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METHODS AND FORMS OF BILINGUAL TEACHING MATHEMATICS AT A TECHNICAL UNIVERSITY

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Higher education in Ukraine is being modernized under the influence of globalization and multicultural professional training. A key direction of this process is the introduction of bilingual education in technical universities [1], where professional disciplines are taught in a foreign language. In this model, the foreign language serves as a medium of instruction rather than an object of study. Higher mathematics is especially important, as it is compulsory for all engineering students.

Although bilingual education has been explored by European and Ukrainian scholars, research has mostly focused on separate aspects. A comprehensive concept of bilingual professional education and its methodological foundations in Ukraine remains underdeveloped. Therefore, this study aims to describe general didactic and specific methods of bilingual teaching of mathematical disciplines for future engineers [2]. The research is based on theoretical analysis and empirical methods such as observation and analysis of teaching practice.

The range of bilingual teaching methods depends on the chosen didactic approach and the recognition of special bilingual methods. Some scholars argue that no specific methods exist and that bilingual instruction applies general educational methods, provided they are effective and safe. These include frontal, group, pair, and individual work, as well as lectures, guided conversations, discussions, debates, brainstorming, projects, and role plays. German didactics classify them into traditional (monologic), developing (dialogic), and open learning methods that promote independent cognitive activity.

Other researchers emphasize special bilingual methods, particularly immersion. Total immersion means teaching entirely in a foreign language, while soft immersion allows limited use of the native language for clarification. Immersion is most effective when students are exposed to the foreign language beyond the classroom [3]. Additional methods include visual, reading, and cognitive language support. Specific techniques involve language input, bridging-prompting, and code-switching. Contextual learning, content-based instruction, and information technologies also contribute to bilingual methodology.

The system of bilingual teaching methods includes general didactic methods, foreign language teaching methods, subject-specific methods, and special bilingual

techniques (fig. 1). General didactic methods may be traditional (lecture, guided conversation), developing (discussion, role play, group work), or open (independent activity, educational project). Special methods include immersion and language support, while bilingual techniques involve language input, bridging-prompting, and code-switching.

To develop professional foreign-language communication, it is necessary to model the subject and social contexts of future professional activity. This is achieved through contextual learning, which integrates mathematical knowledge into simulated professional situations. Three forms of activity are distinguished: academic (lectures, seminars), quasi-professional (simulations, business games), and educational-professional (research projects, internships). In bilingual mathematics classes, role plays and problem-solving simulations encourage students to formulate problems, discuss solutions, and present results in a foreign language.

Problem-based learning is also effective, as it places students in situations without ready-made solutions, stimulating independent thinking. In practice, several methods are combined. A key principle is balanced language use: as much native language as necessary and as much foreign language as possible.

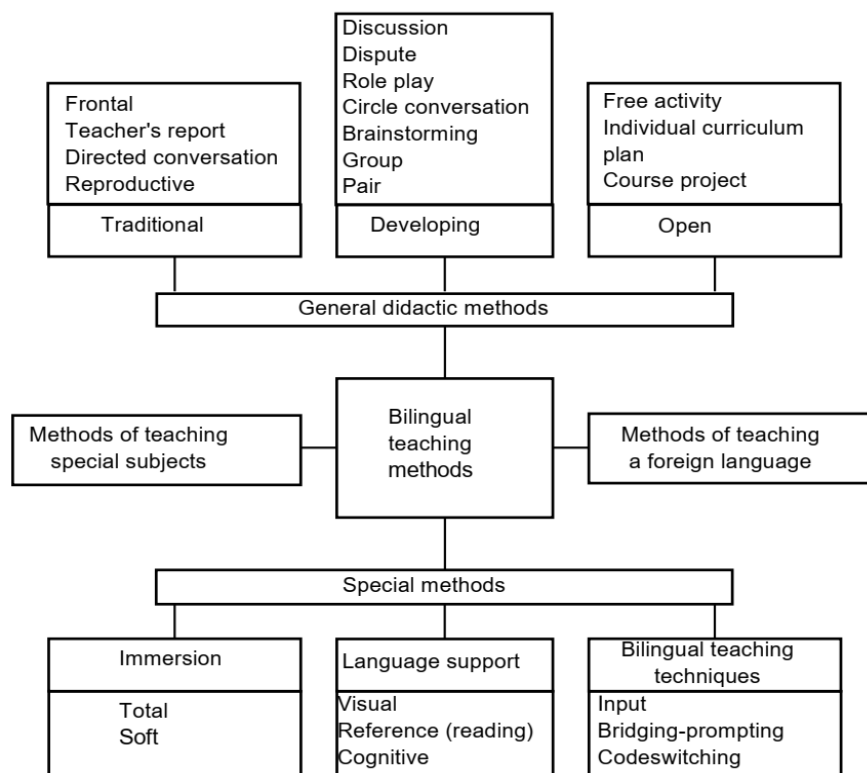


Fig. 1 Set of bilingual teaching methods

Four models describe the relationship between native and foreign languages in bilingual instruction. The duplicating model presents content in both languages. The additive model provides additional foreign-language information. The parity model ensures equal use of both languages and requires high competence. The substitutive model gives dominance to the foreign language and is applied at advanced stages. Instruction should gradually move toward greater use of the foreign language.

Traditional methods in bilingual mathematics include conversation, lecture, and independent work with textbooks and exercises. The conversation method is effective at transitional stages but requires careful preparation. Lectures in a foreign language are appropriate only at advanced levels. Independent work with specialized texts is essential, as texts function as tools for professional communication.

Work with mathematical texts aims to acquire new information, deepen knowledge, and develop communication skills. Students must master terminology, understand scientific expressions, interpret symbols, and work with diagrams and tables. Skills such as note-taking and summarizing support both cognitive development and language proficiency. Professional communication is further developed through collective problem-solving and simulated conferences.

Special subject-specific methods include mathematical modeling and the axiomatic method. Bilingual instruction should imitate authentic mathematical research by analyzing real situations and constructing models. The axiomatic approach encourages students to build small theoretical systems within a topic, fostering abstraction and logical organization.

Information technologies, project-based learning, and the flipped classroom model are also promising in bilingual mathematics education. In the flipped model, students study new material and terminology at home and practice it in class using digital tools.

In conclusion, bilingual mathematics teaching for future engineers involves a wide range of general and specific methods. These ensure effective mastery of mathematics while developing professional foreign-language competence. Further research should focus on project-based learning and the flipped classroom in bilingual mathematical education.

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МЕТОДИ І ФОРМИ БІЛІНГВАЛЬНОГО НАВЧАННЯ МАТЕМАТИКИ В ТЕХНІЧНОМУ УНІВЕРСИТЕТІ

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