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Research Article

# Facilitating the Formation of Foreign Language Professionally-oriented Competence through Problem-based Learning Technology of Non-linguistic Specialty Students

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**Abstract:** This study examines the effectiveness of problem-based learning (PBL) technology in forming a foreign language professionally oriented competence of students of non-linguistic specialities. It was conducted with 60 students divided into experimental and control groups, who were taught a professionally oriented foreign language. The experimental group used PBL technology, while the control group used traditional teaching methods. The pre-and-posttests results showed that both groups demonstrated significant improvements in learning a professionally oriented foreign language. However, the experimental group demonstrated a significant improvement in retention of acquired knowledge compared to the control group. In addition, PBL technology was very interesting for the participating students, and it motivated them to study foreign languages in a somewhat more professional manner. This study provides empirical data confirming the effectiveness of PBL technology as an innovative tool in teaching a professionally oriented foreign language and in the formation of foreign-language professionally oriented competence of students of non-linguistic specialities.

**Dil Dışı Uzmanlık Öğrencilerinin Yabancı Dilde Meslek Odaklı Yetkinliklerinin Oluşumunun Probleme Dayalı Öğrenme Teknolojisi Yoluyla Kolaylaştırılması**

**Özet:** Mesleki amaçlı yabancı dil eğitimi alan ve deney ve kontrol gruplarına ayrılan 60 öğrenci ile gerçekleştirilen bu çalışma probleme dayalı öğrenme teknolojisinin, dil dışı uzmanlık öğrencilerinin yabancı dil mesleki odaklı yeterliliğini oluşturmadaki etkinliğini incelemektedir. Deney grubu probleme dayalı öğrenme teknolojisini kullanırken, kontrol grubu geleneksel öğretim yöntemlerini kullandı. Ön ve son test sonuçları, her iki grubun da profesyonel odaklı bir yabancı dil öğrenmede önemli ilerlemeler gösterdiğini gösterdi. Ancak deney grubu, kontrol grubuyla karşılaştırıldığında edinilen bilgilerin akılda tutulmasında önemli bir gelişme gösterdi. Ayrıca probleme dayalı öğrenme teknolojisi katılımcı öğrenciler için oldukça ilgi çekiciydi ve onları yabancı dilleri biraz daha profesyonel bir şekilde çalışmaya motive etti. Bu çalışma, profesyonel odaklı bir yabancı dilin öğretilmesinde ve dil dışı uzmanlık öğrencilerinin yabancı dil mesleki odaklı yeterliliğinin oluşturulmasında yenilikçi bir araç olarak probleme dayalı öğrenme teknolojisinin etkinliğini doğrulayan ampirik veriler sunmaktadır.

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## 1. Introduction

The way innovations are utilized to teach foreign languages in the twenty-first century has changed significantly due to advances in science and technology. All industries are affected by these swift developments. The education sector is among those that have profited most from applying technology. Technology is heavily utilized in education in terms of the tools and methods employed to enhance teaching and learning. In this instance, we want to highlight problem-based learning (PBL)technology as a useful method for teaching foreign languages. Innovative teaching techniques that boost students' learning motivation, deepen their comprehension, and promote collaboration and active engagement can be used with PBL technology. The educational process is incorporating new technology. PBL technology is defined as "a learner-centered form of education, based on non-structural issues in reality and the process of the learners' active problem-solving" (Chung et al., 2016). PBL technologies are considered not only PBL but also components of a broader learning system. This term is becoming more and more common. As a result, PBL can be seen in teaching a foreign language. In higher educational institutions of Kazakhstan, in the process of teaching foreign languages, more and more attention is paid to modern technologies and approaches, such as the use of PBL technologies.

### 1.1. Literature Review

The growing demand for learning foreign languages in linguistics and non-linguistic specialties has led to innovative technologies such as PBL technologies in teaching foreign languages. Several attempts have been made in the pedagogical literature to define the technology of PBL. PBL refers to several actions, such as structuring a problem situation, formulating a problem (which students gradually become familiar with), providing the necessary assistance in solving the problem, verifying the solution, and guiding the process of systematization and consolidation of acquired knowledge. Binkley et al. (2012) emphasize the critical elements of PBL, such as interacting and collaborating to solve complex problems, adapting and innovating in response to new demands and changing circumstances, and using technology to build new knowledge. "PBL often challenges students since it requires learners to engage in self-regulated learning, that includes, for example, the ability to purposefully regulate own cognitive, motivational, and emotional behavior as well as that of others for optimal learning" (Saqr, 2020). The essence of the process of PBL technology is to present and solve didactic problems to students so that they acquire general knowledge and principles of problem-solving (Schultz, 2004). The most general definition of PBL technology was formulated as a type of technology for developing learning that combines students' systematic, independent research activities with the assimilation of established scientific conclusions (Sohmen, 2020).

The goal of problem-based learning is not only for students to acquire new knowledge but also to take all possible steps to obtain it in active independent research activities. This approach contributes to forming cognitive independence, that is, the ability to set and solve non-standard tasks (Unal, 2019). The goal is to help students develop knowledge, problem-solving skills, and a desire to learn and become independent (Colliver, 2000). PBL methods were first applied in the 1960s at the McMaster University School of Medicine in Canada (Barrows, 1976). It differs from traditional lecture teaching in that it directly presents students with a large amount of specific content but does not provide a visual contextual justification for clinical application. PBL methods are a student-centered approach to teaching and curricula that enables students to identify problems and gaps in their knowledge, conduct

research, integrate theory into practice, apply skills and knowledge, and find solutions to problems (Savery, 2015). PBL methods emphasize students' ability to reconstruct and develop their own experiences, and the role of the teacher is to activate and develop students' previous knowledge so that they constantly gain new experiences. The ultimate goal of PBL is the formation of professional competence in a foreign language, which allows students with non-linguistic specialties to study independently throughout their lives and speak a foreign language fluently in a professional context (Fuhrmann, 1997). PBL is perhaps more effective than traditional memorization in developing practical skills and critical thinking. For future specialists studying under the educational program "Construction", the essential skills for actual practice are, in addition to professional skills, problem-solving and critical thinking skills, especially foreign languages. (Stewart, 1998). "PBL has been the focus of many developments in teaching and learning facilitation in recent years. It has been claimed that PBL produces independent learners who are motivated, engaged in deep learning, work as a team, and develop effective strategies, skills and knowledge for life-long learning and professional work" (Uden & Beaumont, 2006).

Strobel and Van Barneveld (2009) conducted a meta-analysis comparing PBL and traditional teaching methods and found that PBL is associated with relatively better long-term retention of knowledge, while traditional teaching methods are associated with comparative efficiency. Memorizing knowledge, while traditional teaching methods are associated with relatively short-term memorization of knowledge. Achieving long-term memorization is more useful for students trying to understand the material; therefore, PBL is a more favorable approach since it activates previous knowledge and stimulates the development of new information and its integration with existing knowledge. Educators are interested in PBL because of its emphasis on active, transferable learning and its potential for motivating students (Hmelo-Silver, 2004). Moreover, students who studied the PBL program outperformed those who used the traditional approach in studies where learning outcomes were related to academic performance and skill acquisition. "PBL is not the only successful strategy to effectively learn ill-structured and complex domains" (Strobel & Van Barneveld, 2009, p. 55). This was done so that students could study real-life scenarios as a major problem in a professional context. PBL is focused, experiential learning organized around investigating, explaining, and resolving meaningful problems (Barows, 2002). In PBL activity, "student contact hours are 3–4 times greater for educators in a PBL curriculum than for educators in a traditional curriculum" (Koh, 2008). The research questions are as follows:

1. What is PBL technology?
2. What is the purpose of studying a professionally-oriented foreign language?
3. What is the importance of PBL technology in the process of formation of foreign language professionally-oriented competence?

## 2. Method

### 2.1. Research Design

Research study design is a complex procedure for qualitative and quantitative research. Because mixed-methods designs are inherently complicated, this procedure can become considerably more difficult if the researcher employs a mixed-methods approach. This study uses mixed research methods; Creswell (2013) defines mixed research methods as collecting both quantitative and qualitative data and using various schemes, including theoretical foundations. This type of research is based on the premise that combining qualitative and quantitative methods provides a better understanding of the research problem than any of

the methods alone. In this study, quantitative data were collected through a survey, and qualitative data were collected through focus group interviews, which have been widely used as a tool for conducting qualitative scientific research in academic circles over the past 20 years. The participants were divided into experimental and control groups. Before conducting the research, the necessary ethical and official permissions were obtained from the university management.

The number of 2nd-year students in the specialty "engineering" group, 1, 2, 3, and 4, who participated in the experimental training is 60. The purpose of the experimental training was to test the hypothesis of our study, namely: understanding a foreign language professionally oriented competence as a set of inherent sub-competencies: indicative-orientating, factual-accumulating, constructive-synthesizing, as well as polemic-argumentative sub-competence; using the technology of PBL as the leading technology for the formation of Foreign Language Professionally-oriented competence (FLPOC); to form a FLPOC for second-year students of non-linguistic specialties.

During the planning and preparation of the experimental training, we had to solve the following tasks: to diagnose the level of proficiency of FLPOC students, to fill the methodological model with specific content by selecting a system of tasks based on the principles of teaching construction that we have identified, and to select educational material for the proposed tasks; to organize educational and practical activities of students on the formation of FLPOC based on the proposed model; to test the effectiveness of the model developed by us by conducting post-experimental diagnostics of the level of formation of research competence among students of language specialties.

To test the hypothesis of this study and to ensure the reliability and scientific validity of the experimental results, we have defined the function of control groups: the control groups had to demonstrate the effectiveness or the efficiency of the proposed model; the control groups were to be taught a professionally oriented foreign language, taking into account the development of a foreign language professionally oriented competence that determines it, within the framework of a traditional methodology without using PBL technology; control groups had to take part in pre- and post-experimental sections to compare the level of formation of FLPOC with a similar level in experimental groups that were trained according to the proposed model.

### 2.2. Participants

The experimental group participants are second-year students studying at the Faculty of Engineering of M. Auezov South Kazakhstan University. Each group (i.e., experimental and control) consisted of 30 students. The experimental group consisted of 30 students, and the control group consisted of 30. The study participants are familiar with traditional teaching methods but not with the methodology of PBL: according to the Pan-European Scale of Language Competencies (CEFR), the level of foreign language proficiency of second-year students should be B2-C1. We selected second-year students because, according to the educational program, only second-year students can study professionally-oriented foreign languages. Students using PBL methods were interviewed in groups to get their opinions on the experience.

### 2.3. PBL protocol

Based on the same review, protocols for using PBL methods were developed. The identified topics related to PBL elements include small group learning, problem-solving, active learning,

considering problems in context, writing reflections and using the latest technologies. The PBL protocol was developed based on students' group work and included elements of PBL. The protocol incorporates the core values of PBL into the guiding principles of professional education in foreign languages. The protocol can be used as a guide for teaching academic disciplines to develop critical thinking in professional practice. The course usually consists of one semester lasting 15 weeks. The content of training in the new mode includes the main components of PBL (see Appendix A).

### 2.4. Data Collection

The experiment was carried out following the developed protocol. For all courses, the course content was structured in two modules, each presented as a control point for tracking the learning process. The main components of PBL were included in the content of the resources. Topics and problem scenarios simulated the most common problems in an authentic context. The topics and approximate problem scenarios of the two modules are shown in Appendix B. Data on the impact of PBL technology on students was collected through questionnaires, focus groups of interviews, and a detailed study of relevant documentation, such as reflective journals and presentations.

Independent sampling criteria are used to determine the average scores of the experimental and control groups on the students' tests before, after and during subsequent (retention) tests. Focus group interviews are recorded and analyzed using content analysis techniques: five students are interviewed immediately after the intervention in one group session. A total of 30 students were interviewed to participate in the study. Each group interview is recorded within 10-15 minutes. Each interview is saved on mobile devices as an audio file that can be listened to later. After the interview, the audio files are decrypted, and their contents are analyzed according to the recordings. Qualitative data obtained during interviews and focus groups are analyzed and encoded in such a way as to identify topics and categories that arise in connection with the research topic. Bottom-up inductive coding: the approach without pre-defined codes is preferable. Due to the small sample size, two researchers encoded the data manually. English language teachers analyzed the data to improve the reliability of the qualitative data analysis. First, the interview data for each focus group was analyzed separately. The researchers searched for significant topics that repeatedly arose concerning the questions. Based on the data obtained, preliminary categories were identified and divided. The preliminary categories are then compared between the participants, and the researcher analyzes these categories.

The experimental training took place from September to December 2023. A total of 15 classes (60 hours) were held according to the schedule in the natural learning environment of the university. At the end of the experimental training, it was necessary to find out how reliable our hypotheses were and to check the model's validity for the formation of foreign language specialization of non-linguist students.

At the planning stage of experimental training, a distinction was made between variables and non-variable values. The variables in the experiment were a model based on the methodology of PBL proposed by us for the formation of foreign language specialization of students of non-linguistic specialties, which was implemented in the experimental group. The experimental and control group variables were the task system we developed, the number of hours and one teacher. In the control group, during the experimental training, we followed the traditional methodology of forming the foreign language specialization of students of

non-linguistic specialization. All the tasks performed pursued the same goals and results as the experimental group, but the problem-solving approach differed. The course and training content in the experimental group were built per the proposed model for forming students' professional competence in foreign languages.

*2.4.1. Focus group interviews*

According to a growing number of studies, focus group interviews are among the most frequently used qualitative data collection methods. Semi-structured questions were asked to conduct an in-depth analysis of the ideas of the experimental group participants about the use of PBL technology.

## 2.5. Data Analysis

*2.5.1. Quantitative analysis*

With the help of descriptive statistics, students' assessments of the effectiveness of using PBL methods to study a specialized foreign language were analyzed. The psychometric properties of the questionnaire have been verified. The internal consistency and correlations between the total number of elements were checked for reliability and validity. Using methods of statistical calculation and mathematical forecasting, the level of formation of foreign-language professionally oriented competence among students of non-linguistic specialties in percentage terms, we calculated using the formula:

$$X = \frac{C.a. * 100}{Tn}$$

Where X is the level of formation of a foreign language professionally oriented competence in %; C.a. is the number of correct answers; Tn is the number of students who took part in the test multiplied by the number of tasks. The students' work was subjected to a thorough analysis and comparison. The results of the pre-experimental diagnosis are shown in Tables 3 and 4.

*2.5.2. Qualitative analysis*

All interviews in focus groups were recorded on an audio medium and transcribed, including an electronic portfolio and a template for data collection. All the high-quality data has been subjected to analysis. The researcher reread all the data. The arising topics were systematically recorded, and the data were systematized and compared by category. Using the logic of replication and pattern matching, an in-case analysis and case-by-case analysis were carried out to identify processes and results of the PBL protocol in teaching a foreign language.

## 3. Findings

Compared to traditional teaching methods, PBL methods are considered an effective, realistic and practical way to expand the potential of critical thinking and participation in social life. Examples of quotations are given below.

> S5: *I have acquired a range of knowledge and skills in three stages of problem-based learning. The stages of working on theory and practical skills required me to link the acquired knowledge with practical activities. This process has taught me how to move from theory to practice.*(EG)

S10: *This forced me to actively seek resources to research issues related to my professional activities. It was very interesting. I could ask questions and discuss my project with the teacher.* (EG)

S15: *I had the* opportunity *to put my theoretical knowledge into practice. I was able to remove the barriers by trying to solve a professional problem.* (EG)

Focus group interviews have shown that students find the learning process effective because it provides interaction and exchange of ideas, increases their involvement, and inspires them. The students thought that learning is a collective process involving interaction and mutual exchange of information. As part of the project, students supported each other in identifying and solving problems in their professional contexts." Examples of quotations are given below.

S7: *Together, we discussed concepts and generated ideas. If someone did not understand the essence of the question, another classmate helped clarify and explain it.*(EG)

S13: *We learned how to work together and solve different types of problems. In the future, we will be able to work with other professionals and team members. It is essential to involve everyone in the interaction process and encourage them to express their thoughts and concerns about the issues being discussed.* (EG)

Before initiating experimental training, it was necessary to determine the characteristics of the experimental and control groups and to diagnose students' readiness level to perform professional activities in a foreign language. These data were obtained based on the analysis of academic performance in the third semester of 2023 and are presented by groups in Tables 1 and 2.

Table 1.
*Distribution of students by control groups*

| Faculty / specialty | Groups | The average score on the POFL | Distribution by groups in the experiment | Number of students |
|---|---|---|---|---|
| 1.Engineering | 1 | 3.2 | CG 1 | 15 |
| 2. Engineering | 2 | 3.7 | CG 2 | 15 |

Table 2.
*Distribution of students by experimental groups*

| Faculty / specialty | Groups | The average score on the POFL | Distribution by groups in the experiment | Number of students |
|---|---|---|---|---|
| 1. Engineering | 3 | 3.2 | EG 1 | 15 |
| 2. Engineering | 4 | 3.6 | EG 2 | 15 |

According to the data provided in Tables 1 and 2 on the academic performance of students of the control and experimental groups, the average score of the control groups (3.6) was slightly higher than that of the experimental ones (3.3).

Within the pre-experimental assessment section framework, we tried to determine the level of formation of sub-competencies that are part of students' foreign-language specially-oriented competence and developed appropriate parameters for this. Thus, to assess the level of formation of educational-oriented sub-competences, parameters of logical and semantic

interpretation of information were introduced; to assess the level of formation of fractographic sub-competences, a parameter for choosing the optimal way to solve the problem was introduced; parameters of constructive and complex competence to assess the level of formation, we considered it possible to introduce the parameter of the ability to identify high-quality information based on PBL methods, and to assess the level of formation of polemical and argumentative sub-competencies, to introduce the parameter of the ability to apply the data obtained in practice;

Table 3.

*Experimental group 1 and 2 (pre-experimental diagnostics)*

| Parameters for assessing the formation of competencies | EG 1 | | | EG 2 | | |
|---|---|---|---|---|---|---|
| | Total number of students | Number of correct answers | The level of competence formation % | Total number of students | Number of correct answers | The level of competence formation % |
| Logical and semantic interpretation of information | 15 | 8 | 2.7% | 15 | 7 | 2.3% |
| Choosing the optimal way to solve the problem | 15 | 7 | 2.3% | 15 | 5 | 1.7% |
| The ability to isolate high-quality information based on PBL technology | 15 | 6 | 2.1% | 15 | 6 | 2.1% |
| The ability to apply the obtained data in practice | 15 | 6 | 2.1% | 15 | 7 | 2.3% |

The average indicator following the table of the pre-experimental cut of EG 1 was 2.3%, EG 2 was 2.1%. The final overall score is 2.2%.

Table 4.

*Control group 1 and 2 (pre-experimental diagnostics)*

| Parameters for assessing the formation of competencies | CG 1 | | CG 2 | | | |
|---|---|---|---|---|---|---|
| | Total number of students | Number of correct answers | Total number of students | Number of correct answers | Total number of students | Number of correct answers |
| Logical and semantic interpretation of information | 15 | 8 | 2.7% | 15 | 7 | 2.3% |
| Choosing the optimal way to solve the problem | 15 | 8 | 2.7% | 15 | 7 | 2.3% |
| The ability to isolate high-quality information based on PBL technology | 15 | 7 | 2.3% | 15 | 6 | 2.1% |
| The ability to apply the obtained data in practice | 15 | 7 | 2.3% | 15 | 7 | 2.3% |

The average indicator in accordance with the table of the pre-experimental section of CG 1 was 2.5%, CG 2 – 2.25%. The final total is 2.375%.

Table 5.

*Experimental group 1 and 2 (post-experimental diagnostics)*

| Parameters for assessing the formation of competencies | EG 1 | | | EG 2 | | |
|---|---|---|---|---|---|---|
| | Total number of students | Number of correct answers | The level of competence formation % | Total number of students | Number of correct answers | The level of competence formation % |
| Logical and semantic interpretation of information | 15 | 15 | 5% | 15 | 13 | 4.3% |
| Choosing the optimal way to solve the problem | 15 | 12 | 4% | 15 | 12 | 4% |
| The ability to isolate high-quality information based on PBL technology | 15 | 12 | 4% | 15 | 12 | 4% |
| The ability to apply the obtained data in practice | 15 | 14 | 4.6% | 15 | 13 | 4.3% |

The average indicator by the table of the post-experimental section of EG 1 was 4.3%, EG 2 - 4%. The final overall score is 4.2 %

Table 6.

*Control group 1 and 2(Post-experimental diagnostics)*

| Parameters for assessing the formation of competencies | CG 1 | | | CG 2 | | |
|---|---|---|---|---|---|---|
| | Total number of students | Number of correct answers | The level of competence formation % | Total number of students | Number of correct answers | The level of competence formation % |
| Logical and semantic interpretation of information | 15 | 10 | 3.3% | 15 | 9 | 3% |
| Choosing the optimal way to solve the problem | 15 | 9 | 3% | 15 | 8 | 2.6% |
| The ability to isolate high-quality information based on PBL technology | 15 | 8 | 2.6% | 15 | 9 | 3% |
| The ability to apply the obtained data in practice | 15 | 11 | 3.6% | 15 | 10 | 3.3% |

Following the results of the post-experimental section of CG 1, the average indicator was 3.2%, CG 2 – 3%. The final overall indicator is 3.%. Thus, as can be seen from the table above, the dynamics of the formation of foreign language professionally-oriented competence in the experimental and control groups are markedly different. The students of the experimental groups showed a noticeable improvement in all the tested parameters, while the control groups did not demonstrate significant improvement in the tested skills. To visually compare the results of pre-and post-experimental diagnostics, we have compiled the following comparative tables 7 and 8

Table 7.
*Results of pre-and post-experimental diagnostics*

| Parameters of competencies | | EG 1 | | CG 1 | |
|---|---|---|---|---|---|
| | | The average indicator, % | The difference in the growth of indicators, % | The average indicator, % | The difference in the growth of indicators, % |
| Logical and semantic interpretation of information | Pre.<br>Post. | 2.7%<br>5% | +2.3 | 2.7%<br>3.3% | +0.6 |
| Choosing the optimal way to solve the problem | Pre.<br>Post. | 2.3%<br>4% | +1.7 | 2.7%<br>3% | +0.3 |
| The ability to isolate high-quality information based on PBL technology | Pre.<br>Post. | 2.1%<br>4% | +2 | 2.3%<br>2.6% | +0.3 |
| The ability to apply the obtained data in practice | Pre.<br>Post. | 2.1%<br>4.6% | +2.5 | 2.3%<br>3.6% | +1.3 |
| The average indicator, % | Pre.<br>Post. | 2.2%<br>4.3% | +2.1 | 2.4%<br>3.2% | +0.8 |

Table 8.
*Results of pre- and post-experimental diagnostics*

| Parameters of competencies | | EG 2 | | CG 2 | |
|---|---|---|---|---|---|
| | | The average indicator % | The difference in the growth of indicators% | The average indicator% | The difference in the growth of indicators% |
| Logical and semantic interpretation of information | Pre.<br>Post. | 2.3%<br>4.3% | +2 | 2.3%<br>3% | +0.7 |
| Choosing the optimal way to solve the problem | Pre.<br>Post. | 1.7%<br>4% | +2.3 | 2.3%<br>2.6% | +0.3 |
| The ability to isolate high-quality information based on PBL technology | Pre.<br>Post. | 2.1%<br>4% | +2 | 2.1%<br>3% | +0.9 |
| The ability to apply the obtained data in practice | Pre.<br>Post. | 2.3%<br>4.3% | +2 | 2.3%<br>3.3% | +1 |
| The average indicator% | Pre.<br>Post. | 2<br>4% | +2 | 2.2%<br>3% | +0.8 |

The average growth rates of the level of formation of the FLPOC indicate a higher quality of possession of this competence in experimental groups, which is explained by the results of experimental training. In this regard, the experiment can be considered a success. The following are graphs of the results of the pre-and post-experimental sections of the control and experimental groups.

## 4. Discussion and Conclusion

An analysis of the students' responses shows that answering the first question of the questionnaire, most students agreed that a professional foreign language is an important component of educational practice, especially for future non-linguists, but could not give a

rational explanation for this statement. The percentage of respondents evaded the answer to this question is 38%, and 9% only agreed with this statement but did not substantiate this provision. 13% of the surveyed students stated that the use of PBL technologies is necessary for the formation of professional competence in a foreign language; 18% believe that PBL technologies are implemented in a professional context to study existing knowledge in a foreign language or to discover new knowledge; 2% believe that PBL technologies should be used to identify and identification of existing problems and their solutions; 3% believe that PBL technologies affect all areas, covering methodology, the discovery of new knowledge, to improve the educational process, study the characteristics of students and solve existing learning problems. As for the ability to pose a problem, the majority of respondents (55%) noted that they could not pose a problem, which indicates that this group of respondents does not have sufficient information on this topic; 20% of respondents ignored this task, and only 19% identified the problem facing a specific question. It should be noted that these problems were primarily descriptive in nature, although they were able to do so. The results of the answers to the question about existing methods of teaching foreign languages and the scope of their application showed that 68% of respondents evaded the answer to this question, 5% gave irrelevant answers, 6% of students named only one familiar method of teaching foreign languages, and 15% indicated no more than four methods of teaching foreign languages. Based on these indicators, it can be concluded that personal motivation for learning a foreign language in a professional context among students of non-linguistic specialties is at a low level; students do not understand the purpose and scope of studying a specialized foreign language and do not know the relevant concepts.

As for the ability to solve problems in a professional context that requires further study and research, 50% of the audience did not complete the relevant tasks at all, and the rest of the students offered very superficial solutions to the problems posed, simply paraphrasing or using the same expressions for the information provided in the questionnaire, did not analyze the described problems and possible solutions, did not we predicted possible ways to solve specific problems. The student's answers were based solely on available information, without a deep understanding of the problem. Answering a question that requires the ability to analyze the current state of a particular problem or phenomenon, the majority of students, 50%, noted the growing popularity of English as a foreign language in particular and compared this fact with progress in education. In comparison, about 30% of respondents evaded the answer to this question. None of the students adequately assessed the current state of foreign language education regarding existing problems, their causes, solutions and prospects. It was concluded that the students' views on the current state of foreign language education are highly superficial.

In order to assess the ability of students to evaluate the information received critically, that is, to read the definition and ask whether they accept or reject the presented points of view, two different definitions of the concept of "PBL methods in professional foreign language teaching" and different questions representing diametrically opposite points of view on this concept were intentionally used. Nevertheless, the answers to these questions showed that 20% of students agreed that PBL methods are effective in professional foreign language teaching. At the same time, another definition supported the view that using PBL methods is not effective enough in professional foreign language teaching. Most students (60%) ignored both questions, and 27% answered only one or the other but unanimously supported the first definition, and only 1% supported one definition and rejected the other.

If we talk about the ability of students to use problem–based learning technology, then, for example, answering a question about the main characteristics of PBL, approximately half of the students(51%) avoided answering this question, the number of students who answered correctly was only 5%, the rest of the answers were incorrect. This test showed that most students surveyed are unfamiliar with this technology and its capabilities.

In this study, the structure and protocol of PBL for teaching a professionally oriented foreign language in higher educational institutions were developed and tested. The central stages of PBL, as indicated in this structure, are (1) knowing the problem scenario, (2) identifying knowledge gaps, (3) developing resources, and (4) reflecting on knowledge gained. The PBL model has been criticized as overly focused on problem-solving rather than learning, as it adheres to a hypothetical-deductive approach. Other approaches may pay more attention to identifying and filling knowledge gaps. In addition to selecting only one or two models, in this study, a structure based on the generalization of evidence was developed, constructed, and tested.

The structure and protocol developed in this study emphasize learning, built on the integration and generalization of evidence. As in the literature, the PBL approach has been widely interpreted, and practice has varied in different contexts. The technology of PBL is mainly presented in the literature as a set of concepts with rigid procedures, specific guidelines, and practical procedures that could be followed in practice. This study adds a practical way to incorporate PBL technology into teaching.

The results of checking the relevance and effectiveness of our proposed model for the formation of foreign-language professionally oriented competence among students of non-linguistic specialties, which was tested in the process of experimental training at the M.Auezov South Kazakhstan University, are presented. The organization of experimental training was preceded by a preparatory stage, which consists of diagnosing the state of formation of FLPOC and the skills included in it among students, carried out by observing the activities of the subjects, conducting conversations with teachers, selecting specific groups; preparing teaching and control material. Before applying the model we developed in practice, we had to determine the current situation regarding students' proficiency in foreign language professionally oriented competence and its sub-competencies and skills in particular. The availability of this knowledge allowed us to determine further actions within the framework of forming the competence mentioned above and their sequence. To solve this problem, we selected a questionnaire method and developed a pre-experimental test section consisting of 15 tasks, each of which allowed students to show certain skills in the process of solving the task and the extent to which students scoped with the tasks set allowed us to judge the formation of skills to be tested.

This is the first study systematically examining the use of PBL technology in teaching a professionally oriented foreign language. Although PBL as a method has been implemented in more than 100 countries and has been developing for over three decades, there has been no evidence base for effective pedagogy of teaching a professionally oriented foreign language for a long time. This study presented the construction of a structure based on the literature review on PBL and an extensive qualitative study of 60 students in real conditions in a professional context. This structure can potentially inform teachers, practitioners and researchers about the components of an effective methodology for using PBL technology to teach a professionally oriented foreign language.

At the end of the experiment, a post-experimental diagnosis of the level of formation of students' FLPOC was carried out in parallel in experimental and control groups. The types of tasks for the post-experimental section were similar to those used for pre-experimental diagnostics but were filled with new content. The objectivity of the results of post-experimental diagnostics is based on the mathematical processing of the data obtained. The results of the assessment of the level of proficiency of foreign language professionally-oriented competence students in the experimental and control groups are shown in Tables 7 and 8.

The survey result demonstrated that students perceived PBL as an effective method of teaching and learning, which increased competence in the professional field and promoted interaction and exchange between students. As follows from the answers to the open questions, the students were satisfied with their deeper understanding of the knowledge gained due to the learning process. Students were actively involved in the learning process, which was perceived as inspiring. The technology of PBL addressed the student's needs in the learning process. However, several students suggested that the teacher should have talked more about the relevant skills and knowledge rather than allocating much time for consultations and facilitation.

Thus, the results of the experimental work were presented below: The selection of control and experimental groups with different performance indicators was carried out: the average score of the control groups turned out to be slightly higher than the average performance of the experimental groups. A pre-experimental diagnosis of the state of formation of FLPOC in students was carried out, for which a pre-experimental section consisting of 15 tasks was developed, the completion of each of which requires students to possess one or another skill that is part of the FLPOC. Thus, we checked the students' general knowledge of FLPOC, the ability to determine the ideological content of professional activity, the ability to set achievable goals, the ability to identify solutions to a problem, the ability to analyze the information received, the ability to navigate information flows in the field of the problem being studied, the ability to identify the main problem; the ability to find problems or phenomena subject to further research, the ability to analyze the existing state of a problem or phenomenon, predictive skills; the personal interest of students in their future profession and the expectations associated with their future profession were assessed. According to the results of the evaluation of the pre-experimental section, the average index of FLPOC formation in the control groups was 2.3%, and in the experimental groups – 2.1%. The developed set of communicative tasks for forming FLPOC is filled with content. The experiment results have been processed, demonstrating the effectiveness of our proposed model of FLPOC formation.

## Note on Ethical Issues

Ethical permission for this study was attained from M. Auezov South Kazakhstan University's Ethical Committee on 28/08/2023.

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## Appendix A.

*The main components of problem-based learning*

| Weeks | Knowledge acquisition | The evolving phases | Stages of PBL | Embedded PBL elements |
|---|---|---|---|---|
| 1,5,9 | Conceptual learning | Checkpoint 1/2/3 - Knowing the scenario | Knowing the problem | Seeing the problems in context |
| 2,6,10 | Active, practical and experiential learning | Checkpoint 1/2/3 – problem analysis and generate hypothesis | Identifying facts<br>Identifying knowledge deficiencies | Small group learning<br>Tutoring<br>Problem-solving<br>Active learning<br>Seeing the problems in context<br>Using technology |
| 3,7,11 | Active, practical and experiential learning | Checkpoint 1/2/3 – self-directed learning | Develop resources<br>Gain insights<br>Apply new knowledge | Small group learning<br>Tutoring<br>Active learning<br>Seeing the problems in context<br>Problem-solving<br>Using technology |
| 4,8,12 | Active, practical and experiential learning | Checkpoint 1/2/3 - reporting | Reflecting on knowledge gained | Small group learning tutoring<br>Problem-solving<br>Reflection<br>Using technology active learning |
| 13,14,15 | Active, practical and experiential learning | Conclusion and consolidation | Reflecting on knowledge gained | Problem-solving reflection<br>Using technology |

## Appendix B.

*The content of the course*

| Week | Themes | Problem scenario sample |
|---|---|---|
| I Module-Engineering | | |
| 1 | Parts of a building | By state order, Builders erected a shopping and entertainment center in the city center next to the house. The designers made mistakes. They did not consider the conditions and characteristics of the foundations, and all the necessary measures for the preparation of construction production were not carried out. There were vibrations and rising groundwater during the construction of the shopping center pancake of this building. All these mistakes led to the destruction of the famous architectural monument. |
| 2 | Civil engineering | Two nearby buildings in the city suffered large deformations of the foundations of the foundations from a nearby object; in the future, there was a separation of the building structure altogether. Numerous cracks were also found on the building in the brickwork throughout the facade. An examination was carried out to identify deformations, and a conclusion was reached. First of all, these mistakes were made due to the negligence of the designers, who inattentively studied the primary documentation. The measures to strengthen the nearby building were not taken into account. |
| 3 | Geotechnical engineering/ Transportation engineering | Six-storey rectangular building. The building was reconstructed, and two eight-storey wings were included, closely adjoining the old hotel building. The old building was richly decorated with natural stone and had to be preserved. However, the wings adjacent to the building were massively designed, and the draft reached a dangerous value of about 20 cm in |

| | | |
|---|---|---|
| 4 | Environmental engineering | Construction of an industrial building near an existing building. The new building is adjacent to the previously built building in a dense. Taking into account all the loads from columns and building structures, as well as the presence of very weak soils, it was decided during the new construction to erect pile foundations from driven piles 14 m long. The existing building was built on nine-meter piles. The sinking of new piles was very dangerous for all the structures of an existing building. |
| 5 | Construction engineering | For example, the company has a large order to manufacture an automatic line. However, individual units and assemblies are not sufficiently developed and require improvement. The alternative is as follows: either a long but reliable way of debugging individual units or relatively fast production of the entire line at once, for which the customer is already paying much money, which has a beneficial effect on the financial situation of the engineer himself. What to do? To argue with the boss, whose prestige depends on the timing of the order? Give information to the customer without informing the management of your company? Be silent? |
| 6 | Careers | This is a typical problem when designing new equipment. The device is designed the old-fashioned way. Where electronics can be used, mechanics or hydraulics are used. The engineer understands that it is necessary to take a risk and try it to break into the new design market. However, the bosses fear failures, inactivity, and unreliability, so they "drive" an outdated but already proven option. What should an engineer do? Accept it? To conduct research yourself? Looking for sponsors? |
| 7 | Education and Licensure | There is an eternal dispute about quality, quantity, and cost. There are two ways to fulfill any order. The first is to design and manufacture powerful, reliable and durable things. The second is to simulate strength, reliability and durability by using externally similar materials and design solutions (color, shape, mass, speed, etc.). At the same time, the primary attention is paid not to the product itself but to advertising and packaging. Many firms in the so-called developing countries have gone this way: a variant of the "yellow assembly" of personal computers, toys from China, etc. What should an engineer in the company do according to the second option? Don't think about the consequences. Fight for quality improvement? Quit your job? |
| II Module – Construction | | |
| 8 | Construction engineers | A domestic company offers an organization (possibly a state-owned one) its own invention for use in the production of products. The invention promises high efficiency and low implementation costs. However, the organization will negotiate the purchase of similar products in one of the Western countries, and its representatives will travel to this country shortly. The engineer, who should evaluate the proposal as an expert, is reminded of the priority of developing ties with this country (political aspect) and managers' interest in the trip (personal aspect). How should an engineer behave if the effectiveness of a domestic invention is apparent to him? |
| 9 | Buildingconstruction | The engineer is expected to make an unbiased decision in the client's interests, but engineers have their own interests (related to the investment of money, family relations, etc.), which can influence the decision. For example, an engineer is expected to help the company decide which product should be purchased for the company's needs, and this engineer is the owner (or partner) of the company offering such products. Should an engineer get out of a situation in which he has a conflict of interest? Should the engineer inform the client that self-interest makes him biased? |
| 10 | Residential construction | The engineer is concerned about the safety of the project. Events can develop as follows. The engineer reports his concerns to the boss, but the boss does not want to take any action and advises the engineer to remain calm. The engineer must decide whether to "turn on the siren", i.e., contact the authorities, press, etc. At the same time, the employer can treat the engineer very well. How do we combine loyalty to the employer with the protection of the interests of society? When should an engineer "turn on the siren"? |

| | | |
|---|---|---|
| 11 | Authority having jurisdiction | The circumstances are such that you have to choose between a traditional and a fresh solution that promises to increase efficiency and reduce costs. The choice, however, should be based only on preliminary testing. The young engineer's boss unexpectedly informs a group of colleagues that the recommendations must be justified within two days. In engineering school, a young employee had a chance to explore a new device, but now there is no time for thorough research in production conditions. Nevertheless, the device is promising. The engineering group agrees with the boss and recommends an old, proven device. The boss instructs the young employee how to write a report with a high assessment of the old device and a recommendation for its use. The report should not contain a word about the new alternative. What should an engineer do? |
| 12 | Industrial construction | The formula of any invention is drawn up in such a way that it considers an exclusively positive aspect. However, each invention is based on its inner essence, the resolution (removal) of a technical or social contradiction in its dialectical interpretation and development. Therefore, in every innovation, negative consequences are inevitably present and then always manifest themselves. This provision especially concerns environmental problems. Such situations are observed in all typical technical innovations: an increase in engine power leads to increased environmental pollution; an increase in flight speed leads to the appearance of "ozone holes"; an increase in the carrying capacity of vehicles leads to the destruction of roads and soil, etc. What should an engineer do? Where are the boundaries of ethical and unethical, moral and immoral technical solutions? |
| 13 | Design Team | An engineer works on an invention during office hours, using office equipment. When he is close to completing his work, he leaves the company and sells the product as his own invention. Perhaps the engineer received a low salary and irregularly. How can the behavior of an engineer be evaluated from an ethical point of view? |
| 14 | Woodworking | In order to achieve a good uniform, dense color on the wooden surface to prevent leakage and discoloration of the paint, this surface must be thoroughly cleaned of dirt, dust, old coating and grease before painting. Then, treat the wood with a primer to carry out preliminary preparation. The primer will avoid excessive consumption of the primary finish coating, allowing the paint to spread evenly and without forming streaks. In addition, if there are cracks on the surface, then they must be sealed and sanded. Use an acrylic wood sealant or putty, depending on the depth and extent of the cracks. Sometimes, cracks begin to appear on the painted surface. Why is this happening? Solve the problem? |
| 15 | Sanding and finishing | The alignment of walls and other surfaces is designed to ensure the object's structural reliability and aesthetic appearance. Putty is currently the most common and one of the most effective ways to decorate the surface. When creating a single-layer coating, there are practically no problems. However, when a multi-layer application is needed, the risk increases significantly. Identify the causes of difficulties and defects. |