

PREPARATION OF FUTURE PRIMARY SCHOOL TEACHERS FOR THE IMPLEMENTATION OF STEM-TECHNOLOGIES IN PROFESSIONAL ACTIVITIES

The purpose of the research is to theoretically analyse the professional training of future primary school teachers to use STEM technologies in their professional activities.

Statement of the problem in general terms. The dynamism of modern educational processes, caused by Ukraine's aspirations to the European community, progressively affects the renewal of the higher education system. This necessitates solving the problem of modernisation of the national educational system, which encourages pedagogical higher education institutions to train competitive specialists, including future primary school teachers.

The key changes caused by the implementation of the State Primary School Standard and the New Ukrainian School Concept require the implementation of advanced professional training of primary school teachers who must effectively address the problems of modernising the primary level of general secondary education, be ready to use educational innovations in a quality manner both in peacetime and wartime, skilfully adhere to new educational roles, and be capable of lifelong learning and development. That is why the problem of professional training of future primary school teachers to use STEM technologies in their professional activities is becoming particularly relevant.

Today in Ukraine, STEM education in educational institutions is developed in accordance with the Laws of Ukraine "On Education", "On Complete General Secondary Education", "On Scientific and Scientific-Technical Activities", "On Innovative Activities", "On Culture"; the State Standard of Primary Education; and the State Standard of Basic Secondary Education; Concepts for the implementation of state policy in the field of reforming general secondary education "New Ukrainian School" for the period up to 2029; Regulations on the Procedure for Innovative Educational Activities; Order of the Ministry of Education and Science of Ukraine No. 1303 of 16.10.2019 "On Approval of the Standard of Specialised Education in Science"; Order of the Ministry of Education and

Science of Ukraine dated 29.04.2020 No. 574 "On Approval of the Model List of Teaching Tools and Equipment for Classrooms and STEM Laboratories" and other legislative documents (*Metodychni rekomendatsii shchodo rozvytku STEM-osvity v zakladakh zahalnoi serednoi ta pozashkilnoi osvity u 2023/2024 navchalnomu rotsi*).

Summary of the main research material. Modern STEM education technology is the integration of educational activities in such fields as science, technology, engineering and mathematics. The abbreviation "STEM" was first proposed by the American bacteriologist R. Colwell in the 1990s, but it has been actively used only since 2011 thanks to the head of the US Institute of Natural Sciences, Judith A. Ramala (*Velhach, 2021*).

It should be noted that other areas are also quite common, including A (+Art) art - STEAM; R (+Reading wRiting) reading and writing - STREAM. Today, there are various variations of STEAM on other related methods: PBL (Problem Based Learning), PhBL (Phenomenon-based learning), etc. (*Velhach, 2021*).

Another interesting fact for our study is that the concept of STEM education in most European countries includes its own acronym: MST (mathematics, sciences and technology) in Sweden, MINT (mathematics, information technology, natural sciences and technology) in Germany, IMST (Innovations in Mathematics, Science and Technology) in Austria.

In the context of our study, we consider it expedient to highlight the basic concepts of "STEM education", "STEM technologies", "professional training of future primary school teachers".

The concept of "STEM education" is interpreted by researchers as a pedagogical technology for the formation and development of mental, cognitive and creative qualities of students, the level of which determines the competitive ability of a person in the modern labour market (*Slipukhina, Stryzhak, Polihun, Chernetskyi, 2017, p. 21*).

STEM technologies are modern instrumental, technical and technological means that ensure that students master primary engineering, technological and research knowledge and skills, as well as the formation of STEM education values (*Valko, 2020, c. 53*).

We consider the professional training of future primary school teachers as an integral pedagogical system, the functioning of which involves the creation of certain conditions for the development of the future teacher's personality on the basis of mastering the knowledge, skills and abilities necessary for professional activity, development of professional and personally significant qualities that will ensure maximum efficiency of their pedagogical activity.

The analysis of a wide range of psychological and pedagogical sources suggests that the professional training of future primary school teachers in pedagogical institutions of higher education should be carried out as a purposeful, systematic and organised process. It is worth noting that the effectiveness of STEM education in modern educational institutions necessarily requires periodic updating of curricula, improvement of work programmes of educational components, development of practice-oriented teaching methods, etc.

The organisation of the process of professional training of future primary school teachers should take into account the specifics of their further professional activity in the context of the implementation of the provisions of the Concept of the New Ukrainian School. It should be noted that it is conditioned by the complexity of its integrated nature, aimed at taking into account the psychological characteristics of modern students, requires comprehensive mastery of teaching methods for teaching lessons studied in primary school, requires the ability to perform new professional roles (facilitator, moderator, coach, mentor, etc.), the ability to organise the educational process with the introduction of modern ICT tools, etc.

Given the specifics of the primary school teacher's professional activity, it should be noted that it is determined by the complexity of its integrated nature, since it is the primary school teacher who is responsible for simultaneously carrying out educational activities in many educational fields (language and literary, mathematical, natural, technological, informational, social and health, civic and historical, artistic, etc.) Of course, this necessitates the ability of a teacher of grades 1-4 to implement interdisciplinary connections.

It should be noted that it is particularly effective to create special STEM education centres in higher education institutions. These can be academic STEM centres, STEM departments, STEM laboratories, STEM classrooms, etc. The main goal of such an environment is to form the scientific outlook of future primary school teachers, develop their critical thinking, creativity, as well as motivation and readiness to use STEM technologies in their future professional activities.

We are convinced that pedagogical practice plays an important role in the development of knowledge and skills in the use of STEM technologies in future primary school teachers. That is why, during various types of pedagogical practice, students are recommended to be involved in the implementation of STEM education elements in the educational process of primary school.

It is worth noting that in the context of distance education, future primary school teachers are maximally involved in the use of digital STEM education tools. We believe that one of the most convenient interactive educational software is the Mozabook platform. The site contains a significant number of digital lesson plans, a large media library (3D scenes, videos, images, audio, games, etc.), digital products (LabCamera, 3D encyclopedias, mozaik3D application, etc.).

3D modelling with students is also possible in a remote format using special programmes and online services. One of them is the online 3D modelling service TinkerCad, which allows you to work from different devices and provides a variety of ways to create many models. When developing the City of My Dreams project, you can use the service <https://education.icograms.com> or propose the creation of a Smart Home online at <https://www.mozaweb.com/uk/mozaik>. An effective STEM learning game can be offered to students on the online platform <https://tryengineering.org> or developed independently using the Kahoot! service, which is free, convenient, accessible, and allows you to easily create interesting games based on the teacher's creative idea.

Thus, during various types of pedagogical practice, future teachers of this speciality should be involved in the active use of digital tools, as this not only maximises the learning process in terms of STEM education, but also motivates and creates innovative opportunities for student interns and primary education students. Future educators are

convinced that STEM-based lessons are characterised by active communication and teamwork among students. The trainees note that the organisation of the educational process in such conditions allows students to effectively develop logical thinking, communication skills, creativity, reflection, and the ability to express and prove their own opinions.

Conclusions and prospects for further research. Therefore, we believe that the implementation of STEM education is one of the most important priorities for modern education. In modern conditions, a primary school teacher should be motivated, aware of the essence of STEM education, knowledgeable about the methods of using STEM technologies in the educational process of primary school, and able to competently carry out interdisciplinary integration using innovative technologies. This will allow the teacher to not only ensure that students acquire comprehensive knowledge and skills from various educational fields, but also to maintain motivation and cognitive interest in learning and knowledge seeking to help stimulate their curiosity, desire for research, etc.

We see the prospect of further research in the study of the formation of knowledge and the development of skills of future primary school teachers in the implementation of STEM projects in the educational process of primary school.