дошкільного віку. Інноваційна педагогіка. 2024. Вип. 78. Том 2. С. 138–141. URL: http://www.innovpedagogy.od.ua/archives/2024/78/part_2/31.pdf

5. Джура Н.М., Пристайко М.Ю. Формування екологічної свідомості дітей дошкільного віку. SWorldJournal. 2020. Issue 6. Part 4. С. 69–72. URL: https://www.sworldjournal.com/index.php/swj/article/download/swj06-04-037/730/958

6. Дмитренко Л. Виховання обдарованих дітей. Палітра педагога. 2007. № 2. С. 13–15.

7. Лазебна О.М., Лавріненко В.М., Волошина Н.О. Методичний контент екологічної освіти і просвітництва. Інноваційна педагогіка. 2022. Вип. 44. Том. 2. С. 11–17. URL: http://www.innovpedagogy.od.ua/archives/2022/44/part_2/44-2_2022.pdf

8. Лисенко Н. В. Теорія і практика екологічної освіти: педагог-дошкільник: навч.-метод. посіб. для студ. вищ. навч. закл. К.: Слово, 2009. 398 с.

9. Про затвердження Базового компонента дошкільної освіти (державний стандарт дошкільної освіти), нова редакція: Наказ Міністерства освіти і науки України від 12 січня 2021 р. № 33. URL: https://mon.gov.ua/storage/app/media/rizne/2021/12.01/Pro_novu_redaktsiyu%20Bazovoho%20komponenta%20doshkilnoyi%20osvity.pdf

10. Соколовська О. С. Екологічне виховання старших дошкільників у системі підготовки вихователів дошкільних навчальних закладів. Педагогічні науки: збірник наукових праць. 2009. Вип. 1 (51). С. 205–210. URL: https://ps.journal.kspu.edu/index.php/ps/issue/view/31

BILINGUAL INSTRUCTION IN HIGHER MATHEMATICS AT A TECHNICAL UNIVERSITY: STRUCTURE AND DYNAMICS OF MATHEMATICAL LEARNING ACTIVITY

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Bilingual instruction in higher education should be understood as teaching through a foreign language that functions not as an object of study but as an instrument for acquiring specialized knowledge. In this context, the foreign language serves as a means of cognition, professional communication, and access to international scientific discourse. In our case, we are concerned with the teaching of higher mathematics at a technical university, where both the native language and a foreign language, primarily English, are used in the educational process with varying degrees of integration. The foreign language does not replace the native language but enters into a dynamic interaction with it, expanding the cognitive and communicative possibilities of students while they master complex mathematical content.

The development of a model of bilingual mathematics instruction at a technical university [6] is grounded in a number of methodological and theoretical principles. These include the personality-oriented paradigm of modern education [4], the activity-based approach as a fundamental psychological theory of learning [2], the concept of the dialogue of cultures [1], and the idea of humanizing mathematics education [3]. The model also relies on psycholinguistic interpretations of bilingualism [10] and on a structural understanding of mathematical learning activity [5]. Within a psycholinguistic framework, bilingualism may develop from a subordinative type, in which the foreign language depends heavily on the native language, toward compound and eventually coordinate bilingualism, where both languages function relatively autonomously in cognitive processes. The aim of bilingual instruction for future engineers is precisely this transition: to ensure that students are capable of performing professional and mathematical thinking activities in both languages at a sufficiently high level.

Bilingual mathematics instruction at a technical university may therefore be defined as the interconnected activity of teacher and students in the process of studying mathematics through both native and foreign languages, resulting in a synthesis of competencies [7]. These competencies include deep mastery of mathematical content, the development of mathematical language, the formation of a culture of mathematical thinking, and a high level of foreign language proficiency for specific professional purposes. The learning of mathematics in such a context is not reduced to the acquisition of formulas and procedures; rather, it becomes a complex cognitive activity mediated by two linguistic systems.

The process of mastering mathematical knowledge through two languages can be viewed as a specific form of cognitive activity, which may be described as mathematical learning activity [8]. Psychological analysis of cognitive activity traditionally distinguishes several interrelated components. First, there are general logical operations of thinking, such as induction, deduction, analysis, synthesis, comparison, classification, generalization, abstraction, and concretization. These operations are universal and are not limited to mathematics. Second, there are specific mathematical modes of thinking that are characteristic of mathematics as a discipline, including modeling, formalization, symbolic transformation, and proof construction. Third, there is the system of knowledge itself, which forms the substantive basis of activity and includes concepts, definitions, theorems, methods, and problem-solving strategies.

In order to construct a theory and methodology of bilingual mathematics instruction, it is necessary to adopt a model of mathematical activity that adequately reflects the essential characteristics of real mathematical practice while being adaptable to educational needs. Mathematical activity may be understood as consisting of three closely interconnected aspects. The first aspect involves the mathematization of empirical material, that is, the formal description of real or hypothetical situations by means of mathematical models. At this stage, students translate elements of reality into mathematical language, identify essential relationships, and construct formal representations. The second aspect concerns the logical organization of mathematical material. Here, the knowledge obtained through modeling is structured into a coherent system; definitions are clarified, properties are ordered, and relationships are established within a logically consistent framework. The third aspect is the application of mathematical theory, in which theoretical results are used to solve practical or new theoretical problems. These three aspects together form a unified cognitive process in which general logical techniques are integrated with subject-specific mathematical operations and are grounded in an evolving system of knowledge.

In the context of bilingual instruction, however, this traditional structure must be extended. Since thinking and language are fundamentally interconnected and thinking can be interpreted as operating with concepts within a linguistic system, it is necessary to take into account the linguistic representation of mathematical knowledge. Mathematical concepts, definitions, and proofs are always expressed through language, even when symbolic notation is used. Therefore, alongside general logical operations, specific mathematical techniques, and subject knowledge, we must also consider knowledge of how mathematical content is represented and verbalized in the native language and in the foreign language. Students must learn not only the concepts themselves but also the linguistic means for describing these concepts, formulating definitions, expressing relationships, and constructing arguments in both languages.

The system of knowledge in bilingual mathematics instruction thus performs a dual function [7]. On the one hand, it is the result of cognitive activity: as students engage in modeling, reasoning, and problem solving, their mathematical and linguistic knowledge expands. On the other hand, this system of knowledge is a prerequisite for further learning, since mathematics is characterized by a high degree of abstraction and logical structuring, and new material can only be understood on the basis of previously formed conceptual foundations. The absence of prior knowledge significantly limits the possibility of effective cognitive activity, particularly in a bilingual environment where additional linguistic demands are imposed.

At the initial stage of bilingual mathematics instruction, students' activity is primarily based on existing mathematical knowledge and native language competence. As foreign language elements are gradually introduced into lectures, problem-solving sessions, and instructional materials, the structure of activity becomes more complex and dynamic. Mathematical knowledge deepens and expands; at the same time, students develop the ability to operate with mathematical concepts in the foreign language. The enrichment occurs simultaneously in several domains: the domain of mathematics itself, the domain of native-language mathematical discourse, and the domain of foreign-language mathematical discourse. This development has a spiral character. As mathematical understanding becomes more profound, students refine their ability to articulate mathematical ideas in their native language, which in turn facilitates the development of foreign-language competence. The expansion of linguistic resources then supports further abstraction, clarification, and generalization of mathematical knowledge. Thus, bilingualism not only serves communicative purposes but also broadens cognitive possibilities, particularly in the verbalization and structuring of mathematical thought.

Within each specific area of mathematics, thinking may operate at different levels that vary in degree of abstraction, logical rigor, and generality [9]. These levels are associated with corresponding linguistic systems composed of specialized terminology, logical constructions, and elements of natural language. As students progress to higher levels of mathematical thinking, the linguistic system through which this thinking is expressed becomes more complex and more formalized. In geometry and algebra, for example, one can distinguish several levels ranging from empirical and visually oriented reasoning to fully abstract and deductive systems, and even to meta-theoretical reflection on the structure of theories and proofs. Research indicates that secondary education typically does not move beyond intermediate levels of formal reasoning. By contrast, the university course of higher mathematics, especially in the training of engineers, must operate at a theoretical, abstract-logical level. This requires students to understand mathematics as a deductive system, to work with abstract structures independent of specific interpretations, and to appreciate the logical architecture of definitions, axioms, and proofs.

These considerations have important methodological implications for bilingual instruction at a technical university. The transfer of mathematical activity into a foreign-language medium must take into account the current cognitive level of students. They should first be capable of performing the required type of reasoning in their native language; only then can the same level of activity be successfully carried out in a foreign language. If there is a significant gap between the level of students' mathematical thinking and the demands imposed by foreign-language instruction, temporary pedagogical adjustments may be necessary, including scaffolding, additional explanations, or a gradual increase in linguistic complexity. The aim is not to reduce mathematical rigor but to ensure that linguistic difficulties do not obscure conceptual understanding.

In conclusion, bilingual instruction in higher mathematics at a technical university represents a complex and multidimensional educational process in which the foreign language functions as a tool for mastering specialized knowledge. The structure of mathematical learning activity in this context includes logical operations, subject-specific mathematical techniques, and both native and foreign linguistic components that interact dynamically. Properly organized bilingual instruction contributes not only to the development of foreign language proficiency for professional purposes but also to deeper conceptual understanding, greater cognitive flexibility, and the formation of advanced mathematical thinking. When aligned with students' cognitive readiness and supported by appropriate methodological strategies, bilingual mathematics instruction becomes an effective means of preparing future engineers for participation in the global scientific and professional community.

References

1. Біблер В. С. Культура. Діалог культур. К. : Дух і літера, 2018. 368 с.
2. Зубцова Ю. Є. Генеза методології діяльнісного підходу в освіті. Інноваційна педагогіка. 2022. Вип. 48. Т. 1. С. 27-31.
3. Моторіна В. Г., Яловега І. Г. Проблема гуманітаризації математичної освіти. Фізико-математична освіта. 2019. Вип. 2 (20). С. 114–118.

4. Професійна педагогічна освіта: особистісно орієнтований підхід : монографія / О. Є. Антонова та ін. ; за ред. О. А. Дубасенюк. Житомир : Житомир. держ. ун-т ім. І. Франка, 2012. 435 с.
5. Семенець С. П. Концепція моделі навчально-математичної діяльності учнів. Педагогіка вищої та середньої школи. 2017. № 1 (50). С. 136-147.
6. Сніжко Н.В. Модель білінгвального навчання математики в технічному університеті. Проблеми освіти. 2024. № 2(101). С. 44-57.
7. Сніжко Н.В. Передумови та теоретичні основи моделювання білінгвального навчання математики майбутніх інженерів. Strategic Directions for Developing Science and Education in Ukraine: scientific monograph. Ed. M. Filipovych. Riga, Latvia : "Baltija Publishing", 2024. P. 196-223.
8. Столяр А. А. Педагогіка математики. 2006. https://www.mathedu.ru/text/stolyar_pedagogika_matematiki_1986/p0/
9. Fuys D., Geddes D.,Tischler R. The van Hiele Model of Thinking in Geometry among Adolescents. Journal for Research in Mathematics Education, 1988, Monograph 3, NCTM, Reston, VA, USA. 195 p.
10. Krashen S. D. Principles and practice in second language acquisition. Oxford: Pergamon Press, 1982. 202 p.

ЕТИЧНА КУЛЬТУРА ЯК ЦІННІСНА ОСНОВА ЕТИЧНОЇ КОМПЕТЕНТНОСТІ СУЧАСНОГО ПЕДАГОГА

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Сучасний європейський поступ української освіти характеризується радикальними змінами, що висуває нові вимоги до створення інноваційного освітнього середовища для якісної підготовки майбутнього творчого педагога, як компетентного фахівця, сумлінного й відповідального, здатного практично діяти, застосовувати індивідуальні техніки та досвід успішних дій у ситуаціях професійної діяльності.

Перспективи розвитку вітчизняної освіти, активна роль педагога у її модернізації відображено у державних документах: Законах України «Про освіту» (2017 р.), «Про вищу освіту» (2014 р.), Національній доктрині розвитку освіти України у XXI ст., Концепції розвитку педагогічної освіти» (2018 р.), Стратегії розвитку сфери інноваційної діяльності на період до 2030 року (2019 р.), Положенні про порядок здійснення інноваційної діяльності у сфері