and normative (or imperative) sentences in engineering. In general, epistemology is a "nominal concept system," while philosophy of engineering is a "verbal concept system." However, Li Bocong's conceptual analysis considers primarily the ways of thinking and speaking *about* science and engineering rather than communication *within* scientific and engineering communities of practice. The question is, then, how these modes co-exist and translate into each other in scientific-technological projects.

Louis Bucciarelli's (2002) work provides the closest look at the use of language in engineering practice, and, at the same time, an illustration of Li Bocong's criticism of the ontologization of language. Bucciarelli suggests a "Tower of Babel" vision of the design process, in which engineers, "working for the most part alone," as he claims, construct the separate object worlds with regard to their competencies andresponsibilities, and not only "see the object differently," but also "speak different languages." Bucciarelli suggests that the division of labor in an engineering collective creates the isolated worlds of measurements, metaphors, and significance, which are "proper" for their own functions, but mutually neither commensurable nor translatable. One may wonder how such "towers" are still finished, if "one speaks structures, another electronics, another manufacturing processes, still another marketing, etc." (Bucciarelli, 2002, p. 224). To this Bucciarelli replies that, firstly, most projects face multiple failures along their way, and, secondly, there is a safe zone of "boundary objects" (material representations and visualizations, such as sketches, drawings, diagrams, charts, models, prototypes, etc.). He considers these artifacts "linguistic," since they not only convey meaning and represent something else, but their interpretations evolve in time, depending on "context and intentions."

This broader concept of engineering languages, including the non-verbal, is in line with semiotics of art, architecture, etc. However, it is unclear, how would the boundary objects do translation, if both natural and formal languages *and* visualizations are subject to changing interpretations. Also, the (natural) language demarcation is known as both a political and theoretical issue in linguistics, and the same may be said about engineering languages – are they separated by discipline, function, or paradigm? Who are the "native speakers," how are they grouped and divided, and is there any "politics" behind it? To sum up, Bucciarelli's approach seems to imply an over-heterogenization of engineering due to its focus on language ontology rather than on the practice of speaking.

EMPIRICAL STUDIES OF TRANSLATION IN ENGINEERING

The issues of translation in engineering practice have been studied mostly in terms of international communication but pursuing different directions. A first group of studies is dedicated to relativism in formal languages. The formal languages are supposed to be free of ambiguity and imprecision, serving as a universal medium in a specialized domain. The level of mathematization is associated with maturity of a scientific discipline. Since engineering is taught in mathematical language globally, it is believed to converge or at least be able to communicate without national borders, just like science. However, comparative studies reveal some cultural relativity even in disciplines that are part of the engineering curriculum, namely, statistics and probability theory (Krasnoshchekov & Semenova, 2022) and mechanics (Altenbach, 2020). While some of these cultural variations can be historically contingent (such as naming findings and processes after their authors or creators), others are explained by theoretical differences between the national schools. It may be questioned though, how persistent these conceptual differences prove to be in practical work, and whether it is not only methodologically but also ontologically relevant how a process or its result, an action or a situation, an object or a property is described. Krylov et al. (2021) claim that "[t]here is no doubt that English-language written and oral engineering texts, and more broadly English-language engineering discourse, have specific features at the levels of paradigmatics (genus – species, whole – part), at the syntagmatic level (subjective, objective, temporal, spatial relationships, relations of quality and others), as well as at the levels of rhetoric and cohesion."

A second group of studies is focused on the learning processes and the acquisition in parallel of language competencies and professional knowledge. Some studies suggest that translanguaging enables the learning process. Students demonstrate better results in the disciplines that have been taught in more than one language in comparison to those taught solely in native or in foreign languages (Airey, 2008). This might be explained by a higher reflexivity in learning: when the medium becomes problematic, it requires more effort to formalize or explicate what is already known, and this allows one to diagnose misinterpretations or one's lack of knowledge. At a later stage of professional socialization practicing engineers face the problem of translanguaging in the international collectives. The frame of communication may activate creativity or obstruct it. For example, in formal meetings conducted in English, non-native speakers tend to demonstrate less initiative and rely more on visual means of presentation. In technical writing engineers act as "consecutive interpreters" of themselves, thinking in their mother tongue and translating into English, which stimulates their precision and accuracy, but which also creates risks of simplification. In the context of informal discussion, the combination of native and foreign language seems to enable creativity, since expressing and explaining oneself in a hybrid mode without restrictions stimulates better elaboration of one's one ideas: "[b]y utilizing a more natural communicative modality, talking-it-through meant coming-to-know-while-speaking, as interlocutors metatalked and synchronized their intended personalized meaning" (Du & Zhou, 2022).

TRANSLANGUAGING IN COMMUNITIES OF ENGINEERING PRACTICE

The focus on how languages "co-operate" in communities of engineering practice – rather than in the codified body of engineering science texts – seems to be fruitful for an empirically grounded epistemology of engineering. The theories of collective learning rely to a large extent on Lev Vygotsky and Aleksei Leontievs's sociocultural perspective, according to which learning occurs in and through social interaction. This approach is characterized by three principles that are common to Marxist philosophical anthropology: the activist viewpoint (praxis), the unity of individual and collective activity, and historicism. In his classical work *Thinking and Speech* (which, symptomatically, was translated into English as *Language and Thought*), Vygotsky (1934/1962) often refers to Alexander Potebnya's idea that "the thought is not expressed but completed in the word." Not the language itself, but the practice of speech, and the contrast between "inner" speech and social speech refines human thinking.

As a part of the research on tacit knowledge and explication in engineering practice, a series of semi-structured in-depth interviews was conducted in the years 2021 to 2024 with engineering educators who were heading laboratories at technical universities in Russia and China in the fields of nanotechnologies, laser and optics, oil and gas exploration – the general study design, methodology and results of research are to be published in a forthcoming paper (Kazakova, 2024). Without aiming at a complete presentation of the research findings, some points regarding translanguaging can be noted. Situated communication and translanguaging were among the crosscutting topics in the interviews of the educators and their reflection on practical learning. The informants discuss the self-reflective process of explication and transfer of knowledge in the frame of the major communicative situations: teaching, controversy, negotiation, and translation. The functional (e.g. multidisciplinary) or hierarchical (e.g. supervisory) division of labor, i.e., lack of shared knowledge, tend to stimulate the process of explication.

The informants agree on the complementarity and non-interchangeability of natural and formal languages and visualizations (sketches, drawings, mock-ups, models, prototypes etc.), also accentuating the irreducibility of gestures which is characteristic of formal or informal face-to-face communication and which is "lacking" in the mode of distance communication. The subjective experience of insufficiency or limitation of language was compared by one of the informants to "stumbling" – a metaphor which combines delay, disruption, but also a shortcut in communication. The wider repertoire is crucial for an interdisciplinary communication – according to another informant, "[a] text [message] to a neighbor never suffices." The informants are deliberating and planning to switch between languages in their public monological speech (for example, the sequence of illustrations, calculations and verbal descriptions), but they doubt the possibility to fully control this operation in dialogical communication: As one informant noted, "the most detailed instruction ends with finger pointing." Most of the informants also tend to agree that "coming-to-know-while-speaking" occurs even in the course of highly familiar, repetitive, and relatively simple tasks. Similarly, most of them use it as

pedagogical method or heuristic technique, initiating discussions with or between their counterparts – e.g. describing the difficulties and mistakes or speculating about the functions of other participants.

These findings seem to be consistent with the general principles of cultural-historical activity theory. Since engineering "language" (be it colloquial, scientific, or visual) is inseparable from the practice of "speech," it should not be substantialized in order not to elide the more tacit processes of meaning-making in engineering. Even when participants are solving individualized problems or tasks, they are producing meaning in the context of a larger collective project, thus through a form of internalized conversation with the immediate or larger community. The individual-collective production of meaning is best understood as a dialectics of part and whole – the individual actions have meaning within a collective activity, which, on its part, is understood through personified actions. The object-world is thus neither stable nor autonomous. Interaction and dialogue imply co-tuning of the means of expression, and the expansive use of the whole repertoire available within the communicative situation. Translanguaging in this sense is seen as a means of efficient communication, but also as an insight for reflective engineering practice stimulated by external or attributed questioning.

CONCLUSION

Multilinguality is distinctive to engineering more than to other professions, since engineering unfolds in an ensemble of natural and formal languages, switching between different functions of language and also between verbal and visual communication. The formal languages have explicit rules and applications that serve to reduce the ambiguity of interpretations. The visualizations and physical models have less explicit rules of construction but provide visible evidence for comprehension. Natural language has a metalinguistic function that allows explicating both the functions and the boundaries of other languages. So far, translanguaging has been considered mostly in empirical studies of engineering education and international communication, that is, in situations when language itself is problematized. However, translanguaging may be seen as a source for the production and explication of knowledge which is characteristic of the collective and interactive nature of engineering practice. The practices of speech and intersubjective meaning-making point towards the collective learning process in an engineering community of practice.

REFERENCES

Airey, J. (2008, November 26-27) *Language and Engineering: Towards Bilingual Scientific Literacy* [Paper presentation]. Engineering Education Development 2008. Royal Institute of Technology, Stockholm.

Altenbach, H. (2020). Scientific Language – A Comparative Analysis of English, German and Russian. *Technology and Language, 1*(1), 1-5. https://doi.org/10.48417/technolang.2020.01.01

Bucciarelli, L. L. (2002). Between Thought and Object in Engineering Design. *Design Studies*, *23*(3), 219-231.

Davidson, D. (2001). *Essays on Actions and Events*. Oxford. https://doi.org/10.1093/0199246270.001.0001

Du, J. & Zhou, X. (2022). Translanguaging Practices of Chinese/English Bilingual Engineers' Communications in the Workplace. *Applied Linguistics Review, 13*(3), 389-402. https://doi.org/10.1515/applirev-2021-0021.

Krasnoshchekov, V., & Semenova, T. (2022). On the Non-Universality in Mathematical Language. *Technology and Language*, *3*(3), 73-87.https://doi.org/10.48417/technolang.2022.03.06

Krylov, E., Khalyapina, L., & Nordmann, A. (2021). Teaching English as a Language for Mechanical Engineering. *Technology and Language*, *2*(4), 126-143. https://doi.org/10.48417/technolang.2021.04.08

Li, B. (2021). *An Introduction to the Philosophy of Engineering*. Springer. https://doi.org/10.1007/978-3-662-64088-3

Li, B. (2022) Rén hé shì yǔ rén lǐ hé shìlǐ – jiān lùn jù xíng de yǔyán xué zhéxué yánjiū [People and Things, Human Reason and Things Reason – A Discussion on the Linguistic and Philosophical Study of Sentence Patterns]. *Philosophical Analysis, 13*(2), 91-104.

Mitcham, C.,& Mackey, R. (2010). Comparing Approaches to the Philosophy of Engineering: Including the Linguistic Philosophical Approach. In Poel, I., Goldberg, D. (Eds.),*Philosophy and Engineering: Philosophy of Engineering and Technology, vol 2*. (pp. 49-59). Springer. https://doi.org/10.1007/978-90-481-2804-4_5

Pelz, P. (2020). Good Engineering Design – Design Evolution by Languages. *Technology and Language*, *1*(1), 97-102. https://doi.org/10.48417/technolang.2020.01.20

Vygotsky, L. S. (1962). *Thought and Language*. The MIT Press. (Original work published 1934)

СВЕДЕНИЯ ОБ АВТОРЕ / THE AUTHOR

Казакова Александра Андреевна,
socphiltech@gmail.com,
ORCID 0000-0002-2952-8373

Kazakova Aleksandra,
socphiltech@gmail.com,
ORCID 0000-0002-2952-8373

Статья поступила 14 июня 2024
одобрена после рецензирования 28 ноября 2024
принята к публикации 15 декабря 2024

Received: 14 June 2024
Revised: 28 November 2024
Accepted: 15 December 2024