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The Use of Internet Technologies in Teaching Bachelors-Economists Mathematics as a Factor of Students' Professional Growth

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Abstract*: Abstract. Personal professional growth enhances the human psyche, introduces special meaning into human life activity. Mathematical education, as one of the crucial aspects in training a specialist, should reflect the nature of future professional activity and contribute to students' professional growth. To a large extent, it can be related to mathematical training of economics students in which information and communication technologies, due to the uniqueness of the interaction of educational mathematics content and economic reality, can serve as an important means of expanding the professional orientation of education. Methods. One of the modern Internet-based interactive educational technologies which enable students' professional growth is an educational webquest. Educational mathematical webquests contribute to the professional self-development and self-organisation of economics students. The authors have developed educational mathematics webquests for bachelors of economics. Results. The diagnostics of educational findings has proven the increase of the cognitive motivation to teaching mathematics and value attitude to the knowledge bound with professional interests; high level of fundamental and applied knowledge of mathematics necessary for the future professional activity; considerable improvement of research skills; intensification of creativity and reflection; capability to perform self-analysis and self-assessment of one's personal activity. Conclusion. Serving as a key factor in training a perspective specialist, mathematical education should reflect the nature of future professional activity and stimulate a student's professional growth. Educational mathematical webquests promote professional self-development of economics students.

***Index Terms*: professional growth, Internet technologies, mathematical education, an economics webquest.**

I. INTRODUCTION

According to psychologists, the leading activity is crucial for personality development. In the process of mastering a profession and especially in performing a professional activity, structural changes occur both in the personality of a specialist and in the structure of the activity itself, that is, the professionalization of a person leads to a change in the nature and content of the profession [1]. The professional development of a person enhances the human psyche, fills a person's life activity with special meaning. The experimental work showed that the personal characteristics of professional self-determination of bachelors include such personal qualities as social integration, lack of anxiety and a high level of motivation for continuous self-education to achieve the professional development goals. Professional self-determination should be necessarily carried out in terms of a life perspective, the most important elements of which are value orientations, life plans and goals. Modern Internet technologies alongside the methods of active and interactive education and models of self-organization of student's personality, allow them to directly engage in the process of mastering future professional activities, and not only to gain knowledge and acquire necessary skills but also to develop harmoniously [2, 3]. An educational webquest is one of the modern interactive educational technologies based on the Internet that promotes the professional development of students [4, 5]. While the importance of preparing preservice teachers to integrate technology into everyday instruction continues to grow, comparatively little research has been conducted to identify successful approaches. The emergence of WebQuests among practicing teachers provides a focal point for teacher development and classroom integration, and links several key benefits of meaningful technology use including meaningful ties to curriculum, student-centered teaching and learning activities, and tool uses of technology. WebQuests leverage teachers' prior teaching experience and extend their ability to teach with technology [6].

II. LITERATURE REVIEW

Presently, a webquest is considered in pedagogy as an educational Internet resource in which part or all information, necessary for a student, is presented on different websites [7]. A webquest is the most complex type of Internet-based training materials. It implies a project involving all students. During the past decade, WebQuests have become widely used by teachers to integrate technology, especially computers and Internet, into learning and teaching. Recently, teacher educators have explored the WebQuest model for preservice teachers to develop technology integration skills akin to those used in everyday schools.

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According to Dodge, WebQuest is "an inquiry-oriented activity in which some or all of the information that learners interact with comes from resources on the internet". During WebQuests, students learn by solving ill-structured problems, with effective utilization of the web and collaboration with peers. Learning with WebQuests involves technology integration for meaningful learning and requires learners to "analyze and synthesize information and exercise information seeking strategies" [6]. Before dividing students into groups, everyone familiarizes themselves with general information on the topic under study, thereby immersing in the problem of the upcoming project. A teacher selects Internet resources and classifies them so that each group becomes familiar with only one problematic aspect of the topic. Students should express their own opinions, draw conclusions and predict the further possible course of action during discussion (if this is possible). In performing a webquest students should answer one common debatable question through the study of the material and its discussion. For the development of mathematical webquests for economics bachelors the ideas of Bernie Dodge [8, 9] and Tom March [10, 11] from the State University of San-Diego have been utilized.

III. PROPOSED METHODOLOGY

A webquest consists of the following compulsory parts:

- an introduction (topic and justification of the project' s value). At this stage basic information is provided, key concepts are introduced and a question that students will reflect on is presented;
- a task (goals, conditions, a problem and ways to solve it). This is the most important part of a webquest. The assignment directs students to a series of specific actions to solve a problem;
- the process (a step-by-step description of work progress, distribution of roles and responsibilities of each participant, links to Internet resources, final product). This section contains instructions on how students will perform the task (the order of using and sorting information);
- evaluation (self-assessment scale and evaluation criteria for a teacher). This part contains criteria for evaluating the accomplished task in accordance with certain standards;
- a conclusion (summing up the results (what students have learned, what skills they acquired; rhetoric questions or questions stimulating further research on the topic are possible). At this stage reflection further research on the problem are encouraged;
- web pages for students (optional); they contain information to help other teachers who will use the web-quest.

A detailed scale of assessment criteria which enables students to assess themselves, other team members and other students is a key section of any webquest. The same criteria are implemented by a teacher. Since a webquest is a complex task, its assessment should be based on several criteria oriented towards the type of a problem task and the results presentation form. Individual or group projects are the result of webquests. Presentation of the project is carried out through cloud technologies and exhibited either in the teacher's cloud or a specially prepared cloud of a study group. Subsequently, the discussion and assessment of the project by all participants of the educational process is carried out in class or online and offline (in the clouds or forums). Both the content part and the independent activity of the whole group and each participant separately as well as the project's public presentation are evaluated. In terms of the information educational environment a training course platform has been created on the basis of the Arzamas branch of Lobachevsky State University of Nizhni Novgorod, which is completely built on the game quests content – EdQuest. Mathematical education, as one of the crucial aspects in training a specialist, should reflect the nature of future professional activity and contribute to students' professional growth [12]. To a large extent, it can be related to mathematical training of economics students in which information and communication technologies, due to the uniqueness of the interaction of educational mathematics content and economic reality, can serve as an important means of expanding the professional orientation of education [13]. Educational mathematics webquests allow arranging the process of economics students' self-development and self-organization [14, 15].

IV. RESULT ANALYSIS

Here is an example of a webquest in higher mathematics for economics students on the topic: "The economic meaning of the derivative." Students are invited to complete the tasks of a mathematical quest using educational Internet resources and cloud technologies.

Stage 1 is a theoretical stage that includes formulation of the economic problem and consists of the following procedures:

– identifying economic terms and concepts in the contents of the suggested problem;

– familiarizing with the identified economic terms and concepts;

– revising or studying mathematical concepts, necessary for solving the suggested economic problem;

– compiling a glossary that contains all economic and mathematical terms and concepts, necessary for solving the suggested economic problem.

Recommendations for students are presented in the form of a reference list (including printed and Internet sources) in mathematics and economics within the studied topic.

As a result, students must prepare individual projects-glossaries containing all the economic and mathematical terms necessary to solve the problem. All glossaries are exhibited in the study group's cloud.

Stage 2 is a practical stage involving the solution to the mathematical problem with economic content, it includes the following procedures:

– formulating the economic problem independently;

– drawing up a plan of solving the economic problem;

– implementing the plan;

– receiving the answer

Consultations with teachers of mathematics and economics are recommended.

As a result, students must formulate a problem with economic content and receive the answer of the suggested mathematical problem. All problems are exhibited in the cloud.

Stage 3 is a graphic stage involving graphing of the production function and its derivative, it includes the following procedures:

– reviewing computer science literature to work in Excel;
– choosing the range of axes;
– introducing formulas;
– graphing;
– analyzing the obtained result.

As a result, students must graph the production function and its derivative in Excel.

Stage 4 is a final stage involving a project's presentation; it consists of the following procedures:

– issuing a solution to the economic problem;
– preparing a presentation of the solution to the economic problem;
– preparing and making a report.

As a result, students must present a solution to the suggested economic problem. The project can be presented in class or in the cloud.

The final stage can be arranged in the form of the following project:

1. A glossary. A glossary is compiled by each student with the use of Internet resources suggested by a teacher.

The derivative of a function is a concept of differential calculus characterizing rate of change of a function at the given point. It is defined as the limit of the ratio of the increment of a function to the increment of its argument.

The maximum value of the function $y=f(x)$ in the interval X is called such $\max_{x\in X} y = f(x_0)$ value that for any $x \in X, x \neq x_0$ the inequality $f(x) \leq f(x_0)$ holds.

The minimum value of the function $y=f(x)$ in the interval X is called such $\max_{x\in X} y = f(x_0)$ value that for any $x \in X, x \neq x_0$ the inequality $f(x) \geq f(x_0)$ holds.

The extrema of a function are values of a function at largest or smaller points.

Total costs are the overall expenses of producing a certain amount of products.

Unit costs are the costs per unit of output, including the cost of all resources involved in production.

Labor productivity is a derivative of the volume of production over time.

The volume of production includes goods and services produced by using factors of production and consumed by consumers either in the present or in the future, or used by them for the production of other goods and services.

Profit is the difference between the income of the company and its costs.

Production capacity is the maximum possible annual output of the production unit. The calculation of production capacity is carried out in units of measurement of production.

Costs are the amount of resources (measured in monetary terms for simplification purpose) used in the course of economic activity for a certain time period (cost estimate of resources).

Unit variable costs include specific labor and materials associated with the unit of goods sold.

2. The formulation of a mathematical problem with economic content. Students independently select the problem material using the Internet resources offered by a teacher.

The following task can serve an example. The company manufactures and sells 1,000 products per month at a price of 2,000 USD apiece. If the price is reduced by 50 USD, you can additionally sell another 50 products per month. At what price the firm receives the maximum profit and what is its value? [16]

3. A mathematical solution.

Let us present the solution to the suggested problem. Denote by x the number of residues of 50 USD from the base price of 2,000 USD. Then the price of one product (when selling more than 1,000 products per month) is $2000-50x$. The total number of products sold will be $1{,}000 + 50x$ pieces. The total income is expressed as:

$$R(x) = (2000 - 50x)(1000 + 50x) = 20000000 - 50000x + 100000x - 2500x^2 = -2500x^2 + 50000x + 2000000$$

Let us compute a critical point of the function $R(x) = -2500x^2 + 50000x + 2000000$: $R'(x) = -5000x + 50000$ (the derivative $R(x) = -2500x^2 + 50000x + 2000000$),

$$R'(x) = 0$$
$$-5000x + 50000 = 0$$
$$x = 10;$$

if $R''(x) = -5000$, the critical point is the maximum of the function $R(x) = -2500x^2 + 50000x + 2000000$. Thus, the company's profit is maximized when the number of residues is $x=10$. In this case the price of the product is:

$$2000 - 50 \cdot 10 = 1500 \text{ (USD)},$$

sales volume per month are:

$$1000 + 50 \cdot 10 = 1500 \text{ (products)}.$$

Consequently, the company's maximum profit is

$$R_{max} = 1500 \cdot 1500 = 2225000 \text{ (USD)}.$$

4. A graphic presentation of the results, "Fig. 1". Students draw graphs using available means.

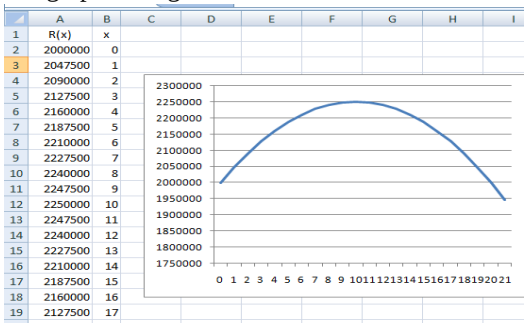

Fig. 1: Results

5. The economic rationale of the received answer.

For the presented example we receive the following rationale: at a price of 1,500 USD per product item, the company's profit is maximized to 2,225,000 USD.

6. Conclusions.

The derivative is the most important tool of economic analysis that allows deepening geometrical and mathematical meaning of economic concepts as well as expressing a number of economic laws through mathematical formulas. After the project is presented, the work and performance are evaluated and the student's self-assessment is taken into account. The considered webquest allows giving additional incentives and meanings to the fulfillment of educational tasks and to put educational cognition in such forms of activity that are attractive for students and harmonious with their inner aspirations. To solve possible motivation issues it is necessary to use Internet technologies and to encourage students' independent activity.

V. CONCLUSION

Internet technologies are necessary for effective mathematics teaching; they make the basis for research and independent students' activities as well as for a productive means of their professional growth [17-19]. The teaching process in terms of professional growth should be carried out through the integrity of Internet technologies, active and interactive technologies and the professional content of academic courses. Students' professional growth implies the development of professional qualities as well as the process of self-awareness formation that includes self-improvement of professionally significant personal traits and self-education. Mathematical education as a key factor in a preservice teacher should reflect special features of professional activity and thus promote professional growth of a student. It largely concerns mathematical education of the economics students in the framework of curriculum. In the process of teaching, Internet technologies allow expanding students' academic knowledge and professional activity as well as forming skills for continuous self-development and self-improvement.

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