DOI 10.12851/EESJ201612C05ART28

Ulughbek Kh. Khankulov,
Senior lecturer,
Gulistan State University

Description of Methodical System of Teaching Elements of Stochastics Line Mathematics Using Computer Technologies

Key words: *methodical system, stochastic elements, multimedia electronic teaching literature, standard mathematical packages, principles, academic lyceum, vocational college.*

Annotation: *The following article describes new methodical system of teaching the line of stochastic elements (combinatory, theory of probabilities and mathematical statistics) of mathematics at lyceums, colleges and gymnasiums by using computer technologies. Also we have discussed in the article influence of methodical system on the main didactic means such as, multimedia electronic teaching literature, and also graphical illustrations of MS Excel software and specially designed system of tasks directed to standard functions of implementation on the interest of students to studying of the subject and other issues related with them.*

Continuous educational system in the Republic of Uzbekistan is conducted based on consistency of State education standards and different level educational programs. Three year of compulsory education at secondary-specialized system after completing 9 year of studying at secondary school is considered to be an independent type of education of Uzbekistan. Academic lyceums and vocational colleges which are the lines of secondary-specialized education are chosen optionally by the students who completed nine years of education at secondary schools. Higher education is based on the foundation of secondary-specialized education and divided into two (bachelor and master's) stages. Stochastic line of mathematics (elements of combinatory, theory of probabilities and mathematical statistics) is included in mathematics teaching program of academic lyceums and vocational colleges and is taught consistently.

Analyzes of conducted research on teaching stochastic elements in different stages have shown that there are several issues. Particularly:

-creating modern and conformable teaching methods of stochastic elements for the post-secondary school period (lyceum, college, gymnasium etc.), designing and implementing methodic systems in accordance with education lines (lyceum, college, gymnasium etc.);

-strengthen teaching by introducing modern technologies and means in teaching stochastic elements, also enriching scientific-methodic resources with these means, practically-implemented orientation of teaching stochastic elements;

-creating methodical systems in order to retrain teacher of mathematics for theory of probabilities and mathematical statistics.

In order to solve these issues there was created specific methodic system of teaching stochastic elements by using computer technologies at pre-high education stage (lyceum, college, gymnasium etc.) after completion of secondary school and being implemented in educational process. Practically it is known that sufficient and proper usage of computer technologies in teaching process allows students to develop their interest to realize the subject. While learning stochastic elements students can effectively use computer as a calculation mean, learn to implement standard functions of practical software, analyze the results. Consequently teaching stochastic elements by using computer technologies there were achieved an increase of share of self-independent activities in establishing inter-subject relation and managing student's learning activity.

T. Vamosh, M.I Bekoeva, S. A. Bogdanov, A. V. Vashorin, Ye. I. Mashbitz, D.A. Lukashenko, M.U. Ashuriv, L.P. Martirosyan, P.V. Razbegaev, O.B. Tyshenko have studied influence of computer technologies in forming interest to the subject of mathematics in their scientific researches.

Polish mathematician-methodologist Ye.I. Mashbitz enlightens issues of using computer technologies in teaching process in his research works and offers the method that has a positive influence on interest of students to realize the subject of mathematics. In his opinion, "when using computer in teaching process each of the student can work in own temp and if there is an opportunity then can also prevent gaps in his/her knowledge by using reference materials" (1). Russian mathematician-methodologists such as R.A. Maier, V.R. Maier, A.V. Vanyurin, D.V. Maier have compiled general principles on effectively using computer technologies while teaching mathematics (*principle of adequacy, principle of visualization, prnciple of using new information technologies as instrument of cognition, principle of activeness and self-determination, principle of systematicness and motivation*) (2).

Researches regarding to teaching theory of probabilities and mathematical statistics by using computer technologies are conducted much less than in other lines of mathematics and they belong to S.A. Samsonova, Charles M, Grinstead J, Laurie Snell, A.M. Andronov, M.A. Suvorova, A.S. Rasulov. All proposed methods are destined for higher educational institutions.

Russian mathematician-methodologist S.A. Samsonova offers to use standard mathematical packages (MathCAD, Mathematlca) while teaching theory of probabilities and mathematical statistics. She stresses on using computer as a calculation device and in her opinion, "using modern computer technologies (such as MathCAD, Mathematlca etc.) releases students from compiling routine programs and necessity of remembering rules of recording them. Using computer with MathCAD package considerable decreases time spent for solving tasks of theory of probabilities and mathematical statistics" (3).

It is known, that in practice computer software packages "Statistica" are widely used. Package Statistica represents powerful integrated system which provides statistic analyze and data processing and statistic modules are included in the package. In the designed teaching manual for higher educational institutions created by the Russian mathematician A.M. Andronov there given instructions on using package Statistica, analyzing experiments in theory of probabilities and mathematical statistics, and also calculating algorithms. Uzbek mathematician A.S. Rasulov has also offers in his teaching manual to use some opportunities of standard functions of Excel software in practical courses of theory of probabilities and mathematical statistics in higher educational institutions. This manual is destined for the students who study in economical

direction and it mainly consists of tasks and problems related with economical and social contents. American mathematicians, such as Charles M, Grinstead J, Laurie Snell in their developed methodological system offer to use programming for implementation of imitative modeling, algorithm of constructing graph processing for smaller quantity of experiments while studying theory of probabilities and mathematical statistics. In the process of learning the material author distinguishes different algorithms of modeling and calculating which can be implemented in different programming languages (4).

We have created methodological system of teaching stochastic elements by using computer technologies for the pre-higher educational stage for (lyceum, college, gymnasium etc.) after completion of secondary school and enriched it with new didactic means of existing scientific-methodological resources in theory of probabilities and mathematical statistics. There are given some recommendations regarding to implementation teaching stochastic elements through computer technologies in this methodological system:

- to implement modern technologies and means in teaching process of stochastic elements, to use multimedia electronic teaching literature in teaching stochastic elements;

- to use computer as a calculation device, to strengthen studying stochastic element concepts by implementing standard mathematical and statistical functions of Excel software which in its turn perfects the idea advanced by S.A. Samsonova, A.M. Andronov and A.S. Rasulov.

- to enrich teaching content with probability and practical tasks that are specialized according to its implementation, category and facts that have historical-biographical character.

The following methodological system that is based on computer technologies consists of hierarchical components which are related with each other: *objects, content, methods, means and forms of teaching.*

Object of teaching: this component includes educational, educative, developing functions and also teaching functions and principles. Computer technology directed to teaching stochastic elements is formed on the basement of multimedia electronic teaching literature and standard mathematical package Excel. Multimedia electronic teaching literature opens wide opportunities for reflecting materials visually. When students use ready standard mathematical and statistical functions of Excel software they not only save their time but also automatically revise the educational material, test their knowledge and also develop their implementation of skills. This definitely allows to sustainable and deep mastering of teaching material. There is an opportunity of rapid updating the teaching material subject with latest achievements and also student evaluates own knowledge when multimedia electronic teaching literature. Can be prevented boringness and losing motivation towards realizing of the student.

Functions of teaching: there we determined the following functions in teaching stochastic elements by using computer technologies:

- to develop interest towards studying stochastic elements by implementing computer technologies to the teaching process;

- to form skills related with usage standard functions of Excel software in practice effectively;

- to develop culture of using multimedia electronic teaching literature and getting self-independent knowledge by the students;

- to form knowledge of students on implementation of theory of probabilities and mathematical statistics in different spheres and inter-subject relations.

Principles of teaching: there are several principles related with education and training in pedagogical literature. For instance, M.I. Skatkin proposes principle of transfer from teaching to self-independent education. And Y.K. Babanskiy has developed optimizing theory which offers three principles (5). Although, there are principles of general character that on the basis of studying abovementioned objetcs and functions we bring forward the principles of teaching stochastic elements by using computer technologies.

Scientific content: it should be formed in educational institutions that stochastic elements are the same as other sections of the mathematics to form scientific conceptions, that theory of probabilities and mathematical statistics are practical-implementative subject, its methods can be implemented in different spheres, modern point of views about importance, role by the students. Usage of computer technology in teaching process forms clear idea of new information technologies and methods being implemented in theory of probabilities and mathematical statistics. Scientific principle means not only developing interest of students to theory of probabilities and mathematical statistics but also implementing mathematic and statistic functions of Excel software in practice and developing working culture with multimedia electronic teaching literature as well.

Systematicness and consistency: systematicness and consistence principles are reflected as following regarding to the teaching process of stochastic elements by using computer technologies:

- to present mathematical and statistical functions of Excel software in systematic and consistent, informative form in studying teaching material;

- to provide correspondence of teaching content and method existing in multimedia electronic teaching literature with personal abilities of the student;

- to take into consideration development of competencies that forms in students on each section of teaching material;

- to construct educational process that is determined by logic, object, functions.

Visualization: The followings are used as visual means while teaching stochastic elements by using computer technologies:

- using multimedia electronic teaching literature (specially prepared electronic teaching literature that corresponds to the criteria of III and IV-categories in the shape of multimedia electronic teaching literature named “Combinatory, theory of probabilities and mathematical statistics”);

- using histogram, polygon in analyzing results of experiment, building graphs through using graphic illustrations of Excel software.

- specially developed system of tasks and methodological instructions that can be solved by students through implementing standard functions of Excel software (in the shape of teaching manual “Special course of mathematics: elements of theory of probabilities and mathematical statistics”).

Availability of animations, sounds, hyperlinks, videoreels and other multimedia technologies in multimedia electronic teaching literature are appreciative for visualization. Usage of graphic illustrations of Excel software does not only allow students to increasing data transfer speed and intensiveness of understanding it, but also develops their abilities such as intuition, keenness, imaginative thinking as well.

-differential and individual approach: this pronciple of teaching process signifies importance of correspondence of student's level of knowledge, age, physiological opportunities, individual features. As a result of implementing computer technologies during teaching process we will be able to work with students more, especially individualizing and categorizing home tasks and control works. As the method is built based on usage of multimedia electronic teaching literature in teaching process and implementing mathematical and statistical functions of Excel software, teacher can manage without repeated explanations, revisions and remindings while implementing this principle and control knowledge of huge amount students fast and effectively. The teacher will have a favorable opportunity of complicating, dividing into groups taking into consideration of students' specific features and working with them through individualizing and categorizing tasks in practical classes.

-self-instruction: as computer technologies have been introduced in teaching process, there were widened opportunities of using modern means in classes, practical lessons and self-instructions by the students. In the proposed method the principle of self-instruction is conducted on using teaching method (specially designed system of exercises and tasks that is solved through implementation of mathematic and statistic functions of Excel software), self-instruction and using multimedia electronic teaching literature in order to widely master teaching materials, scientific data regarding to the subject effectively based on computer technologies. Multimedia electronic teaching literature consists of text, graph, sound, videoereel, animative materials and data, presentations for extracurricular studying and serves to self-instructive, individual study, assessment of gained knowledge, control it, use it in practice and consolidate it. It is considered to be comfortable didactic complex in self-instruction of students in extracurricular activities, spares teaching process, establishes interactive relationship not between teacher and student but between student and computer. The student learns to master the knowledge independently, and teacher provides important materials in theoretical and practical classes as supervisor, monitor and consultant.

-historical significance: dynamic of development of scientific concepts and presenting historical data regarding to the subject in teaching process develops activeness, interest and scientific point of view of students. Principle of historical significance is extremely important in deep respect to history, proudness of patriotism, humanity, ancestors, sense of mastering positive sides from the researches of great scientists, also in forming spiritual-ethical qualities in students' upbringing. When teaching stochastic elements by using computer technologies, this principle is conducted in the sections such as "historical overview", "Preface", "Theoretical data", "Additional data", "Presentations" of specially designed multimedia electronic teaching literature named "Combinatory, theory of probabilities and mathematical statistics". Through these sections there are offered to the student to study interesting information about development history of theory of probabilities and mathematical statistics, teaching conditions of the subject in different foreign educational institutions, famous mathematicians and their creative activities.

Also proposed method provides opportunity of conducting principles such as consciousness and activeness, intelligence, solidity, relating teaching with real life which are considered to be general in pedagogic.

Forms of teaching: as P.I. Pidkasisty mentions, it is necessary to understand under teaching form "construction of segment, cycle of teaching process, implemented in accordance with supervising activity of teacher and supervised educational activity of students on mastering particular content of teaching material and mastering methods of activity" (5). The great Uzbek encyclopedist Abu Nasr Farabi of IX, X centuries has left valuable recommendation about teaching subjects by grouping in his works (6). The following teaching forms are used in proposed computer technologies: *grouping, general, individual, self-instruction and distance education.*

Content of teaching: in the following methodological system are recommended to include such materials in the content of stochastic elements:

- exercises regarding to stochastic elements oriented to implementation of graphic illustrations and standard functions of MS Excel software;

- facts that have historical-biographical character, materials that are presented by multimedia electronic teaching literature (video-lessons, presentations, animations, video/audio materials etc.), practical tasks that specialized, categorized according to probability and its implementation.

Methods of teaching: thoroughly selected teaching modes and methods are to be decisive important in fully revealing teaching material, mastering knowledge consciously and deeply. In the proposed method is widely used method researched by D. Poya "teaching mathematics through exercises and problems". In his opinion, "mastering mathematics - means to solve problems that are unusual at the moment, demanding freedom of thinking and healthy logic considerably" (7). According to the abovementioned ideas in the following designed method, there is an opportunity to conduct classified and studied (explaining, inductive, deductive, reproductive, problem thinking, partial research, exploratory, working with technical means) method by I.Yu. Lerner, M.N. Skatkin, T.A. Ilina, Yu.K. Babanskiy and also recommended method by V.N. Kasatkin (computerized modeling).

Means of teaching: one of the important means of designed method in teaching stochastic elements is complex of exercises and methodic instruction oriented to implementation of standard functions of Excel software, and these materials are presented through special developed teaching manual "*Special course of mathematics: elements of theory of probabilities and mathematical statistics*". Multimedia electronic teaching literature is also considered to be one of the important means as didactic resource of proposed computer technologies that allows to perfection of knowledge of students, consolidation and also self-instruction and automatization of control of gained knowledge. By this mean student does not only gain the lesson by seeing it, but also can listen it. It is known from the experiments that student gains 12% through reading, about 25% visually, 65% and more when it is textual, visually and soundly.

Presently by the department "Developing Information Technologies and Distance Education" under the Ministry of Higher and Secondary-Specialized Education of the Republic of Uzbekistan was developed standards of electronic teaching literature. By using them reasonably we have created multimedia electronic teaching literature which is one of the main teaching means for proposed computer technologies. By the Agency of Intellectual property of the

Republic of Uzbekistan there was given certificate No. DGU 03795 to the electronic teaching manual named "*Combinatory, theory of probabilities and mathematical statistics*", and registered in state registry of "programs for electronic calculating devices", and being widely implemented in the practice. By the classification this electronic teaching manual corresponds to criteria of III and IV-categories, and by usage is based on periodicity of individual, teaching information and materials renovation together with pedagogic (didactic and methodical), psychological and technical requirements.

At the same time we have referred to the following principles while creating multimedia electronic teaching literature "Combinatory, theory of probabilities and mathematical statistics": *principle of quantum, principle of complex, principle of visualization, principle of branching, principle of management, principle of collection.*

Multimedia electronic teaching literature "Combinatory, theory of probabilities and mathematical statistics" can be renewed with teaching information and materials periodically, widened and supplemented with new sections and themes, news of science and technology. Multimedia electronic teaching literature "Combinatory, theory of probabilities and mathematical statistics" consists of *unit of information, unit of education and unit of control tasks*.

After having taken necessary tasks from special section of this multimedia electronic teaching literature based on online system, students can independently use MS Excel software that is installed in PC.

The following electronic literature can be used equally with printed literature in complex way and this electronic teaching literature will definitely enriches electronic libraries of theory of probabilities and mathematical statistics, students and teachers' electronic libraries as well.

In order to implement created methodological system there were conducted experimental-trial activities at lyceums, vocational colleges in different locations of the Republic of Uzbekistan. In order to determine efficiency of methodological system we have regularly analyzed results experimental-trial activities. The results of experimental-trial activities have shown that level of knowledge between testing group pupils is higher rather than assessment group pupils. And this proves reliability of proposed method from the point of view of pedagogic and its exploitation in senior classes of the secondary schools, lyceums, vocational colleges, gymnasiums and specialized schools while teaching stochastic elements.

References:

1. *Mashbitz. Ye.I. Psycho-pedagogical issues of computerization of teaching: (Pedagogical sciences –reform of school), Moscow, 1988; 192.*
2. *Maier R.A., Maier V.R.. About computerization of mathematical courses in pedagogical higher educational institutions. Pedagogical science, technology, practice, Barnaul, 2004; №. 1 (16); 130-133.*
3. *Samsonova S.A. Methodical system of using informational technologies in teaching stochastic. Archangelsk, 2004; 240.*
4. *Charles M., Grinstead J., Laurie Snell. Introduction to Probability. American Mathematical Society, 1997; 510.*
5. *Pedagogic. Teaching manual for the students of pedagogic universities and colleges. Under edition of P.I. Pidkasisty, Moscow, 1998; 640.*
6. *Abu Nasr Farabi. Science and sharpness. Tashkent, 2010; 457.*

7. Poya D. Mathematic discovery. Moscow, 1976; 448.