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PROFESSIONAL ORIENTATION OF A TEACHER IN THE CONTEXT OF STEAM EDUCATION INTRODUCTION AND THE PREREQUISITES FOR STEAM COMPETENCIES FORMATION

Abstract: the issue of teacher`s professional development in the context of STEAM education introduction is considered. Emphasis is put on the actualization of 4C method which is used to overcome the misunderstanding between the knowledge that students acquire in higher education institutions and the skills that employers expect from students. This method includes such main components as: communication skills, creativity, critical thinking and teamworking. The proposed recommendations for the development of STEAM competencies can contribute to the formation of professional success and development of innovative pedagogical experience of higher education institutions teachers. This research does not solve the problem of teacher`s professional development in the field under consideration and can be continued in analyzing its features depending on the professional area of study.

Key words: STEAM education; STEAM competence, transdisciplinary approach; competence approach; 4C formula, teacher professional development, communication skills; creativity; critical thinking; teamwork; definitions of STEM education.

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ПРОФЕСІЙНА СПРЯМОВАНІСТЬ ПЕДАГОГА В УМОВАХ ЗАПРОВАДЖЕННЯ STEAM-ОСВІТИ ТА ОСОБЛИВОСТІ РОЗВИТКУ STEAM КОМПЕТЕНТНОСТЕЙ

Анотація: розглянуто питання професійної спрямованості та розвитку педагога в умовах запровадження STEAM-освіти. Зроблено акцент на актуалізації методу 4К, який використовується для подолання невідповідності між знаннями, які отримують студенти на етапі фахової підготовки і тими навичками, що очікують від студентів роботодавці. Цей метод включає в себе основні складові: комунікативні навички, креативність, критичне мислення та командну роботу. Запропоновані рекомендації розвитку STEAM компетентностей можуть сприяти формуванню професійної успішності та розвитку інноваційного педагогічного досвіду викладачів ЗВО. Дане дослідження не вичерпує проблему професійного розвитку педагога у розглянутій галузі та може бути продовжено у напрямі вивчення її особливостей залежно від фахових напрямків навчання.

Ключові слова: STEAM-освіта; STEAM-компетентність; трансдисциплінарний підхід; компетентнісний підхід; формула 4К; професійний розвиток педагога; комунікативні навички; креативність; критичне мислення; командна робота; дефініції STEAM-освіти.

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Розширена анотація для ознайомлення з цією темою:
"Професійна спрямованість педагога в умовах запровадження STEAM-освіти та особливості розвитку STEAM компетентностей"

Постановка проблеми у загальному вигляді *та її зв'язок з важливими науковими, чи практичними завданнями. В умовах реформування освіти та її переорієнтації на формування компетентностей випускника особливого значення набуває проблема якісної підготовки випускників педагогічних університетів у зв'язку з їхньою майбутньою багатофункціональною діяльністю. Концепції освіти STEM та STEAM, визнані педагогічними інноваціями XXI століття. Для успішного впровадження інтегрованої STEAM-освіти компетентність викладачів є ключовим елементом.*

Аналіз останніх досліджень та публікацій, *у яких започатковано розв'язання цієї проблеми і на які спирається автор. Теоретичні засади*

STEAM-освіти викладені в роботах сучасних педагогів та психологів: Н. Морзе, В. Вембер, М. Бойко, Л. Варченко-Троценко (організація STEAM-занять в інноваційному класі), С. Доценко, С. Подлєсний, О. Тарасов, O. Haatainen, M. Aksela (науковий дискурс, освітні практики та технології STEAM-освіти), Н. Сороко (функції STEAM-орієнтованого освітнього середовища), Н. Поліхун, І. Сліпухіна (STEAM в умовах формальної й неформальної освіти), О. Патрикеєва, О. Коршунова, Н. Гущина, І. Василашко (професійний розвиток педагога в умовах STEM-освіти), В. Андрієвська, Л. Білоусова, Huynh Tan Hoi (STEAM-освіта у початковій школі), D. Aguilera, J. Ortiz-Revilla (STEAM-освіта у ЗВО). Дослідники зазначають, що STEAM-освіта має практичну спрямованість та є інтегрованим проєктним підходом в педагогіці. В останні роки література зі STEAM зосередилася на документуванні інноваційних практик та навчальних експериментів на різних рівнях освіти (педагогіка STEAM), їх позитивному впливі на учнів (компетенції STEAM), включаючи просування професійних інтересів (ставлення STEAM) та модернізації навчальних середовищ у школі (класи STEAM).

Формулювання цілей статті *(постановка завдання). Зробити аналіз підходів до розвитку професійної компетентності викладача закладу вищої освіти в умовах впровадження STEAM-освіти. З'ясувати основні вимоги до професійного розвитку педагогів вищої школи в цих умовах, визначити та сформулювати поняття STEAM-компетентність педагога та виокремити основні STEAM-компетентності фахівців педагогічного напрямку, а саме: комунікативні навички; критичне мислення; креативність; командна робота.*

Виклад основного матеріалу дослідження *з повним обґрунтуванням отриманих наукових результатів. STEAM-освіта спрямована на розвиток особистості через формування компетентностей, природничо-наукової картини світу, світоглядних позицій та життєвих цінностей із використанням трансдисциплінарного підходу до навчання на основі практичного застосування науково-математичних, технічних і інженерних знань та вмінь розв'язувати практичні задачі для подальшого їх використання у професійній діяльності.*

В статті представлено аналіз різних підходів до STEAM-освіти як сучасного освітнього явища. З'ясовано, що науковці наголошують на підвищенні якості викладання дисциплін, пов'язаних із наукою, технікою, математикою та мистецтвом. Метою цього є підготовка студентів до більш ефективного навчання, застосування отриманих знань для вирішення професійних завдань та розвитку компетенцій STEAM.

Авторами показано, що звернення сучасної педагогіки до STEAM-освіти може стати ефективним кроком до вирішення проблеми підготовки кадрів для сучасного мінливого ринку праці. В статті зазначено, що успішне впровадження STEAM-освіти передбачає розвиток наукової освіти. Для формування базових та інтегрованих умінь у навчальному процесі вчителі повинні володіти дослідницько-пізнавальними технологіями навчання та методикою навчальних проектів.

Виходячи з вищевикладеного, важливо забезпечити умови для посилення інноваційної складової освіти поєднанням особистісно-орієнтованого, компетентнісного, діяльнісного підходів, оновленням та суттєвим доповненням отриманих психолого-педагогічних знань, оволодінням новими технологіями організації навчання, педагогічного процесу, узагальненням та впровадженням перспективного педагогічного досвіду тощо.

Аналізуючи наукову літературу та спираючись на дослідження сучасних науковців, автори статті вважають за

доцільне розкрити сутність Формули 4К стосовно діяльності викладачів ЗВО.

1. Комунікативні навички.

2. Творчість.

3. Критичне мислення.

4. Співпраця (Командна робота).

Аналізуючи професійний розвиток педагога в умовах STEAM-освіти можна констатувати, що STEAM-компетентність у вищій освіті передбачає інтеграцію компетентностей на трьох рівнях:

- рівень компетентності студентів;

- рівень компетентності майбутніх спеціалістів;

- рівень компетентності вчителів.

Таким чином, формування STEAM-компетентностей студентів є динамічним процесом цілеспрямованої, прогресивної та якісної зміни цього явища під час спеціально організованої навчальної діяльності ЗВО.

Також в статті розглянуто формування STEAM-компетентності майбутніх викладачів ЗВО. До цього входять проектування навчального контенту; організація діяльності студентів; організація навчального процесу; використання сучасних педагогічних технологій та ін..

***Висновки з даного дослідження** та перспективи подальших розвідок у даному напрямку. Проведене дослідження надає змогу з'ясувати основні вимоги до професійного розвитку викладача вищої школи в умовах впровадження STEAM-освіти, визначити та сформулювати поняття STEAM-компетентності викладача та виокремити основні STEAM-компетентності педагогічних працівників. Аналізуючи досвід впровадження STEAM-технологій у навчальний процес університету, можна зробити висновок, що STEAM-технології стимулюють розвиток студентів у рамках концепції 4C (креативність, критичне мислення, співпраця та комунікація — чотири навички, які допомагають досягти успіху в будь-якій справі).. Впровадження STEAM-освіти вимагає від викладачів активного впровадження новітніх педагогічних підходів до навчального процесу та оцінки використання інноваційних міждисциплінарних методів навчання, зокрема здобуття знань на основі інтегративного підходу, розробки методів та інструментів для формування дослідницької діяльності та інженерно-технічні компетенції. Ступінь успішності впровадження STEAM-підходу в освітній простір безпосередньо залежить від викладача. Дане дослідження не вирішує проблеми професійного зростання педагога і може бути продовжене в напрямку вивчення його особливостей залежно від професійних напрямів освіти.*

Problem setting. In conditions of education reforming and its reorientation to the formation of a graduate`s competencies that will provide his learning and development in a changing high-tech, multicultural environment, the issue of qualitative training of pedagogical universities graduates in connection with their future multifunctional activities, participation in the development of education, science, production and life of society is of a particular importance.

The concepts of STEM and STEAM education recognized as pedagogical innovations of the 21st century is among the most promising modern approaches to the new generation specialists training, oriented to innovative activities in modern conditions of social mobility, worldwide globalization, economic, political and cultural integration in the most developed countries of the world.

Under modern conditions, in order to ensure the competitiveness of Ukraine among the European Union countries, the educational space of Ukraine is being reformed. Educational priorities are changing and new ego models are being created in order to increase its effectiveness. The basis of the construction of these models are such

innovative processes as individualization and personalization of education: formation of individual training trajectories and necessary competences at the request of employers; pragmatization of education: orientation of educational institutions to the needs of economy and society, formation of educational programs based on actual requests of an employer, development of practice-oriented studies; education throughout life: a rapid change in informational and technological background as a factor ensuring the continuity of education that accompanies a person throughout his life.

The issue of higher education modernization in Ukraine, its components and directions closer to the European space of higher education, is based on the key regulatory and legal support of higher education in Ukraine: Goals of sustainable development; Law of Ukraine "On Higher Education", Education and Science Reform; Strategies for the development of higher education of Ukraine for 2021–2031; Forum "Ukraine 30. Education and Science" and others.

According to the Law of Ukraine "On Higher Education", the purpose of higher education is the acquisition of a high level of scientific (creative, artistic) professional and general competences, which are necessary for activities in a certain specialty or in a certain field of knowledge [1].

Reforming education in the direction of STEM is caused such key factors as the need for specialists with more complex and flexible knowledge, skills and abilities that meet the requirements of the XXI century and the demand for STEM literacy, which is necessary to solve technological and environmental problems.

For the successful implementation of an integrated STEAM education, the competence of teachers is a key element. The high-quality training of new generation of mobile students, capable to find the ways to solve problems not in theory, but right now through trial and error will largely depend on educators, who know how to see the world as a whole.

Recent research and publication analysis. The retrospective analysis of scientific literature on STEM education confirms the presence of numerous works by both domestic and foreign scientists, in particular V. Andrievska, T. Andrushchenko, N. Balik, S. Brevus, L. Bilousova, I. Vasylashko, Yu. Velychko, L. Harrison, D. Langdon, B. Means, E. Peters-Burton, N. Morel, J. Confrey, A. House and many others. The theoretical foundations of STEAM education are outlined in the works of such modern scholars and psychologists as: N. Morse, V. Vember, M. Boyko, L. Varchenko-Trotsenko (organization of STEAM lessons in an innovative classroom), S. Dotsenko, S. Podlesny, O. Tarasov, O. Haatainen, M. Aksela (scientific discourse, educational practices and technologies of STEAM education), N. Soroko (functions of a STEAM-oriented educational environment), N. Polihun, I. Slipukhina (STEAM in conditions of formal and informal education), J. Ortiz-Revilla (STEAM education in higher educational institutions). The researchers note that STEM education has a practical orientation and is an integrated project approach in pedagogy. In recent years works about STEAM has focused on documenting innovative practices and learning experiments at various levels of education (STEAM pedagogy), their positive impact on students (STEAM competencies), including the promotion of professional interests (STEAM attitudes) and the modernization of learning environments (STEAM classrooms). Analysis of research innovations in STEAM education allows us to state the desire of scientists to prepare a new generation of youth to solve the problems of technological era and contribute to the innovative development of society. The formation of STEAM education in Ukraine is quite actively developing and being introduced into the education and science system of Ukraine, which is expressed in a wide research demand, the involvement of various institutions in the learning process. The implementation of this approach, a huge number of thematic events, initiatives and

projects implemented in the educational process, which contribute to the development and popularization of STEAM education, stimulate the interest in scientific disciplines and prepare young specialists for a future career in STEAM fields.

Paper objective. In today's professional reality, the need for a universal form of future specialists' certification in the sphere of pedagogical science as a marker of universal and professional competencies level while obtaining higher education is becoming a matter of topical interest. Training of a modern teacher should meet the requirements of the present time, one of the main competencies of which is not only professional but also modern STEAM competencies. The purpose of this article is to highlight the current issues of professional orientation and development of a teacher, the conditions for the implementation of STEAM approach in education and the analysis of approaches to professional competence development of high school teachers in conditions of STEAM education implementation.

Paper main body. Strengthening the role of STEM education is one of the priorities of education modernization, an integral part of state policy to increase the level of national economy competitiveness and the development of human capital as one of the main factors of innovative activity in educational sphere that meets the demands of economy and needs of society [2].

STEM education is aimed at the development of an individual through the formation of competencies, a natural-scientific picture of the world, worldview positions and life values using a trans-disciplinary approach to learning based on the practical application of scientific, mathematical, technical and engineering knowledge and skills to solve practical problems for their further use in professional activities [3].

STEM is an integrated learning approach in which academic science and technology concepts are studied in a real-life context. The goal of such an approach is to create stable connections between an educational institution, society, a workplace and the whole world, which contribute to the development of STEM competencies [3].

During the last ten years, the concept of STEM approach began to experience "pressure" from a young "competitor" — a renewed direction in education — STEAM, which started in the USA and began to actively spread among leading European countries. Current education emphasizes the importance of creativity in today's innovative technologies. It is an education that is based on the application of an interdisciplinary and applied approach, when all five disciplines (Science — natural sciences; Technology; Engineering — design; Art — art, design; Mathematics) are combined into a single system of teaching.

Without incorporating the Arts into the wider field, full creative potential often goes unlocked and unused. The heightened cross-disciplined nature of STEAM vs STEM is advantageous as different perspectives and the way people view problems through different lenses is often an instrumental factor in successful ventures [4].

STEAM is the key to creativity, which is the most important component of innovation. In order to support the modification of STEM to STEAM, all interested parties (business leaders, arts professionals, representatives of education system, etc.) must unite, explaining to the authorities of various levels, the media and the general public, the need for the inclusion of arts in national curriculum [5].

STEAM (as a subtype of STEM) includes certain thematic modules:

– Natural sciences, designed to explain the effect of specific facts, theories, rules of nature that affect all aspects of human life (from everyday life to professional experience and activity);

– Technology, which involves the development of scientific activity and creative abilities while searching for a solution, an answer to the research question and the application of previously acquired knowledge in practice;

– Engineering. This block is designed to connect modern tools, methods and technologies to the training system, to improve and increase the efficiency of actions and to make decisions, to optimize the situation taking into account the opportunities;

– A mathematical block is focused on the development of accuracy, concentration, attentiveness, development of critical thinking, analytical mind, skills in clear application of instructions and algorithms;

Humanitarian (artistic) block, serves not only to broaden one's horizons and deepen the understanding of ongoing processes but to develop technical creativity, professional culture and business communication, learn to defend one's own point of view, conduct a constructive and reasoned dialogue [6].

At the same time, all the blocks are studied in connection, by including logic, thinking, and tracing relationships (one problem can be studied from different angles, positions, sciences and theories).

At the moment, there is also the concept of "STEAM profession". These are technical, natural science and engineering narrow-profile specialties: professions related to computer technology and mathematics, natural sciences and medicine, architecture and engineering, education specialists, sales managers, etc.

Ukrainian scientists [7; 8; 9], researching the implementation of STEAM approach in the educational process, single out the functions that a STEAM-oriented educational environment should provide to support the implementation and development of STEAM education in Ukraine:

– Technological, which provides for ensuring communication between the subjects of educational process, supporting the performance of laboratory, practical works and tests and their evaluation, access to various data sources (databases, conferences, electronic libraries, etc.);

– Psychological, which helps in motivating subjects of educational process (teachers; students; parents; specialists in certain fields of education, science, business, etc.) to participate in educational STEAM projects; contributes to the formation of responsible behavior of students during the implementation of these projects and the development of professional competences of teachers to encourage the subjects of the educational process to participate in them;

– Educational, which contributes to the formation of students' competencies which they acquire during their studying at an educational institution and to the guidelines for their further professional career; which is designed to form responsible behavior of students during their participation in educational STEAM projects, group activities and defense (presentation) of these projects;

– Didactic, which involves the appropriate use of computer-oriented teaching aids, IT, means and services of local computer systems of educational institution to facilitate the implementation of educational process in accordance with the calendar and thematic plans of educational disciplines.

Considering the functions presented above, we can state that the STEAM-oriented educational environment of an educational institution is designed to provide students with the tools for intellectual activity during the implementation of STEAM approach and in their interaction and creative self-expression.

Thus, the analysis of various approaches to STEAM education as a modern educational phenomenon shows that all the scientists emphasize improving the quality of teaching disciplines related to science, technology, engineering, mathematics and art, the purpose of which is to prepare students for more effective application of the acquired knowledge for solving professional problems (including the development of highly organized thinking) and the development of STEAM competencies.

The competence-based approach, existing in pedagogical science, expands the boundaries of knowledge and skills and is focused on the purpose and outcome of

learning from the perspective of improving professional competences. It is the most appropriate for market economy. The main result of learning should be not only a system of knowledge, skills and abilities but also the ability of a person to be ready to act and make appropriate decisions in a particular professional situation, i.e., the formation of professional competences. In this case, competences serve as indicators that will form the basis for their further growth and development [10].

Thus, the appeal of modern pedagogy to STEAM education can be an effective step towards solving the problem of training personnel for modern changing labor market. New forms of pedagogical technologies in the modern world, the design of which is available in STEAM education by combining interdisciplinary and applied approaches to teaching, can help solve not only general pedagogical problems associated with the development of innovative and technological thinking but also the development of the 21st century skills — STEAM competencies. In this regard, this issue requires more in-depth study.

Such scientists as L. Hrynevych, N. Morse, V. Vember, M. Boyko, researching the role of digital technologies in the development of STEAM education, emphasize the information and digital competence of future specialists and analyze the implementation of highly-qualitative, inclusive and accessible digital education based on the development of an effective digital educational ecosystem and the improvement of digital skills and competencies [11].

In addition, we should note that the successful implementation of STEAM education involves the development of scientific education. In order to form basic and integrated skills in education process, teachers must possess research-cognitive learning technologies and method of educational projects.

Based on the above-mentioned, it is important to provide conditions for strengthening the innovative components of education through a combination of personally oriented, competence-based, activity approaches, updating and significantly supplementing the obtained psychological and pedagogical knowledge, mastering new technologies for organizing pedagogical process, generalizing and implementing promising pedagogical experience, etc. The main feature of modern teacher qualification is his professional development and ability to ensure the quality of education.

In order to implement STEAM education system in practice, it is necessary to have highly-qualified personnel of educators who are specialists in this sphere. Training of future teachers, whose activity is not limited just to teaching their subjects, becomes dominant. A specialist should be capable of making interdisciplinary connections, be aware of the importance of professional knowledge in the context of socio-cultural space. His ability to organize the educational process as a pedagogical interaction aimed at the development of an individual, his preparation for solving life-creating issues is critical.

Pedagogical activity of a university teacher is a creative activity for the professional training of future specialists and self-creation. It acts as a means of self-realization and professional self-affirmation. The need for self-expression, for personal self-realization and the process of professional and pedagogical activity is gradually becoming the dominant value of teacher's personality [12].

An instructional line of a university, especially its educational component, has a significant socio-pedagogical potential for the formation of modern professional competence of students both at the level of motivation, activities and attitudes.

In order to fully implement STEAM education, teachers who are proficient in the methodology of STEAM learning are required. That is why STEAM education is especially relevant in a competency-based training of future teachers, since it is STEAM

education that allows them to develop STEAM competence — ability to think comprehensively and in a wide range of interdisciplinarity.

World educational practice currently demonstrates the effectiveness, efficiency and practicality of STEAM approach to the formation of competencies and skills defined by P21 and other regulatory documents.

The main definitions of STEAM education correlate with the content of skills defined in Framework P21 [13], where they are divided into four main groups (4C Formula):

1) skills in mastering the main disciplines that form the content of knowledge and educational topics of the 21st century;

2) educational and innovative skills, among which the main attention is paid to creativity, critical thinking, communication and cooperation;

3) skills in working with information, media and technologies;

4) skills for a successful life and career.

The creation of such a 4C method was proposed by the company "Partnership for 21st Century Skills" to overcome the misunderstanding between knowledge that students acquire in higher educational institutions and skills that employers expect from them. This method includes such main components as: communication skills, creativity, critical thinking and teamworking.

Analyzing the scientific literature and relying on the research of modern scientists, we consider it expedient to reveal the essence of 4C Formula in relation to the activities of university teachers.

1. Communication skills. Communication is a complex process consisting of interdependent steps, each of which is necessary in order to make our thoughts clear to another person. Today, correctly formulated communication is an effective tool for achieving success.

Key communication skills are:

– information literacy;

– clarity when sending data;

– selection of necessary communication channels;

– flexibility and adaptability;

– determination of desired communication results;

– formation of understandable messages;

– desire to understand a partner.

At the same time, we believe that mutual understanding, professionalism, trust and efficiency during communication are the basis for an effective implementation of teacher's professional activity, without which the highest level of qualitative interaction cannot be reached.

2. Creativity. Creative thinking is a combination of perception carried out in a new way, ability to find new connections and relationships, production of new ideas, tendency to realize and recognize novelty, activity of the mind, transformation of one`s experience into a new skill. Most often, creativity is understood as an ability to produce innovative and useful ideas. The main components of 4C creativity include:

– interest in actions;

– finding answers to interesting questions;

– production of one's own ideas;

– overcoming difficulties;

– level of professional training;

– processing of proposed ideas.

An effective way to increase creativity in the pedagogical process is learning how to learn and to think differently and also cognitive exercises such as brainstorming (rapid generation of ideas) and finding the real essence of a problem.

3. Critical thinking. This is one of the main skills of the XXI century because of the high speed of modern life and constant changes in all spheres of activity. Critical thinking is the courage of future specialists` reasoning. Every student should be given the right to self-organize, self-learn, self-educate, i.e., to create conditions for self-knowledge as much as possible. Therefore, such a toolkit of cognition allows one to see the phenomenon as a whole and analyze it correctly. Critical thinking consists of the following components:

– evaluation of arguments;

– formalization of positions;

– formulation of strategy;

– evaluation of processes quality;

– explanation of conclusions.

Critical thinking allows teachers to continuously learn and adapt to changes, avoid bias and defend their points of view.

4. Cooperation (Team work). Teamwork is the result of efforts of both the individual members and the entire team. Cooperation or teamwork consists of the following elements:

– interpersonal communication;

– ability to resolve conflicts;

– managerial skills.

Collective work in pedagogy contains a number of values that encourage listening to other opinions and constructively responding to them, providing mutual support, providing students with an opportunity to doubt and recognize their interests and achievements.

We would like to emphasize that the very emergence of STEAM education is dictated by the importance of integrating educational content and practices. Accordingly, the competencies necessary for a teacher to implement STEAM approach in education also constitute an integrative characteristic of a modern teacher – STEAM competence. We can state the fact that the foundations of STEAM competence are laid within the professional standard of a higher school teacher.

The Professional Standard of a Higher Education Teacher dated on March 25, 2021 of The Ministry of Education and Science of Ukraine has the following general competencies [14]:

– knowledge and understanding of the subject area and professional activity;

– possession of critical thinking skills;

– possession of communication skills, ability to show empathy;

– ability to use information and communication technologies;

– ability to search, process and analyze information from various sources;

– ability for personal and professional development;

– ability to generate new ideas (creativity);

– ability to apply best practices in professional activity;

– ability to motivate people and move towards a common goal;

– ability to act on the basis of ethical considerations (motives);

– ability to show tolerance and respect for cultural diversity;

– ability to act responsibly and consciously.

Analyzing the professional development of a teacher in the context of modern educational transformations, let us consider the views of some scholars on this issue.

As V. Vytyuk notes, a teacher is the main protagonist of any educational transformation that requires to re-orient his activities to the new pedagogical values. An important place in the educational process belongs to the personality of a teacher, his communication skills, ability to carry on a dialogue with students, to understand and adequately perceive the world of another person – not a subordinate, but an equal partner, a colleague in the complex art of learning. The goal of professional development is to prepare and support teachers in order to help students get high standards of learning and development, the effectiveness of which depends on an innovative management of educational institutions [15].

Analyzing the professional development of a teacher in the conditions of STEAM education O. Korshunov, N. Gushchyna, I. Vasylashko, O. Patrikeeva [16] highlight the following aspects:

– scientific and theoretical aspects of STEAM education: conceptual foundations, didactic principles and approaches of STEAM education, domestic and foreign models of STEAM education;

– successful educational practices for STEAM learning: individualization of learning through project-research activities,

life hacks, non-standard methodological techniques, IT and VR visualization of learning, cases for the implementation of cross-cutting lines of STEAM subjects and for the development of STEAM classes and excursions, making, modern visibility, etc.;

– partnership: educational management, fundraising, crowdfunding, leadership in education, building effective communications with partners;

– STEAM teacher: development of professional competence of teachers, motivation, opportunities, successful experience, public recognition, etc.;

– psychological and pedagogical aspects of STEAM education: individualization of education from the point of view of psychology, harmony and kinesiology in the educational process, education of a new generation, a new look at the role of a teacher in the educational process.

Kinakh N. emphasizes the formation of creative personality of a teacher. In her opinion, this is one of the most urgent issues today because preparation for professional activity achieves its goal only when it is possible to form an initiative, creatively active teacher, who in turn is able to shape the creative personality of a student. A creative personality is the greatest value for any society as it is characterized by high productivity, effectiveness of personally and socially significant creative work due to which humanity takes another step in its progress. In order to successfully develop the creativity of students, modern teacher must be a creative person, strive to overcome the power of the template and formality in teaching educational material [17].

Analyzing the experience of introducing STEAM technologies into the educational process of a university, we can conclude that STEAM technologies stimulate students` development within the framework of 4C concept (creativity, critical thinking, cooperation, and communication — four skills that help to succeed in any sphere). The implementation of STEAM education requires teachers to actively introduce the latest pedagogical approaches to teaching process and evaluate the use of innovative interdisciplinary teaching methods, in particular, the acquisition of knowledge based on an integrative approach, development of methods and tools for the formation of research and engineering-technical competencies.

The degree of success of STEAM approach introduction into the educational space directly depends on a teacher: on the degree of his understanding and implementation of all the components of STEAM education: productive methods and tools of teaching. The professional development of a teacher in the context of STEAM education introduction becomes dominant. For the effective implementation of this technology, it is necessary to prepare teachers by forming their research competences, i.e., for the implementation of STEAM education, teachers of a new format are needed, possessing innovative thinking, ready for non-standard solutions, capable of perceiving new ideas and using productive methods and teaching tools in educational activities. Formulated conditions for the development of STEAM competencies can contribute to the formation of professional success and development of innovative pedagogical experience of specialists in the pedagogical direction.

Thus, we can state that STEAM competence is an integrative quality of a future teacher, which develops on the basis of pedagogical technologies, information technologies in education, ability to communicate effectively, creativity and the desire for self-knowledge, self-organization and self-education.

Accordingly, STEAM competence in higher education involves the integration of competencies at three levels:

– the level of students' competence;

– the level of future specialists` competence;

– the level of teachers` competence.

In turn, studying the competencies of

future specialists, Ukrainian scientists [18; 19; 20; 21] note that a graduate of a modern educational institution who will live and work in a post-industrial society, in order to be able to find his place in it throughout his life, must possess certain personal qualities:

– to quickly adapt to changing life situations, to be able to independently acquire the necessary knowledge, skillfully apply it in practice to solve various emerging problems;

– to think critically and independently, be able to see problems that arise in reality and using modern technologies, look for the ways to rationally solve them;

– to be clearly aware of where and how the knowledge obtained by him can be applied in reality that surrounds him;

– to be able to generate new ideas, think creatively;

– to competently work with information (be able to collect the facts necessary for solving a certain problem, analyze them, put forward hypotheses for solving problems, make the necessary generalizations, compare them with similar or alternative solution options, establish statistical regularities, draw reasoned conclusions, apply the draw conclusions to identify and solve new problems);

– to be communicative in different social groups, be able to work together in different areas, different situations, easily prevent or be able to get out of any conflict situations;

– to work independently on the development of one's own morality, intelligence and cultural level.

Hence, the main strategic direction of the education system development lies in solving the problem of person-oriented education, i.e., education in which the personality of a student would be the focus of teacher`s attention; where the activity of learning is a cognitive activity but not teaching itself.

The main task of a teacher implementing STEAM technologies is related to planning and organizing students` activities, developing skills and competencies, creating pedagogical conditions for the formation and development of creative abilities, meeting the needs for intellectual, moral and physical improvement, organizing free time and vocational guidance; ensuring students` achievement of the established results of mastering additional education programs.

The fundamental goal of any pedagogical process is the achievement of certain learning outcomes by students, i.e., formation of competencies that will become the basis for their further growth and development. The degree of success of STEAM approach implementation into the educational space directly depends on a teacher, namely: on the degree of his understanding of what STEAM education is, what the methods, techniques and ways of integrating STEAM disciplines are. The dominant aspect is the preparation of a STEAM teacher, whose activities are not limited to teaching his subject but his ability of implementing interdisciplinary connections, awareness of the importance of professional knowledge in the context of sociocultural space and the necessity to develop STEAM competencies of students.

It also should be noted that teaching is in the zone of increased communicative responsibility. It determines the high level of requirements for the quality of speech: compliance with language and etiquette standards, high information content. Researchers recognize the important role of communicative interaction between a teacher and the students in the process of personality formation.

Professional and special communicative competence of a teacher is expressed in the manifestation of flexible communication skills in different complex pedagogical situations. The development of these skills occurs in successive pedagogical stages during the study of special cultural, pedagogical and psychological disciplines, in training sessions, scientific activities and is improved in the practice of interaction with the subjects of educational process.

Thus, the formation of STEAM competencies of students is a dynamic process

of targeted, progressive and qualitative change of this phenomenon in the process of specially organized university educational activities.

Today, there is a wide variety of means for the targeted development of students` STEAM competencies at different stages of training. Lectures, seminars, practical classes, and trainings that include the use of personality-developing technologies, collective social learning, special programs and courses, various types of practice, as well as project and scientific activities designed for the period of study at a university, must meet the challenges of modern times and be improved. It is necessary for modern educational space, since in modern society, STEAM competence has become one of the main components of high professional level. For teachers, STEAM competence is a leading professional characteristic on which personal success, competitiveness and personal satisfaction depend.

Formation of STEAM competence of future university teachers can be presented as follows:

– to design educational content in STEAM logic;

– to carry out content activities (selection and composition of educational material, planning and construction of pedagogical process) with the aim of implementing STEAM approach;

– to combine educational material to obtain new knowledge during the integration of different STEAM blocks;

– to organize student`s activities aimed at finding and formulating a problem that can be solved by a student or a team of students in the process of STEAM education;

– to organize the learning process in STEAM logic to find a solution to the identified problematic situation;

– to organize group activities of students based on the knowledge of group dynamics processes and principles of team formation during the implementation of STEAM education;

– to observe the principles of tolerance and dialogue in the process of communication;

– to build an extensive system of finding, supporting, training and accompanying talented students;

– to develop a creative environment for identifying especially gifted students;

– to use modern pedagogical technologies: search methods (setting cognitive tasks); problematic approach; methods of individual training; methods of active learning; game methods (involvement of students in creative activities); interactive learning methods; involvement of students in various types of activities;

– to follow the principles of implementation of pedagogical technology: interest (updating the subject's experience), understanding, reflection.

– to use modern information technologies (IT) and information and communication (ICT) learning technologies.

Conclusions of the research. Thus, the conducted research on the professional development of a teacher in the conditions of STEAM education introduction provide us with the opportunity to find out the main requirements for professional orientation and future development of high school teachers, to define and formulate the concept of STEAM competence of a teacher and to single out the main STEAM competence of pedagogical specialists.

The formulated recommendations for the development of STEAM competencies will effectively contribute to the development of innovative pedagogical experience and professional success of pedagogical specialists.

Summarizing the above-mentioned, we should note that the development of all the competencies defined above, at all educational levels and in various academic disciplines, reveals the possibilities of pedagogical disciplines and is considered as one of the goals of education. This study does not solve the problem of professional growth of a teacher and can be continued in order to study its peculiarities depending on the professional area of study.

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