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PECULIARITIES OF TEACHING PHYSICS AND ASTRONOMY AT THE FACULTY OF PHYSICS IN THE CONDITIONS OF DISTANCE LEARNING

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Development of high quality teaching remotely is currently at the forefront of higher education developments. Particularly challenging is remote delivery of the teaching programs that require deep understanding of complex scientific phenomena, as well as development of practical skills and professional competencies. In this work, we discuss the experience of remote delivery of Physics degree. It is noted that different approaches are needed for different teaching elements. Based on this, we make recommendations for approaches to enhance student experience and to enable successful completion of the degree programs.

Remote defense of the diploma projects in the format of research conference (using Zoom, Skype, GoogleMeet and other video communication) showed that this stage of the educational process is successfully implemented and is almost identical to the face-to-face defense. Consultations (on training courses, research projects, diploma projects) can be conducted remotely.

When conducting written assessments of learning: tests, quizzes and examinations in the distance mode (using standard procedures such as distribution of questions and tasks), it is quite difficult to control the quality of students' performance, since there are opportunities for use various sources of information. A test system can provide a suitable substitute.

The experience of conducting lectures and practical classes in the distance mode has shown that the lecturer does not have the feedback that occurs in classroom teaching. The lecturer is unable to interact with the audience, since students hardly ask questions and during the lecture they can go about their own business rather than listen to the lecturer.

Key words: *distance learning, creative skills, scientific work of students, problem-based learning.*

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INTRODUCTION

Over the past two years of martial law, we have gained considerable experience in working with students via remote access. Delivering distance learning under such conditions makes it difficult to work with students on the quality of specialist training. One could complain about the insufficient material base, however reports from colleagues from well-known European and US universities that do not have such problems, have indicated challenges in delivering the quality of training in distance learning [1, 2]. What is the reason for this situation?

EXPERIENCE TEACHING IN DISTANCE LEARNING SETTINGS

Our colleague, a lecturer at Vinnitsa University, expressed an interesting opinion: 'Distance learning is a great option for those who want to continue their studies but cannot attend classes on a regular basis. However, distance learning is not the right choice for everyone - it is best suited to those who are self-disciplined and self-motivated' [3]. At the same time, the Law of Ukraine on Higher Education [4] and the relevant standard of Bachelor's degree in Physics and Astronomy [5] set rather high requirements for the quality of education and the level of competencies of a university graduate: 'higher education is a set of systematized knowledge, skills and practical abilities, ways of thinking, and other competencies that are higher in complexity than the level of complete general secondary education'. This implies graduates' ability to 'solve complex specialized tasks and practical problems in physics or astronomy'. It can be seen that there are no 'concessions' or 'discounts' and no references to martial law in these program documents. In this situation, practical experience of working with students can be useful.

During the two years of quarantine related to COVID-19, the Faculty of Physics and Astronomy has gained considerable experience in working with students via remote access in teaching physics and astronomy. With some refinements (for example, the use of the Moodle platform), it has come in handy in today's difficult conditions. We summarize our observations for different types of teaching delivery:

1. Remote defense of the diploma projects in the format of research conference (using Zoom, Skype, GoogleMeet and other video communication) showed that this stage of the educational process is successfully implemented and is almost identical to the face-to-face defense.

2. Consultations (on training courses, research projects, diploma projects) can be conducted remotely.

3. When conducting written assessments of learning: tests, quizzes and examinations in the distance mode (using standard procedures such as distribution of questions and tasks), it is quite difficult to control the quality of students' performance, since there are opportunities for use various

sources of information. A test system can provide a suitable substitute.

4. The experience of conducting lectures and practical classes in the distance mode has shown that the lecturer does not have the feedback that occurs in classroom teaching. The lecturer is unable to interact with the audience, since students hardly ask questions and during the lecture they can go about their own business rather than listen to the lecturer.

Based on our experience in delivering remote teaching, we found a number of approaches that allow successful completion of teaching and training as well and possible route to stimulate students' engagement.

The types of educational process that either require individual work of the lecturer with one student (e.g. preparation and defense of diploma projects) or do not require long-term systematic work with a large student group (e.g. lectures on special courses and seminars) can be conducted quite successfully in the distance mode. In other words, forms of education that involve an active oral on-line dialogue, such as individual interviews and small group teaching, are more successful.

In term of assessments, significant changes are needed, as traditional assignments used for in class examination are unsuitable. On-line timed assessments, such as tests and multiple-choice tests, provide a suitable alternative, and a means to examine fundamental knowledge and understanding of a specific subject. Development of problem solving skills is one of the key requirements for higher education degree programs. Problem based learning practices are successfully used for various degree programs from sciences to medicine [6]. We recommend that this approach to the student assessment can be very productive in the remote teaching mode, as it requires application of fundamental knowledge, and can stimulate deep learning and critical thinking.

Online resources are shared with the students to provide them with key information needed to develop deep understanding of the subject. At the time when vast amount of information is available in open access, undirected independent learning can be overwhelming for student, and can result is patchy knowledge of the subject. Careful selection of these resources can support quality of student learning and enhance their experience.

DEVELOPMENT OF PROFESSIONAL SKILLS

Development of professional skills remotely is challenging, as there is limited opportunity for students to practice their knowledge in professional setting. Individual online learning can hinder the development of professional skills, such as communication skills and team work. More attention should be paid not only to the rights but also to the responsibilities of university students, supporting the development of soft skills, such as self-discipline and self-

motivation. It is recommended that at the beginning of the academic year, during the first two weeks of study, students (especially freshmen) have tutorials with their supervisors to discuss the university internal regulations, student responsibilities, communication ethics (including email ethics), academic integrity, and the traditions of our university. With good understanding and compliance with these, high quality teaching and learning can be successfully delivered in remote mode.

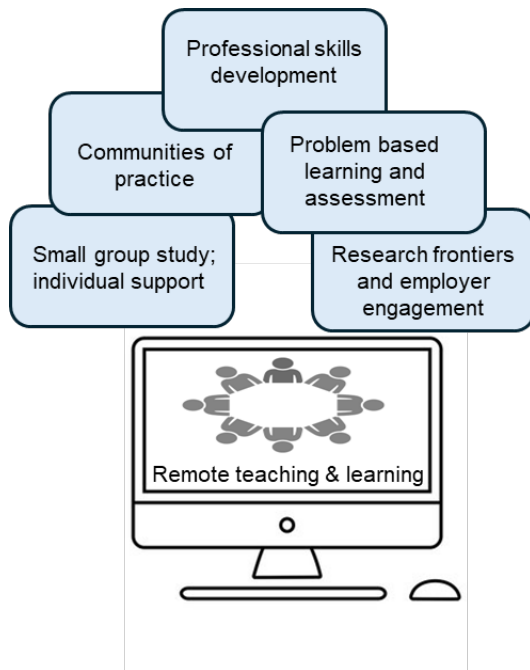


Fig. 1. Schematic diagram of recommendations for teaching and learning delivery in the remote mode.

Communities of practice and study groups are widely recognized to be beneficial for student motivation, self-directed learning and professional development [7, 8]. Hence in the remote teaching context, it is important to create opportunities for peer-to-peer learning and support, as well as time as space for scientific discussions. Moderated problem based teaching sessions can stimulate group discussions and can be instrumental in establishing supportive learning communities. Selecting topics that appeal to each particular student group, e.g. physics problems related to their interests, hobbies and future

career aspirations, will ensure student engagement in the on-line session and will stimulate further group discussion as well as individual exploration of the topic, beyond the context of the taught course.

In supporting further studies, and developing students into life-long learners, particularly beneficial and stimulated are on-line lectures by renown national and international scientists as well as prospective employers on the current global developments in research as well as on various career path and professional requirements for successful careers.

CONCLUSIONS

We conclude that despite the challenges of remote teaching delivery, high quality education and professional training can be delivered by including small group teaching and individual dialogue, and shifting emphasis to professional skill development and productive engagement with the course.

CONFLICT OF INTEREST

The authors declare that they no conflict of interest.

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ОСОБЛИВОСТІ ВИКЛАДАННЯ ФІЗИКИ ТА АСТРОНОМІЇ НА ФІЗИЧНОМУ ФАКУЛЬТЕТІ В УМОВАХ ДИСТАНЦІЙНОГО НАВЧАННЯ

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Розвиток високоякісного дистанційного навчання наразі займає перше місце у розвитку вищої освіти. Особливо складним є дистанційне виконання навчальних програм, які вимагають глибокого розуміння складних наукових явищ, а також розвитку практичних навичок і професійних компетенцій. У цій роботі ми обговорюємо досвід дистанційного викладання університетської програми з фізики. Зазначається, що для різних елементів навчання потрібні різні підходи. На основі цього ми робимо рекомендації щодо підходів для покращення досвіду студентів і забезпечення успішного завершення освітніх програм.

Проведення захисту дипломних проектів у дистанційному режимі у форматі наукової конференції (з використанням відео зв'язку Zoom, Skype, GoogleMeet та інших) показало, що цей етап навчального процесу успішно реалізується і майже не відрізняється від очного захисту. Проведення консультацій (з навчальних курсів, курсових робіт, дипломних проектів) цілком може проводитись у дистанційному режимі.

При проведенні письмових контрольних заходів навчання: контрольних робіт, заліків та екзаменів у дистанційному режимі (з використанням стандартних процедур: роздачі питань та задач), достатньо складно проконтролювати якісну успішність студентів, оскільки є велика можливість списування з різноманітних джерел. Заміною може бути тестова система.

Досвід проведення лекцій та практичних занять у дистанційному режимі показав, що викладач не має того зворотного зв'язку, котрий виникає при аудиторному навчанні. Викладач не має можливості взаємодіяти з аудиторією, адже студенти майже не задають питань і по ходу лекції можуть займатися своїми нагальними справами, а не слухати лектора.

Keywords: *дистанційне навчання, творчі навички, наукова робота студентів, проблемне навчання*