## КОМП'ЮТЕРНІ НАУКИ

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# IMPLEMENTATION OF INTERACTIVE TECHNOLOGIES IN HIGHER EDUCATION INSTITUTIONS WHEN CONDUCTING TRAINING PRACTICE FOR STUDENTS

*Summary.* The modern system of higher education is undergoing a transformation driven by the digitalisation of society and the need for a new generation of specialists. Educational practice is an important stage of professional training, and its effectiveness largely depends on the use of interactive technologies that ensure the active participation of students in the educational process.

Interactive technologies are a set of methods, tools and platforms that provide two-way interaction between participants in the educational process.

They include: virtual simulations and laboratories; case studies and project-based learning; gamification and augmented reality (AR/VR); online collaboration platforms (Padlet, Miro, Google Workspace); and the Arduino learning platform.

The introduction of interactive technologies into the educational practice of students allows: modelling real production situations without risk to students; developing teamwork and communication skills; ensuring individualisation of learning through adaptive digital resources; increasing motivation through game and visualisation elements; providing prompt feedback to correct the educational process.

For the effective integration of interactive technologies, it is necessary to: improve the digital competence of teachers; update the material and technical base; develop interactive internship programmes; and engage employers in creating content that meets the real needs of the labour market.

Interactive technologies are a powerful tool for modernising teaching practice in higher education. Their implementation contributes to the formation of students' professional readiness, development of flexible skills and ensuring high quality of the educational process.

*Keywords:* analysis, educational practice, higher education students, interactive technologies, implementation, training.

*Statement of the problem.* Today in Ukraine, conditions have been created for the transition to humanitarian personality-oriented education aimed at forming a spiritually rich personality. This creates opportunities for the realisation of the creative abilities and professional qualities of each student in the pedagogical process [1]. The use of interactive technologies in the educational process of a higher education institution allows students to develop non-standard thinking, move away from stereotypes, develop imagination, communication skills, intellectual, emotional, motivational and other areas of personality.

The training of future specialists has a well-established system of personnel training, which uses traditional forms of teaching: lectures, practical classes, laboratory work, consultations,

tests, exams, and various forms of extracurricular activities [2]. In connection with the transition to a competency-based approach to training future specialists, there is a need to change the technologies, forms and methods of teaching, which will avoid the consequences of the existing contradiction between theoretical training and the effectiveness of practical work of specialists. This necessitates the development and use of innovative teaching technologies in the training of competent specialists.

The development of modern pedagogical technologies poses new challenges for education that require a revision of the content of education, forms, methods, and teaching methods, which is why this article is relevant.

*Analysis of recent research.* A significant contribution to the development and implementation of interactive technologies in education was made by scientists V. Bespalko, M. Klarin, E. Pyehota, G. Selevko and others. The theoretical and practical aspects of this problem are considered in the scientific works of Ye. Pometuna, L. Pirozhenko, A. Panchenkova, T. Remeh, O. Sagan, O. Strebnoyi.

Also, a significant contribution to the problematic area of solving issues and promoting interactive technologies in education was made by such scientists as: M.A. Radchenko [1], M.Yu. Kademiya [2], N.P. Volkova [3], S.V. Sharov [4; 6], D.V. Lubko [4; 5], O.G. Zinov'yeva [6].

The topic of designing various engineering systems on the Arduino platform and their implementation in the production and educational process at different times was dealt with by such well-known foreign scientists as: Blum Richard [7]; Ethan Thorpe [8]; John-David Warren [9]; Simon Monk [10]; Jeremy Blum [11]; Michael Margolis [12].

*Formulation of the purpose of the article.* The main purpose of this paper is to consider and analyse the introduction of interactive technologies in higher education institutions in the course of educational practice by students.

*The main part.* Interactive learning technology as a system contains the following components: clearly planned learning objectives – a clear qualitative and quantitative expected result of the process in the form of students' learning achievements; specially selected and structured learning content; interactive forms, methods and techniques by which learning is organised and students' active participation is stimulated; teaching aids adequate to the objectives, forms and methods; organizational and psychological and pedagogical conditions that allow you to effectively plan and implement interactive learning [3].

The main pedagogical idea behind the use of interactive learning technologies is to activate students' mental activity, update basic knowledge, individualise the learning process, provide opportunities for independent comprehension of the meaning of the knowledge gained for use in practice, and foster a positive attitude to the subject.

*There are five main requirements for successful learning in the mode of interactive technology:*

1. Positive relationship – group members must understand that joint learning activities benefit everyone.
2. Direct interaction – group members need to be in close contact with each other.
3. Individual responsibility – each student should master the material and be responsible for helping others, but more able students should not do the work for others.
4. Development of teamwork skills – students should learn the interpersonal skills necessary for successful work, e.g., distribution, task planning.
5. Evaluation of work – during group work, special time should be allocated to allow the group to evaluate how well it is working.

*Interactive learning* is an effective pedagogical tool and a prerequisite for the optimal development of students and teachers, so the training of future professionals using interactive technologies is relevant today [4].

Interactive learning (from the English «inter» – mutual and «act» – to act, i.e. capable of interaction, dialogue) is a specific form of organising cognitive activity, which has the intended purpose of creating comfortable learning conditions,

*The overall goal of this internship* is to consolidate the skills of programming and drawing up electrical circuits acquired over two years of study using a structural approach. During the internship, the student independently performs all stages of creating a software product: from setting a task to practical implementation, accompanied by instructions for its use; learns to use specialised literature, catalogues, reference books, standards.

*The objectives of the students' practical training are:* to acquire skills of independent work with scientific and technical literature; to summarise the experience gained, to make scientifically based conclusions and recommendations for the creation of software products; to develop the ability to give a mathematical statement of the problem; to develop the ability to develop algorithms for the created software products and to choose tools for the implementation of the proposed algorithm; to design, draw up and build electrical circuits using a structural approach; to develop the ability to

The process of improving the practical experience of students during internships is carried out using hardware and software tools for building systems and Arduino models. Namely, the Arduino platform and microcontroller are used in practice as a basic element of interactive learning to solve practical engineering problems.

*Note.* Arduino is a trademark of hardware and software for building and prototyping simple systems, models and experiments in the field of electronics, automation, process automation and robotics [4].

Let's look at the practical tasks for this learning experience, namely the specific actions to be performed during its completion [6]. *Required:*

1) Develop a capacitive soil moisture sensor and an automated irrigation system;

2) Based on the diagram, develop code for the Arduino microcontroller, which will allow you to read the numerical readings of soil moisture sensors and analyse the need for soil irrigation based on them.

3) To show the disadvantages of the solutions obtained, namely the problems of installed soil moisture sensors.

4) Show the advantages of the solutions we (the students) have proposed to solve the problem;

5) Draw conclusions on the work done.

Let's consider the main stages and phases of the students' practical assignment. The necessary stages and phases of development that should be followed when creating software products are as follows: creation of a technical task; creation of a draft design; creation of a technical design; creation of a working design; implementation stage [5].

*Let's take a closer look at the stages and phases of development of the task in practice:*

A) At the stage of the technical task, the task is formulated, the general requirements for the programme are determined, input and output data are determined, the programming language is selected, and the requirements for technical means are determined.

B) At the preliminary design stage, the methods for solving the problem are specified, the structure of input and output data is determined, and a general description of the problem-solving algorithm is developed.

C) At the technical design stage, a detailed algorithm for solving the problem is developed, input and output data representation is determined, the programme structure is developed, and the hardware configuration is finally determined.

D) At the detailed design stage, the task is programmed and the programme is debugged. The final stage of detailed design is testing of the created automated system on a control example, and adjusting the programme based on the test results.

E) At the implementation stage, the programme and programme documentation are handed over to the teacher.

Let's also consider the issue of the relevance and importance of determining and measuring soil moisture in the design of an automated soil irrigation system as an important engineering task in the course of students' practical training.

Moisture measurement is essential for a wide range of industrial applications, including pharmaceutical, food, medical and electronics. Some humidity sensors have been developed based on the feedback interaction between a material and water vapour, i.e. acting as a gas sensor. Existing methodologies for measuring humidity also depend on the optical, gravimetric, capacitive, and resistive properties of the selected materials. Recently, it has been reported that the use of nanostructures, such as nanoparticles, nanowires, nanotubes, and polymer nanocomposites, as moisture-sensitive materials can significantly improve the performance of humidity sensors. For these nanostructured materials, the surface effect becomes dominant due to their large surface-to-volume ratio, which is beneficial for the construction of humidity sensors. When maintaining a vegetable garden and greenhouses, every owner faces the question of how to reduce labour costs for such a routine operation as watering the soil. The most obvious way is to automate the irrigation process.

*Objectives of creating an automated soil irrigation system:*

1. Providing convenience and comfort when watering the territory (garden, plot).
2. Minimising the time spent on watering the territory compared to the manual method of watering.
3. Watering with the right amount of water, at a given (defined) time for effective plant growth (often it is almost impossible to do with a hose).
4. Avoidance of any inconvenience when watering manually (dragging hoses from place to place, switching the pump on/off, opening/closing taps, constant change of water pressure, etc.).
5. Watering even in the absence of the owners in the irrigation area.
6. Watering plants strictly as needed, i.e. at the moment when the soil moisture sensor data will give a high resistance value (i.e. when the soil is already in need of water saturation).
7. Rational water consumption. This is very important today, as the cost of water is not cheap. At the same time, plants are provided with an equal amount of water that they need for growth.

The disadvantage of using existing automated irrigation systems is their financial cost, as well as the inability to monitor and analyse the quality of plant growth. Therefore, there is an urgent need to develop an automated soil irrigation system and continuous monitoring of plant growth quality indicators.

This is what determines the relevance of this topic, especially in the context of its use in the course of educational practice for students. And also when using this system in households and farms engaged in growing plants for various purposes.

Based on the results of the theoretical and practical research, the following conclusions can be drawn:

1) Most often, a junior developer (hereinafter referred to as «junior developer») is a third or fourth year student of a university who has decided to link his or her future activities with the IT sector. A junior developer differs from a specialist in that he or she has no (or very little) practical commercial experience. That is why junior developers need to try themselves in different areas by synchronising the knowledge gained during their studies;

2) The proposed internship methodology makes it clear to junior developers that without a solid investment of effort and time, as well as the correct use of the knowledge gained during training, it will not be possible to become a highly qualified specialist in the IT field.

3) After the internship, a junior developer understands that: at first, he or she will have to spend a huge amount of time studying; he or she needs to be able to combine study/work with

study/practice; he or she needs to master such skills as responsibility and independence; he or she needs to be able to search for the necessary information; he or she needs to be able to ask the right questions. All this allows the student to become highly motivated and adequately ambitious.

4) In the classroom, the use of modern interactive technologies allows you to learn the relevant material much faster, more conveniently, and most importantly, better: «Object Oriented Programming» and «Electronics and Electrical Engineering» by students and helps them to think more broadly and reveal their potential abilities in the field of agrotechnology when solving engineering problems on the basis of interested enterprises that need it.

Thus, the training practice is of great benefit for the rapid and high-quality assimilation of the relevant material, and also contributes greatly to the personal development of students, as it motivates them to work independently and arouses great interest, which in turn contributes to high-quality and deep knowledge of the individual.

The created automated system can be expanded both systematically (for any agricultural enterprise) and functionally (to increase the number of sensors for students to develop in practice).

*Conclusions.* The introduction of interactive technologies makes it possible to organise the learning process in such a way that all participants of the educational process take part in it, interacting with each other (students) and the teacher, and also opens up the possibility of independent learning, solving vital problems. Students learn to work in a team, defend their own point of view, present relevant developments, etc. The requirements for teachers and their work are changing. Working in an interactive mode will contribute to the development of: communication skills; skills in organising the learning environment; formation of skills for independent work; ability to create situations that encourage the integration of knowledge to solve the problem.

It is very important for a mentor (tutor or mentor) to understand that each student has different skills, productivity, and motivation. The mentor's task is to find the right approach to the student, understand his or her true motives, and most importantly, to see his or her potential in performing the task. Potential is the acceleration with which a person can develop, gain the necessary knowledge and improve themselves. Therefore, we can confidently state that the development and independent implementation of practical work using the Arduino microcontroller plays a significant role in deepening students' knowledge with the help of modern interactive technologies. And all this ensures the combination and synthesis of the already acquired knowledge in the field of drawing up electrical circuits and creating software code for the Arduino microcontroller, that is, combines knowledge of physics, mathematics, electrical engineering and programming. The proposed stages of creating an automated device, as well as the issue of involving students in solving the tasks, create an effective impact on the intensification of learning in higher education and can be successfully implemented in the modern education system in the field of educational practice.

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# УПРОВАДЖЕННЯ ІНТЕРАКТИВНИХ ТЕХНОЛОГІЙ У ЗАКЛАДАХ ВИЩОЇ ОСВІТИ ПІД ЧАС ПРОВЕДЕННЯ НАВЧАЛЬНОЇ ПРАКТИКИ ДЛЯ ЗДОБУВАЧІВ

***Анотація***

Основна мета роботи – розглянути та провести аналіз упровадження інтерактивних технологій у закладах вищої освіти під час проведення навчальної практики здобувачами.

Сьогодні в Україні створено умови для переходу до гуманітарного особистісно-орієнтованого навчання, спрямованого на формування духовно багатої особистості. Це створює можливості для реалізації у педагогічному процесі творчих здібностей і професійних якостей кожного студента (здобувача вищої освіти). Використання інтерактивних технологій у навчальному процесі вищого навчального закладу дає змогу розвивати нестандартне мислення студентів, відійти від стереотипів, розвиває уяву, комунікативні вміння й навички, інтелектуальну, емоційну, мотиваційну та інші сфери особистості.

У підготовці майбутніх фахівців склалася усталена система підготовки кадрів, у якій використовуються традиційні форми проведення занять: лекції, практичні заняття, лабораторні роботи, консультації, заліки, екзамени, різноманітні форми поза аудиторної роботи. У зв'язку з переходом на основу з компетенціями в підготовці майбутніх фахівців виникає потреба у зміні технологій, форм і методів проведення занять, що дасть змогу уникнути наслідків наявної суперечності між теоретичною підготовкою та ефективністю практичної роботи фахівців. Це і зумовлює необхідність розроблення і використання інноваційних технологій навчання в підготовці майбутніх компетентних фахівців.

Розвиток сучасних педагогічних технологій ставить перед освітою нові завдання, які потребують перегляду змісту освіти, форм, методів, прийомів навчання, це й зумовило актуальність теми статті.

Упровадження інтерактивних технологій дає змогу організувати процес навчання так, що в ньому беруть участь усі учасники навчального процесу, тобто взаємодіють між собою здобувачі та викладач. А це відкриває можливість здійснення самостійного навчання та розв'язання багатьох життєво важливих проблем. Здобувачі навчаються працювати в команді, захищати власну точку зору, репрезентувати свої

відповідні напрацювання та ін. Змінюються вимоги до викладача, до його діяльності. Робота в інтерактивному режимі сприяє розвитку комунікабельності, умінь організації навчального середовища, формуванню умінь до самостійної діяльності, уміння створювати ситуації, що спонукають до інтеграції знань для розв'язання висунутої проблеми.

***Ключові слова:*** аналіз, навчальна практика, здобувачі вищої освіти, інтерактивні технології, упровадження, навчання.