INTERDISCIPLINARY TASKS AS A MEANS FOR FORMING TECHNICAL COMPETENCE OF THE FUTURE TEACHERS OF INFORMATICS

Assoc. Prof., PhD Tkachuk H.
Department of Physics, Mathematics and Informatics,
Pavlo Tychyna Uman State Pedagogical University, Uman, Ukraine
e-mail: galanet82@gmail.com

Abstract: *The article describes the possibilities of realization of interdisciplinary links in the process of forming the technical competence of future computer science teachers in the study of general computer disciplines. The author offered content and integrated tasks of an interdisciplinary nature, which make it possible to form the technical competence of specialists.*
KEYWORDS: *INTERDISCIPLINARY TASKS, INTERDISCIPLINARY LINKS, TEACHERS OF INFORMATICS, TECHNICAL COMPETENCE.*

1. Introduction.

Among the whole set of issues of the modern methods of teaching computer science in high school, the first place takes the issue of introducing an interdisciplinary approach in the process of forming the professional competence of the future computer science teachers. An important component of the professional competence of the future teacher is technical competence, which can be formed not only during study of the technical disciplines, but also in the process of studying the interrelated and interacting educational disciplines of the information processing cycle as a whole.

A considerable psychological problem is the formation in students of the ability to apply the systematic method of thinking, combining the elements of knowledge from different academic disciplines. The student should be able to comprehend critically the material studied and compare it with the tasks that are known to him, compare them, analyze them, add them to the previously known [2, p.17].

The use of interdisciplinary links allows to solve the problem of differentiating teaching tasks and control tests to diagnose students' academic achievements, to effectively and timely monitor the level of mastering the teaching material of a group of students in general and an individual student in particular, and also to determine the correspondence of these achievements to the trajectory chosen by the student. Systematic and methodically substantiated establishment of interdisciplinary connections is also aimed at providing students with a holistic picture of the surrounding world [3, p.69].

2. Preconditions and means of solving the problem.

The problem of interdisciplinary approach is not a new one, but it does not cease to be relevant. At different times, including the present, the following scientists have been dealing with the problem: V.Bykov, I.Voitovych, S.Goncharenko, R.Gurevich, A.Syazyun, V.Kogut, N.Nichkalo, V.Nichyshyna, S. Tyshchenko, G. Fedorets, A. Yasinskiy. Analysis of the works of the above-mentioned researchers revealed that the role of interdisciplinary training is enshrined in the general didactic principle of interdisciplinary connections, which provides coordinated study of the scientific tools. This principle focuses on the application and synthesis of the knowledge, skills and abilities of technical disciplines and disciplines of general professional practical training. These studies show the positive impact of interdisciplinary connections on the quality of knowledge, because when they are implemented in the educational process, the scientific tools are reciprocally used, the elimination of repetitions and the formation of a unified system of views.

Despite the active discussion of the problems of the interdisciplinary approach in teaching, it is worth noting that some issues remain still open. In particular, the issues of forming the technical competencies of the computer science teacher in the context of the interdisciplinary approach, the consideration of specific professional disciplines and the implementation of interdisciplinary connections in their study.

Basically, technical competence is formed in the process of study of purely technical disciplines (for example, "Computer architecture", "Organization of computer networks and systems," etc.), whereas technical issues are also considered in the study of the disciplines of the general information cycle, so there is a need for implementation of the interdisciplinary approach and unity in the interpretation of the content of the general cycle of disciplines.

Let us turn to the conceptual definition of our research – "interdisciplinary connections". We will use the most complete definition: "Interdisciplinary connections is a pedagogical category for designating synthesizing, integrative relations between objects, phenomena and processes of reality, which are reflected in the content, forms and methods of the educational process and perform educational, developmental and educational functions in their organic unity "[4, p.25]. Thus, the introduction of interdisciplinary connections is an important precondition for the formation of certain competencies in one discipline in the course of studying the others.

Interdisciplinary connections contribute to the solution of the existing contradictions between the acquired knowledge in various disciplines and the need for their integration, as well as the practical application of this body of knowledge. Thus, the future teacher of computer science will be able to use the methodology, basic concepts and provisions of technical disciplines in the interdisciplinary connections with the other disciplines of the cycle for solving tasks of a technical direction.

These days, the process of developing the general theory of technology is actively undergoing, since the use of technical knowledge in all spheres of human activity is closely related to their fundamentalization. This is due, on the one hand, to the selection in the structure of the general picture of the world, along with the natural-scientific and socio-historical, technical picture that reflects the world of technology in the system of scientific and technical knowledge. On the other hand, this process is connected with the wide introduction of technology in various spheres of production and the role played by technology at the present stage of the society development [1, p.224].

Informatics as a technical science assumes that technical competencies can be formed both in the process of studying special technical disciplines ("Computer architecture", "Fundamentals of computer networks and systems", etc.), and in the process of studying general computer disciplines ("Informatics and ICT", "Database organization", "Web application development technologies", etc.), which require formation of technical skills indirectly. Therefore, the formation of technical competencies should be considered not only when studying purely technical disciplines, but also all the informational disciplines taking into account the interdisciplinary approach.

Therefore, it is advisable to consider the content of general computer disciplines and identify topics in which you can create technical knowledge and skills. Besides, technical competencies are best formed in the process of performing practical tasks, when it becomes necessary to solve the problem using knowledge of various disciplines. That’s why it is expedient to determine the list of interdisciplinary tasks that will contribute to the formation of technical competencies.

It should be noted that in our study the basis for technical competence of the future teacher of informatics is a set of technical knowledge, skills, abilities that include: understanding the principles of work, characteristics and limitations of technical devices; the ability to present educational material about the technical side; the ability to select, study and summarize scientific and technical literature, normative and methodological materials on technical tools; the ability to classify and select the necessary technical equipment depending on its main characteristics.

3. Solution of the problem.

Let's consider examples of the implementation of interdisciplinary connections in the system of forming technical competence of future teachers of computer science while studying the discipline "Technologies of Web application development". In particular, integrated tasks were used in the classes, which enabled students to create qualitatively new knowledge that is characterized by a high level of comprehension, dynamism of application in new situations, increasing their effectiveness and system.

When studying the first topic "Approaches to the development of Web applications", which provides study of common principles in the field of web programming, it is useful to recall the principles of network building as a whole, since this is the technical basis for functioning of any web service. When considering this or that approach to the development of web applications, system performance issues are considered that involve studying allocation of physical resources between the processor, RAM, hard disk and other components of the system. It should be noted that any program, including a web application, consumes physical resources of the computer and the main issue is to develop a web application that would use minimum of these resources. Since, in addition to server-side web applications, there are client-side ones, it is also advisable to consider the issue of consuming the physical resources of the potential client (that is, the user's computer) and the technical capabilities of its system.

The study of various approaches to web development involves the use of terms that may have in another context a different sense and meaning.

For example, the term "architecture" in the interpretation of "computer architecture" means logical organization, structure and resources, that is, the means of the computer system that can be allocated to the data processing process, whereas in the interpretation of "the architecture of frameworks (frameworks) of web applications" means a fundamental scheme of the structural organization of a certain software system, which consists of predefined subsystems, and also precisely defines their areas of responsibility and relationship. Therefore, to implement the interdisciplinary approach it is advisable to analyze the term "architecture" in different contexts – hardware (technical) and software. The terms "server", "client", "controller", "preprocessor", "configuration" and others may also acquire technical and software coloring.

In addition to the content part, it is also worth touching the practical part of the academic discipline that provides for the student's activity. In particular, practical tasks may include issues related to computer technology. Here is an example of the implementation of various algorithms in PHP and their relationship to technical knowledge.

In the PHP practice an important place is occupied by logical operators. To understand the role of a logical operator, students are encouraged to imagine the usual logical conclusion. For example, one can draw such a logical conclusion: "If the diagonal of the monitor is more than 22 inches, but less than 26 inches, then you can buy". In PHP, the code for this statement might look like this: if ($ monitor> 22 && $ monitor <26) dobuy ();. Thus, the student is offered to link knowledge about the monitor and its parameter – the diagonal and realize it in the form of program code.

When considering relationship operators, you can suggest implementing such a PHP code:

```
<?php
$memory = "USB";
if ($memory == "USB")
echo "The main parameters of flash drives: volume, interface, body material, color, manufacturer";
?>
```

Having a variable $memory, assign it a value of USB, which indicates the memory implemented as a flash drive. Using the comparison operator, check the contents of the variable $memory and display information about the main parameters of the flash drives on the screen, if the value is true.

When studying the principle of the three-component operator "?" it is possible, for example, to offer the following PHP code:

```
<?php
echo $charge <= 10 ? "Connect the charger!" : "Charge is sufficient!";
?>
```

In this fragment of the PHP code, the variable $charge is checked. If its value is less than or equal to 10 (10% charge), then a message is displayed on the screen that it is necessary to connect the charger, otherwise a message can be displayed that the charge is sufficient.

To continue the charge indicator topic, one can suggest implementing this task using the while cycle. Accordingly, PHP code can have the following form:

```
<?php
……
while ($charge > 10)
{
// Proceed operating without charge...
echo "Charge is sufficient!";
}
?>
```

This example illustrates the operation of the cycle, constantly checks the laptop's charge while the user is running and displays the message "Charge is sufficient" while the $charge variable is greater than 10, that is, while the laptop's charge is more than 10%.

An interdisciplinary connection can be realized when considering arrays. Since an array is an ordered set of the elements of the same type, which can contain several data values, it is possible to create an array with elements that characterize all the parameters of a certain component and, if necessary, output a separate component. For example:

```
$processor = array('frequency', 'number of cores', 'bitness', 'buffer', 'manufacturer');
echo $processor[3];
```

This PHP-code describes a variable $processor, which contains an array with five line elements – the characteristics of the processor. The echo command displays information about the characteristics of the processor under number 3 – "buffer". This example allows students to recall the technical parameters of the processor and its characteristics.

Getting deeper into the subject arrays, one can offer a task to create a multi-dimensional associative array and implement various computer devices and their characteristics. The PHP code may be following:

```
<?php
$computer = array (
 'processor' => array( 'frequency' => "frequency", 'cores' => "number of cores"),
 'ram' => array('amount' => "Amount", 'type' => "Type"),
 'hdd' => array( 'amount' => "Amount", 'form-factor' => "Form-factor") );
echo $computer['processor']['cores'];
?>
```

To implement this task, students need to recall the components of the computer and their characteristics.

Since the discipline "Technologies of Web application development" contains topics related to the study of the SQL language, it is advisable to offer tasks related to the formation of queries. For example, in the database there is a table of various

components of the computer and the user needs to display information about certain products with a certain characteristic. The SQL query can be implemented as follows:

```
SELECT * FROM hdds
WHERE interface = 'SATA';
```

In this example, a query is made to the "hdds" table (hard disks) to display all the parameters of the hard drives with the condition that their interface is SATA.

Table 1. *Table "hdds" in the database*

Product	Device	Read	Write	Storage	Price	Interface
Segate Enterprise 15K 2.5"	HDD	0.2	0.2	600	200	SAS
Western Digital 16MB 2.5"	HDD	0.16	0.16	4000	230	SATA
…	…	…	…	…	…	…

You can also suggest adding data to an existing database table (Table 1) using queries in the SQL language. This will make it possible to implement interdisciplinary connection, because to accomplish this task, students need to apply the relevant technical knowledge (understanding the parameters of the hard disk: type, write and read speed, volume, interface, etc.).

4. Results and discussion.

These examples allow to influence the development of creative activity (to use the knowledge and skills obtained in the new situation, to draw logical conclusions, the ability to pay attention to various characteristics of the object of study, etc.). With the help of interdisciplinary connections in the educational process, it is possible to stimulate and motivate future specialists to professional self-improvement and self-education.

In order to check the students' level of technical competence we conducted an experiment in which 60 students of the specialty "Informatics" took part. We selected 31 students for the control group and 29 students for the experimental group. Students of the experimental group were offered tasks of an interdisciplinary origin.

At the beginning of the experiment (2016), that is before the beginning of the study of the discipline "Development of Web applications", testing was carried out for all groups, with the purpose to reveal the level of technical competence of the future computer science teachers.

We determined the following levels of technical qualities: initial, medium, sufficient and high.

The initial level characterizes the student's knowledge as basic, initial ideas about technical tools and the possibilities of using them.

The medium level – a student can reproduce technical knowledge, do tasks based on assigned pattern, has elementary skills of educational activity and does individual tasks with the teacher's help.

Sufficient level – the student has sufficient technical knowledge to independently perform individual tasks, uses technical knowledge and skills in standard situations, makes correct conclusions, corrects mistakes. The student's answer is correct, but his own judgments are not quite enough.

High level – the technical knowledge of the student is deep, strong, systematic, which are used both for solving standard tasks and creative ones. The student's academic activity is characterized by the ability to independently evaluate various technical assignments, facts, concepts, to discover and defend personal position.

At the beginning of the experiment, approximately the same levels of competence may be observed, both in the control and in the experimental groups, which makes it possible to obtain a more precise selection.

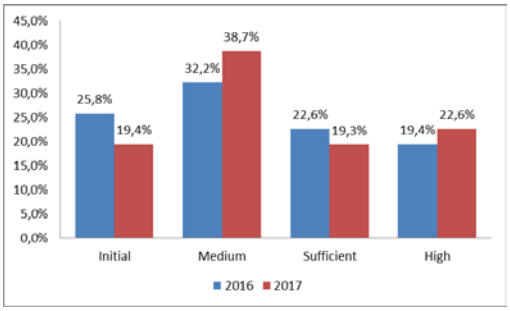

Figure 1. *Results of the control group experiment*

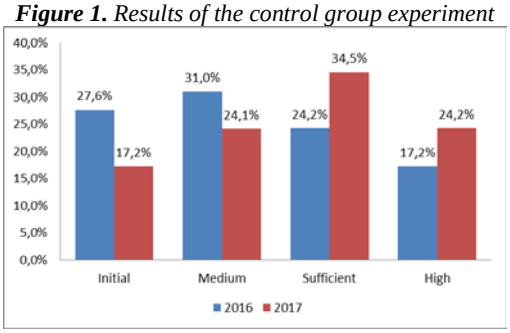

Figure 2. *Results of experimental group experiment*

After studying the discipline "Technologies of Web application development" (2017), we conducted a final test to determine the level of technical competence in both groups and found that the percentage of sufficient and high levels increased significantly in the experimental group, while in the control group, such a noticeable increase was not detected (Figure 1, 2). This gives grounds to believe that the introduction of the offered interdisciplinary approach is effective and influences significantly formation of the technical competence of the future computer science teachers.

5. Conclusion.

Introduction of the interdisciplinary approach with the application of interdisciplinary assignments into the educational process makes it possible to form a unified scientific worldview of students, to envisage the development of system-forming ideas, concepts, general scientific methods of educational activity, the possibility of a comprehensive application of knowledge from different academic disciplines. Interdisciplinary connections provide increased interest in learning subjects and help in the professional orientation of students. The approach based on the interdisciplinarity influences the composition and structure of educational subjects, since each subject is the source of various types of interdisciplinary connections. Taking into account the above said, a promising area for continuing research is the study of the issues of introducing interdisciplinary connections in the process of forming technical competence while studying other professional computer disciplines that are not of a purely technical nature.

6. *References.*

1. Voitovych, I. Integration of fundamental and professional training in the physics of the future teachers of informatics. – Visnyk Chernihivskoho natsionalnoho pedahohichnoho universytetu, Issue 89, 2011, p. 223-226.
2. Kopniak, N. Realization of interdisciplinary connections in the system of formation of IT competence of the students of a secondary school. – Kompiuter u shkoli ta simi, #1, 2012, p.17-19.
3. Mendereckiy, V. The importance of information technologies for the implementation of interdisciplinary connections at physics classes in secondary school. – Visnyk Kamianets-Podilskoho natsionalnoho universytetu imeni Ivana Ohiienka. Fizyko-matematychni nauky, Issue 8, 2015, p.68-71.
4. Fedorets, G. Interdisciplinary connections in the learning process, Saint-Petersburg, publishing house of St. Petersburg State University, 1994, 250 p.