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Theoretical and Methodological Foundations for the Professional Orientation of Mathematics

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Abstract. *The problems of low level of mathematical knowledge among students of technical universities are considered. An analysis of scientific and pedagogical literature is conducted to identify ways and means of achieving a higher level of knowledge in mathematics among technical university students. The level of pre-university mathematical knowledge of different specialties for 2019-2021 and the final level of knowledge in mathematics are compared. One of the ways of solving the existing problem is proposed – the way of professional orientation of the entire course of mathematics. This should arouse interest in learning, which will lead to an increase in academic performance.*

Keywords: *professional orientation in mathematics, ways to develop interest in learning, learning process in higher education.*

Introduction. Historically, there were two sides to the purpose of mathematics: the practical, which is associated with the creation and application of tools needed by man in his productive activities, and the spiritual, which is associated with human thinking, with the mastery of a particular method of knowledge and transformation of the world – the mathematical method.

Mathematical training in a technical university is necessary for understanding the principles of structure and use of modern methods and technologies, for the perception of scientific and technical concepts and ideas. It is used to model, study and predict many processes. Mathematics provides the basis for the study of other specialist disciplines. The role of vocational orientation in mathematics in the learning process is therefore great, and it has a direct impact on the learning, developmental and cognitive objec-

tives of the course. At the same time, professional orientation shapes students' scientific outlook, helps to see the world in achievement and development, contributes to the establishment of logical relationships between concepts, thus developing logical thinking of students, acts as a means of preventing and eliminating formalism in student knowledge, allows to form a system of knowledge, which appears before students not as stagnant, but as dynamic, qualitatively changing.

The teacher's task is to equip students with learning and cognitive apparatus, ways of activity. This, in its turn, requires students to form a certain system of skills. In our opinion, all learning skills can be divided into two groups: special, formed on the basis of one discipline, and general, formed on the basis of many disciplines. These include: general logical, training, search and information, organizational and cognitive. The formation of special skills occurs within a discipline, but it is possible to transfer them into the field of related disciplines.

So, for example, abilities and skills of statistical information processing, in a course of mathematics are formed at students for the further use at processing of results of researches in various technical disciplines. And the statistical processing of data obtained both in the experiment and by daily accounting is necessary to check the degree of reliability of the results, their proper generalization and identification of patterns of processes. Especially important is the role of statistical methods in modelling technological systems and processes and the subsequent use of these models to make the right decision in conditions of uncertainty.

Research methods. It should also be borne in mind that the rapid development of scientific progress has exacerbated the need to train highly qualified personnel in the field of engineering, who meet modern requirements. Leading scientists such as G.I. Shchukina, L.I. Bozhovich and others have established that the success in acquiring knowledge by students and, in particular, mathematics, depends largely on the formation of their cognitive interest [1, 2]. At the same time, the experience of teaching mathematics shows that a significant part of students has an extremely low level of formation of cognitive interest in mathematics.

In our opinion, one of the productive approaches to solving this problem is the approach, the essence of which is that mathematics teaching should be presented not only in the logic of modern mathematics, but also in the logic of the future professional activity of the student. In this case, the aim of student's learning activities is not only to master the mathematical apparatus as an integral scientific system, but to form professionally significant qualities of personality based on the logic of mathematics. It is this approach that should provide optimal conditions for the formation of cognitive interest in higher mathematics among students of any higher education institution.

The following methods were used in the implementation of this approach: formation and development of cognitive interest, professionally oriented teaching.

Scientific results. In the conducted research of students of Karaganda Technical University named after Abylkas Saginov of all educational programs we conditionally divided into 3 groups:

1 – technical direction;

2 – educational programs related to computer technology;

3 – educational programs of economic profile.

Analyzed were the results of examination sessions for 2019-2020 and 2020-2021 academic years are presented in Table 1.

There was also conducted a survey of students to determine the level of mathematical knowledge for the period of taking the UNT (Table 2).

The analysis has shown that students have an insufficient level of knowledge in mathematics from the secondary school course year by year and this certainly affects the further study of the discipline «Mathematics» in higher education. The obtained results allow us to conclude that the level of pre-university mathematical knowledge of students from different educational programs within the group does not practically differ, and does not depend on the year of study.

The difference between the results of the groups is due to the following, students in group 1, are trained mainly on the basis of state grants, students in group 3 are almost 100% trained on a contractual basis, in group 2 students are also trained on grants on a contractual basis, so the average score of UNT is so different between the groups.

Mathematical training is basic, and is a prerequisite for a large number of special disciplines, so students who have a low level of school preparation in mathematics have a low level of university knowledge of the course «Mathematics», which subsequently affects the overall performance of the student as a whole (Figure).

Thus, students have an insufficient level of knowledge in mathematics from the secondary school course year by year and this certainly affects further study of the discipline «Mathematics» in higher education institution.

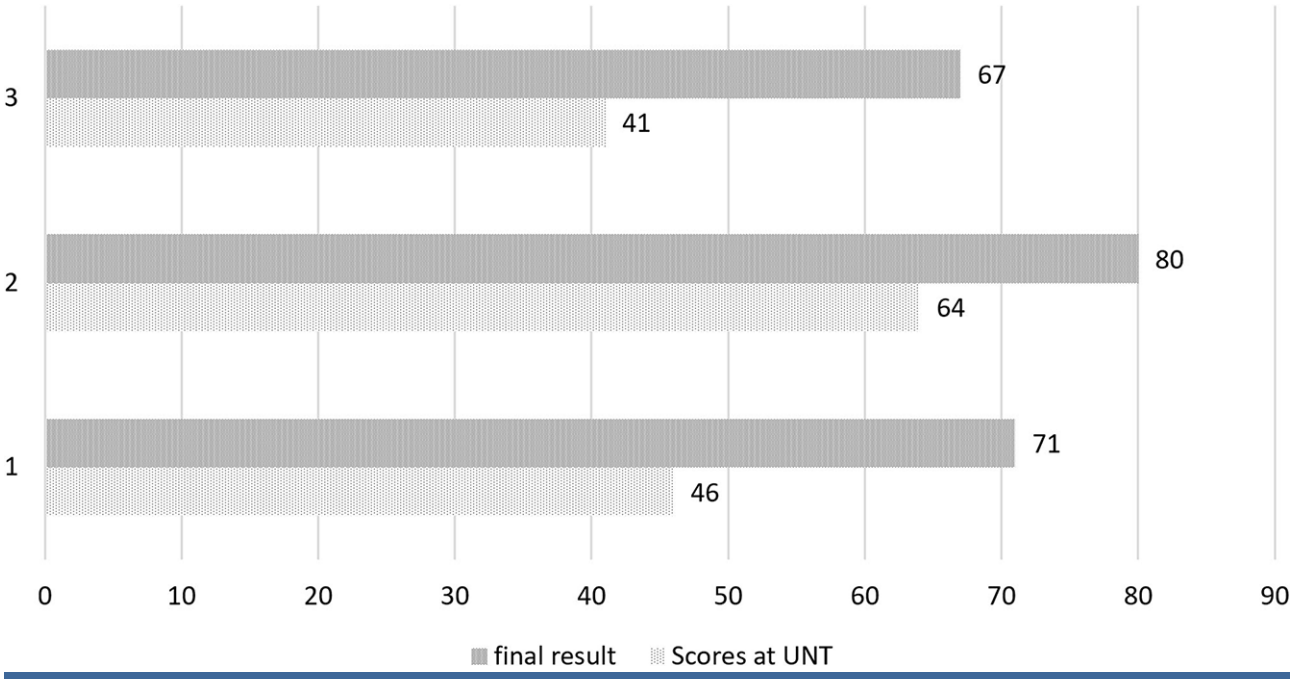
The analysis of scientific and methodological literature allowed identifying ways of improving the quality of mathematical knowledge. One of the ways as proves pedagogical practice – development of cognitive interest. Interest is of paramount importance in the implementation of any human activity, it is one of the most significant incentives for the acquisition of knowledge, increases cognitive activity of the person, causes the desire to work in a certain area, serves as one of the most important conditions of a truly creative attitude to work. The role of interest in learning activities, in the successful mastering of the studied subject is great [3]. In the presence of interest, knowledge is mastered thoroughly, firmly; in the absence of interest, learning material is learned with difficul-

Table 1 – Average student performance in mathematics

Study year	Group	Educational programs	Average score
2019-2020	1 – technical direction	- Transport, transport equipment and technology, - Organization, transport, traffic and operation of transport, - Geodesy and cartography, - Mineral processing, - Power engineering, - Power and heat engineering, - Geology and Mineral Deposit Marking, - Surveying- Standardization and certification (by branch), - Logistics (Transport), - Technological machines and equipment, - Oil and Gas, - Metallurgy, - Engineering, - Biotechnology, - Construction, - Manufacture of building materials, products and constructions, - Material science and technology of new materials, - Mining, - Engineering systems of buildings and structures, - Mineral processing, - Life safety and environmental protection, - Automation and Control	2.84 (71% achievement)
	2 – computer technology	- Information systems, - Information security systems, - Computer hardware and software; - Digital aerial photography, - IT Medicine	3,21 (80% achievement)
	3 – economic profile	- Industrial economics, - Accounting and auditing in industry, - Valuation (by industry)	2,67 (67% achievement)
2020-2021	1 – technical area	- Transport, transport engineering and technology, - Organization, transportation, traffic and operation of transport, - Geodesy and Cartography, - Mineral processing, - Power Engineering, - Heat Power Engineering, - Geology and Mineral Deposit Marking, - Surveying, - Standardization and certification (by branch), - Logistics (Transport), - Technological machines and equipment, - Oil and Gas, - Metallurgy, - Engineering, - Biotechnology, - Construction, - Manufacture of building materials, products and constructions, - Material science and technology of new materials, - Mining, - Engineering systems of buildings and structures, - Mineral processing, - Life safety and environmental protection, - Automation and Control	2,89 (72% achievement)
	2 – computer technology	- Information systems, - Information security systems, - Computer hardware and software, - Digital aerial photography, - IT Medicine	3,14 (79% achievement)
	3 – economic specialization	- Industrial economics, - Accounting and auditing in industry, - Valuation (by industry)	2,71 (68% achievement)

Table 2 – Quantitative results of the initial level of mathematical knowledge

Group	Scores at UNT in Mathematics (%)
1 – technical direction	25%-68%
2 – computer technologies	48%-80%
3 – economic direction	25%-52%



Student performance in Mathematics UNT – Final result

ty, often formally, is not applied in life, it is easy and soon forgotten. Interests are formed and developed in the process of learning, work, social activities of a person and depend on the conditions of his life, education and upbringing [4].

L.S. Vygotsky emphasized that interest is a natural engine of behavior, it is a true expression of instinctive drive [5]. As established by a number of researchers, a special type of interest appears in learning – «interest in cognition, or, as it is called now, cognitive interest. Its field is an activity in the process of which there is a mastering of the content of academic subjects and the necessary ways or abilities and skills by means of which the learner is educated» [6]. Cognitive interest is extremely important for learning activities.

In the conditions of learning cognitive interest is expressed by disposition of a pupil to learning, to cognitive activity, a need for deepening, creative application of knowledge. The peculiarity of cognitive interest is its ability to enrich and activate the activity process. V.M. Vergasov emphasizes that «interest in cognition is one of the elements which disinhibit the mechanism of perception and create conditions for activization of cognitive activity in general, i.e. create conditions for increasing productivity not only of the mechanism of thinking, but also of the mechanisms of perception and behavior» [7].

G.I. Shchukina's research has established that not only the productivity of mastering knowledge, ways of cognitive activity, but also the general tone of the whole learning activity depends on interest. Considering interest as a cognitive problem through the prism of values, G.I. Shchukina writes, «it is possible to state that thanks to interest the objective world to some extent comes nearer to a person, becomes not indifferent to him, but necessary, valuable for his existence and development». «Cognitive interest is the most important formation of personality which is formed in the process of human life activity. In cognitive interest there is an opportunity to penetrate into scientific truth, to expand the scope of cognition» [1].

The analysis of psychological and pedagogical and methodical literature indicates that the formation and development of interest in knowledge should be based on the psychological and pedagogical basis of this process. Pototsky M.V. states that «interest in learning should be considered as one of the powerful factors of learning» [8].

A.A. Verbitsky's research states: «In theory and in practice, there is a shift in emphasis from the teaching activity of the teacher to the cognitive activity of the

student» [9].

Conclusion. It is certainly not possible for a university teacher to influence the level of mathematical knowledge in schools, but it is in his interest to make students interested in mathematics [9]. Of course, this road to knowledge enhancement is a difficult one, as the teacher needs to fundamentally restructure his work with the students. Undoubtedly, we cannot change the model curriculum approved by the Ministry of Education of the Republic of Kazakhstan, but we can enrich it with professional orientation. Lectures should be accompanied by examples from the future professional activity of the student, at practical lessons and SRSP to solve not only simple mathematical problems, but to consider the problems that have a professional orientation. Then, already at the first stages of higher mathematics, students will have an idea of the application of mathematical knowledge in their future professional life, and then they will treat the study of mathematics not as «unnecessary and very difficult subject», but as a tool for further study of professional disciplines. Some of the students, even after graduation, will use mathematical baggage to improve their professional competence.

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Математика пәнінің кәсіби бағыттардың теориялық-әдістемелік негіздері

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Аңдатпа. *Техникалық университет студенттерінің математикалық білімнің төмен деңгейінің мәселелері қарастырылған. Техникалық университет студенттері арасында математикадан жоғары білім деңгейіне жетудің жолдары мен тәсілдерін анықтау үшін ғылыми-педагогикалық әдебиеттерге талдау жүргізіледі. 2019-2021 жылдарға арналған әртүрлі мамандықтардың жоғары оқу орнына дейінгі математикалық білім деңгейі мен математика пәнінен қорытынды білім деңгейі салыстырылады. Ағымдағы мәселені шешу жолдарының бірі – математиканың бүкіл курсының кәсіби бағдарлау жолы ұсынылады. Бұл оқу үлгерімінің артуына әкелетін оқуға деген қызығушылықты ояту керек.*

Кілт сөздер: *математиканың кәсіптік бағыттылығы, оқуға деген қызығушылықты дамыту жолдары, жоғары оқу орнындағы оқу үрдісі.*

Теоретические и методологические основы профессиональной ориентации математики

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Аннотация. *Рассматриваются проблемы низкого уровня математических знаний у студентов технических вузов. Проводится анализ научно-педагогической литературы на предмет выявления путей и средств достижения более высокого уровня знаний по математике у студентов технического вуза. Проводится сравнение уровня довузовских математических знаний различных специальностей за 2019-2021 годы и итогового уровня знаний по математике. Одним из путей решения, сложившейся проблемы предлагается – путь профессиональной ориентации всего курса математики. Это должно вызвать интерес к обучению, что повлечет за собой повышение успеваемости.*

Ключевые слова: *профессиональная ориентация математики, пути развития интереса к обучению, процесс обучения в высшей школе.*

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