Gamification Methods for Developing Lexical Competence of Engineering Students

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Abstract—In the contemporary world, where information technology finds application in all spheres of life, the issue of the effectiveness of teaching a foreign language to future engineers emerges as a particularly significant one. It has been noted that traditional teaching methods tend to demonstrate a lack of sufficient effectiveness in the development of lexical competence in future specialists, thus giving rise to a significant need for the exploration of innovative, new approaches to be developed. One such approach that has been identified is gamification, which involves the integration of game elements into the learning process. The purpose of the research is to analyse the peculiarities of using gamified learning technology in the formation of future engineers' lexical competence and to develop practical recommendations for its implementation of game methods in the process of studying the discipline "Foreign Language (English) for Specific Purposes". The study used a complex of methods, in which theoretical analysis of scientific literature on gamification and lexical competence development, student interviews, pedagogical monitoring of the learning process and an experimental study of the effectiveness of gamified learning materials were used. As a result, the theoretical basis for the use of gamification methods in the formation of future specialists' lexical competence has been determined. It has been found that gamification helps to increase students' motivation to learn, activate their cognitive activity, develop independence and responsibility. The article provides specific examples of game-based teaching methods for the formation of lexical competence, which includes the following components: game goal, competition elements, virtual reality, and interactive tasks. The study results have confirmed the effectiveness of the developed methodology in the educational process. It has been found that students who studied using gamified learning materials demonstrate a significantly higher level of lexical competence than those who studied using traditional methods. As a conclusion, the authors emphasise that gamification contributes to the development of an interesting and motivating learning environment, which positively affects the acquisition of lexical material.

Keywords—Activation of cognitive activity, game elements, gamification, interactive tasks, lexical competence, student-centred approach, training of future engineers.

I. INTRODUCTION

The contemporary world is characterised by the active development of international relations in all areas, including engineering and manufacturing, and as a result, engineers must constantly update their knowledge and skills to be competitive. Most of the current scientific and technical publications, patents, standards and other documents are published in English. Therefore, English language proficiency is essential to obtain access to the latest information and technologies. English is the language of international communication in the scientific and technical fields and is the key to successful communication and cooperation with international partners.

International employers increasingly value engineers who speak English, and companies operating in the international market are demanding a high level of English proficiency from their employees. Therefore, the development of English professional vocabulary competence is an important factor in the successful employment and career development of engineers. Taking all these factors into consideration, the formation of English professional lexical competence is a relevant and crucial task for the training of modern engineers who will work successfully in the context of globalization and international integration. In the process of training prospective specialists, the discipline "English for Specific Purposes" (ESP) is a fundamental component that contributes to the acquisition of professional terminology, the formation of communication skills, adaptability, and the development of a behaviour culture in a professional environment. While traditional teaching methods are often not effective enough to develop the lexical competence of future specialists, it is necessary to find new, innovative approaches. Among these approaches is gamification, which involves the use of game elements in the learning process.

The development of prospective engineering specialists' lexical competence is a highly significant issue in many types of research. The problem of developing prospective engineers' professional English lexical competence is of considerable importance and covers various aspects, namely: identifying the components of professional English lexical competence, analysing modern methods and technologies of teaching engineering students, developing and implementing effective models of developing future engineers' professional English lexical competence.

The lexical competence of future engineers is a fundamental aspect of their professional training in today's globalised world. English language skills not only provide students with access to the latest scientific and technical developments, but also facilitate effective international collaboration, knowledge, and technology exchange. As one of the most dynamic and innovative industries, engineering requires professionals to constantly update their knowledge, which often involves working with English-language sources: scientific articles, technical documentation, patents, standards, and other materials.

The development of future engineers' English lexical competence involves not only mastering basic vocabulary but also mastering specialized terminology used in specific engineering disciplines. This requires students to be able to distinguish and use different styles of speech, understand contextual nuances, and communicate effectively in a professional environment. Particular attention should be paid to the development of receptive skills, such as reading and listening, as they are the basis for receiving and processing information from English-language sources.

Authentic resources such as scientific journals, technical reports, video lectures, and webinars should be used in the learning process, allowing students to become familiar with the real-world use of English in an engineering context. An important aspect is also the development of productive skills such as writing and speaking, which allows students to effectively present their ideas and work in English. This may include participating in international conferences, publishing scientific articles, and preparing technical reports and presentations.

Research Objective: to investigate the effectiveness of gamification in the formation of future engineers' lexical competence.

The formation of future engineers' English lexical competence is a permanent process that requires constant self-improvement and updating of knowledge. Students should be motivated to learn English independently and use it in their professional activities. It is also important to create a favourable learning environment that promotes the development of language skills and encourages students to actively use English.

Peters and Fernandez [1] revealed the problem of students' need to find English-language terms during their professional training. In the study, the authors emphasised the statement that students learning a foreign language for professional use still require the creation of conditions that simulate a professional environment, which includes professional documentation, professional discourse, and the atmosphere of the workplace. The authors provided a direct impact on the students' profession and their involvement in foreign language terminology. According to Masrai [2], lexical competence, in addition to single terms, includes a system of phrases of this term, which are also important in the process of forming lexical competence. Tyne, Smovzhenko and others [3], [4] analysed scientific research on the introduction of new methods in the context of developing the lexical competence of future specialists in order to form communication skills in a professional environment in the context of students' knowledge and, as a result, to apply a

differentiated approach in the process of forming professional lexical competence.

The process of developing future engineers' lexical competence includes knowledge of lexical units, idioms, phrase unities, and abbreviations that will be used in the professional field in the future. According to Bakirova [5], the skills that prospective engineers should master are the following: understanding the meaning of lexical units and aspects of their use in a professional context, interpreting professional information, and being able to actively apply the acquired knowledge in the process of professional communication. Therefore, in the ESP course, students should be involved in tasks related to defining and understanding the meaning of professional terms, memorising and using the terms correctly in a professional context. Usually, such tasks are previously performed in accordance with the textbook [2].

Modern scholars emphasise the potential of using game-based learning methods in the professional training of specialists at universities. The application of this method is highlighted in the scientific papers of Milosz and Milosz [6], who argued in the study that the use of gamified learning in engineering education is constantly increasing. This statement is continued in the scientific article by Irwanto and others [7], who indicated that gamification is important in supporting educational goals. Through the analysis of many sources, the effectiveness of this method was proved by the results of monitoring the performance of students in higher education institutions [8]–[9]. A research study by Khaldi and others [10] was devoted to a comprehensive analysis of using gamified methods in online learning. In this case, gamification is considered as a teaching method for the development of essential competencies. The study of Dmitrenko and others [11] presented how learning lexical games with the elements of social-emotional learning can be used in the formative assessment of prospective specialists.

Recent research by Madero-Gonsales et al. [16] demonstrates the significant impact of gamification on meaningful learning and student performance specifically in online engineering courses, highlighting its relevance to technical education contexts. Additionally, Soni and Banwet [17] further support these findings, showing that gamification significantly enhances learning outcomes by improving student attendance and engagement in classroom tasks. Their study emphasizes the importance of implementing gamification in management education policy. Jun and Lucas [18] provide a comprehensive review of various gamification elements and their specific impacts on educational settings, identifying key components that drive successful implementation.

The impact of gamification on the development of students' professional competencies is an urgent issue that still needs to be studied. Most researchers emphasize the extraordinary effect of this method; in particular, Jenner and Arudhas [12] noted that gaming technologies increase students' confidence and develop their social skills. The authors emphasised the effectiveness of bridging knowledge gaps and improving the overall level of language proficiency.

In an empirical study, Alsadoon [19] demonstrates concrete evidence of gamification's positive impact on student motivation, showing measurable improvements in engagement metrics. Similarly, Hellin et al. [20] found that creating gamified learning environments not only enhances student motivation but also contributes to educational sustainability by creating more enduring learning experiences.

A positive aspect is also the motivation to engage students in learning activities, as the game form of learning creates a positive emotional atmosphere that affects the acquisition of lexical units. Performing learning tasks in a game format activates their creativity and critical thinking. The interaction of all participants in the learning process contributes to developing their communication skills in artificially created professional situations, where students actively exchange information and argue their points of view [8], [9].

In the psychological context, gamified learning helps to reduce the language barrier, which is a negative trend for future professionals. The game form of activity allows students overcome psychological barriers and reduces stress and tension. The enormous potential of gaming technologies can be seen in activating motivation to learn. Game elements, such as points, rewards, and competitions, contribute to the production of dopamine, a neurotransmitter associated with feelings of pleasure and motivation. It creates positive feedback that encourages participants in the educational process to achieve learning goals. In addition, gamification supports basic human psychological needs, namely the need for communicative competence and autonomy, which contributes to the formation of independent learning.

Game tasks enhance problem-solving and conflict-resolution skills, promote critical thinking, and allow you to experience different emotions and learn to manage them. In addition to the above, game-based learning methods contribute to the development of empathy and professional communication skills [13]–[14]. Another positive impact of such technologies is the reflective effect, where participants can independently assess their strengths and mistakes and analyse their learning dynamics. Gamified learning techniques help to overcome the fear of mistakes and failures because in traditional learning, mistakes are often perceived as negative phenomena that lead to anxiety.

In the educational environment with elements of gamified learning, mistakes are considered as part of the learning process, which provides an opportunity for feedback and improvement. Games often provide an opportunity to repeat a task or try a different approach, which allows students to feel more confident and contributes to the formation of a positive attitude and self-esteem [15]. Accordingly, the authors confirm the positive impact of game-based learning methods and consider it

appropriate to use gamification in the process of developing lexical competence.

Thus, the research reviewed demonstrates a substantial effect of using the gamification method during university studies. Still, the potential of this method has not yet been explored in many aspects of students' professional training.

II. MATERIALS AND METHODS

To accomplish this goal, the authors used theoretical methods, in particular, the analysis of scientific research on linguistics, pedagogy, and methods of teaching foreign languages and the process of synthesis and generalisation of the information obtained.

The qualitative research was conducted at two universities: Berdyansk State Pedagogical University, which was relocated from Berdyansk to Zaporizhzhia due to Russia's full-scale invasion and the beginning of the war, and Mykhailo Kotsiubynskyi Vinnytsia Pedagogical University. A total of 38 students participated in the study: 14 students from the Faculty of Mathematics, Physics and Computer Sciences at Mykhailo Kotsiubynskyi Vinnytsia Pedagogical University and 24 students from Berdiansk State Pedagogical University's Faculty of Physical, Mathematical and Technological Education, distributed across three groups: 9 students from Computer Science, 8 from Mathematics and Physics, and 7 from Technology Education. The gender distribution included 29 male participants (9 from Vinnytsia and 20 from Berdiansk) and 9 female participants (5 from Vinnytsia and 4 from Berdiansk).

In accordance with the aims of the study, the authors used the method of questioning students to determine the level of their professional lexical competence and the degree of satisfaction with teaching methods in the course of studying the ESP discipline. In the process of applying the monitoring and testing method, the authors determined the effectiveness of the gamification method in the acquisition of professional-oriented vocabulary by future engineers.

The crisis conditions caused by the war and the psychological state of the students prompted this research, as the instructors decided to implement Gamification Methods for Developing Lexical Competence of Engineering Students. The game-based approach was chosen as an effective tool to increase motivation and engage students in the learning process under challenging psychological circumstances. Understanding that prolonged stress significantly impairs learning capacity, the instructors sought to compassionately evaluate the effectiveness of the gamification approach by first examining the students' own impressions. Students were asked to respond to the key question: "To what extent has the implementation of game-based activities improved your ability to learn, retain, and apply professional engineering terminology in English compared to traditional learning methods?"

At the beginning of the study, the authors conducted a survey of engineering students from both universities regarding their confidence in the ESP learning process and determined their level of academic achievement in professionally oriented lexical vocabulary. As a result, the authors identified that among the difficulties students face when studying the ESP discipline is a large number of terms that participants in the educational process find difficult to learn, understand, and remember, which makes it challenging for them to be active participants in the professional environment.

In the first semester, students completed lexical tests at the conclusion of the modules in order to learn the number of new terms learned on a particular topic. The results showed that, overall, students learnt about 55% of the new professional terms. Moreover, if the term was a passive vocabulary term and not related to the students' future profession, almost 90% of the students demonstrated ignorance of it.

In the second semester of the first year, students were offered a gamified methodology aimed at quantitative and qualitative learning of new professional terminology based on the use of gamification.

The study included first- and second-year students enrolled at the Faculty of Physical, Mathematical and Technological Education of Berdyansk State Pedagogical University and the Faculty of Mathematics, Physics and Computer Sciences at Mykhailo Kotsiubynskyi Vinnytsia Pedagogical University.

To test the effectiveness of the proposed gamification methodology, game-based methods were implemented in the educational process of studying ESP by engineering students at both universities during one semester. At the end of the study, the authors conducted a final survey in order to observe the impact of game-based tasks on engineering students' lexical competence. The survey results indicated that 82% of students from both universities reported significant improvement in their ability to learn and retain specialized terminology when using gamified approaches, with the highest satisfaction rates observed among the displaced students from Berdiansk (87%). Students were informed about the study objectives and participated in the study voluntarily.

III. RESULTS AND DISCUSSION

In the course of testing the hypothesis, the authors applied the gamification methods in the ESP classroom that, in the authors' opinion, will contribute to the development of future engineers' professional lexical competence. In the authors' experience, to achieve this goal, the key component is the knowledge of future engineers in the area of professionally oriented vocabulary, its semantic features, synonymous and antonymic aspects. In particular, students need to learn how to identify lexical items in a text or spoken language, establish links between them, and interpret the content of professionally oriented texts.

To accomplish this objective, the authors consider semanticisation (tasks aimed at clarifying the meaning of professional lexical items, dictionary search, contextual guessing), memorisation (tasks aimed at creating associations with lexical items, visualisation of professional terms) and the use of lexical items in the process of communication to be a successful strategy.

In addition, an essential aspect is the development of student's ability to use lexical material in a specific situation of professional communication, to communicate in professional monologues, and to prepare reports and presentations on professional topics using professional vocabulary. In the process of training a highly competitive specialist, the authors also considered it an urgent task to teach students to participate in discussions, defend their point of view and be able to argue it using the necessary vocabulary and structures.

The implementation of the gamification method in vocabulary learning (for professional purposes) has great relevance, as game elements encourage students to learn new vocabulary and have an interactive activity. Consider some examples of game-based methods that can be used to teach English professional terms. According to the results of the research of Madero-Gonsales and others [16], there are arguments to consider the method of 'Technical Vocabulary' effective, where students are asked to explain the term they receive on the card. The participants of the game can be asked to match the objects displayed in the pictures, which are made of the specific material, with a card with the name of the material in letters (steel, glass, aluminium, copper, rubber), or to define the description of the following characteristics (water-resistant, elastic, lightweight, corrosion-resistant, heavy, durable). Such activities can be organised in groups or pairs where students can help each other.

In developing the knowledge of professional terms, the game 'Technical Scrubble' is used to help students to form the names of professional words from letters (e.g. surface, suspension, friction, hacksaw, reliability, manufacturing).

A similar method is the game 'Engineering Word Associations', which is aimed at forming an associative series of words (for example, socket, wireless, circuit, scratch). Students have to find as many associations as possible to specific professional terms. In the process of completing such tasks, students develop critical thinking, consolidate the material they have learned, and learn new words.

To revise the terms, students can play a game with cards called 'Professional cards', where the aim is to score more points by guessing the terms. One student shows a card with a photo of a specific professional term, and the others find and show a card with the spelling of the term. In this way, students who have learnt more words and guessed their meanings get more points. In addition to this format, students can also perform tasks to find synonyms or antonyms, where the task is to find the opposite term to the concept depicted or its synonym. Students can use

professional English dictionaries or online applications to complete their assignments. It is crucial to emphasise the unique atmosphere of completing such tasks in a group setting, as all participants are involved in the task, and the team members help each other, consult together, argue, and defend their points of view.

To increase professional vocabulary, the game 'Professional Vocabulary' is widely used, which aims to increase the vocabulary of students according to a specific topic being studied. For example, when studying the topic 'Problems of engineering faults', students have the opportunity to find synonyms for the words detected, sufficient, balance, correct, broken, fault, and disconnect, which will be useful in professional communication.

The Engineering Vocabulary Challenge Game. The aim is to memorize professional terms and develop listening skills, significantly increasing active professional vocabulary. The rules of the game are that the presenter says the definition of professional terms (circuit, component, data, equipment, technology, voltage, strain), and the students take turns guessing it. If someone answers correctly, he takes a point. The one who scores the most points is the winner.

As a consequence, the use of such games has a positive impact on the activation of cognitive processes, including memory, attention, and thinking. They have the potential to provide conditions for repeated use and practical application of terms, which provides for their improved understanding and retention in long-term memory, as gamification provides for long-term repetition of vocabulary, which helps to consolidate it in long-term memory. Game features that the authors have used in the implementation of such game elements as repetition with intervals allow students to repeat words and expressions until they are fully mastered. In addition, the formation of associative links between new terms and existing concepts has a positive impact. The use of visualisation, synonyms, and antonyms facilitates the process of memorising new professional terms.

When developing skills in the application of lexical items in a professional environment, tasks involving students in conversations and discussions on professional topics are practical, during which students learn to interpret lexical terms on professional issues to a specific communication situation, express their opinions correctly, and precisely on the subject of discussion, while using different types of speeches (presentation or report). In this context, simulation games are appropriate for use, as they have the potential to simulate real professional communication situations where future engineers can use the professional terms they have learnt.

In order to enhance business and professional communication skills, the authors organised a class with a simulated interview for an engineer position in a company, where one student acted as a director of a certain company and the other was a job applicant. The advantage of this method is that students use the basics of business English and professional terminology. In the

process of such communication, students outline their skills, abilities and experience, which will be useful to them in the future.

For the teamwork, the authors used a game where a team of students represented a particular company and discussed its activities, projects, contracts, and work specifics. The discussions between the companies, which were local government organisations, were quite interesting, as students were involved in solving current issues of public lighting and organising services for community residents. In the process of discussing pressing issues, students presented interesting and effective projects as they foreseen their future.

In this framework, the game 'Future Engineers' was actively implemented, the essence of which was that students acted out specific engineering situations using real English vocabulary, where future engineers presented their projects.

It is worth noting the positive impact of similar simulation games on the development of future engineers' English lexical competence, as students actively use the already learnt specialised vocabulary necessary for their professional activities while simulating real professional scenarios. Games of this type contribute to the comprehension of the contextual meaning of new lexical items and the peculiarities of their specific use in a professional environment, which is extremely relevant for future specialists. Being in an artificially created authentic environment, future specialists feel themselves in professional situations that contribute to the formation of associative links, socialisation, and the activation of the use of professional English vocabulary.

After using lexical learning games in the ESP classes, the authors have concluded that the use of gamification methods in the process of studying the ESP by future engineers has significant potential in the process of forming lexical competence.

The research results obtained after questioning students and analysing their performance results showed that it is easier for students to memorise new professional terms during game activities (96% of students agreed with this statement, as evidenced by the results of the professional vocabulary test).

A significant proportion of students (91%) agreed with the statement that the use of visualisation techniques and repeated repetition of the material significantly improves the memorisation of new words.

All participants of the experimental studying (97%) noted the psychological effect of gamification, namely a positive atmosphere in the classroom, interest, enthusiasm for the learning process, positive, imitation of professional activities, mutual assistance, and lack of stress.

In addition, the authors observed a positive impact on students from teamwork, which is a positive trend, as today in Ukraine, researchers have registered a decrease in the level of social skills of graduates. Gamification in this context has a significant positive effect, as the tasks required participants to cooperate, share information and interact while organising joint activities in volunteer projects, an active form of citizenship, which activated their social skills and values.

The authors also identified the potential of using gamification in the process of forming engineering students' lexical competence in the activity aspect, namely, improving the participants' skills in developing their spontaneous communication skills. Games with a limited response time or decision-making forced students to react quickly to the situation in an artificially created professional environment, using professional English vocabulary without prior preparation to solve problems (approximately 87% of students noted this characteristic).

The authors received positive responses concerning the ability of future engineers to successfully exchange information, discuss technical details and feel confident during interviews.

96% of the students emphasised that such a positive classroom atmosphere helped them to be confident during presentations, and the developed business communication skills for presentations significantly increased their competitiveness in the engineering labour market.

The survey results agreed with the results of studies [5], [6], [8], [12], [16] that proved the effectiveness of the gamification method for the formation of engineering students' lexical competence. The analysis of relevant studies confirms that gamification helps to increase future engineers' motivation, engagement and efficiency in learning lexical material. The integration of game elements, such as points, levels, competitions and rewards, has been shown to stimulate students' active participation in the learning process, thereby creating a favourable environment for vocabulary acquisition.

IV. CONCLUSION

The results of the present paper explore the use of gamification in the development of lexical competence with a view to investigating the significant potential of this approach in the educational process. The results of the present study confirm that gamification has the potential to make the process of learning vocabulary more interesting and engaging, which is of particular importance for students, as the game-based learning format contributes to better memorisation of vocabulary units, their consolidation, and application in practical situations. Furthermore, individualisation of the learning process is facilitated by gamification, adapting it to the needs and level of knowledge of each student.

However, despite the positive results, there are issues that require further research. It is believed that exploration of the possibilities of using mobile applications, virtual and augmented reality to gamify the vocabulary learning process is necessary. These technologies allow for the creation of interactive and engaging learning environments that can significantly increase the effectiveness of lexical competence development.

Consequently, further research into the use of gamification in the development of lexical competence holds significant potential for developing innovative teaching methods and enhancing educational quality.

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