Arab World English Journal
INTERNATIONAL PEER REVIEWED JOURNAL ISSN: 2229-9327
مجلة اللغة الانكليزية في العالم العربي

Arab World English Journal (AWEJ) Special Issue on the English Language in Ukrainian Context, November 2020 Pp. 124 -131
DOI: https://dx.doi.org/10.24093/awej/elt3.11

Interdisciplinary Approach to Modeling in Teaching English for Specific Purposes in the Ukrainian Context

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Abstract
The article highlights exploiting modeling in the interdisciplinary educational process at a modern technical university in Ukraine. The focus of the study is to consider the interdisciplinary approach to modeling in teaching English for Specific Purposes (ESP) to develop technical students′ strategic competence as the cognitive ability to intervene in solving various problems. The methodology involves the complex of complementary methods: analysis of psychological and pedagogical sources on the issue under study; the observation of the educational process, and monographic practice (interpreting the results obtained in a coherent, logical perspective); generalization and systematization of the collaboration between the Faculty of Chemical Engineering and the Faculty of Linguistics of the National Technical University of Ukraine "Igor Sikorsky Kyiv Polytechnic Institute" (after this officially abbreviated name – Igor Sikorsky KPI) on implementing the model of interdisciplinary interaction to develop students′ strategic competence through producing secondary sci-tech texts in the course of preparing their qualifying papers. The suggested interdisciplinary model covers three stages of realization: initial stage (activates knowledge in the subject area transferred to the foreign language environment), cognitive-communicative stage (activates the cognitive processes to develop the levels of thinking within the framework of Bloom′s taxonomy), and communicative-productive stage (develops communicative strategies for writing abstracts of patent documents in English).
Keywords: English for Specific Purposes, interdisciplinary approach, modeling, strategic competence, technical students.
Cite as: Fedorenko, S., Kolomiiets, S., Tikan, Y., & Tsepkalo, O. (2020). Interdisciplinary Approach to Modeling in Teaching English for Specific Purposes in the Ukrainian Context. *Arab World English Journal*: *Special Issue on English in Ukrainian Context.* 124 -131.
DOI: https://dx.doi.org/10.24093/awej/elt3.11

Introduction

Nowadays, developing modern approaches to foreign language teaching driven by challenges of the third-millennium society has already undergone a procedure called the fourth industrial revolution. The essence of this fourth procedure lies in the technology fusion, blurring the boundaries between the physical, digital, and biological spheres, developing artificial intelligence and the virtual economy (Bartodziej, 2017; Davis & Schwab, 2018). Thus, state-of-the-art technologies, breakthrough ways of production, and modernized educational standards (for instance, the comprehensive introduction of the competence approach to the educational process) have changed the methods of teaching ESP dramatically. As the professional world of the XXI century is interdisciplinary, the teaching in higher education must consider the interdisciplinary approach, thereby addressing the needs of contemporary students.

Additionally, as communities are becoming more culturally diverse, social relationships are getting more dependent on the ability to interact successfully with people from various cultures whose values and patterns of behavior may differ from one′s cultural practices. And today′s increased globalization is a forcing demand for an internationally competent workforce – future specialists will be working for international companies, competing in a growing global talent pool, and facing increasing challenges. Foreign language acquisition contributes to communicating and interacting in multilingual communities. Moreover, a graduate of a technical university should deal with international scientific and technical literature, which is mostly in English. In this regard, the development of strategic competence in the preparation of innovatively active specialists in different technical fields in mastering a foreign language for specific purposes (English in our case) is among high-priority tasks in modern technical universities.

However, forming technical students′ strategic competence in creating secondary texts of patent documentation has not been brought into a particular focus. At the same time, it is worth noting that Ukrainian engineers are obliged to patent inventions for launching into mass production and, consequently, to profit from their professional activities at the international market, which requires developing skills of processing patent documents in English.

Therefore, the problem under study is to educate Ukrainian future engineering specialists to effectively perform their professional tasks related to the use of English as a foreign language, while creating secondary sci-tech texts for experts around the world.

The purpose of the article is to cover the specifics of the interdisciplinary approach to modeling in teaching ESP to develop the strategic competence of students in the settings of a technical university in Ukraine.

Methodology

The study employs a set of complementary methods (Wallen & Fraenkel, 2013), which are as follows: analysis of psychological and pedagogical sources on the issue under study; the observation of the educational process; monographic practice (interpreting the results obtained in a coherent, logical perspective); generalization and systematization of the collaborative practice of the Faculty of Chemical Engineering and the Faculty of Linguistics of Igor Sikorsky KPI on implementing the model of interdisciplinary interaction to develop students′ strategic competence.

The theory of cultivating the communities of practice (Wenger, McDermott & Synder, 2002) underpins the present study, providing an understanding of interdisciplinary modeling in teaching ESP from a sociocultural scope. It reflects the view that a process of sociocultural learning occurs when people with a common interest in a particular subject area collaborate over a certain period sharing knowledge, and determining solutions.

Additionally, the research exploits the theory of interdisciplinary studies (Barry, Born & Weszkalnys, 2008; Boix Mansilla, 2005; Newell, 2011). According to this theory, the knowledge and modes of thinking from two or more relevant disciplines are integrated into a comprehensive unity "to produce a cognitive advancement – for example, explaining a phenomenon, solving a problem, creating a product, or raising a new question – in ways that would have been unlikely through single disciplinary means" (Boix Mansilla, 2005, p. 14).

Theoretical backgrounds

Nowadays, at a technical university of the research type (like Igor Sikorsky KPI), an adequate response to the challenges of modern globalized society is supposed to be given through the interdisciplinary collaborative practice of university departments. Such a task requires implementing a favorable interdisciplinary education environment, which embraces interdisciplinary collaboration via co-teaching in English and curriculum integration of knowledge areas, providing cross-curricular topics, issues, or ideas. Thereby, the four main dimensions of the interdisciplinary education environment (Beane, 1997), giving the grounds for successful developing students′ strategic competence on a broad scale, are as follows:

1) integration of experience accumulated by both humanity and by the person, which altogether helps any student to understand and solve problems in all spheres of life;
2) social integration (based on the study of ways of solving personal and social issues);
3) integration of knowledge and multi-sectoral experience from different spheres of life;
4) integration of curriculum design (based on the cross-curricular topics, themes, issues, or big ideas that contribute to content and language integrated learning, where students learn a subject and a second language (in our case, it is English) the same time.

We argue that in terms of interdisciplinary teaching, it is advisable to focus on its procedural aspect that entails such a powerful teaching method as modelling.

Modeling as scientific knowledge, representing the construction and operation of the system under study, has been widely used in technical and natural sciences, and more recently – in the pedagogical sphere. Modeling in teaching presupposes constructing an educational environment, and designing the outcomes of learning, providing steps for fulfilling didactic objectives (Joyce, Weil & Calhoun, 2017). This method is conducive to developing highly tuned and more varied learning contexts, modifying other methods of teaching and instructional techniques to better meet the needs of current students.

As noted by Joyce, Weil, and Calhoun (2017), quality modeling in teaching encompasses: 1) intended outcomes of learning; 2) structure and the sequence of steps to realize the model; 3) principles of organizing the educational process; 4) interactions between students and

instructor; 5) supporting pedagogical techniques for effective implementation of the model; 6) efficacy of the model transference to real life.

Traditionally, models of teaching have been designed according to classic philosophy, and educational psychology. Therefore, they are subdivided by the scholars (Driscoll, 2000; Elliott et al., 2000; Joyce, Weil & Calhoun, 2017) into:

– *social* (exploiting productive ways of interacting in social settings);

– *information-processing* (emphasizing the methods of learning specific information and of acquiring and organizing data, solving problems; enhancing intellectual development, as well as metacognitive abilities);

– *personal* (fostering self-cognition, self-esteem, self-efficacy, etc. in creating, directing, and structuring personal meaning);

– *behavioral* (concentrating on distinctive predetermined patterns of behavior);

– *constructivist* (focusing on students' active construction of their knowledge based on the experience gained).

Considering the ways of presenting learning material in teaching ESP at technical universities, the models split into *models of assimilating and accommodating knowledge* (technological orientation), and *discovering background* (humanistic orientation). In our view, the interdisciplinary approach on a broad scale applies to the models of the latter type mentioned, and they deserve special attention in teaching ESP. Their main aim is to provide students with a deeper understanding of the modern world, one of the imperatives of the integrated unity of knowledge from different spheres.

Modeling in teaching ESP for technical students at Igor Sikorsky KPI

The interdisciplinary model is regarded as an innovative pedagogical tool of achieving a synergistic effect in teaching ESP to technical students (Olkhovaya et al., 2016). In our case, this model has been implemented through the interaction of foreign languages department with specialist ones, and, therefore, focuses on developing strategic competence of future engineering specialists in particular, and on enhancing the relationships between various domains of knowledge; the self and the world at large on the whole.

The analysis of recent linguistic and lingua didactic studies (Dörnyei & Scott, 1997; Ellis, 2008; Gass & Selinker, 2008) made it possible to clarify the essence of the strategic competence in foreign language acquisition. The competence under study includes a system of knowledge about productive and interpretive-receptive speech strategies, and the ability to make use of them through a set of verbal, and nonverbal tools. Forming individual strategic competence as an invariant core of communicative competence presupposes metacognitive processes (planning, execution, management, control, and reflection).

Turning to the interdisciplinary modeling in teaching ESP, we must mention simulation-based learning, the essence of which lies in modeling professional communication (Colella, 2000). Simulation, as a model of phenomena or activities that students learn through interaction, is considered the third pillar of science, which has not yet taken a firm place in technical universities. The purpose of simulations is to help students acquire knowledge through exploring, practicing, testing (Magana, 2017). Simulations, regarded as the models of quasi-professional

communication, are adequately organized through the collaborative interaction between the teachers of ESP and the academic staff of specialist departments of universities.

Let us consider the interdisciplinary collaboration between the Faculty of Chemical Engineering and the Faculty of Linguistics of Igor Sikorsky KPI to develop students′ strategic competence in the course of preparing their qualifying papers on the particular technical issue in the sphere of engineering. It is important to emphasize that the analysis of students′ needs in professionally oriented written communication during their final research proves the feasibility, and rationality of authentic English texts of patent documentation.

Designing qualifying projects presupposes a considerable amount of work with British and American patents, which differ in their structure and ways of presenting the material. Given this fact, the students should be able to appreciate the cultural diversity of patent documentation critically, and apply the acquired knowledge and skills to writing abstracts in English. Therefore, it is essential to model ways and methods of developing students' communicative strategies to process patents information. The teaching materials involve English texts of patent documents, prepared in collaboration with the academic staff of the Faculty of Chemical Engineering. We give priority to the texts of patent documents accompanied by extra lingual supports (tables, diagrams, figures, etc.). And students master different linguistic and extralinguistic features of the texts of patent descriptions. These features are as follows: broad coverage of English-speaking countries; generalization, isolation, and abstractness of presentation; logical presentation, and the accuracy of expression; evidence, objectivity, and saturation of factual information; genre-specific features (uniqueness, efficiency, authenticity and universality, structure, specifics of lexical and grammatical structure).

The didactic nature of the model in question is in the stepwise and consistent forming strategic competence in students. This model involves three stages of implementation: initial, cognitive-communicative, and communicative-productive. The initial stage activates knowledge in the subject area transferred to the foreign language environment (in this case, it is English). At the cognitive-communicative stage, we start the cognitive processes to develop the levels of thinking (under Bloom′s taxonomy), and design the strategies for patent text processing. At the communicative-productive stage, which is the final in our model, we develop students' communicative strategies for writing abstracts of patent documents in English, taking into account the primary text (cognitive-communicative stage), and exploiting the formed language skills (initial stage).

We have developed a system of exercises aimed at mastering strategies of creating the secondary text of patent documentation for each stage. We provide some examples below.

Example 1 (initial stage)
Purpose: to develop grammatical skills in producing the secondary text of patent documentation.
Task: Look through an extract from a background of the invention. Put the verbs in brackets into the correct tense form and make other changes (if necessary).
1. Replaceable wear liners often _____ (1 incorporate) into cone crushers to form the crushing surfaces. Cone crushers typically _____ (2 comprise) of an assembly that rotates about a

stationary shaft resulting in a gyratory motion, which _____(3 harness) to crush material as it _____(4 traverse) between crushing surfaces in the crushing chamber, where the replaceable wear liners are _____ (5 locate). ……..

Example 2 (cognitive-communicative stage)
Purpose: to develop strategies for understanding the text.
Task: Define which section of a patent application contains the following phrases.

– There are several prior art references directed towards powder classifying apparatuses and methods.

– These and other objects will become more apparent from the following detailed description when considered with the accompanying drawings.

– What we claim is a game device, comprising a handle and a head portion connected to the handle.

– It is an object of this invention to provide deflector means for substantially reducing the amount of coarse material carried by the gas stream from the grinding elements to the classifier.

Example 3 (cognitive-communicative stage)
Purpose: to form in students a strategy of evaluating the primary text of patent information.
Task: Patent applications contain both descriptions and explanations. To distinguish them, group the sentences in those which describe and those which explain.

1. The apparatus operates as follows: a fan (1), a shaft (5), and a rotor (3) are driven at suitable speeds; the gaseous fluid is sucked through a duct (22).
2. It is a principal object of the present invention to provide an improved form of cyclone separator that effectively achieves higher particle separation efficiencies than can be performed by centrifugal separators previously known in the art.

Example 4 (cognitive-communicative stage)
Purpose: to form in students a strategy of assigning information to the primary text of patent documentation.
Task: Read the patent sections *Background of the Invention* and *Summary of the Invention* and then: a) write the advantages and disadvantages of the prior art; b) give your evaluation of the patented chemical apparatus/machine/mechanism.

Example 5 **(**communicative-productive stage)
Purpose: to form in students a strategy of information compression aimed at creating an abstract.
Task: Read the patent section "Detailed description of the invention" and make it less detailed, choosing three features of the chemical apparatus/machine/mechanism, and describing them in writing.

Consequently, exercises such as those mentioned above provide practice in the use of communicative strategies. Arguably, they effectively build personal resources, which will enable students to be more flexible in finding ways to convey information in real-life interactions. It is relevant to indicate that the ability to exploit the communicative strategies contributes to forming strategic competence of future specialists in science and technology. We argue that the formation of strategic competence in learning ESP should be considered one of the crucial aspects of training

technical students. It is explained by the fact that students of technical universities must present the findings of their research work in a foreign language (in English in our case), and apply foreign language skills in the field of their specialty, in the production of secondary texts of patent documentation, in particular.

Conclusion

To sum up, we conclude that exploiting the model of interdisciplinary interaction enhances forming technical students′ strategic competence. It also contributes to making a more in-depth assessment of the acquired knowledge from both the specialist area and English to develop professional communication. We also note the importance of combining the expertise of the academic staff from linguistic and specialist departments in a technical university to provide successful interdisciplinary collaboration. From an instructional perspective, such simulation-based learning develops highly tuned and varied professional repertoires. On a broader scale, it creates practical instructional experiences.

In the context of the problem under study, the scope of further research envisages researching the epistemic relation between students as observers and simulation-based learning as a system. Thus, the ultimate analysis will focus on the reality that remains beyond the grasp of our model.

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