Conclusion

It is obvious that semantic imbuing of concepts distinctive in the context dominating a greater or lesser the concept feature, emphasizing their vitality. M. V. Pimenova writes "Priorities in selection a certain features of the concept allows to make conclusions about peculiarities of the author's individual picture world" [4, 38]. Hence, literary concepts enhance opportunities of "linear" national concept even in some situations of the novel "IQ84" accomplishing great number of functions: from the plot structuring (a story of two cordial souls) to the exposing tragedy of a mystic Leader (stony soul – stony body), from metaphorical characteristics (warm soul) to the concept decoding of "emptiness" 「空隙、空白」.

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THE USE OF INFORMATION AND COMMUNICATION TECHNOLOGIES AND VISUALIZATION OF LEARNING MATERIAL FOR THE INTEREST OF FUTURE TEACHERS IN PROBLEMS OF MATHEMATICAL STATISTICS

Abstract. The authors demonstrate a possible method of the interest of the future math, physics and computer science teachers in the mathematical statistics problems by the tools of the programming and use of mathematical software. The applied task is proposed. The flow chart of the visualization of the algorithm for its solution was created based on awareness of the essential theory. The process of this task solving and the design of the answer, using Java programming and the system of computer mathematics Maple, is described. The final step is the visualization of the result using the curve in these software. The conclusions about the advantages and disadvantages of such a construction with the use of information and communication technologies was made.

Key words: information and communication technology, IC competence, software, visualization, computer visualization, flowchart, normal distribution, Pearson's test.

Introduction. One of the modern problems of education is a significant decrease of the interest of teenagers in study of Mathematics and Physics. This is evidenced by small sets of students in universities of Ukraine on the specialty of mathematical and natural science cycle, the lowering of the quality of the results of external independent evaluation, and the reduction of the participants in the school Olympics in these disciplines, etc.

Significant changes in the society of the XXI century come with the advent of innovation technologies. These changes affect especially on the younger generation, which is surrounded by modern technical devices, which influence on their consciousness and the nature of perception, in everyday life,

The current state of the society is characterized, on the one hand, by the providing young people with opportunities for development and self-education, on the other hand, by a real danger of regressive ways of using information technology (smartphones, tablets, computers, etc.). The new generation is used to obtain information in mosaic form, in the separate systematic and

generalized portions. Thus long book texts are perceived hardly, poorly remembered and understood. These facts adversely affected the quality of acquired knowledge. Such a radical changes in the perception of young people are needed of filtering, systematization, consolidation and presenting the most part of the information flow in readable form. It requires teachers to use visualized content during training.

Therefore, there are the following objectives in modern education:

- to motivate young people to study through modern devices, that is to give the opportunity to develop in the education with the modern information and communication technologies (ICT);
- to visualize the learning material, make it more visual, which requires preparation of teachers to use the tools of computer visualization (TCV) in the future professional activity.

Modern personality that is not formed yet needs help to understand that the education, like science, is not static and is developing. New teaching methods are applied, curricula, devices, modern digital and virtual lab for experiments and tests, various learning tools are developed

The main task of higher vocational education in modern conditions is not a direct transmission of knowledge from teacher to student, but the training their ability to find and transform required information in the professional activity. This is because the learning environment changes constantly, the intensive processes of globalization and integration pose graduates faced with the need to adapt to changes quickly and effectively that is to change the type and the scope of its professional activities. The professionals, who are prepared for the life in such conditions, are self-implemented successfully and feel comfortable at the modern labor market. Therefore, it is necessary to form abilities and skills of the visualization of the learning material in addition to basic professional skills, that will provide future teachers the readiness to self-development and self-improvement of professional skills during pedagogical activity.

More and more teachers of mathematical and nature science disciplines used ICT tools in their practice, therefore, a treasure of information and communication competences (IC competence) as the ability to use computer, information technology (IT) and TCV in the learning process are the most promising and the most effective for them.

IT extend the capabilities of the organization and management of educational activities and allow realizing the potential of the promising methodological developments in the traditional learning. The ICT use allows making the subject of teaching not only the receiver of the finished material, but also the participant in its creation, transformation, operation, processing and at the same time, a person who is actively developing the visual thinking.

There is no doubt about the effectiveness of IT use in the study of various academic subjects, including Mathematics, Physics and Computer science. Significant advantages are that their use helps to make the learning process personal oriented, to formulate and solve new, unconventional educational objectives (formation and development of research, information, communicative and other skills of students, develop their thinking and abilities, the formation of the model representations, etc.) [1]. Opportunities for formation of ability to carry out research activities using a computer experiment, to build up their information skills, understanding of the scope of the experiment to demonstrate the real phenomena and properties of certain entities which cannot be observed in real life are appeared.

Today, the use of ICT and in particular the TCV is an integral part of the educational process. New challenges that require new ways of solving various socio-educational problems and innovative methods of management, appeared in modern conditions of mass computerization of the society for education. The introduction of new technology is not only a source of knowledge for teachers and students, but at the same time creates the conditions for the application of the new methodology of teaching and communication. Therefore, the formation of the IC competence of teachers and preparation of them to use the TCV is one of the modern education tasks.

Problems of implementation and effective application of ICT in the educational process have been engaged by such national and foreign teachers, as V. Bespalko, V. Bykov, B. Gershunsky, S. Goncharenko, G. Gurevich, M. Zhaldak, N. Kademiya, M. Kozjar, Yu. Mashbyzya, E. Polat, I. Robert, S. Sysoeva, etc. National scientists believe that the use of ICT in education requires a high level of methodological training of teachers to use IT in their professional activities [2].

Note that the analysis of the results of psychological-pedagogical research in the field of the visualization of the learning material has shown interest in this problem by wide range of scientists. The techniques and technologies of the visualization of the learning material in the study of certain disciplines are actively explored by S. Aronova, V. Davydov, P. Erdem, L. Zamkowym, V. Zinchenko, G. Lavrent'ev, N. Manko, A. Pskova [3].

Many works of famous teachers are devoted to the problems related to the formation of the IC competence of the future teachers (V. Vembra, A. Gurgia, A. Kuzminsky, N. Morse, A. Ovcharuk, S. Spirin). The competence approach is considered in the reseachers of N. Bibik, V. Bykova, M. Golovan', I. Winter, A. Lokshina's, A. Markov, A. Pometun, S. Rakov, A. Savchenko, G. Selevko, S. Skvortsova, N. Tarasenkova, A. Hamlet, V. Shadrikov [4; 5].

The methods and techniques of using of computer mathematics systems in the study of some disciplines are actively examined by A. Spivakovsky, Y. Trius, V. Dyakonov, M. Zhaldak, N. Lvov, M. Drushlyak, O. Semenikhina) [6]. The use of IT tools in the process of professional preparation of teachers are actively examined by A. Andryshak, V. Beloshapko, S. Beshenkov, I. Bogdanov, V. Vinogradov, G. Gurevich, N. Klokar, A. Kuznetsov, V. Lednyov, I. Robert, V. Shevchenko [7].

Based on the analysis of scientists researchers, it can be argued that one of the conditions for successful

implementation of the tasks of modern education is the solution of the problem of future teachers' preparation, in particular teachers of mathematical and natural science disciplines, to use ICT and the TCV in their professional activities and the formation of their professional IC competence [8]. A future teacher needs to understand that an increase of IC competence will allow him to intensify and facilitate his work.

Results. We are often faced in practice that the modern youth is interested in different programming languages. They are programmed as simple interactive applications as complex multi-function and electronic resources. The interest in programming is quite clear. The profession of a programmer is becoming a popular in the world, because engineers are trying to make the world automatically programmed to make the life of people easy. On this basis we can conclude that the attraction of programming to the study of other disciplines, such as Mathematics, is required. It remains to deal with the possibilities of such involvement.

The possibility of using IT in teaching. A large number of education software is developed to facilitate learning. The examples of such software are dynamic mathematics software (Cabri 3D, Archimedes3DGeo, GeoGebra, Gran3d, Geometria, etc.) and computer algebra systems, physics, biology and chemistry digital and virtual laboratory (FourierEdu, Einstein, LabDisc, L-micro, AllForSchool the like), application software, electronic interactive textbooks. There are educational software and software that developed by teachers independently offer to build the learning process in new ways [6].

It is appropriate and useful to use Microsoft Excel in solving problems on a particular subject. It is a powerful tool with which you can create, edit, process and display information in a spreadsheet. The visualization of the data by constructing graphs, charts, histograms gives the opportunity to observe the mutual dependence characteristics of the process if you change other parameters of this process [9]. Spreadsheet is very handy as a means of knowledge control. The results of experiments, which are presented in graphical form, support a more detailed analysis of the phenomena, allow better visibility. The use of spreadsheet not only provides interdisciplinary connection with computer science, but also saves significant training time.

Solving various tasks in the mathematical and natural science cycle disciplines by IT tools, using programming as the most interesting activity for youth [10], provides followings for future teachers.

- *Programming skills*. The perception and consolidation of the material is better in practice. Besides ways of realization of research, the choice of methods and approaches to solving problems are expanding. The student will decide independently, analyzing the problem, how to prescribe results and by what tool. Then he will try to reach the correct answer by "trial and error" attempts. All the mentioned provides interest of the future teacher in solving the problem this way.

- *Awareness of the importance of the algorithmic approach.* The understanding of the steps of solving is one of the most important moments in tasks of any complexity. The algorithmic approach is to teach any general method of solution by means of the complete algorithm. The algorithm is a step-by-step visualization of the solution.

- *Development of the logical thinking.* The logic of thinking in the educational process directs it, contributes to networking in the learning of scientific material, and determines the correctness of the constructed explanations. The formation of the logical thinking plays a major role in the sequencing results of the knowledge and understanding of the solved problems.

- *Formation of the IC competence.* The formation of this competence among students of pedagogical universities involves the development of not only skills to use ICT in their future teaching activities but also to create and program their own software and teaching tools. The formed IC competence in training and everyday life is the efficient use of computer and computer devices in solving tasks, that connected with processing of information, its search, systematization, storage, representation and transfer; visualization of informational models and investigating them by ICT [11].

- *The formation of skills to visualize the material in short form and in different ways*. Large amounts of information can be presented in a concise, folded, convenient and logical form due to the possibilities of visualizing. All these contribute to the intensification of training. When rendering a learning material visual images reduce a chain of verbal reasoning, and can synthesize a schematic image of a more "capacity", thereby reducing the volume of information [12].

Considering the findings of scientists and teachers in the ICT use, we propose to consider and resolve the typical problem of mathematical statistics in the traditional students' way of using a pen and a notebook at first, and then by means of auxiliary software and tools.

We offered students in the process of solving the given task to visualize the solution algorithm in the form of a block diagram, and then using the software Maple, and using programming in Java to reproduce the process of finding the problem answer. The final step is the visualization of the result by the constructing of the curve in these software and draw conclusions about the advantages and disadvantages of such a construction with the use of ICT.

The construction of the algorithm as a major aspect of finding solutions. For the interest of students in studying mathematical statistics, students are encouraged to implement the solution of the applied character problems.

Task. *Test whether the hypothesis about normal distribution of students' performance" with the empirical distribution of the sample of students of size* $n = 25$ *(the discipline "Selected issues of information technology"). The sample is in the form of intervals and their corresponding frequencies: 5 students have scores from 35 to 60, 8 students from 60 to 75, 5 students from 75 to 90 and 7 students from 90 to 100. Use the Pearson's test at a significance level of 0.05*

To create a code to solve this task the students must learn the algorithm of the solution [13]:

1. Calculate the sample mean $\bar{X}$ and sample standard deviation of g, and as an option x_i^* be the arithmetic mean of all intervals. The solution of students get the

following results $x_1^* = 47.5$, $x_2^* = 67.5$, $x_3^* = 82.5$, $x_4^* = 95$, $\bar{X} = 74.2$, $g = 17.08$.

2. Standardized universe X. To do this, we need to take a random variable $Z = (X - \bar{X})/g$ and calculate the ends of the intervals z_i for this random variable. The students receive the following: $z_1 = -\infty$, $z_2 = -0.83$, $z_3 = 0.05$, $z_4 = 0.93$, $z_5 = +\infty$.

3. To calculate the theoretical frequencies$n_i' = n \cdot P_i$. First you need to calculate the probability $P_i = \Phi(z_{i+1}) - \Phi(z_i)$ of falling in the corresponding intervals where $\Phi(z)$ is the Laplace function. Students receive the following: $n_1' = 5.082$, $n_2' = 7.917$, $n_3' = 7.597$, $n_4' = 4.405$.

4. We find the value of Pearson's test

$$\chi^2_{\text{obs}} = \sum \frac{(n_i - n_i')^2}{n_i'}.$$

Using the previous data, we find $\chi^2_{\text{obs}} = 2.42$.

5. Found to compare χ^2_{obs} with the critical point of the $\chi^2_{\text{cr}}(\alpha; k)$ distribution, where α is the significance level, $k = s - 3$, s is the number of sampling intervals. In this problem, $\chi^2_{\text{cr}}(0.05; 1) = 3.8$.

6. We need to draw a conclusion. If $\chi^2_{\text{сп}} < \chi^2_{\text{кр}}$, there is no reason to reject the hypothesis of normal distribution of the universe, but otherwise the hypothesis is rejected.

Since $\chi^2_{\text{obs}} < \chi^2_{\text{cr}}$ for the found values of the inequality, the students conclude that the empirical and theoretical frequencies differ insignificantly, i.e., these observations are consistent with the hypothesis of normal distribution of student performance.

Now the algorithm can be visualized as a flow chart (Fig. 1). The algorithm is the sequence of blocks, which indicate the performance of some operations, and relationships between these blocks. In other words, it is a graphical representation of the analysis or method of the problem solving. The students can easily solve this task by any known method with the help of this flow chart.

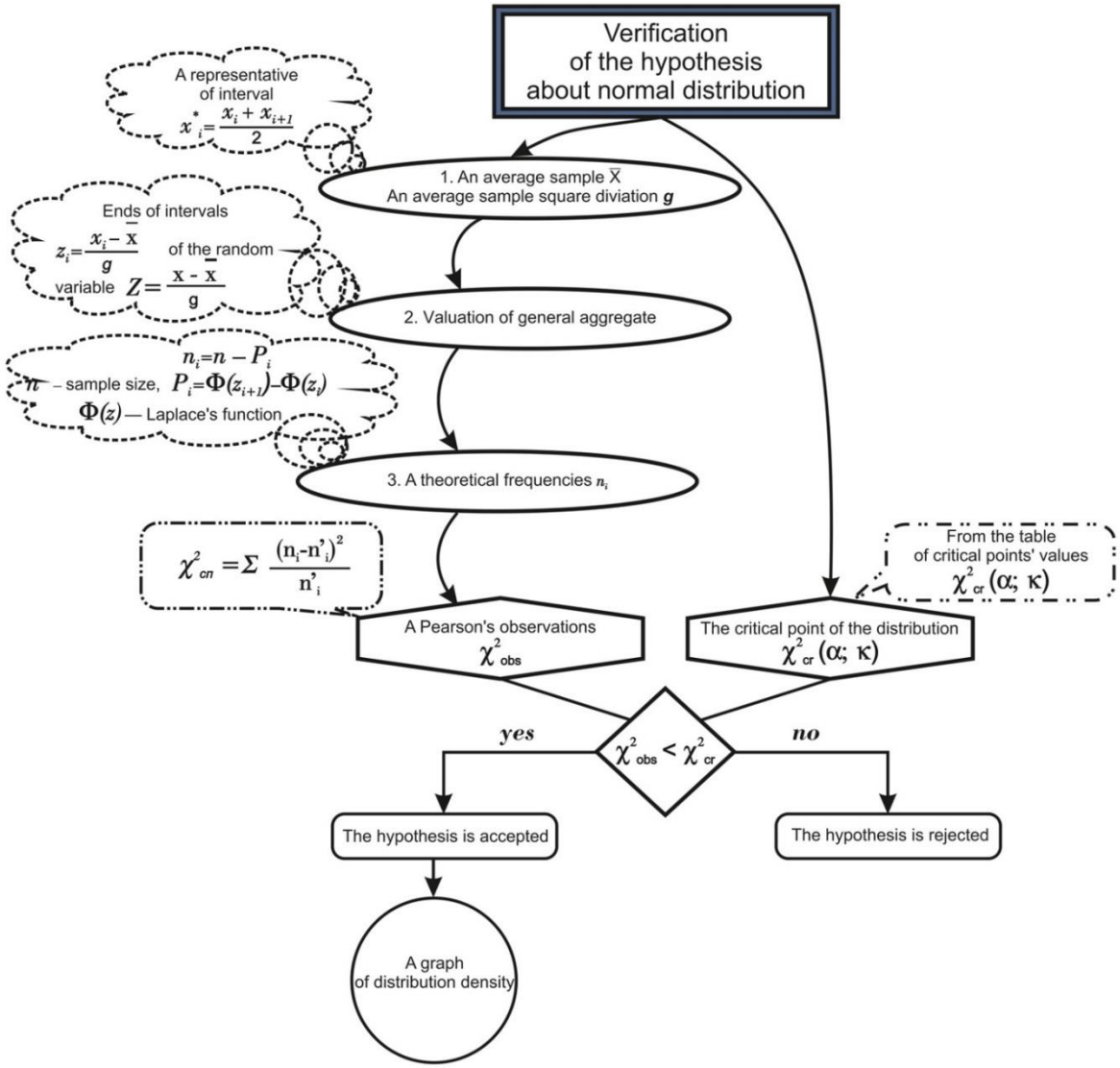

Fig. 1. *Flow chart of the algorithm to the problem.*

Implementation of the solution of the problem by future teachers by ICT tools. In this case, we offered to the future Math, Physics and Computer science teachers to construct the graph of the differential function of normal distribution with mathematical expectation of 74.2 and mean square deviation of 17.08 using programming on Java and software Maple. Note that

these computer tools are not only for use in such purposes and students were given the opportunity to become familiar with them while studying the discipline "Programming" and "Systems of computers mathematics".

The students must do the mathematical operations of calculating the parameter standard deviation at first, and then to program the output to the screen the desired curve, using programming to build the necessary distribution curve of student performance (Fig. 2).

```
XYSeries series = new XYSeries("крива нормального розподілу");

for (double i = 15; i < 130; i += 0.01) {
    series.add(i, 1/(g*Math.sqrt(2*Math.PI))*
            Math.exp(-(Math.pow(i-m,2))/(2*Math.pow(g,2))));
}

XYDataset xyDataset = new XYSeriesCollection(series);
JFreeChart chart = ChartFactory
        .createXYLineChart("Нормальний розподіл", "x", "y",
                xyDataset,
                PlotOrientation.VERTICAL,
                true, true, true);

JFrame frame =
        new JFrame("Curve of normal distribution (StaticChart)");
// Помещаем график на фрейм
frame.getContentPane()
        .add(new ChartPanel(chart));
frame.setSize(600, 400);
frame.show();
```

Fig. 2. *Differential function of the normal distribution of student performance using the programming on Java*

The students hold similar operations for the visualization of results in software Maple. They also get a graph of a Gaussian curve (Fig. 3).

$g := 17.08$

17.08

$m := 74.2$

74.2

$$f := \left(\frac{1}{(g \cdot \mathrm{sqrt}(2 \cdot \mathrm{Pi}))}\right) \cdot \exp\left(-\frac{((x-m))^2}{2 \cdot g^2}\right)$$

$$\frac{0.02927400468\, e^{-0.001713934700\,(x-74.2)^2}\sqrt{2}}{\sqrt{\pi}}$$

$plot(f, x = 15..130)$

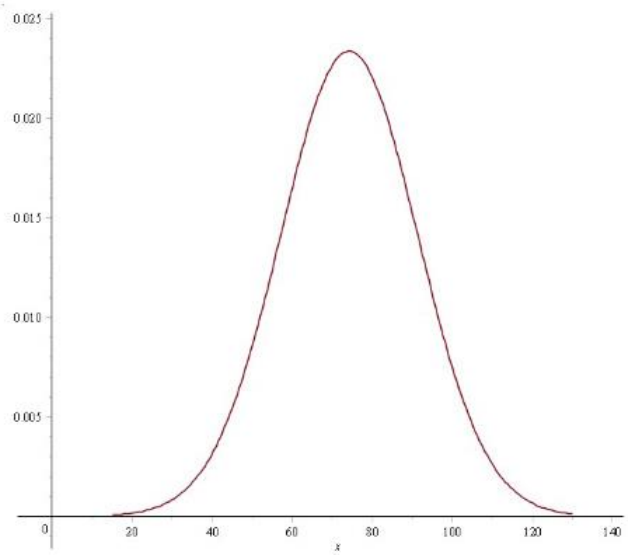

Fig. 3. *Differential function of the normal distribution of student performance by Maple tools*

Generalizing the use of ICT to solve problems and visualize results it is possible to draw conclusions about the similarities and differences between these ways, about choosing the right software tools, about the ease of use and the database of the necessary knowledge and skills in the application of this tool, etc.

For example, most of the students noted that the use of software Maple is better suited to solving of complete tasks, because they can see the result after each step. Besides, the visual dependence is built, the formula is written, the operations are separated in this software better. Maple is easier than to write a program yourself. Supporters of programming saw the advantages of writing code in Java, namely, that in this

way you can solve more complete tasks, using the built-in libraries, ask any step or interval to construct the curve by points. The students also noted the possibility of the curve visualization in separate window with a pre-defined scale. This is an important point, because if you need to view the curve you do not need to open the software and start it, just run compilation file with visualization.

No students from the entire groups said that it is better to solve problems in the traditional way at the board after a survey on the advantages of ICT in the study of mathematical and natural science cycle disciplines. 97% of surveyed future teachers agree that using ICT in their teaching activities required and this improves their IC competence as young professionals.

Conclusions. Despite the difficulties of society in general and teachers to make an effort to introduce ICT in modern educational process, we insist on the formation of IC-competence of the future teachers in pedagogical universities. The advantages of using ICT in the teacher's preparation were marked by many scientific and methodological researchers. It is consistent with the modern ideas of informatization of the educational environment. Based on our experience, the shift of traditional teaching towards active use of computer opportunities and programming ideas will allow not only to motivate young people to learn, and bring to a qualitatively new level of understanding of the basics of mathematics, programming skills, understanding of algorithmic approaches, development of logical thinking and the formation of the IC competence of the modern teacher. Involvement ICT in the teaching process is based not only on the teachers' internal motivation to use such software at their lessons, but also on the ability to choose the most efficient software. Understanding and ability to work with it is a necessary part of the modern math and natural sciences teacher's preparation.

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