Binary using of denotational graphs in the educational process for agrarian students

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Abstract. In order to develop the thinking potential of students, their creative mastering of knowledge, skills and abilities in the chosen professional sphere, the authors of the article consider it necessary to use problem-based training in the educational process. It is the main stimulus for independent cognitive activity of students in the field of research activity. It is difficult for students to work with extensive information. Therefore, the authors have developed and presented in the framework of problem-based training graphic ways of presenting the material in graphical form. They are denotation graphs that make it possible the students to classify and to perceive better the presented information. The authors proposed a binary using of denotation in two subjects: integrated plant protection and foreign language. The article describes the stages of making a denotation graph and its different forms. As a result of the experiment, the authors concluded that binary using of denotation graphs enables students to study the material better and stimulates their studying arousing interest.

1 Introduction

Training future agricultural specialists with a high level of knowledge, critical thinking, creative abilities, professional competence, capable of finding solutions in difficult situations requires teachers to use non-standard forms and methods of training in the educational process. In our opinion, such methods are problem-based teaching methods. The essence of problem-based training is the construction of training lessons where under the guidance of a teacher, a problem situation is created, and students are engaged in active independent activities to resolve it. The result of this activity is the development of the mental potential of students and the creative development of knowledge, the acquisition of skills and skills in the chosen professional field. From our point of view, problem teaching is the main method of developing creativity, which is the main incentive for independent cognitive activity of students in the field of research activities.

Analyzing these definitions, we come to the conclusion that problem-based learning is the most effective in modern conditions. This should embrace the method of discussion; research, analysis, search; a method of projects and cases that include both discussion and analysis, and search, and research. All of them will help us to form models of scientific research, scientific experiment, models of making certain extraordinary decisions among

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future employees of the agricultural and industrial complex, which will be applied by them not only in practice, but also in life situations.

As teachers of the Institute of Economics and Agribusiness of the Bryansk State Agrarian University, we conducted an experiment by selecting some topics of an agricultural profile and introducing them into the work program on a foreign language. We found this interesting because students of agronomy, having received special knowledge on the topic in Russian, will be able to learn this topic more easily in English. We believe that students' binary assimilation of a particular topic will contribute to deepening their knowledge and interest in studying not only special subjects, but also foreign language.

Modern students do not have any difficulties in finding the information they need due to the large number of sources. The complexity causes the inability to work with a huge flow of it. There are various techniques and methods of working with information. These are graphs, diagrams, tables. They are aimed at systematizing students' thoughts, which allows them to turn complex models into simpler and more understandable ones. Presenting information in the form of graphs gives them the opportunity to better organize and understand it. The process of creating diagrams, graphs, tables develops students' ability to analyze the studied material.

The ability of students to present information in the form of charts and graphs is relevant. Practical application of this method in classes on Integrated Plant Protection (hereinafter - IPP) and Foreign Language allows students to deal with this information more thoroughly, highlighting key concepts and their features. At the same time, they develop the ability to analyze independently.

2 Materials and methods

In our research, we focused on the graphical form of presentation of educational material - denotation schemes or graphs. A denotation graph is a method of isolating significant features of a basic concept from a topic, paragraph, or text. A one-stroke scheme is a productive form not only of obtaining new knowledge, but also of controlling students' knowledge, skills and abilities.

A denotational scheme is a logical scheme that differs from the usual plan in that it teaches how to apply knowledge, skills, and abilities in certain situations; demonstrate, systematize, perceive, evaluate, analyze, draw conclusions, make informed decisions, and engage students in interactive activities in the classroom [1]. This methodical technique can be used in any lesson, based on any material.

The denotational structure of a topic, paragraph or a single text represents a certain system of subject relations mediated by the interrelationships of the whole relevant sphere of reality demonstrated in the cognition of the individual. This is the information structure, and the external form of a topic or paragraph represents the form of presentation of material and knowledge. We understand denotates to mean various processes, objects, phenomena, etc., which constitute the meaning of a linguistic expression. The objects of real reality expressed in the text are the denotates, not the words reflected in our thinking. We consider a set of denotates as a certain object of reality or a model of a particular situation expressed by linguistic means in the topic under study. The system of denotates represents the content of a topic or paragraph. It is a dynamic model of the subject situation, which is described in a topic, paragraph or fragment of a paragraph or text.

The research of the denotational structure of the studied material is one of the actual approaches to study how understanding is carried out (in our case, it is associated with the formation in the student’s mind of an image of the semantic content of information).

It is worth noting that students’ work on compiling denotation graphs can be carried out both during the period of their survey and at the stage of studying new material and its
control. At the same time, we recommend constructing a graph individually, as part of a group, in pairs or under the guidance of a teacher. In the case when students work independently, the teacher can check not only the correctness, completeness, and logical chains of the denotation graph, but also clarify why these objects, subjects, processes became denotations. In addition, he can conduct a conversation with students and clarify how they worked to create it.

In our case, initially an important role is played by students studying biological disciplines, peculiar denotations, such as phytopathology, entomology, herbology, nematodology. They precede the formation of knowledge on the basic block – integrated plant protection, since without studying the morphology, biology, ecology of harmful organisms, it is impossible to carry out high-quality phytosanitary monitoring and choose the ideal scheme of protective measures for the cultivation of crops. Certainly, this block helps future specialists to form obligatory professional competences of students (PCS), in particular, mentioned in the Federal State Educational Standard, PCS - 3 (able to develop environmentally sound integrated plant protection systems and agrotechnical measures to improve phytosanitary condition of crops).

According to V.A. Chulkina, when developing a strategy for integrative plant protection, one should take into account a scientifically based goal, which is determined by analyzing the evolutionary-ecological characteristics of the types of life cycle strategies of pests [2]. Recently, a justification for the concept of adaptive-integrated plant protection has appeared, and it is formulated taking into account modern scientific achievements, many years of experience gained in the Russian Federation and abroad, as well as in accordance with the provisions of federal laws and administrative documents in the field of agro-industrial production, which allows adjust existing crop cultivation technologies.

The concept of integrative plant protection as an independent scientific, educational discipline and as a part of crop cultivation technology began to take shape in the 50s of the last centuries. Professor D. Shpaara and others believe that there are more than 70 different types of definitions of integrative plant protection. At the same time, there are two different groups of definition of integrative plant protection:

1) Integrative plant protection is a holistic, ecologically oriented new quality of plant protection;
2) Integrative plant protection is a simple combination of chemical and alternative pest control methods [3].

The creation of a logical transition from biological disciplines to integrative plant protection takes place within the framework of the educational process, including laboratory and practical classes, practical exercises, lecture material, databases of the electronic information and educational environment, teaching aids, including glossaries. An important stage in consolidating theoretical basic knowledge is the educational technological practice taking place in the experimental field Bryansk State Agrarian University, during which students master various methods of phytosanitary monitoring of agricultural crops (cereals, legumes, technical, potatoes, vegetables, fruits and berries), indicators of the economic threshold of harmfulness of dominant harmful organisms are taken into account to build models of IPP (integrated plant protection).

3 Results and Discussion

Three groups took part in our study: an experimental group and two control groups. The chosen topic was studied by students in an IPP lesson, and then in a foreign language lesson.

Before including the denotation graph in the educational process, we taught students how to compile it, offering patterns and steps.
Steps of compiling a denotation graph (Figure 1):
1. Select a topic, paragraph or text (foreign language), according to the work program.
2. Analyze the content of the topic or paragraph to determine the denotation. Denotations are educational elements: processes, phenomena, events, actions, properties, objects. We present the content of educational material as a diagram of the relationships of those objects and subjects that are discussed in it. These objects are denotations, and their ranking represents the meaning of a topic or paragraph.
3. Make a list of denotations.
4. Highlight the main generalizing denotation. It is identical to the title of the topic, paragraph or text.
5. Mark the nodal denotations. These are the names of the subtopics.
6. Formulate the main denotations - the names of concepts.
7. Designate denotation signs.
8. Place denotations on the graphs.
9. Establish logical connections between educational elements, that is, between denotations.

Fig. 1. Pattern for compiling a denotation graph.

As part of the study of the topic in the disciplines Integrated Plant Protection and a Foreign Language, we have developed a binary form for presenting educational material. First of all, we have compiled a list of denotations on the topic “Integrated plant protection”, this is what students are required to know. The list includes the following denotations:
1) integrated plant protection,
2) phytopathology,
3) entomology,
4) phytosanitary monitoring,
5) herbology,
6) nematodology,
7) plant quarantine,
8) agrotechnical method,
9) selection and seed production method,
10) physical-mechanical method,
11) biological method,
12) chemical method,
13) crop rotation,
14) methods of soil cultivation,
15) optimal seeding rates,
16) organic and mineral fertilizers, liming and phosphorite treatment,
17) optimal timing and methods of sowing,
18) optimal timing for harvesting and storing agricultural products.

The listed denotations are reference points in the educational process in the study of integrated plant protection, phytopathology, entomology, plant quarantine, agrotechnical method, biological method, selection and seed production method, chemical method, etc. In the future, the main denotations in IPP are various methods of plant protection and their study (plant quarantine, agrotechnical method, biological method, selection and seed production method, physical and mechanical method, chemical method), which allow optimizing the phytosanitary situation of agrocenoses by preserving and increasing the activity of natural entomophages, antagonist microbes in order to obtain environmentally friendly agricultural products in the required volume.

Highlighting denotations for each method, for example, agrotechnical, makes it possible to specify the elements of crop cultivation technologies [4], using crop rotation, selection of predecessors, application of optimal seed sowing rates, soil cultivation, application of organic and mineral fertilizers, phosphorite and liming of the soil, optimal timing and methods of sowing and harvesting crops. These elements of IPP must be adapted to a specific natural and climatic zone, taking into account the reproduction tactics, survival and trophic relationships of pests common in a particular crop [5]. In the educational process, each denotation of IPP should be consolidated gradually, forming a complex of knowledge of future agricultural specialists, based on agroecosystem and agroecenotic approaches, taking into account rational scientific and practical experience in the field of plant protection, minimizing the negative effects of the chemical method to maintain biodiversity and soil suppressiveness. Students were offered a ready-made model of a denotation graph (Figure 2), which they had to logically complete in a lesson in IPP, and then in a Foreign Language.

![Fig. 2. Pattern 1 of the denotation graph on the topic of IPP.](image)

For students who easily coped with this type of graph, we offered a more complex pattern 2, omitting individual denotations in the discipline block, methods and technology elements (Figure 3).
Since the list of denotations was compiled in advance, students could test their knowledge independently or with each other. Similar work was carried out in Foreign Language classes [6, 7], where students were offered terms studied in the IPP in English, which made it possible to more quickly master the terms and make it easier to fill out graphs and compile them.

Due to the fact that a denotation graph can be compiled not only on a studied topic, but also on a separate paragraph or text (Foreign Language), students in Foreign Language classes were offered the text “The chemical properties of soils” after how they studied this topic in a special subject lesson. Before making a graph, students had to translate the text from English into Russian. Preliminary study of this topic in Agricultural Chemistry classes allowed them to cope with this task without using dictionaries. But this time a denotation graph pattern was proposed, which was different from the previous ones. First, they had to depict the content of the text schematically, highlighting separately each chemical feature of the soil discussed in the text (Figure 4). And then build a graph where students had to highlight the main idea of the text, ideas in paragraphs and facts supporting these ideas.
Based on the educational material “Chemical properties of soils,” students were asked to create two patterns for constructing a denotation graph to choose from and construct their answer according to the diagram they depicted (Figures 5-6).

**Fig. 5.** Pattern 1 of the denotation graph based on the educational material “Chemical properties of soil.”

**Fig. 6.** Pattern 2 of the denotation graph based on the educational material “Chemical properties of soil”.

Compiling denotation graphs is not an end in itself. They are important for completing tasks on the studied material. Tasks for a denotation graph can be different.

For example:
1. Read the paragraph and fill in the column.
2. Read the paragraph. Study the graph and say what facts you read about that are not reflected in the graph.
3. Create a denotation graph yourself and provide explanations for it.
4. Retell the paragraph (in Russian and foreign languages), using the finished graph as a support.

Teachers working in the experimental and control groups were given a questionnaire on the topic: “What does the binary use of a denotation graph give to a student?” It was unanimously noted that its introduction into the educational process teaches students to analyze, generalize, isolate the main thing, develop intellectual and creative abilities, expand knowledge on a special subject, and help to master a given topic in a foreign
language. We analyzed the results of students’ assimilation of educational material based on its binary study in the form of denotation graphs in the experimental and control groups and came to the conclusion that the marks in the experimental group were higher than the results in the control groups. In the experimental group in the IPP discipline, grades were distributed as follows: “excellent” - 7 people, “good” - 9 people, “satisfactory” - 4 people. In the two control groups, respectively: “excellent” - 3 and 2 people, “good” - 8 and 10 people, “satisfactory” - 8 and 9 people (Figure 7).

![Fig. 7. Student marks on IPP.](image7)

The distribution of Foreign Language marks in these groups is as follows. Experimental group: “excellent” - 8, “good” - 10, “satisfactory” - 2. Control groups 1 and 2: “excellent” - 5 and 6 people, “good” - 7 and 9 people, “satisfactory” - 7 and 6 people respectively (Figure 8).

![Fig. 8. Student marks on Foreign Language.](image8)
4 Conclusion

One of the ways to use a problem situation when teaching agricultural students is to use denotation graphs in the classroom. This technique seems relevant for working with several disciplines. Binary use of denotation schemes was found in our study in relation to the disciplines Foreign Language and Integrated Plant Protection. According to the results of the study, the experimental group showed a significantly higher level of knowledge than the two control groups in which the stated methodology was not used. We consider the results of the study to be an indicator of the success of working on educational material with agricultural students, which once again emphasizes the development of critical thinking among students and their intellectual capabilities. We believe that similar work should be carried out on the material of other academic disciplines, since it makes it possible to establish relationships between phenomena, concepts, facts, which ultimately improve students’ ability to accurately understand the subject reality, at the same time, to convey information about it fully and correctly.

References


