Use of Open Training Portals to Host Developed STEM Courses

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One of the topical areas of innovative development of education is STEM education. It involves the formation of a future specialist spatial understanding of the logical connections between events or processes with approaches to their solution. Such formation can be realized through interdisciplinary communication, considering how some fundamental knowledge is put into practice. As a rule, basic and professional courses are taught separately, so most students do not form a holistic picture of knowledge. In this way, students slowly learn their professional skills. Therefore, a training course was created that combines two disciplines Probability Theory and Information Theory between which there is a strong link. Open training portals allow you to use similar courses. The course is being tested in groups of students of the specialty Secondary Education Informatics.

Keywords - STEM education; training course; combines disciplines; education portal

1. INTRODUCTION

In today's society, education is becoming one of the key areas of society in which its future intellectual wealth is shaped. The rapid growth of information volumes requires rapid updating of content, forms, methods and learning tools. The priority in the preparation of future specialists was the need to develop the student's creative thinking, to develop his communication skills and practical preparation for active life. STEM education is one approach to learning that meets these needs. STEM education is a low or sequential course or course of study that prepares students for successful employment, requiring different and more technically complex skills, including applying an interdisciplinary and applied approach, mathematical knowledge and scientific concepts [1]. It is constantly evolving and taking on new forms. A new element is added to each of these forms, which fills the education with new content to develop a creative approach to acquiring new knowledge and the ability to use them. The idea behind STEM education is to combine basic knowledge with their immediate use to solve technological or engineering applications. The works of many authors working in the field of STEM-education are devoted to this [2-6]. It shortens study time, increases interest in knowledge acquisition and develops a creative approach that is the key to successful employment.

A. Open educational web portals

Open educational portals contribute to the development of qualitatively new Internet projects in the field of education. The goals of the educational portal are to create a new communication space and information field of the educational professional community through the Internet [7, 8]. STEM education is best suited to these goals. The development of educational portals contributes to: improving the links between existing resources; exchange of information; observance of copyrights, protection of intellectual property; announcing competitions for the best online course, educational technology, educational service, etc.; announcement of vacancies; rating of open educational establishments or establishments using distance education technologies; placement of specialty ratings depending on labor market demand. Educational portals have the ability to change and update their content automatically and include all the latest communications and training services over the Internet in a virtual information space: audio and video conferencing, automatic data sharing, electronic message boards, and e-mail. All these opportunities make it possible to introduce training courses to a wider audience. Ukraine uses the Ukrainian online education portal http://prometheus.org.ua/.

B. Reasons

All disciplines taught in the university are divided into three cycles: humanitarian and socio-economic training, mathematical and natural science training, professional training.

Skills and knowledge acquired in the study of basic disciplines are used in the study of professional disciplines. However, the teaching of the disciplines is separate, most students have the idea that the knowledge acquired in the study of these disciplines is in no way interconnected, and in the study of professional disciplines, they have difficulty using the knowledge already acquired in the basic disciplines. STEM education involves the formation of a spatial understanding of the logical connections between processes using approaches to solving them. Such formation can be implemented through the use of interdisciplinary communication in the learning process. Integrate core teaching and training courses that are closely related. Particular attention should
be given to the examples, thus moving away from the general examples used in most of the basic textbooks.

II. PREVIOUS RESEARCH

The aim of this work was to prepare a training course that would integrate disciplines from the block of basic and professional disciplines and place it in the e-learning system of the university and in the open web portal.

After analyzing the basic disciplines and disciplines of professional training, the disciplines that are closely related were identified all the theoretical knowledge obtained in the basic discipline is the basis of an integral part of the professional discipline.

A close link was found between the disciplines of Probability Theory and Information Theory, so it was suggested to create a training course that would combine the two.

Probability Theory is a further development of the school mathematics course and aims at an in-depth study of this discipline.

After examining the list of topics and the examples given in the textbooks on Probability Theory and Mathematical Statistics, it was found that they are all built on almost identical general purpose examples. In the following, only the topics of Probability Theory were considered. Example:

- In the textbook Probability Theory and Mathematical Statistics, by Zhiltsov O. B. – more examples are given, such as: tossing a dice; tossing a coin and fixing the face it will fall into; random taking out of white or black balls from the box, etc.
- In the textbook Probability Theory and Mathematical Statistics, by Zaitsev E. P. – more theory than examples. Examples include: probability of snow or rain, determining which shooter is better, tossing a coin, etc.
- In the textbook A Guide to Solving Problems in Probability Theory and Mathematical Statistics, by Gmurman V. E. – more examples than the theory, among the examples: are throwing two dice, determining the intended number, determining the best students in the group, etc.

In any textbooks is hasn’t been found any examples that could be used when solving problems that arise in professional activity.

The course Information Theory and Coding is part of the professional training cycle of specialists of educational and qualification level "bachelor". Only the first part of Information Theory was considered.

Analyzing textbooks in the discipline of "Information Theory and Coding" it was found that they are all built in almost the same way. However, in some textbooks such as: "Information Theory and Coding" Zhurakovsky Yu. P., Poltorak V. P.; "Information theory and coding in problems" Zhurakovsky Yu. P., Gnilickiy V. V.; "Information Theory and Coding" Kozhevnikov V. L., Kozhevnikov A. B., there is more theoretical material, but few examples for practical tasks.

To prepare the course, the textbooks that formed the basis for the course Probability and Information Theory were selected:

- Probability Theory and Mathematical Statistics by Zhiltsov A. B. [9] namely part I "Random events and their probabilities" and part II "Random quantities", because it is in this textbook more structured material, after each topic there is a task for self-study, self-test questions.
- Fundamentals of the Theory of Information and Coding, Krushniy V. V. [13]

III. RESULTS AND DISCUSSION

The course curriculum consists of the following topics.

The first topic is random events. The basic concepts of Probability Theory which including:
- events and their varieties;
- what the experiment is and what it is related to;
- sets, as a series of elementary events and operations on them;
- statistical probability of events and its attributes;
- probabilistic model;
- measure of the set.

Basic concepts that are part of the mathematical model of information transmission, in the discipline of Information Theory which including:
- information measure;
- entropy of information,
- amount of information.

The second topic is the concept of Probability Theory – elements of combinatorial and their applying in the calculation of probabilities. The formulas of addition, subtraction, and multiplication of probabilities:
- elements of "combinatorial";
- rules of sum and product;
- probability addition theorem;
- conditional probability;
- what events are independent;
- probability multiplication theorem;
- probability addition theorem for events where events are compatible.

From the discipline of Information Theory:
- send signals through communication lines.

The third topic is Probability Theory – Full Probability Formula and Bayes Formula:
- full likelihood formulas;
- hypothesis;
- Bayes' formula.

From the discipline of Information Theory:
- the communication channel;
- capacity;
- noise or obstacle;
- general scheme of information transmission.

The fourth topic is the concept of Probability Theory is the scheme and formula of Bernoulli. Bordering theorems in the Bernoulli scheme:
- the Bernoulli scheme;
- the Bernoulli formula;
- the rules of large numbers;
- central bordering theorems;
- local Laplace function;
- Bernoulli's theorem;
- Laplace integral function;
- the local Moivre - Laplace theorem;
- P. L. Chebishev's theorem.

From the discipline of Information Theory:
- entropy of typical discrete distributions;
- basics of the theory and practice of message encoding in technological information transmission systems.

The fifth theme is the concept of Probability Theory is a random variable whose numerical characteristics and functions, continuous random variables.
- random variable;
- a discrete random variable;
- continuous random variable;
- the law of distribution;
- number of distribution;
- types of discrete distributions;
- distribution function;
- absolutely continuous and singular continuous random variables;
- types of absolutely continuous distributions;
- numerical characteristics.

From the discipline of Information Theory:
- notification items;
- entropy of continuous messages;
- entropy formulas for continuous messages.

The sixth theme is the concept of Probability Theory is a system of two random variables:
- two-dimensional random variable;
- distribution function;
- the density of distribution;
- conditional law;
- numerical characteristics of conditional laws;
- conditional density.

From the discipline of Information Theory:
- methods for effective coding of the correlative sequence of characters.

Examples of all topics include definition tasks in the Information Theory discipline, which include the basic concepts of the Probability Theory discipline.

The developed course was placed include to the university's distance learning system Fig. 1.

In half a year, more than one hundred students have studied it. This includes not only the students who study at the Informatics and Higher Mathematics Department, but also the students who do course at other departments. Students' interest indicates that the combination of disciplines enables them to understand how to apply the knowledge gained from basic disciplines in their professional activities, and also facilitates the resolution of examples. The study process quality check for disciplines Probability Theory and Theory of Information showed that the quality of training increased by 32% compared to when the courses were taught separately. For the test, an experimental group of students was created which studied the course "Probability Theory and the Theory of Information", instead of the general program, like everyone else. This has become possible due to the
fact that, at first, the basics of Probability Theory are studied at secondary school, Math Statistics is a separate block, and, third, Coding Theory is also separated. Later students of the experimental group joined the rest of the other students. The average score by the five-point system in the experimental group was 3.8 points, and among the rest students, who were not included from this group – 4 points. At the end of the semester, students passed the common test. The test was divided into four blocks: Probability Theory, Math Statistics, Theory of Information and Coding Theory. The results of this test showed that the average score on the Theory of Probability in the experimental group was 4.5 points and in the regular group 3.8 points, on the Theory of Information 4.6 points and 3.6 points, respectively. Score on Math Statistics and Coding Theory were almost the same. But to get more accurate results on effectiveness of this course, we need to use an open learning portal. Then everyone will be able to access it and the statistics will be more accurate. We are currently working on this issue.

IV. CONCLUSION

Basic and professional training disciplines were analyzed as well as isolated disciplines that are closely related. A close link was found between the disciplines of Probability Theory and Information Theory. It was suggested to create a training course that would combine the two disciplines.

The textbooks that formed the basis for the training course Probability and Information Theory were selected. Theoretical and practical materials were developed according to the course plan. The integrated course is based on the principles of STEM education.

The developed course was tested among university students who got acquainted with it in the e-learning system of the university. Testing results show that students learn the material better. Further testing of the course will be held in an open education portal, which will give more reliable results.

REFERENCES