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Quantifiable structure of professional language competence

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Abstract

The competence-based approach in education has made it easier to use qualimetric procedures to assess learning outcomes. Given the fundamentally integrative nature of competencies, they tend to have more and more complex structures. This paper discusses the structure of one such competence, professional language competence, especially relevant to future technical university graduates who have to be able not only to solve professional problems but also use a foreign language to help them do this.

The purpose of this study is to find out the component-wise structure of professional language competence of future technical university graduates and show experimentally that its development level can be assessed quantitatively, thus guaranteeing its development in students.

The main research methods are pedagogical experiment, testing, method of expert group assessment. The pedagogical experiment involved 23 second-year students blogging in English on profession-related topics as part of their independent work organized with the author's pedagogical technology.

The results of the study show the effectiveness of this technology. Comparative assessments are provided of the level of different components of professional language competence as well as subcomponents of one such component.

The monitoring of the changes in subcomponents and components of professional language competence allows a teacher to identify weaknesses in linguistic training and difficulties that students face in their independent work so that one address them in a timely and systematic manner.

Keywords: professional language competence, technical university, competence-based approach, qualimetric approach, students' independent work.

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Introduction

With the *competence-based approach* having been introduced in higher education, pedagogical science now considers students' education as the development of their competencies. In Russia, the competence-based approach is typically considered an orientation towards the vector-goals of education: learning abilities, self-determination, self-actualization, socialization, and individuation (Zeer, 2005). The concept of *competence* has been introduced to empower the cooperation between higher education and labour market both of which have a number of discrepancies. To eliminate them, the idea of competence is used as a learning outcome that can be evaluated objectively. Also, the communication of educational institutions with their graduates' employers is now conducted in the language of competencies both parties share and is aimed at building "an integrated educational, professional, and cultural environment which facilitates university graduates' academic and professional mobility" (Baidenko, 2005).

The new generation of federal state educational standards in the Russian Federation establishes as planned learning outcomes a set of universal, general-professional, and professional competencies, with more focus given to universal ones. However, due to the integral and multifaceted nature of competencies, it seems reasonable that the complex process of development of many different competencies simultaneously, in particular domain-specific ones, is more important (Gareyev, 2016).

This paper analyzes the quantifiable structure of such competence especially relevant for the university training of engineers – professional language competence, which implies the ability of a future engineer to use a foreign language to solve professional problems. The main distinguishing feature of this research is that the level of a student's professional language competence development can be assessed *quantitatively*. This is achieved by the qualimetric approach which, in this research, was used to evaluate the structure of the given competence and its development level in undergraduate students (Gareyev, Shikhova, & Shikhov, 2019).

Purpose and objectives of the study

The purpose of the study is to find out the component-wise structure of professional language competence of future technical university graduates and show experimentally that its development level can be assessed quantitatively, thus guaranteeing its development in students.

Literature review

Russian researchers point out the integral nature of competence describing it as: "integration of knowledge, skills, and abilities that generate professional activity" (Zeer & Symanyuk, 2005), "ability and willingness to show flexibility under changing labour market conditions" (Galyamina, 2004), "generalized characteristic of personality" that expresses one's knowledge, skills and experience "in a specific social or professional area" (Medvedev & Tatur, 2007), "a component of human quality, a group of one's properties which determine one's ability to perform a specific group of actions" (Subetto, 2009).

The integral nature of competence is also evident due to various researchers including in its structure not only cognitive (knowledge) and operational (skills) components but also motivational, ethical, behavioural, and others. Moreover, historically the transition from knowledge-based to competence-based paradigm indicates a trend towards a gradual extension of the content of competence. For example, initially, the concept of competence was used only by linguists who mostly used the term "communication competence". Later, in the 1970-90s, the ideas of professional and social competence became more common (Zimnyaya, 2004). Today it's more common to encounter a more extensive competence like professional language competence used in this study.

In the context of the given research, the definition by Subetto (2009) seems more adequate for a number of reasons. Not only does it represent the qualimetric aspect of competence in a detailed and precise manner but it also suits the technical character of engineering training. Another advantage of his definition lies in its connection of two distinct notions, of *competence* as "knowing the language" and *performance* as its actual use in different situations, originally introduced by Chomsky (1965), thereby adding strictness in how the concept can be used in real educational procedures and pedagogical studies. Thus, from this perspective and in the context of improving the quality of technical university students, their having a certain level of competence implies what professional activities they are *able and willing* to perform, as their activities to a greater extent are practical.

Professional language competence, a term which was first introduced by Kruchinina & Mikhailova (2012), means "the ability and willingness of future specialists to solve communication problems in their professional area by communicating in a foreign language with native speakers, searching and analyzing the information needed to study a foreign experience, as well as dealing with scientific and technical literature and documentation in a foreign language in the area of the chosen specialization with the use of information and communication technologies".

Let us focus on a few details present in this definition, as they help to refine the structure of professional language competence. Here, the competence: a) includes an often-used among language teachers "foreign language communication competence"; b) has an explicit practical orientation towards solving scientific or technical problems; c) implies developed analytical skills and critical thinking; d) requires basic skills of using information and communication technologies.

Another aspect of this definition is concerned with the possibility of discerning *invariant* and *variative* parts for general and professional uses respectively which is suggested in educational standards of higher education. This aspect is of high importance to the given research, as it enables the use of individual educational trajectories for future graduates depending on their needs and goals, i.e. either going on to study for a Master's degree or getting an engineering job.

The disadvantage of structures of professional language competence in Kruchinina & Mikhailova's (2012) and other scientists' studies is the lack of objective, quantifiable evaluation of its components which is exactly what is suggested in this paper.

Methodology

The review of pedagogical literature and dissertation research has shown that the structure of professional language competence of technical university students must have three main components all of which meet the requirements of educational standards of higher education:

- *Communication* component: characterizes the ability to comprehend texts in a foreign language and apply linguistic constructions with regards to a professional or learning situation;

- *Cognitive* component: reflects the ability of self-education, self-organization, searching, analyzing, and synthesizing profession-oriented information, including one in a foreign language;

- *Domain-specific* component: points to the ability to use one's knowledge from a professional domain to perform communication tasks.

This three-component structure does not mean that each of these components is developed separately: they have separate functions but by no means genetic roots. On the contrary, the processes of thinking (cognitive component), speaking (communication component), and professional activity (domain-specific component) are closely intertwined, interact with and influence each other (Vygotsky, 1997).

For example, when translating a technical text, if a student lacks the understanding of advanced grammar in a given sentence, his or her extensive professional knowledge can make up for it, so that this student becomes able to make sense of a grammatically unclear passage.

In addition, the domain-specific component comprises two *individual educational trajectories* which correspond to future engineers' needs and goals:

- *Scientific* trajectory: focuses on the development of scientific writing skills, abilities to analyze scientific texts and compose a scientific paper based on a task performed or research conducted;

- *Technical* trajectory: implies the development of technical writing skills, abilities to translate and compose technical documentation.

The student's choice of one of these trajectories indicates a preference towards primarily scientific or technical professional activities each of which has its own features and, thus, requires the emphasis on different aspects of professional language training. It is worth noting that these two trajectories are in full accordance with the main professional tasks of engineers pointed out in educational standards of higher education.

This three-component quantifiable structure of professional language competence with its subcomponents listed below has been approved using the method of expert group assessment.

Table 1 below shows the subcomponents of each component in professional language competence. They help to identify how well each component of this competence is developed and are necessary to diagnose learning difficulties.

Table 1. Subcomponents of professional language competence

Communication component (CM)	**Cognitive component (CG)**	**Domain-specific component (DS)**
1. Understanding of vocabulary and grammar (CM-1). 2. Reading skills and analysis of profession-related written texts (CM-2). 3. Listening skills and analysis of profession-related audiovisual content	1. Ability to identify the essence of the text, including the main idea of profession-related information (CG-1). 2. Quality of searching profession-related content relevant to a given task (CG-2). 3. Ability to assess the importance of a piece of profession-related information	1. Understanding of processes and phenomena from a professional area (DS-1). 2. Experience in using professional terms in both oral and written communication (DS-2). 3. Willingness to use new professional terms (DS-3). 4. Experience in scientific or

(CM-3). 4. Writing skills and clarity of written communication (CM-4). 5. Speaking skills and clarity of oral communication (CM-5).	for a given task (CG-3). 4. Self-reflection, ability to assess the quality of one's profession-related activity (CG-4). 5. Ability to predict and produce hypotheses about a profession-related issue (CG-5)	technical writing (depending on the trajectory chosen) (DS-4).

As a result, the developed pedagogical technology allows a researcher or teacher to assess the development level of both professional language competence as a whole and its components separately. In this paper, an example of one component's assessment will be given. The levels of this competence development can be distinguished as follows:

1) *threshold* level: a student can convey *a general idea* of a text, comprehend basic professional vocabulary related to *general-professional* topics;

2) *basic* level: a student can *use* simple linguistic structures and professional vocabulary to communicate on few *professional* topics, correctly comprehend *the essence* of a professional text;

3) *analytic-synthetic* level: a student is *able and willing* to use *complex* grammar and *extensive* professional vocabulary to communicate on a few professional topics, *willing to search and analyze* profession-related information in a foreign language, *synthesize* logically coherent statements based on this analysis;

4) *predictive* level: a student is able and willing to *critically assess* statements based on one's professional knowledge, *rationalize and articulate* one's assessment to make *fact-based predictions*, ready for *creative activity*.

A pedagogical experiment to see how students' professional language competence, according to the aforementioned structure, might be developed was conducted in the 2018-2019 academic year. During the experiment, i.e. the four-month professional English course, a group of 23 second-year technical university students composed and published profession-related content for their individual blogs in English. Their participation was voluntary. Among the 23 student blog topics are mode structure control in laser cavities, effectiveness of new types of energy in Russia and the world (both – in scientific trajectory; for the example blog post on the latter, see Figure 1 below), development of simple systems on the Arduino platform, how to read electronic circuits and how electric vehicle hardware works (all three – in technical trajectory).

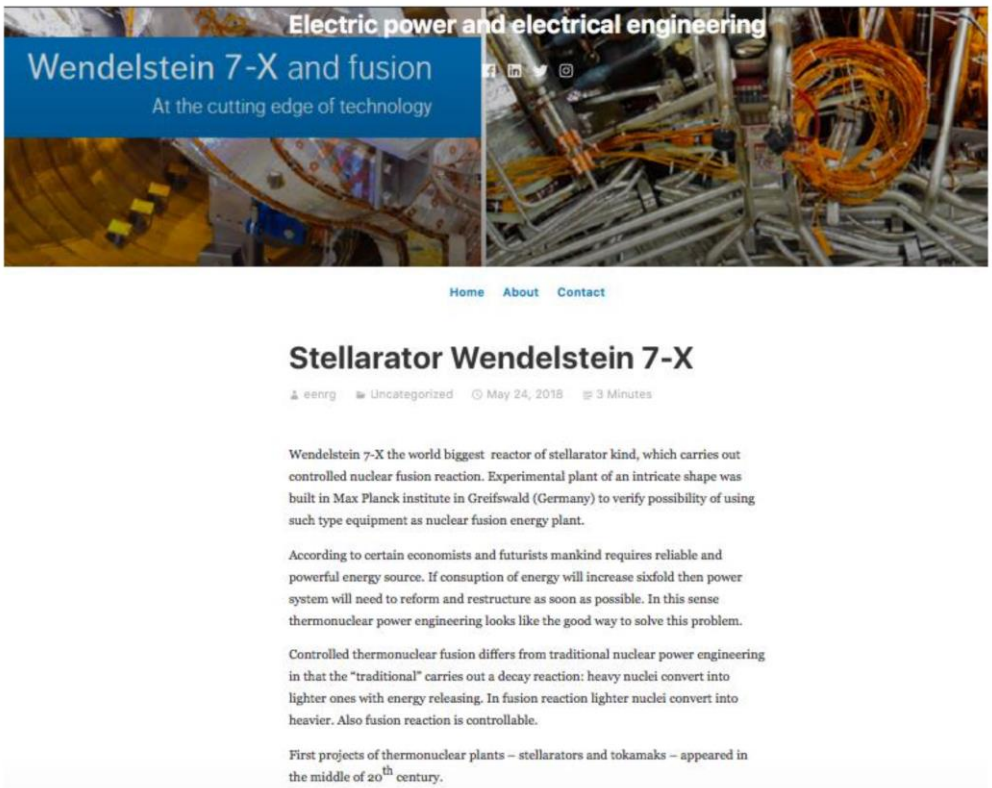

Figure 1. Example of student blog post

Results

The results of the pedagogical experiment can be seen in Table 2. In this table, the assessments of all three components of professional language competence are given at an initial (pre-experiment, IS in Table 2) and final (post-experiment, FS in Table 2) testing stages.

Table 2. Comparative assessments of the level of different components of professional language competence

Professional language competence components	**Levels of competence development**							
	Threshold		**Basic**		**Analytic-synthetic**		**Predictive**	
	Number of students (%)							
	IS	**FS**	**IS**	**FS**	**IS**	**FS**	**IS**	**FS**

Communication	39	-	52	39	9	48	-	13
Cognitive	30	9	30	30	40	43	-	17
Domain-specific	48	-	48	48	4	30	-	22

As it can be seen from Table 2, the domain-specific component is the most challenging one to acquire: this is evident both at the initial testing stage (only 4% of the students are at analytic-synthetic level, 0% at predictive level) and at the final testing stage (52% of the students are at two higher levels with 60% and 61% of the students respectively for other components). This is likely to be caused by the lack of profession-related subjects and technical English language courses during the first two years of study at a technical university.

Of all three components, the most developed one at an initial testing stage is the cognitive one (40% of the students are at the analytic-synthetic level while 4% and 9% of the students respectively are for other components). This might be explained by the analytical nature of most of the subjects studied in the first years of bachelor programs in a technical university. Communication and domain-specific components, being the least developed in students, thus show the highest growth rates (52% and 48% respectively at two higher levels compared with the 20% growth for the cognitive component).

Also, differentiated assessment for subcomponents of each competence component has been made possible. As an example, Table 3 shows comparative test results at initial (IS), midpoint (MS), and final (FS) stages of different subcomponents for the domain-specific component.

Table 3. Comparative assessments of the level of subcomponents for domain-specific component

Domain-specific subcomponents	**Levels of competence development**											
	Threshold			**Basic**			**Analytic-synthetic**			**Predictive**		
	Number of students (%)											
	IS	**MS**	**FS**	**IS**	**MS**	**FS**	**IS**	**MS**	**FS**	**IS**	**MS**	**FS**
DS-1	22	-	-	48	27	22	13	43	43	17	30	35
DS-2	30	13	-	57	44	39	13	30	39	-	13	22
DS-3	35	13	-	61	48	48	4	22	22	-	17	30
DS-4	48	22	-	48	43	48	4	35	30	-	-	22

Table 3 demonstrates that DS-1 (see Table 1 for this and other subcomponents explanation) is the easiest subcomponent to acquire (only 22% of the students are at the initial stage, 0% at the final stage, growth from 30% to 78% at two higher levels).

This, i.e. understanding of the basics of a professional area, is expected of all students at technical training programs.

DS-3 and DS-4 are more difficult to acquire. That is why both of them showed the highest growth rate (from 4% to 52% at two higher levels). The lack of willingness to use new concepts at the initial testing stage might be explained by a low number of profession-related subjects and, thus, students' experience in their self-learning of new phenomena from their professional area and the terms which these phenomena are described with. Such labour-intensive students' independent work with its further practical application (e.g., writing a course paper) begins, as a rule, at the third year of study.

With that, at the midpoint testing stage about half of the students had no experience of scientific writing (48% with threshold level at the initial stage). This seems natural for second-year students, as usually very few of them have a chance to gain experience in writing scientific papers or technical documentation. These are the activities that are common only among either the most active students or those who already do profession-related work, the latter being extremely rare for second-year students.

Positive dynamics are also seen in the DS-2 subcomponent (growth from 13% to 61% at two higher levels). The lack of experience in the use of professional terms can be explained by the lack of speaking practice on professional topics, even in Russian. This is possible since profession-oriented subjects in the first year of study are typically represented in the form of lectures where the main students' activities are note-taking and listening but not the use of this material in new contexts.

Discussion

As it can be seen from the example above, the monitoring of the changes in subcomponents and components of professional language competence allows a teacher to identify weaknesses in linguistic training and difficulties that students face in their independent work. This, in turn, points out either the need for timely support from a teacher or possible corrections to be made in the way students' independent work is organized.

Thus, the results of students' independent work, organized with the pedagogical technology developed in this study and based on student blogging in English, demonstrate high rates of development of their professional language competence which, in turn, implies the stimulation of their independent work and a higher quality of its organization.

Conclusion

As we have seen, the use of qualimetric approach and quantitative analysis of changes in students' competencies represents an active research area with a lot of potential for improvement of learning outcomes. This study, unfortunately, represents an outlier rather than a norm in how the results of teaching and learning are measured. It is partly due to the complexity of quantitative analysis, especially for ordinary non-technical university teachers, such as English teachers, partly because of the labour-intensive nature of qualimetric procedures that require the collaboration of experts from several university departments.

Still, to support teachers and experts who participate in qualimetric procedures there is plenty of opportunities to automate a part of their job. Different software applications and the potential of artificial intelligence tools give hope for the elimination of routine tasks that people now have to perform. For example, Grammarly is an application that allows a teacher to automatically assess how accurate the grammar and vocabulary of a particular student's text is without reading the whole piece.

The results of this research are far from being conclusive. So far, it is just an example of how we can be more observant of educational processes and more specific in what outcome we want to achieve from students' work. To refine and improve the technology and quantifiable competence structure suggested, more effort from other teachers and researchers is needed so that they could reproduce the results of this study and build their tools and models of how students' work can be organized more efficiently.

References

Baidenko, V. I. (2005). *Bologna process: the midway*. Moscow: Research Center for Quality Problems in Specialist Training.

Chomsky, N. (1965). *Aspects of the Theory of Syntax*. Cambridge, MA: MIT press.

Galyamina, I. G. (2004). Design of educational standards of higher education of new generation with competency-based approach. *Research Center for Quality Problems in Specialist Training*, *1*(49), 285-297.

Gareyev, A. A. (2016). The necessity of professionally oriented foreign language training of vocational education teachers (the results of the survey). *Bulletin of Kalashnikov ISTU*, *2*(19), 127-128.

Gareyev, A. A., Shikhova, O. F., & Shikhov, Yu. A. (2019). Profession-oriented blogging as the optimal teaching tool for the development of students' professional language competence. *ARPHA Proceedings, 1*, 1213-1226.

Kruchinina, G. A., & Mikhailova, E. B. (2012). Forming professional foreign language competence in students of engineering specialities under the conditions of informatization of higher professional education. *Bulletin of Lobachevsky Nizhny Novgorod University*, *4*(1), 26-33.

Medvedev, V., & Tatur, Y. (2007). Training of university teachers: competence-based approach. *Higher education in Russia, 11*, 46-56.

Subetto, A. I. (2009). The ontology of the competence-based approach in educational systemology. *Siberian Pedagogical Journal, 1*, 100-126.

Vygotsky, L. S. (1997). *The collected works: problems of the theory and history of psychology* (Vol. 3). New York: Plenum Press.

Zeer, E. F. (2005). Competency-based approach to education. *The education and science journal*, *3*(33), 27-40.

Zeer, E. F., & Symanyuk E. E. (2005). Competence-based approach to modernization of professional education. *The higher education in Russia*, *4*, 23-30.

Zimnyaya, I. A. (2004). *Key competencies as a result-goal base for competency-based approach in education*. Moscow: Research Center for Quality Problems in Specialist Training.