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PROBABILISTIC METHODS IN TECHNICAL EDUCATION: TEACHING THROUGH PROFESSIONALLY ORIENTED APPLIED TASKS

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Abstract. In the context of technological advancement and the increasing complexity of engineering systems, there is a growing need to train specialists capable of effectively operating under conditions of uncertainty, analyzing data, and making informed decisions. In this regard, the application of probabilistic methods in the education of engineering students is of particular relevance. The aim of this study is to develop and substantiate methodological approaches to the use of probabilistic methods in professionally oriented education. The main directions of the research include the integration of probabilistic models into the educational process, the adaptation of curriculum content to the needs of engineering and IT fields, and the development of students’ skills in data analysis, forecasting, and decision-making. The key idea of the study is to bridge theoretical training with real-world industrial tasks. The scientific significance of the work lies in substantiating the role of probabilistic methods as a tool for developing professional thinking and analytical competencies. The practical significance is determined by the possibility of applying the proposed approaches in the design of educational programs.The research methodology is based on a quasi-experimental design involving control and experimental groups, pre-test and post-test assessments, and the application of statistical data analysis methods. The experimental instruction was carried out using professionally oriented tasks based on probabilistic models. The results of the study demonstrate that the use of probabilistic methods significantly improves students’ academic performance: the experimental group showed an increase in the mean score by 16 points with statistically significant differences ($p < 0.001$), whereas the control group showed only limited improvement. These findings confirm the effectiveness of the proposed approach. The value of the study lies in the development of a methodological model for integrating probabilistic methods into professionally oriented education. The practical significance of the results is reflected in their applicability to the modernization of educational programs and the training of specialists capable of effectively operating under conditions of uncertainty and technological complexity.

Keywords: probabilistic methods, professionally oriented education, applied tasks, professional competence, repeated (Bernoulli) trials, Bernoulli formula, de Moivre–Laplace local limit theorem, de Moivre–Laplace integral theorem

Introduction

Today's world is one of digital transformation, globalized production, and many forms of technological uncertainty; this is why Technical Education has become an important tool for producing qualified and competitive professionals. With so many new technologies being developed at such a fast rate, along with the increasing complexity of modern manufacturing systems, students cannot be expected to simply know a lot about the theory behind the process and then go out into an industrial environment and effectively use that theory through real-world data analysis, forecasting, and decision-making. Traditional instructional strategies have been unable to effectively convey the complexities involved in today's manufacturing environments and equip students with the required preparedness to make informed and timely decisions under uncertainty.

The professionally oriented approach to teaching probabilistic methods is widely considered in research as an effective mechanism to address this gap. In the works of S. K. Yermaganbetova, A. E. Abylkasymova, and K. Zh. Baishagirov, the importance of teaching mathematics through professionally oriented tasks and practical situations is emphasized [1]. Continuing this line, D. Sipos, S. Bendea, and I. Kocsis demonstrate that the development of probabilistic modeling skills in engineering education fosters professional thinking, enhances decision-making abilities under uncertainty, and improves the efficiency of solving industrial tasks [2]. In addition to this, A. Haldar and S. Mahadevan also provide an overview of the application of probabilistic and statistical analysis techniques as part of the evaluation of engineering design risk and uncertainty [3]; J. Walrand provides a detailed review of the applications of probabilistic models in Electrical Engineering and Computer Science [4] (From a pedagogy/psychology standpoint), C. Batanero and R. Alvarez-Arroyo have highlighted the importance of probabilistic thinking in many areas of practice and work [5]. M. Baron's work demonstrates the professional and applied aspects of probability and statistics in computer science, offering methods and examples that strengthen students' skills in solving professional tasks [6]. Thus, the literature confirms the relevance of mastering probabilistic methods in a professional context, while also requiring clarification of mechanisms for their systematic implementation and assessment.

The purpose of this study is to explore the possibilities of effectively applying probabilistic methods in the training of technically oriented specialists and to develop corresponding methodological guidelines. The main objectives are: to analyze existing practices; to adapt probabilistic models to the educational process with a professional orientation; and to assess their impact on the development of students' analytical thinking as well as practical skills.

The findings of this study are based on the hypothesis which is as follows; The inclusion of probability-based methods within a professional development program will increase students' abilities in analyzing data, forecasting and decision making when faced with uncertainty and their adaptability to various manufacturing processes. In order to accomplish these objectives, theoretical models related to industrial environments will be combined with practical case studies to illustrate scenarios in which the full scope of using probabilistic methods in the educational system can be demonstrated.

Materials and Methods

The study was conducted within the framework of a quasi-experimental design involving control and experimental groups, with pre-test and post-test measurements. To evaluate the effectiveness of the proposed methodological approach, descriptive statistical methods were used, including the calculation of the initial mean score (M), final mean score (M), and the mean gain (ΔM). These indicators made it possible to assess the dynamics of students' academic performance in both groups. To determine the variability and consistency of the obtained results, the standard deviation of differences (SD_diff) was calculated. This allowed for a more accurate interpretation of the changes observed in students' performance. For the statistical verification of the results, Student's t-test for both dependent and independent samples was employed. The statistical significance of differences between pre-test and post-test results was determined using the p-value (p, 2-tailed). These methods ensured the reliability and validity of the conclusions regarding the effectiveness of the proposed approach.

To conduct the pedagogical experiment, two groups with comparable initial levels of preparedness were formed:

1. Control group (CG) – n = 23 (traditional teaching methods);
2. Experimental group (EG) – n = 23 (teaching stochastic methods through professionally oriented tasks).

The comparability of the groups was ensured through an initial diagnostic assessment: both groups were given identical pre-test tasks related to probability theory and stochastic methods. The results of the pre-test indicated no statistically significant differences between the groups, which allowed them to be considered equivalent at the baseline stage.

In both groups, instruction was conducted over the same duration and based on the same curriculum. The only difference lay in the methodology of organizing the learning activities and the nature of the tasks used. To ensure the pedagogical validity of the experiment, the content of assessment tasks, evaluation criteria, task complexity, and the pace of instruction were kept identical in both groups.

Stage 1. Diagnostic stage. The first phase of the research involved an examination of the prior knowledge of the students' with respect to applying probability methods, their ability to understand probabilistic models, and their skill in solving real world applications. Both treatment and control groups received diagnostic tasks that contained identical amounts and complexities of material relative to applying probabilistic models. An initial analysis revealed that the prior knowledge base of both groups were similar. This similarity provided a foundation to continue with further stages of the research.

Stage 2. Formative stage. In the control group, instruction was carried out using traditional methods, including explanation of theoretical material, application of formulas, and solving standard problems. In contrast, in the experimental group, instruction was based on the application of stochastic methods through professionally oriented tasks, characterized by the use of real-world problems related to industrial and IT contexts, as well as the organization of students' research-oriented activities. Within the learning process, tasks were used not only as a means of problem-solving but also as a tool for modeling professional situations.

Stage 3. Final stage. At the final stage of the experiment, assessment procedures were organized to determine changes in students' learning outcomes. These included a final test on probability methods, tasks for solving applied problems, and a comparative analysis of the results of the control and experimental groups. The effectiveness of the methodological approach was evaluated based on the increase in the proportion of correctly completed tasks, improvement in the quality of solving applied problems, the level of correct application of probabilistic models, and indicators of students' learning activity.

In developing the methodological approach, probabilistic models and methods widely used in engineering sciences were taken as the basis.

In engineering sciences, probabilistic models and methods were applied to develop methodological approaches. These approaches are based on probabilistic laws and mathematical modeling. On this basis, it becomes possible to effectively analyze and manage random phenomena and systems under conditions of uncertainty.

Probabilistic methods are research approaches based on the laws and models of probability theory. They are used for decision-making under uncertainty, describing random phenomena, and analyzing data. These methods make it possible to predict the behavior of complex systems, determine their reliability, and select effective management strategies [6,7].

Bernoulli's Formula

If several trials are conducted and the occurrence of event A in each trial does not depend on the outcomes of other trials, then such trials are called independent with respect to event A.

Theorem. Suppose that in several trials the probability of the occurrence of event A in each trial is constant and equal to p. Then, if n trials are conducted, the probability that event A occurs exactly k times is given by:

$$P_n(k) = C_n^k p^k q^{n-k}$$

where $q = 1 - p$. The formula is referred to as Bernoulli's formula.

The most probable frequency of an event in repeated experiments

If the probability that event A occurs exactly k_0 times in n trials is greater than the probabilities of its occurring any other number of times, then the number k_0 is called the most probable number.

Theorem. In the case of n trials, the most probable number k_0 of occurrences of event A is determined by the inequality: $np - q \le k_0 \le np + p$.

Note. If $np - q$ is an integer, then the most probable number has two values, because the difference between the right-hand side and the left-hand side of the inequality is equal to $1 = q + p$

The Local De Moivre–Laplace Theorem

When conducting *n* trials, the probability $P_n(k)$ of event *A* occurring exactly *k* times can be calculated (for sufficiently large *n*) using the Local De Moivre–Laplace Theorem.

Theorem. If the probability of the occurrence of event A in each trial is constant, and the number of trials n is sufficiently large, then for every value of k, representing the number of occurrences of event A, the following holds:

$$P_n(k) \approx \frac{1}{\sqrt{npq}} \varphi(x),$$

where

$$x = \frac{k - p}{\sqrt{npq}}, \quad \varphi(x) = \frac{1}{\sqrt{2\pi}} e^{-\frac{x^2}{2}}$$

the values of $\varphi(x)$ represented in the table [10], with $\varphi(x) = 0$ taken for x>4.

The Integral De Moivre–Laplace Theorem

Theorem. If the probability p of the occurrence of event A in each trial is constant, and the number of trials n is sufficiently large, then the probability that the number of occurrences of this event lies between a and b is given by

$$P\,(a \le k \le b) \approx \Phi(\beta) - \Phi(\alpha)$$

where

$$\alpha = \frac{a - p}{\sqrt{npq}}, \quad \beta = \frac{b - p}{\sqrt{npq}}, \quad \Phi(x) = \frac{1}{\sqrt{2\pi}} \int_0^x e^{-\frac{t^2}{2}} d$$

The function Φ(x) called the Laplace function or the probability integral. The Laplace function is an odd function $\Phi(-x) = -\Phi(x)$ and $\Phi(0) = 0$. $\Phi(x)$ is a monotonically increasing function, and for x>5 it is assumed that $\Phi(x) = 0.5$.

1. Server reliability under load testing

The company intends to evaluate how reliable their server cluster will be. The server cluster will contain ten separate servers; each server has a .02 chance of failure daily. a) The goal for this problem is to determine the likelihood of two or more of the ten servers failing within one day, b) as well as the likelihood that the server cluster would function without failing.

Methodological guidelines for solving the problem

a) the probability of failure of 2 or more servers in the cluster $P_0\,(k \ge 2) = P_0\,(2) + P_0\,(3) + P_0\,(4) + P_0\,(5) + P_0\,(6) + P_0\,(7) + P_0\,(8) + P_0\,(9) + P_0\,(0\;)$

, Alternatively, we can find the probability of the complementary event and subtract it directly from 1, that is, by calculating the probability of 0 server failures and the probability of 1 server failure, and then subtracting their sum from 1

$$P_{10}(k \geq 2) = 1 - \left(P_{10}(0) + P_{10}(1)\right)$$

$$P_{10}(k \geq 2) = 1 - \left(P_{10}(0) + P_{10}(1)\right) = 1 - \left(C_{10}^{0} p^{0} q^{10} + C_{10}^{1} p^{1} q^{9}\right) =$$

$$= 1 - \left(0.02^{0} \cdot 0.98^{10} + 10 \cdot 0.02 \cdot 0.98^{9}\right) = 0.0162$$

b) the probability of the cluster operating without failure (i.e., the probability that none of the servers will fail). The probability of the cluster operating without failure is equal to the probability of 0 server failures, that is:

$$P_{10}(k = 0) = C_{10}^{0} p^{0} q^{10} = 0.98^{10} = 0.8171$$

2. Data transmission quality over a network

Transmitting packets of data across a network has a probability of loss for each packet transmitted as 0.05 or 5% and in one transmission session there are 100 packets sent. Therefore, we need to determine: a) The probability of losing at least one packet; b) The probability of losing exactly 3 packets.

Methodological guidelines for solving the problem

Where: n=100, p=0.05, q=0.95

a) the probability of losing at least one packet $P(k \geq 1)$

$$P(k \geq 1) = 1 - P(0)$$

$$x = \frac{k - np}{\sqrt{npq}}$$

$$x = \frac{0 - 100 \cdot 0.05}{\sqrt{100 \cdot 0.05 \cdot 0.95}} \approx -2.29$$

, where φ - an even function, and its value can be found using the Laplace function table [10].

$$P(0) = \frac{1}{\sqrt{100 \cdot 0.05 \cdot 0.95}} \varphi(-2.29) = \frac{1}{\sqrt{4.75}} \varphi(2.29) \approx \frac{1}{\sqrt{4.75}} \cdot 0.029 \approx 0.01$$

$$P(k \geq 1) = 1 - P(0) \approx 1 - 0.0133 \approx 0.9867$$

b) the probability that 3 packets are lost $P(k = 3)$

$$x = \frac{3 - 100 \cdot 0.05}{\sqrt{100 \cdot 0.05 \cdot 0.95}} \approx -0.92$$

, where φ - an even function, and its value can be found using the Laplace function table [10].

$$P(0) = \frac{1}{\sqrt{100 \cdot 0.05 \cdot 0.95}} \varphi(-0.92) = \frac{1}{\sqrt{4.75}} \varphi(0.92) \approx \frac{1}{\sqrt{4.75}} \cdot 0.2613 \approx 0.1$$

3. Software testing (bug)

When software is being tested, there is a 10% chance (0.1), that an error will be found on each test (as indicated by a 0.1 probability). There were 8 tests performed independently. So we need to find: a) The probability that at least one error was found during testing. b) The probability that exactly three errors will be found during testing.

Methodological guidelines for solving the problem

a) the probability that at least one error will be detected:

$P_8(k \geq 1) = 1 - P_8(0)$,

$P_8(k \geq 1) = 1 - P_8(0) = 1 - C_8^0 p^0 q^8 = 1 - 0.1^0 \cdot 0.9^8 = 0.5695$

b) the probability that exactly 3 errors will be detected:

$P_8(k = 3) = \tilde{N}_8^3 p^3 q^5 = \dfrac{8!}{3! \cdot 5!} 0.1^3 \cdot 0.9^5 = 0.031$

4. DDoS attack and traffic filtering

When a hacker uses a DDoS (Distributed Denial of Service), he sends to the server, 10,000 malicious packets as a way to slow down or block the server from working properly. For this reason, the use of filters to protect against these attacks are used. A filter can be configured to stop a malicious packet with a 90% (probability = 0.9) chance, and allow the remaining 10% (probability = 0.1) of the malicious packets to go to the server. We need to determine: a) The probability that 1,050 or more malicious packets will get past the filter; b) The probability that 950 or less malicious packets will get to the server.

Methodological guidelines for solving the problem

Where:

n=10 000, p=0.1, q=0.9

a the probability that at least 1050 malicious packets will pass through the filter $P(1050 \leq k \leq 10000)$

$\alpha = \dfrac{a - np}{\sqrt{npq}}$, $\beta = \dfrac{b - np}{\sqrt{npq}}$

$\alpha = \dfrac{1050 - 10000 \cdot 0.1}{\sqrt{10000 \cdot 0.1 \cdot 0.9}} = 1.6$,

$\beta = \dfrac{10000 - 10000 \cdot 0.1}{\sqrt{10000 \cdot 0.1 \cdot 0.9}} = 300$ where the function $\Phi(x)$ is taken $\Phi(x) = 0.5$ for x>5.

$P(1050 \leq k \leq 10000) = \Phi(300) - \Phi(1.6\ ) \approx 0.5 - 0{,}4515 \approx 0{,}0485$

b) the probability that at most 950 malicious packets will reach the server $P(0 \leq k \leq 950)$,

$\alpha = \dfrac{a - np}{\sqrt{npq}}$, $\beta = \dfrac{b - np}{\sqrt{npq}}$

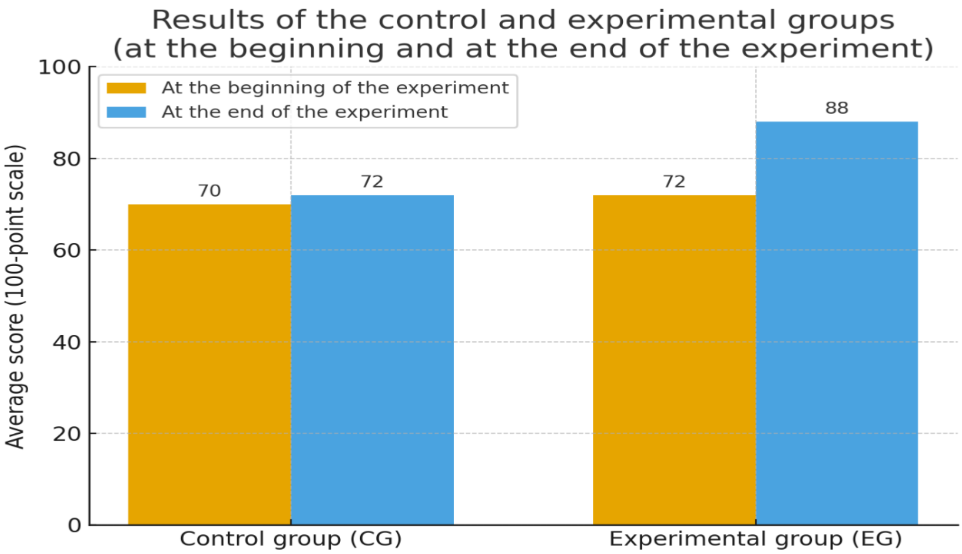
$\alpha = \dfrac{0 - 10000 \cdot 0.1}{\sqrt{10000 \cdot 0.1 \cdot 0.9}} = -3\ ,3$, $\beta = \dfrac{950 - 10000 \cdot 0.1}{\sqrt{10000 \cdot 0.1 \cdot 0.9}} = -1.6$

where the function $\Phi(x)$ is an odd function, and for x>5 it is taken to be $\Phi(x) = 0.5$.

$P(0 \leq k \leq 950) = \Phi(-1.6\ ) - \Phi(-3\ .3\ ) \approx -\Phi(1.6\ ) + \Phi(3\ .3\ ) = -0.4515 + 0.5 \approx 0.0485$

Results

A total of 2 student groups participated in this research. Group 1 (ISk-23-1) acted as the control group and continued learning using traditional teaching methods, whereas, Group 2 (ISk-23-2), which acted as the experimental group, used innovative teaching methods that use probabilistic methods. New teaching methods were developed to be able to assist the students in problem solving through the utilization of analytical thinking, data analysis, forecasting, and decision making while operating in an environment of uncertainty. This study was structured to have an experimental design consisting of two phases. Phase one consisted of each group being given the same pre-test with the same subject matter to compare the baseline knowledge of the two groups. At the beginning of this experiment, the mean score of the experimental group and the control group were 72.0 and 70.0 respectively.



Picture 5 - Comparison Chart of Results

Table 1. Outcomes of teaching effectiveness using probabilistic methods (control and experimental groups)

Group	Initial Mean (M)	Final Mean (M)	ΔM	SD_diff	t	p (2-tailed)
Experimental group (EG)	72	88	+16	8.9	+9.85	<0.001
Control group (CG)	70	72	+2	6.37	+1.72	0.09

At the end of the experiment, a follow-up test was conducted, and the average score of the experimental group was 88.0, while the control group's average score was 72.0. As such, for the experimental group, $\Delta M = +16.0$ and for the control group $\Delta M = +2.0$. As well as the mean difference being large, with standard deviation of differences, SD_diff = 8.90, $t = +9.85$, $p < 0.001$, it is clear that the results are both statistically and practically meaningful. The mean difference (the increase) is very consistent. In contrast, while the control group experienced an increase in standard deviation of differences (SD_diff = 6.37), $t = +1.72$, $p = 0.09$, the results were not statistically different than chance. Therefore, it cannot be determined whether the small increase seen in the control group is due to chance or some other factor.

Discussion

Probabilistic techniques have become increasingly integrated into curricula of technology-focused programs through professionalized instructional methods; which allows students to connect theoretical concepts to workplace-based problems and enhance student's skill for making decisions in an environment of uncertainty. The authors of S.K. Yermaganbetova, A.E. Abylkasymova, K.Zh. Baishagirov emphasize the need to link professionalized tasks with workplace based scenarios to industrial based scenarios in the learning process [1], as do Peter Frejd and Christer Bergsten when they state that mathematical modeling is part of professional practice and that it is necessary to use authentic workplace scenarios to validate models and present results in a way that clearly communicates to all stakeholders and develops effective communication skills. Both of these positions support the research we have conducted on the professionally focused instruction of probabilistic techniques and add additional support for the inclusion of professionalized tasks in the instructional curriculum [9] .

Engineering Education research supports this direction as well, as D. Sipos, S. Bendea, and I. Kocsis emphasized that developing the skills for probabilistic modeling is an important element of sustainable education and will enable engineers to think professionally, make decisions in environments of uncertainty, and manage industrial processes [2]. The authors Haldar and Mahadevan, provided a detailed discussion of how probabilistic and statistical methods can be used in engineering design to account for risk and uncertainty, and highlight the utility of these methods in assessing the reliability of designs and in evaluating design decisions [3]. Additionally, J. Walrand, provided a systematic overview of the application of probabilistic methods in Electrical Engineering and Computer Science and provides a basis for developing students' experiences in using probabilistic models to resolve problems that arise in a professional setting [4].

From a psychopedagogic perspective, C. Batanero and R. Alvarez-Arroyo emphasize the need for probabilistic thinking to be developed within a practical and professional context; which illustrates the need to develop students' understanding of probabilistic techniques beyond a purely theoretical framework and to develop a connection between probabilistic techniques and applicable scenarios [5]. Overall, both the literature and the data collected during this research indicates that instruction of probabilistic techniques through a professionalized approach, enhances students' analytic competencies, enhances students' culture of working with data, and enhances students' ability to make decisions in an uncertain environment.

Conclusion

Teaching probabilistic methods to students from technical specialties in a professionally-oriented way is very important to improve analytical thinking, data analysis skills, and decision-making under uncertainty. The analyses carried out and scholarly research have shown that when probabilistic methods are applied in a professional context, students can combine their theoretical knowledge with practical tasks. The outcomes of the research indicate that the tasks based on probabilistic models promote professional thinking among the students, and facilitate them adapting to the industrial conditions. These include: professionally-oriented problems; probabilistic modeling skills; methods for taking account of uncertainty and risk; and the experience of solving real engineering or computer science problems — all these contribute to the professional competence of the students. Professionally-oriented teaching of probabilistic methods not only facilitates deeper understanding of the theory by the students, but it also allows them to apply this theory to the solution of the real industrial problems. Such approaches allow adapting the educational system to requirements of modern industry and the digital transformation. In the future, improving the systems of professionally-oriented tasks based on probabilistic methods, and their broader application to the educational practice will continue to be one of the most important directions.

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ТЕХНИКАЛЫҚ БІЛІМ БЕРУДЕ ЫҚТИМАЛДЫҚ ӘДІСТЕР: КӘСІБИ-ҚОЛДАНБАЛЫ ТАПСЫРМАЛАР АРҚЫЛЫ ОҚЫТУ

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Аңдатпа. Технологиялық даму мен инженерлік жүйелердің күрделенуі жағдайында белгісіздік жағдайында тиімді жұмыс істей алатын, деректерді талдап, негізделген шешімдер қабылдай алатын мамандарды даярлау қажеттілігі артып отыр. Осыған байланысты техникалық мамандықтардағы студенттерді оқытуда ықтималдық әдістерін қолдану ерекше өзектілікке ие. Зерттеудің мақсаты – кәсіби-бағдарлы оқытуда ықтималдық әдістерін қолданудың әдістемелік тәсілдерін әзірлеу және негіздеу. Негізгі жұмыс бағыттары ықтималдық модельдерін білім беру процесіне интеграциялаумен, оқыту мазмұнын инженерия және IT саласының міндеттеріне бейімдеумен, сондай-ақ студенттерде деректерді талдау, болжау және шешім қабылдау дағдыларын дамытумен байланысты. Зерттеудің негізгі идеясы теориялық дайындықты нақты өндірістік міндеттермен жақындату болып табылады. Жұмыстың ғылыми маңыздылығы ықтималдық әдістерінің кәсіби ойлауды қалыптастыру және аналитикалық құзыреттіліктерді дамыту құралы ретіндегі рөлін негіздеуде. Практикалық маңыздылығы әзірленген тәсілдерді оқу бағдарламаларын жобалау кезінде қолдану мүмкіндігінде. Зерттеу әдіснамасы бақылау және эксперименттік топтарды пайдалана отырып, квазиэксперименттік тәсілге, алдын ала және қорытынды тестілеу жүргізуге, сондай-ақ деректерді өңдеудің статистикалық әдістерін қолдануға негізделген. Экспериментте ықтималдық модельдеріне негізделген кәсіби-бағдарланған есептер пайдаланылды. Зерттеу нәтижелері ықтималдық әдістерін қолдану студенттердің оқу жетістіктерінің айтарлықтай артуына ықпал ететінін көрсетті: эксперименттік топта орташа баллдың 16- ға өсуі статистикалық маңызды айырмашылықтармен ($p < 0{,}001$) тіркелді, ал бақылау тобында өзгерістер шектеулі сипатта болды. Алынған деректер ұсынылған тәсілдің тиімділігін растайды. Зерттеудің құндылығы ықтималдық әдістерін кәсіби-бағдарланған оқытуға интеграциялаудың әдістемелік моделін әзірлеуде. Нәтижелердің практикалық мәні олардың білім беру бағдарламаларын жаңғырту және белгісіздік пен технологиялық күрделілік жағдайында тиімді

жұмыс істей алатын мамандарды даярлау кезінде қолданылу мүмкіндігінде.

Тірек сөздер: ықтималдық әдістер, кәсіби-бағдарлы оқыту, қолданбалы тапсырмалар, кәсіби құзыреттілік, қайталама сынақтар, Бернулли формуласы, Муавр-Лапластың локальдық теоремасы, Муавр-Лапластың интегралдық теоремасы

ВЕРОЯТНОСТНЫЕ МЕТОДЫ В ТЕХНИЧЕСКОМ ОБРАЗОВАНИИ: ОБУЧЕНИЕ НА ОСНОВЕ ПРОФЕССИОНАЛЬНО-ПРИКЛАДНЫХ ЗАДАНИЙ

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Аннотация. В условиях технологического развития и усложнения инженерных систем возрастает необходимость подготовки специалистов, способных эффективно работать в условиях неопределённости, анализировать данные и принимать обоснованные решения. В этой связи особую актуальность приобретает применение вероятностных методов в обучении студентов технических специальностей. Целью исследования является разработка и обоснование методических подходов к использованию вероятностных методов в профессионально-ориентированном обучении. Основные направления работы связаны с интеграцией вероятностных моделей в образовательный процесс, адаптацией содержания обучения к задачам инженерной и IT-сферы, а также развитием у студентов навыков анализа данных, прогнозирования и принятия решений. Ключевая идея исследования заключается в сближении теоретической подготовки с реальными производственными задачами. Научная значимость работы состоит в обосновании роли вероятностных методов как средства формирования профессионального мышления и развития аналитических компетенций. Практическая значимость заключается в возможности использования разработанных подходов при проектировании учебных программ. Методология исследования основана на квазиэкспериментальном подходе с использованием контрольной и экспериментальной групп, проведении предварительного и итогового тестирования, а также применении статистических методов обработки данных. В эксперименте использовались профессионально-ориентированные задачи, основанные на вероятностных моделях. Результаты исследования показали, что применение вероятностных методов способствует значительному повышению учебных достижений студентов: в экспериментальной группе зафиксирован прирост среднего балла на 16 пунктов при статистически значимых различиях ($p < 0,001$), тогда как в контрольной группе изменения носили ограниченный характер. Полученные данные подтверждают эффективность предложенного подхода. Ценность исследования заключается в разработке методической модели интеграции вероятностных методов в профессионально-ориентированное обучение. Практическое значение результатов состоит в их применимости

при модернизации образовательных программ и подготовке специалистов, способных эффективно работать в условиях неопределённости и технологической сложности.

Ключевые слова: вероятностные методы, профессионально-ориентированное обучение, прикладные задания, профессиональная компетентность, повторные (бернуллиевские) испытания, формула Бернулли, локальная теорема Муавра-Лапласа, интегральная теорема Муавра-Лапласа

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