UDC 551.51:378.147.018.43.091.33-027.22

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PROBLEMS OF CONDUCTING EDUCATIONAL PRACTICE IN ATMOSPHERIC PHYSICS IN A REMOTE LEARNING MODE

Abstract. *The article examines the challenges of organizing and conducting practical training in atmospheric physics under distance learning conditions. The main difficulties are outlined, including the lack of access to meteorological equipment and the inability to conduct measurements at a standard meteorological site. The impact of the remote format on the development of students' professional competencies is analyzed. Possible solutions to these issues are proposed.*

Keywords: *atmospheric physics, distance learning, practical training, meteorological observations, digital technologies.*

Анотація. *У статті розглянуто проблеми організації та проведення навчальної практики з фізики атмосфери в умовах дистанційного навчання. Окреслено основні труднощі, пов'язані з відсутністю доступу до метеорологічного обладнання та неможливістю проведення вимірювань на стандартному метеорологічному майданчику. Проаналізовано наслідки дистанційного формату для формування професійних компетентностей студентів. Запропоновано можливі шляхи вирішення цих проблем.*

Ключові слова: *фізика атмосфери, дистанційне навчання, навчальна практика, метеорологічні спостереження, цифрові технології.*

Relevance.

Atmospheric physics is a science that studies various physical phenomena and processes occurring in the Earth's atmosphere. It examines the nature of atmospheric phenomena, establishes relationships between meteorological variables and events, and reveals their underlying patterns.

Like other branches of physics, atmospheric physics relies not only on the analytical theory of phenomena but also on experimental data. The latter is obtained, for example, through the modelling of physical phenomena in adiabatic, climatic, and other chambers. However, in most cases, researchers have to rely on passive experiments in the atmosphere, which involve measuring its essential parameters under conditions created by nature itself [4].

Educational practice plays a crucial role in shaping students' competencies, as it allows them to work directly with meteorological instruments, observe atmospheric phenomena, and analyse meteorological variables.

However, under the conditions of distance learning initially necessitated by the spread of COVID-19 and later by the treacherous attack of the aggressor country – the implementation of the "Atmospheric Physics" training practice faces several challenges, which will be thoroughly examined below. The relevance of this article lies in the need to adapt the educational process to the conditions of distance learning, particularly in the field of natural sciences, where the practical component plays a key role.

In this regard, special attention will be given to the problems arising in the organization of atmospheric physics training practice without the possibility of direct use of meteorological equipment and field measurements. The lack of practical experience may negatively impact the formation of students' professional competencies, requiring the search for effective alternative teaching methods. This article is relevant as it analyses these challenges and proposes possible solutions to improve the quality of distance learning in the field of hydrometeorological education.

Objective – to analyse the main challenges in organizing and conducting the "Atmospheric Physics" training practice under distance learning conditions, assess their impact on the formation of students' professional competencies, and propose possible solutions to ensure effective acquisition of practical skills.

Presentation of the Main Material.

Practical training is an integral part of the educational process, with its requirements defined by the educational and professional program for higher education applicants at the "bachelor's" level in the specialty 103 "Earth Sciences."

The primary goal of training practices is to consolidate and deepen the theoretical knowledge acquired during studies, as well as to develop students' professional competencies necessary for independently solving specialized tasks in real-world conditions. Educational practice facilitates the mastery of modern methods, organizational forms, and tools of professional activity that meet the requirements of the future profession. Additionally, it fosters in students the need for continuous knowledge and skills renewal, as well as a creative approach to their practical application [2].

Practical training of students is carried out in accordance with the principles of continuity and logical sequence, ensuring the systematic acquisition of professional skills. Training practices are aimed at familiarizing students with the specifics of their future professional activities and developing specialized competencies (knowledge, abilities, and skills) as outlined in the educational and professional program "Hydrometeorology" at the bachelor's level in the specialty 103 "Earth Sciences" [3].

The objective of the "Atmospheric Physics" practice is to introduce first-year students to meteorological parameters and atmospheric phenomena that characterize the state of the atmosphere, methods of observing these phenomena, and the rules for the initial processing of such observations [1].

The main task of the practice is to demonstrate to students that the physical state of the atmosphere is highly variable in both space and time and depends on a large number of factors.

As a result of completing the practice, students should [1]:

Know:

– Rules of meteorological observations,
– Timing and scope of meteorological observations,
– Units and accuracy of meteorological measurements,
– Cloud forms according to the international classification,
– Rules for encoding meteorological information.

Be able to:

– Use basic instruments for measuring meteorological parameters,
– Process and analyse observation results,
– Use psychrometric tables to determine air humidity characteristics,
– Encode meteorological information using the KN-01 code.

The training practice in Atmospheric Physics (Fig. 1, 2) takes place at 15 Lvivska Street, ONU, Room 302, at the ONU Meteorological Centre (Odesa, Chornomorka) or at the ONU Marine Centre (Odesa) [1].

When conducting the Atmospheric Physics training practice in a remote format, several difficulties arise that complicate its completion. The main challenges include:

1. Lack of access to meteorological equipment installed at the meteorological site. One of the key components of the *Atmospheric Physics* training practice is working with meteorological instruments, such as:

- Wind vane/anemometer (for measuring wind direction and speed);
- Barometer (for determining atmospheric pressure);
- Psychrometric system, which includes dry, wet, minimum, and maximum thermometers (for measuring air temperature-current, minimum, and maximum-and determining its humidity);
- Ground thermometers (for measuring surface temperature);
- Rain gauge (for measuring precipitation), etc.

Figure 1 – Educational practice "Atmospheric Physics" (photo from the archive of the Department of Meteorology and Climatology, ONU).

In the context of remote practice, students are deprived of the opportunity to directly work with the aforementioned instruments, which significantly reduces the quality of practical training. It is important to note that the use of video materials cannot replace the real-life experience of working with meteorological instruments.

Figure 2 – Processing meteorological observations (photo from the archive of the Department of Meteorology and Climatology of ONU).

Possible consequences:

a. Lack of skills in handling professional meteorological equipment.

b. Difficulty in adapting to work in real-world conditions at meteorological stations after graduation.

c. Limited opportunities for conducting independent research in the future.

2. Loss of field research skills. Meteorological observations involve direct work in natural conditions. Students must measure meteorological variables and record atmospheric phenomena at a standard meteorological station. During in-person practice, students travel directly to practice bases (meteorological sites), where they learn to collect meteorological data and analyse it in real-time, observe atmospheric processes, and monitor their evolution throughout the duration of the practice. In the distance learning format, such opportunities are unavailable.

Possible consequences:

a. Lack of practical skills in conducting field meteorological observations.
b. Inability to independently carry out measurements in real conditions.
c. Reduced preparation level of future meteorologists and meteorologists.

3. Limited interaction among students (development of soft skills). One of the key aspects negatively impacted during distance learning is the development of teamwork skills. In a traditional educational environment, interaction between students and instructors occurs in person, fostering the development of communication skills, the ability to argue one's point, listen to others, collaborate effectively, and distribute tasks in group activities. The distance learning format significantly reduces opportunities for such natural socialization, as the primary mode of communication is limited to text messages, video conferences, or asynchronous discussions.

Possible consequences:

a. Decreased effectiveness of team interaction.
b. Limited development of communication skills.
c. Problems with social adaptation.

4. Difficulties with visual observation of natural processes. One of the most important components of the "Atmospheric Physics" practical training is the visual observation of atmospheric processes. Students must learn to identify cloud forms, types, and varieties, observe changes in meteorological parameters (atmospheric pressure, temperature, humidity characteristics), and analyse the weather during and between observation periods.

In the distance learning format, this opportunity is absent, which significantly complicates the understanding of fundamental meteorological processes.

Possible consequences:

a. Superficial understanding of meteorological processes.
b. Loss of practical observation skills.
c. Difficulty in determining cloud types and analysing weather conditions.

As we have established, organizing the "Atmospheric Physics" practical training in a distance format presents a number of challenges. To minimize these challenges and enhance the effectiveness of the educational process, modern digital technologies and adaptive teaching methods must be implemented. Specifically:

1. Use of digital meteorological platforms and databases. Integrating the educational process with open meteorological platforms (such as MeteoBlue, Windy, NOAA, ECMWF, GFS) allows students to analyse real-time weather conditions. Studying synoptic maps, satellite images, and radar data helps compensate for the lack of direct observations. The use of data processing software (GrADS, IDV, Python for meteorology) promotes the development of analytical skills.

2. Virtual laboratories and simulators. Using virtual laboratories to study atmospheric phenomena formation processes (for example, atmospheric dynamics simulators) can offset the lack of real observations. Platforms such as PhET Interactive Simulations, NASA WorldView, Earth Nullschool allow students to model atmospheric phenomena behaviours. Tasks for independent execution using available resources (such as measuring meteorological variables with home weather stations).

3. Online communication and interactive tasks. Conducting group projects for analysing meteorological data fosters teamwork and scientific communication skills. The use of case-based methods to analyse real weather situations allows students to apply theoretical knowledge in a practical context. Educational games and quizzes to assess knowledge of atmospheric physics can further engage students.

4. Use of a hybrid learning format. The introduction of a blended learning model, which combines distance learning with short offline workshops for conducting meteorological measurements, can help bridge the gap in practical training. Recording video lectures from actual meteorological stations (e.g., the Hydrometeorological Center of the Black and Azov Seas) will allow students to gain visual experience without physical presence.

Conclusion. The implementation of modern digital technologies, interactive teaching methods, and hybrid educational models will effectively compensate for the limitations of the distance learning format in the "Physics of the Atmosphere" practical course. This approach will contribute to the development of necessary professional competencies in students and enhance the quality of training specialists in the field of hydrometeorology.

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