Journal of Learning on History and Social Sciences
Homepage : https://journal.antispublisher.id/index.php/EJLHSS
Email : admin@antispublisher.com

e-ISSN : 3031-7347
JLHSS, Vol. 2, No. 2, February 2025
Page 166-172


# Pedagogical Conditions for The Development of Students Research Skills in The Use of The Laboratory in Biology Lessons

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**DOI : https://doi.org/10.61796/ejlhss.v2i2.1230**

**Sections Info**

***Article history:***
Submitted: February 06, 2025
Final Revised: February 11, 2025
Accepted: February 16, 2025
Published: February 20, 2025

***Keywords:***
Laboratory
Demonstration
Process competence
Biological process
Biological event
Observation
Experiment
Understanding
Explanation
Biological object

**ABSTRACT**

***Objective:*** *To examine the methodological foundations underpinning the formation of the competence "Observation, understanding, and explanation of biology through laboratory works and experiments."* ***Method:*** *A qualitative analysis was conducted, reviewing current pedagogical strategies, curriculum designs, and laboratory practices to assess their effectiveness in fostering scientific inquiry and conceptual understanding.* ***Results:*** *The findings demonstrate that a structured approach to laboratory work significantly enhances students' abilities to observe, comprehend, and articulate biological phenomena, thereby establishing a critical basis for the development of broader professional competencies.* ***Novelty:*** *This research offers an innovative framework that integrates theoretical insights with practical applications, providing a novel contribution to biology education by linking laboratory-based activities with the cultivation of essential research skills.*
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## INTRODUCTION

Nowadays, it is becoming more and more important to prepare students as fully qualified specialists through the consistent application of competency-based approaches to educational processes. The curriculum of "Biology" developed in 2023 based on DTS for the educational direction of the Ministry of Public Education and Pre-school Education also envisages the formation of general competencies in biology in students, and through its implementation, competent aimed at training students [1].

Although the issues of formation of competences among students have been deeply studied in the scientific and pedagogical researches related to biology, the methodological bases of the general competences related to biology, i.e. the essence and characteristics of these competencies, have not been sufficiently disclosed. As a result, in various studies, there are cases of explaining the general competencies related to biology through the basis and other competencies [2].

In addition to understanding, systematic formation of explanatory competencies is also important in the formation of science-related competencies in students. In general, explanation means to explain the nature of events and processes in the world on a logical-methodological basis [3].

Although understanding and explanation are closely related to each other, it should be remembered that understanding does not imply explanation, that is,

connecting the studied phenomenon to law and reason. Distinguishing them, M.M. Bakhtin wrote: "In explanation, only one mind, one subject, and in understanding - two minds, two subjects participate. There can be no dialogical relation to the object, therefore the explanation has no dialogic aspects (except for formal-rhetorical ones). Understanding is always dialogical to a certain extent" [4].

Based on the DTS that is used in practice in our country, it can be said that we can systematize the types of general competencies of students in biology as follows:

## RESEARCH METHOD

General competencies in performing laboratory work in biology:

1. Competence to observe, understand and explain laboratory work in biology;
2. Competence to use measuring instruments used in laboratory work in practice;
3. Competence to conduct laboratory work, measure biological quantities and draw conclusions.
4. Competence to calculate the results obtained from laboratory work.

## RESULTS AND DISCUSSION

Below we will give a brief understanding of the dictionary meanings of the words observation, understanding and explanation.

Observation - is the process of systematic, continuous, exaggerated and perfect perception of things in objective existence; one of the main empirical methods in psychological-pedagogical research. In a broad sense, observation is carried out in the form of recording changes in natural pedagogical phenomena and processes, and is used as an important method in the field of pedagogy [5].

During monitoring, the results of various experimental studies are obtained with the help of special equipment, laboratory equipment and special technical visits.

Comprehension:

1. The ability to form new ideas, concepts, and judgments about things and events that are considered objects of perception or thinking in the educational process, to have an understanding of distinguishing events from other things and events according to their signs;
2. A state of mind based on certain processes, relationships between events, the causes of occurrences and events, and revealing the essence of the content of the text or educational materials.

Explanation is a pedagogical method that consists of explaining and interpreting educational materials to pupils and students using words [6].

Explanation is the main task of science and education. Forms of explanation: scientific explanation, rational explanation [7].

It is not possible to explain all the above competencies in one article. Therefore, in this article, we will try to reveal the methodological basis of students' competence to observe, understand and explain biological processes and phenomena [8].

About the most general aspects of this competence, it can be said that students receive preliminary information about events, phenomena and processes occurring in the environment by performing laboratory and demonstration experiments, that is, observation is the most widely used empirical method for learning about the world. In this method, performing laboratory and demonstration experiments, that is, the student objectively learns a biological process or phenomenon as it is (without affecting or interfering with it). As a result, observation provides an opportunity to acquire knowledge about the objective properties and relationships of biological phenomena, processes, regardless of the student's will, emotions, and will. This method relies on information from the senses. In the process of observation, the student learns not only about the external aspects of the object of knowledge, but also about its important properties and relationships as the ultimate goal. Monitoring can be done directly or indirectly using various tools and other technical equipment.

At first glance, the observation method seems to be simple to use, but there are specific requirements for its implementation, such as the accuracy of the object of observation, the possibility of control through repeated observations or using other methods (for example, experiment). Based on these requirements, we believe that the method of observation in biology should be implemented in the following stages [9].

Steps in using the observation method in biology:

Step 1: Selection of laboratory work in biology.

Step 2: Identify the phenomenon or process that should be learned from the selected laboratory work.

Step 3: The process of performing laboratory experiments with identified learning.

Step 4: Processing of information obtained from laboratory work in learning.

Now, let's stop at these steps in performing laboratory experiments.

1. The stage of choosing a biology object: In order for the student to understand the biological experiments or process through observation, he must first be able to choose one of the laboratory works and collect the necessary equipment and preparation from it. For example: laboratory work #1 is to get acquainted with the organoids of the cell. First of all, students should know what equipment and measuring instruments are necessary for laboratory work. Microscope, thin onion peel, tweezers, pipette, water and laboratory glass.

   Microscope view of onion thin shell cells.

2. The stage of identifying the phenomenon or process that needs to be studied in the selected biological object. After choosing biology as an object of observation, it is very important to determine among the numerous events and processes occurring in this object, which belong to the subject or department.

Not only the laws of biology, but also other biological phenomena and processes occur in the laboratory work "Getting to know the organelles of cells". In this case, students should know which of the events and processes occurring in the selected biological object should be observed. Based on the above examples, with the help of the topic "Getting to know the organelles of cells", we will learn the laws of biology,

measuring instruments useful in laboratory work and their use, i.e. a microscope, thin onion skin, tweezers, a pipette, water and a laboratory glass. they need to learn how to use it.

1. Prepare a preparation from the thin peel of the onion.
2. Cover the drug with a cover glass and drop a drop of water next to it.
3. Observe the cell name of the preparation through a microscope.
4. Find and identify cell organelles in the preparation.
5. Draw a picture of the preparation.
6. Mark the organoids of the cell in the picture.

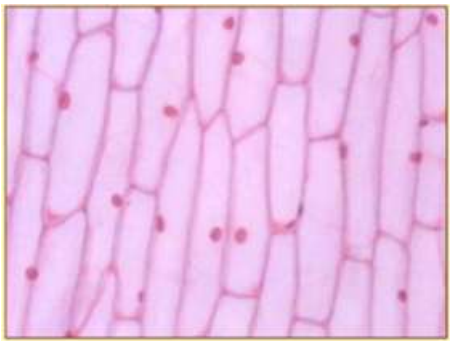

**Figure 1.**

In practice, the more correctly selected various events and processes occurring in a biological object, the higher the chances of understanding their essence.

Observation of a biological phenomenon or process that is determined to be studied [10]. At this stage, a biological phenomenon or process that has been determined to be studied is observed. The level of observation largely depends on the students' prior knowledge of the observed biological phenomenon or process, their attention, and active thinking. Various questions, misunderstandings and abstractions arise in the thinking of students about the happening events or processes. As a result of the analysis of these mental operations, the process of understanding the essence of biological phenomena and processes takes place in students. It is the process that starts from this situation that starts the stage of understanding in the students' thinking.

Competence of understanding and explanation: It is known that "understanding" is a person's understanding and perception of the world, its events and processes. From this point of view, we can define the competence of understanding as "the ability to use the general system of thoughts and information formed in human thinking in different situations to understand the same events and processes in the world." Competency of students' understanding of biology can be considered as the ability to apply the existing biological laws and rules understood by them to understand biological phenomena or processes in different situations. In human thinking, the stage of understanding occurs after the stage of knowing. In most cases, knowing is interpreted as awareness of an event or event in the environment, while understanding means processing, perceiving, and understanding this event or event in thinking. Comprehension is often the next step after knowing an event or phenomenon, and it is a psychological process. We will try to

explain this study with the above-mentioned "Getting to know the organelles of cells" observation tools. Let's suppose that they say to determine the appearance of cells using amicroscope. A student may superficially have knowledge of the appearance of cells under a microscope, but for the formation of competence in understanding this experience, the student must first understand the essence of concepts such as cells. At the same time, this mental process can be formed in the opposite direction.

If the student has an understanding within the framework of the above-mentioned examples and has the ability to use it in any problem situations related to this type of learning, then the competence of understanding related to this topic has been formed.

Speaking about the relationship between explanation and understanding (interpretation), Vrigt suggests that it is better to distinguish these concepts. He sees this difference in: "What is this?" Answering the question is the result of interpretation. For example, when answering the questions, why did the demonstration take place or what "triggered" the revolution?, we try to explain the happenings in a narrow sense. In addition, these two factors are interrelated and in a certain way rely on each other. A one-sided explanation often paves the way for a higher level interpretation of the evidence.

After a comparative analysis of the definitions and classifications in the existing pedagogical and philosophical literature on explanation, we can say that "Explanation is the study of the events and events or processes that are being studied in the student's interaction activity using different methods (transmission of ideas, interaction (transmitting a secret, influencing, communicating, imitating) with the help of clarifying, understanding, combining existing knowledge and experiences in thinking, leading to understanding is an activity. Explanation is carried out in individual, trialogical, polylogical forms with the participation of those who explain the idea and those who receive the idea, and they differ from each other in terms of their duration, scope, means of transmission, and the priority of verbal and non-verbal types of speech.

Many pedagogical studies show that in the process of explaining to others (the teacher or students) the concepts formed in the student's mind about an event or process, new thoughts, ideas, and conclusions are formed. can be. In this, mental uncertainties and abstractions deepen. This thought process can be shortened to "Understanding by Explanation". Sufficient formation of students' explanatory competences related to science is of great importance in the sharp development of their independent thinking skills. There are opportunities to do these things not only during class, but also during extracurricular time through various media (for example, telephone).

## CONCLUSION

**Fundamental Finding:** the study reveals that the strategic use of Telegram messenger to facilitate scientific channels and interactive dialogues, combined with multimedia-enhanced laboratory work, substantially augments students' acquisition of biological knowledge and competency development. **Implication:** This integrated approach underscores the potential for digital tools to complement traditional laboratory practices, thereby fostering a more dynamic and accessible learning environment.

**Limitation:** However, the reliance on modern communication platforms may limit the approach's effectiveness among students with varying levels of technological access and proficiency. **Future Research:** Further investigations should examine the long-term impact of multimedia-supported laboratory activities on comprehensive competence formation in biology, assess the scalability of this approach across diverse educational settings, and explore methods to mitigate digital disparities to ensure equitable learning opportunities for all students.

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