Annual of Sofia University "St. Kliment Ohridski"
Faculty of Biology
Book 4 - Scientific Sessions of the Faculty of Biology
2022, volume 107, pp. 28-34
Scientific Conference "Kliment's Days", Sofia 2021

# CONCEPT OF HANDS-ON ACTIVITIES FOR LEARNING BIOLOGY IN THE CASE OF DISTANCE EDUCATION IN AN E-LEARNING ENVIRONMENT

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**Keywords:** practical activities, biology, distance learning, pedagogical experiment

**Abstract:** The paper presents a concept of practical activities in distance learning in biology. The emphasis is placed on the practical activities assigned in conducting a pedagogical experiment with students from the 9th and 10th grades of Foreign Language School "Dimitar Dimov" in the town of Pleven. The article describes a method of assigning experimental tasks and traces the practical and emotional results in the realization of the learning tasks. The objectives of the pedagogical experiment are to prove the role of the practical tasks carried out at home in developing skills for working with bio-objects, skills for following an algorithm, and stimulating students' creativity in performance and presentation of the task results. An analysis of the experiment validation results is presented.

## INTRODUCTION

Distance learning in an e-learning environment has gained significant popularity in Bulgaria after 13 March 2020 (4) as imposed by an Acts of the Ministry of Health and followed by the decision of the Ministry of Education and Science. These concerned an immediate switch to e-learning due to the emergency caused by the COVID19 pandemic. This placed teachers in a complex situation that necessitated ad-hock decisions while learning and adapting. As a result, the teachers have gained immense experience while going through the challenges the new situation raised; they showed creativity, resourcefulness and learned by the day. This paper is dedicated to the description of a pedagogical experiment related

to the implementation of more hands-on activities in biology classes. Natural science itself is intimately concerned with the surrounding environment and events, therefore practical activities are indispensable for acquiring knowledge in biology.

The research was conducted by the first author, a teacher of Biology and Chemistry in English, in a High School of English as a Foreign Language, Pleven, Bulgaria. The school follows the Bulgarian educational system curriculum requirements of CLIL-based teaching. General subjects are taught in two languages -- Bulgarian and English, the students study the basic biological and chemical concepts in both languages. The participants in the current study are 136 students in 9th and 10th grades; aged between 15 and 16. The objectives of the experiment are as follows:

- to demonstrate the role of practical activities in the acquisition of biological knowledge;
- to develop skills in working with biological objects, apply an algorithm in carrying out practical activities, describe results and draw conclusions;
- to achieve a flexible learning structure;
- to stimulate creative development through learning.

## MATERIAL AND METHODS

The object of the paper is the operational component of learning, and two types of activities - practical and emotional (7 in particular. The techniques through which students' practical competences are developed rely on performing experiments and practical activities at home with tools that are readily available in every home. Setting the tasks follows a scheme that is based on an adaptation of Beetham's activity model (1). According to Beetham, all components should be interrelated and should not be separated (Fig. 1):

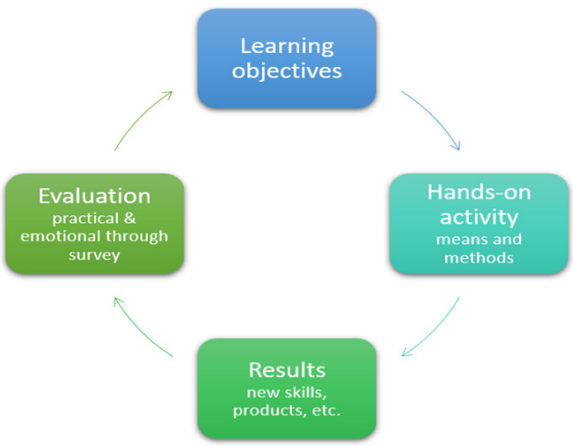
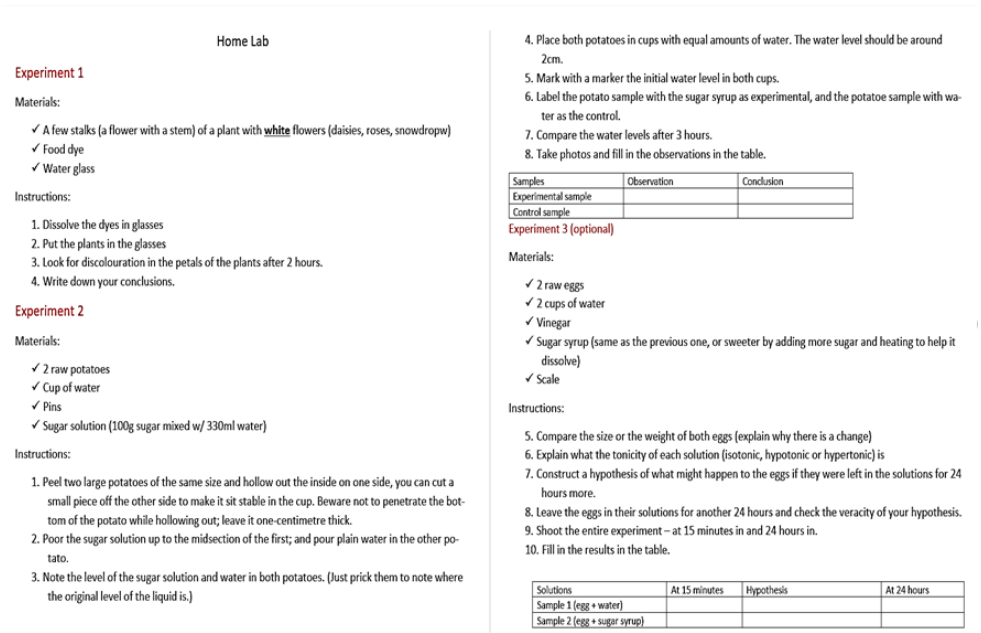



*Figure 1:* Beetham Learning Activity Scheme (Beetham 2009)

Hands-on activities in the form of an experiment are an integral part of teaching biology and changing the way it is conducted leads to new solutions in the teaching process. The experiment is the essence of science and learning science without hands-on experimental work is no different from learning literature without reading books. In the context of distance learning in an e-learning environment, the adopted solution was to turn the school lab into a home lab. Thus, the practice lessons to conduct experiments were redesigned into hands-on home activities. The activities are presented to the students in the form of a worksheet titled "Home Lab". The worksheet describes in a step-by-step the materials to be used, the stages to be followed, the questions to be answered and the expected form of conclusions to be drawn from the activity. The worksheets are available through the messaging system of Shkolo, an e-learning platform officially used by the school. The worksheets correspond to the specific curriculum. (8) In the worksheets, in addition to the instructions for the activity, the students receive information about the timeframe in which they have to complete it, how to present the results and where to send them.



Home Lab

Experiment 1

Materials:

- ✓ A few stalks (a flower with a stem) of a plant with **white** flowers (daisies, roses, snowdropw)
- ✓ Food dye
- ✓ Water glass

Instructions:

1. Dissolve the dyes in glasses
2. Put the plants in the glasses
3. Look for discolouration in the petals of the plants after 2 hours.
4. Write down your conclusions.

Experiment 2

Materials:

- ✓ 2 raw potatoes
- ✓ Cup of water
- ✓ Pins
- ✓ Sugar solution (100g sugar mixed w/ 330ml water)

Instructions:

1. Peel two large potatoes of the same size and hollow out the inside on one side, you can cut a small piece off the other side to make it sit stable in the cup. Beware not to penetrate the bottom of the potato while hollowing out; leave it one-centimetre thick.
2. Poor the sugar solution up to the midsection of the first; and pour plain water in the other potato.
3. Note the level of the sugar solution and water in both potatoes. (Just prick them to note where the original level of the liquid is.)
4. Place both potatoes in cups with equal amounts of water. The water level should be around 2cm.
5. Mark with a marker the initial water level in both cups.
6. Label the potato sample with the sugar syrup as experimental, and the potatoe sample with water as the control.
7. Compare the water levels after 3 hours.
8. Take photos and fill in the observations in the table.

| Samples | Observation | Conclusion |
|---|---|---|
| Experimental sample | | |
| Control sample | | |

Experiment 3 (optional)

Materials:

- ✓ 2 raw eggs
- ✓ 2 cups of water
- ✓ Vinegar
- ✓ Sugar syrup (same as the previous one, or sweeter by adding more sugar and heating to help it dissolve)
- ✓ Scale

Instructions:

5. Compare the size or the weight of both eggs (explain why there is a change)
6. Explain what the tonicity of each solution (isotonic, hypotonic or hypertonic) is
7. Construct a hypothesis of what might happen to the eggs if they were left in the solutions for 24 hours more.
8. Leave the eggs in their solutions for another 24 hours and check the veracity of your hypothesis.
9. Shoot the entire experiment – at 15 minutes in and 24 hours in.
10. Fill in the results in the table.

| Solutions | At 15 minutes | Hypothesis | At 24 hours |
|---|---|---|---|
| Sample 1 (egg + water) | | | |
| Sample 2 (egg + sugar syrup) | | | |

*Figure 2.* Worksheet with instructions for practical activities

The results of the practical activities, the answers to the assigned questions and the conclusions of the students' work are communicated to the teacher via the e-platform messaging in the form of an MS Word document and pictures.

In order to have feedback on students' attitudes towards using more hands-on activities, a survey in which they reflect on their opinions of the learning process was proposed after each such topic.

**A concept of practical tasks**

The concept is drawn based on the following description of two asynchronously conducted practical lessons. In one of the tasks, the first three stages involve working with a text that contains elements related to the practical activity. The concept of practical activities applied on the topics "Prokaryotic organisms and their significance for humans" (1) and "Chemical composition of the cell - properties of water" (2) is presented in Table 1, following Beetham's e-learning model.

**Table 1:** Concept of practical tasks

| Activities | Practical activity 1 | Practical activity 2 |
|---|---|---|
| Objectives of the activities | Development of skills for:<br>- working with biological objects;<br>- extracting information from a text;<br>- presenting results through MS Word documents and photos; | Development of skills for:<br>- work on algorithm;<br>- extracting information from a text;<br>- skills for presenting results through word files and photos; |
| Methodical materials | Working with a text - extracting information about two types of bacteria,<br>Algorithm for experimenting - fermenting yogurt. | Algorithm for conducting an experiment - proving capillary properties, density, and surface tension of water. |
| Presentation technology | Worksheet with instructions. | Description of the stages of the activities in a text message. |
| Results - skills, products | MS Word document with text answers, conclusions from the activities, and photos of the final product - yogurt. | Communication via an electronic platform with conclusions from the performed activities and photos at the stages of their implementation. |

**Early results**

To validate the results of the experiment, a triangulation was performed: evaluation of the results of the practical activities by the teacher, observation of the students' attitude towards the implementation of the practical activities, and anonymous feedback by 136 students. The teacher participant-observation led to the conclusion that the students manage well with the assigned activities.

About 75% of them send complete solutions, correct conclusions, and photos from the practical activities. About 20% of children encounter difficulties with the online instructions and seek contact via email for clarification. A small part of the students - 2-3% expressed a desire for more tasks to be assigned to deepen their knowledge through experimental activities related to the topics they were studying during this period.

The comments of 55% of the students are that it is more interesting for them to include more practical activities in the learning process. About 28% believe that they had to spend more of their time on activities, and 14% do not want to perform such tasks.

The results of the anonymous survey conducted with students showed the following results:

When asked whether the distance form of learning biology is more challenging than the face-to-face one, 32% answered that it is "partly true". 20% of the respondents answered this question with "absolutely true". More than half of the students - 52% answered "absolutely true" that the classes with practical activities are interesting. Children who think that biology classes with experiments are boring are only 3% and 45.45%. are on the opposite opinion A total of 63% of the respondents answered "true" (partly 40.40% and absolutely 23.23%) that the lessons with practical activities are easier. Not a small part of the students - 32% answered that they prefer the face-to-face form of education to the distant one.

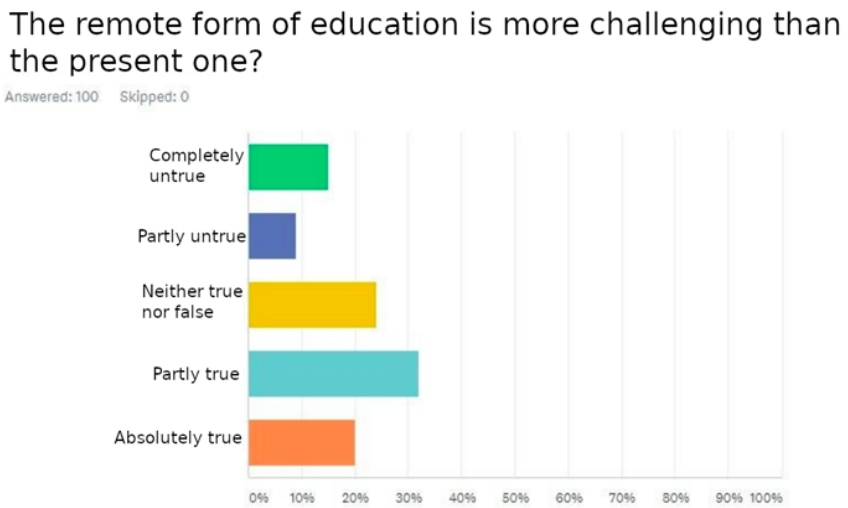



*Figure 3. Survey results*

## CONCLUSION

The analysis of the results proves that the goals of the conducted practical activities were achieved. The trainees cope with the set instructions, they successfully process results, make analyzes, and formulate conclusions. Moreover, the majority of the students show an active interest in such classes and express their desire for more practical activities in science classes both through the survey and during the synchronous work.

Future work includes further application of the described concept of practical activities through distance learning in an electronic environment, researching on the students' results in the process of acquiring biological knowledge. During the current school year, it is planned to give tasks in an electronic environment synchronously and asynchronously, and in a face-to-face classroom. In addition, the general intention is to continue communicating with the students through an electronic environment because information technology is an integral part of their daily lives and should be used for learning activities. Furthermore, it is decided to continue the process of creating worksheets with tasks, as well as an observation on the impact of the quantity of the tasks, the amount of the description of the instructions, and the time needed to perform the activities on the learning process the training.

Involving students in solving more hands-on science problems brings them closer to the real processes in nature, making them direct explorers. Curiosity and the spirit of exploration are enhanced through scientific experimentation. In times when we are more in touch with nature virtually than physically, any experiment showing real natural processes increases the desire to learn and the love for natural science.

Assigning experimental tasks for home laboratory activities is also applicable to the face-to-face, blended (with part of the material/activities online), or hybrid (with some of the students in distance mode) learning contexts. Instructions can be given verbally, during class, and in writing via a document in an electronic environment. Teachers can set different criteria for the presentation of the task results - through photos, video, describing the experiment on paper or as a Word document, etc., using a shared space or virtual learning environment. Thus an individual approach to meeting students' needs having in mind their respective abilities is achieved.

The success of this pedagogical experiment proves the positive effect of giving practical activities remotely in the future, as the school laboratory does not provide sufficient opportunities for practical activities, especially in the case of ensuring participation of all students at the same time. Excellent results can be achieved at home with algorithms for conducting safe practical activities. Using the various opportunities of distance learning in an electronic environment, more students can be attracted to active learning activities.

***Acknowledgments:***The presented research was conducted under the grant by project 80-10-170/05.04.2021 "Designing and researching the efficiency of hands-on activities for Biology classes (in English) in distance learning context", funded by Sofia University Science Research Fund.

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