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INFORMATION AND COMMUNICATION COMPETENCE OF PHYSICS TEACHERS: STRUCTURAL AND LOGICAL ANALYSIS

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INTRODUCTION

The introduction of information and communication technologies (ICT) in all spheres of society requires a person to have specific competencies in the field of ICT, so the professional training of a modern specialist requires special attention to the formation of appropriate digital skills. In support of this, the State Program "Education" (Ukraine of the XXI century) provides for the use of information technologies (IT) in the educational process as one way to improve it.

Another way, which is a characteristic feature of the development of the national education system is its development on a competence-oriented basis. Therefore, one of the priority tasks of higher pedagogical education is training a competent teacher. The orientation of education to the free labor market requires the graduate not only the possession of specific knowledge, skills, and abilities that are necessary for his successful professional activity but also the ability of the teacher to apply this knowledge in professional activities, the desire for self-improvement and constant professional growth, social and professional mobility. Assessment of the quality of education is based not on the duration or content of training but on the knowledge, skills, and abilities that graduates have mastered and the ability to use them in their professional activities. In other words, the main thing is the learning outcome.

The modern information society is marked by the rapid advancement of science and technology, the proliferation of digital technologies, and the swift 'obsolescence' of acquired knowledge. The pace of change is so brisk that individuals are compelled to continually enhance their qualifications or develop new ones throughout their lives. Lifelong learning is not just a possibility but a necessity, underpinning the notion that a particular set of competencies is essential for successful education.

Recently, the issue of training future teachers based on the competence approach as one that provides training of a specialist by the requirements of today has been actively discussed. The issue of the competence approach is considered in the research of V. Bykov[1], M. Golovan[2], N. Morse[3],

[1] Биков В. Ю. Оцінювання компетентності в системі професійної освіти. Piotrkowskie Studia Pedagogiczne. *Didaktyka informatyki* / pod redakcja Michala Pindery. Piotorkow

O. Ovcharuk[4], O. Pometun[5], S. Rakov[6], Y. Ramsky[7], Y. Sikora[8] and others. The process of vocational and pedagogical training became the object of P. Husak's research [9], O. Dubasenyuk[10], T. Koval[11], V. Proshkina[12], A. Sbrueva[13], O. Semenog[14], S. Sysoeva[15], O. Shapran[16] and others.

Education informatization is characterized by the improvement and spread of IT, including interactive technologies, which are widely used in the interaction process between teachers and students. In this regard, future teachers must have sufficient knowledge of IT and be qualified enough to apply it in their professional activities. Training future teachers who are oriented towards this should facilitate the achievement of such a goal.

TRybunalski: Naukowe Wydawnictwo Piotrkowskie przy Filii Akademii Swietokrzyskiej, 2003. Tom 10. P. 153–162.

[2] Головань М. Інформатична компетентність: сутність, структура і ставлення. *Інформатика та інформаційні технології в навчальних закладах*. 2007. № 4. С. 62–69.

[3] Морзе Н. В., Кузьмінська О. Г. Компетентснісні задачі з інформатики. *Науковий часопис НПУ імені М. П. Драгоманова. Серія № 2: комп'ютерно-орієнтовані системи навчання*. К. : НПУ імені М. П. Драгоманова, 2008. № 6 (13). С. 62–69.

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[6] Раков С. А. *Формування математичних компетентностей учителя математики на основі дослідницького підходу у навчанні з використанням інформаційних технологій* : дис. ... д-ра пед. наук : 13.00.02. Харків, 2005. 538 с.

[7] Рамський Ю. С. Зміни в професійній діяльності вчителя в епоху інформатизації освіти. *Науковий часопис НПУ імені Драгоманова. Серія № 2. Комп'ютерно-орієнтовані системи навчання* : зб. наук. праць. К. : НПУ ім. Драгоманова, 2007. Вип. 5 (12). С. 10–12.

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[9] Гусак П. М. *Підготовка учителя: технологічні аспекти* : монографія. Луцьк : РВВ «Вежа» Волин. держ. ун-ту ім. Лесі Українки, 1999. 278 с.

[10] Дубасенюк О.А. Компетентнісний підхід у професійній підготовці вчителя. *Формування естетичної компетентності особистості засобами народознавства* : зб. наук. праць молодих дослідників / за заг. ред. О.С. Березюк, Л.О. Глазунової. Житомир: Вид-во ЖДУ ім. І. Франка, 2010. С. 10-16.

[11] Коваль Т. І. *Професійна підготовка з інформаційних технологій майбутніх менеджерів економістів*: Монографія. К.: Ленвіт, 2007. 264с.

[12] Прошкін В. В. *Інтеграція науково-дослідної та навчальної роботи в університетській підготовці майбутніх учителів: теорія та практика* : монографія. Луганськ : Вид-во ДЗ «ЛНУ ім. Тараса Шевченка», 2013. 456 с.

[13] *Інновації у професійно-педагогічній підготовці майбутнього вчителя: методологічні, змістові та методичні засади* : монографія / за ред. проф. А. А. Сбруєвої. Суми : Видавництво «МакДен», 2011. 432 с.

[14] Семеног О.М. *Професійна підготовка майбутніх учителів української мови і літератури*: Монографія. Суми: ВВП "Мрія-1" ТОВ, 2005. 404 с.

[15] Сисоєва С. О., Баловсяк Н. В. *Інформаційна компетентність фахівця: технології формування* : навч.-метод. посіб. Чернівці : Технодрук, 2006. 208 с.

[16] Шапран О. Професійна підготовка педагогічних кадрів в умовах регіональних університетських комплексів. *Рідна школа*. 2012. № 11. С. 23-27.

The analysis of scientific research has shown that one of the critical benchmarks for the professional training of specialists is the formation of their IC competence (general and special professional), which corresponds to the development of technologies in the information society. Possession of IC competencies becomes a prerequisite for successful learning, everyday life, and the professional sphere. The authors of the UNESCO project "ICT Competency Standards for Teacher" pay special attention to the fact that to successfully live, study, and work in the information society, teachers, teachers and students must be able to:

– search for data, analyze it, and carry out specific operations with it;

– solve professional problems and make decisions using information technology;

– creatively and effectively use ICT to increase training and professional implementation productivity.

V. Zabolotnyi, Y. Zhuk, O. Lyashenko, N. Sosnytska, M. Shut, and others have researched the problems of training teachers to use ICT tools in the subject area. In their works, scientists consider improving school physics experiments using ICT, combining traditional teaching tools, notably a textbook on physics, with electronic means, developing software, and developing pedagogical tools for studying specific topics of the school physics course.

The methodological foundations of the use of ICT in physics lessons are considered in the works of P. Abrosimova, K. Antsiferov, R. Bordovsky, V. Medvedeva, A. Slutsky, and others. For the secondary school physics course, electronic educational resources and methods of their application have been developed. These works touch upon specific areas of the methodology of teaching physics using information technologies. Some developments investigate the impact of physics courses on the level of preparation of students and future physics teachers for using ICT. The issue of studying the structure of IC competence of a physics teacher was dealt with by L. Karpova[17], K. Bila and V. Kadchenko[18], O. Pinchuk[19], N. Petrytsia, S. Velychko[20], V. Sharko[21], and others, the formation of IC

[17] Карпова Л.Г. *Формування професійної компетентності вчителя загальноосвітньої школи* : автореф. дис. на здобуття наук. ступеня канд. пед. наук : спец. 13.00.04. Харків, 2004. 27 с.

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[19] Пінчук О. П. *Формування предметних компетентностей учнів основної школи в процесі навчання фізики засобами мультимедійних технологій*: автореф. дисертації на здобуття наукового ступеня канд. пед. наук: спец. 13.00.02. «Теорія та методика навчання (фізика)». Інститут інформаційних технологій і засобів навчання Національної академії педагогічних наук України. К., 2011. 17 с.

[20] Петриця А. Н., Величко С. П. До проблеми вдосконалення навчального експерименту з фізики засобами новітніх інформаційних технологій. *Наукові записки*.

competence of future physics teachers using electronic Internet technologies has not been sufficiently studied.

A significant contribution to the clarification of the essence of understanding Internet technologies was made by scientists and teachers who studied the role of computer technologies in the conditions of the formation of the information society. Among them, I. Adamova[22], A. Alekseeva[23], P. Bisirkin, I. Bakalenko, L. Bashmanivska[24], S. Yashanov etc. These scholars, along with others, have noted that at the present stage of society's development, the impact of Internet technologies on the younger generation and their implementation in the educational process of secondary and higher schools is quite relevant. That is especially true for learning subjects, who are very sensitive to various social transformations, such as the rise of social media, the increasing use of online platforms for learning, and the growing importance of digital literacy, since the assimilation of moral and social norms takes place in them in different ways, including through the Internet. Moreover, in the current era of postmodernism, information relations are leading.

After analyzing scientists' research, we can argue that several aspects require further study. In particular, the analysis of the state of teaching physics and computer science in higher education shows that the level of formation of Information and Communication (IC) competencies of future physics teachers after training in these courses needs to meet today's requirements sufficiently. IC competencies refer to using digital technology, communication tools, and networks to access, manage, integrate, evaluate, and create information to function in a knowledge society. In the context of the credit-module system, the scientists ignore studying the formation of IC competence in physics teachers' training. After analyzing the works of scientists on the competence approach, the question arises – what competencies should a physics teacher have when performing modern pedagogical activities? The answer to this question leads to the need to

Серія: Педагогічні науки. Кіровоград: РВВ КДПУ ім. В. Винниченка. Вип. 77. 2008. Ч. 1. С. 339-344.

[21] Шарко В. Д., Куриленко Н. В. Використання інформаційних технологій у процесі формування екологічної компетентності на уроках фізики. *Інформаційні технології в освіті*. 2011. № 10. С. 41 – 49.

[22] Адамова І. З., Уграк М. І. Використання інтернет-технологій у навчальному процесі. *Вісник Чернівецького торговельно-економічного інституту. Економічні науки*. 2014. Вип. 1. С. 374-379.

[23] Алексєєва А., Астрашенок М. Сучасні інтернет-технології у суспільстві. *Інформаційна освіта та професійно-комунікативні технології XXI століття*: зб. матеріалів VIII Міжнар. наук.-практ. конф., Одеса, 10-12 вересня 2015 року / під заг. ред. В.Г. Спрінсяна. Одеса : ФОП-Гаража, 2015. С. 357-360.

[24] Башманівська Л. А. Вплив інтернет-технологій на формування особистості учня в умовах інформаційного простору. *Інформаційні технології в освіті на науці*: Збірник наукових праць. Мелітополь: Вид-во МДПУ ім. Богдана Хмельницького, 2016. Випуск 8. С. 35-39.

specify the concept of IC competence of a future physics teacher' and clarify its structure.

The article aims to analyze the concept of "information and communication competence of physics teachers" structurally and logically.

Methods

– analysis and systematization of philosophical, pedagogical, and psychological literature, works of domestic and foreign authors, normative legal documents, and methodological materials, according to which the relevance of the research problem is substantiated;

– analysis (historical and comparative) of literary sources, concepts, and theories, which was carried out to compare, generalize, and contrast different views on the implementation of the competence approach in the training of future physics teachers;

– terminological analysis to define the concept of "IC competence of future physics teachers" and structural-logical analysis to identify the components of this concept;

– classify and generalize various approaches to determining IC competence formation levels.

Results

1. IC-competent teacher of a physics teacher

A systematic analysis of the interpretation of IC competence revealed that a teacher's IC competence is understood as an individual's ability to apply modern ICT to solve educational and scientific problems. That includes the relevant knowledge, skills, and ability to apply them to practical activities. It also encompasses understanding web design, developing presentations, using graphic programs, accessing information from online libraries, web browsers, and office software (word processors such as Microsoft Word and table processors such as Microsoft Excel), etc. The significance of IC competence in modern education is that it equips teachers with the necessary skills to effectively use technology in their teaching, enhancing student learning outcomes and preparing them for the digital age.

Thus, an IC-competent teacher is a teacher who carries out pedagogical activities at a sufficiently high level while achieving consistently high results in teaching and educating students, solves tasks and problems in an organized and independent manner, and also independently evaluates the results of his activities[25] and at the same time freely uses ICTs to access, search, organize, process, evaluate information, and to produce and

[25] Кітова О. А., Стешенко В. В., Чернишов С. О. Сутність педагогічної компетентності вчителя трудового навчання і технологій в контексті професійного стандарту вчителя. *Наукові записки. Серія: Педагогічні науки*, 2021. Vol. 198. P. 116-121. https://doi.org/10.36550/2415-7988-2021-1-198-116-121.

transmit/disseminate information sufficient to live and work successfully in a professional activity.

We describe our relevant analysis of scientific sources. First, let's focus on electronic learning means (ELM), which directly characterize the IC competence of a physics teacher.

Yes, N. Olefirenko[26] ELM means software systems designed to solve problems related to creating computer educational tools. I. Slobodianiuk[27] ELM includes virtual, interactive, multimedia, and others. These can be a variety of spreadsheets, presentations, testoriums (a system for creating test tasks for teachers, teachers, students), video films, creating a database, etc. D. Antoniuk[28] clarifies ELM as special-purpose learning software, the main role of which is to teach the educational material in more detail and visually and interact directly with the students. This type of educational software is used by students individually because it improves skills and abilities during the assimilation of academic material.

2. Electronic means of learning as means of IC competence of the physics teacher

To use ELM in secondary schools in Ukraine, we detect the main types[29]:

– ELM, which is designed to expand modern teaching methods further and is created to maintain the conditions for the introduction of computerization of the educational process;

– ELM as an information learning system that combines computer software, information equipment, and multimedia tools.

The undeniable advantage of ELM is the structuring of existing data, their clear systematization, and the presence of an information retrieval system that makes it easy for students to navigate the learning process.

In the context of our research, ELM for a future physics teacher is one of the most effective means for demonstrating and further assimilating physical phenomena studied in the physics course. With the help of ELM, it is much more accessible to study objects and physical phenomena and to conduct the necessary experiments, the accurate reproduction of which is complicated by the lack of essential devices in schools of Ukraine or, if available, may not give the expected result. The consistency and accuracy of ELM contribute to

[26] Олефіренко Н. В. Сучасні інструментальні засоби створення електронних ресурсів навчального призначення. *Комп'ютер у школі та сім'ї.* 2012. № 6. С. 36-41. URL: http://nbuv.gov.ua/UJRN/komp_2012_6_9.

[27] Slobodianiuk I. Y. E-Learning In The System Of Innovative Approaches To Improving The Efficiency Of The Educational Process In Physics. *Вісник Житомирського державного університету імені Івана Франка. Педагогічні науки,* 2017. Випуск 2 (88). С. 254-260.

[28] Antoniuk D. E-learning tools: definition and classification. *Physical and Mathematical Education*. 2019. Issue 3(21). P. 12-18.

[29] Мисліцька Н.А., Бутківська С.В. *Нариси з історії фізики (з мультимедійною підтримкою)* : навчальний посібник. Вінниця, 2019. 80 с.

the fact that with the help of a PC, it is possible to change the settings and demonstrate the properties of selected objects, change the initial conditions of research, etc.

ELM for future physics teachers includes[30]:

– multimedia electronic textbooks, reference books, and encyclopedias;

– means of knowledge control (system of tests and tasks);

– educational databases (a systematized set of data intended for use in the learning process);

– interactive environments (interactive applications, physical multimedia models of phenomena and processes);

– virtual physical laboratories (a system that contains demonstrations from the course, explanations, and simulation models of laboratory work, which allows you to predict the results and check their mathematical reliability).

The research goals and promising results can be achieved thanks to ELM in teaching physics. Therefore, we will highlight the main advantages and disadvantages of using ELM in studying physics.

The advantages of using ELM in the educational process of teaching physics are increasing interest in physical experiments and physics as a science in general, obtaining fundamental knowledge from the course, improvement of the demonstration experiment, visualization of complex physical phenomena and processes, obtaining illustrations of a step-by-step demonstration of a physical phenomenon, demonstration of the details of the experiment that are difficult to notice with the naked eye; application of a differentiated approach to teaching students, in particular, the choice of a group and individual approach to learning; increasing interest in the subject and developing creative thinking in the classroom; creating a favorable psychological environment in the school; optimization of the teacher's work; conducting original and modern classes; management of educational activities.

The disadvantages of using ELM in teaching physics, in our opinion, are increasing the time spent on a PC, as a result of which eye fatigue occurs; the threat of loss of sensation between the real and virtual worlds, between a natural phenomenon and a projected physical model, the complexity of modeling various physical phenomena and processes; additional training for teachers on the use of specialized software in the field of physics. Therefore, the introduction of ELM in the professional training of a physics teacher is undoubtedly practical, in particular, for forming his IC competence.

IC competence of a modern teacher is a complex multicomponent concept, which in contemporary scientific literature is characterized from the

[30] Okhrimenko O., Semenikhina O. Digital resources in the work of bachelors of special education. *Physical and Mathematical Education*. 2019. Issue 4(22). Part 2. P. 127-132.

point of view of several scientific approaches: socio-cultural, activity, communicative, professional, context-informational, and psychological. Each approach only partially exhausts the scientific analysis of the problem of IC competence. All these approaches are interrelated with each other and complement each other.

3. Structure of a physics teacher's IC competence

Studies of the structure of IC competence of teachers were carried out by such scientists as A. Dragaytsev[31], M. Zhaldak[32], N. Morse[33], S. Lytvynova[34], L. Karpova[35], S. Semchuk[36], and others.

Analyzing the essence and structure of IC competence demonstrates that it is an essential indicator of each teacher's professional development.

S. Proskura[37] proposes introducing a competency-based approach to the training of subject teachers to focus efforts on:

– Determining the general competencies of subject teachers of secondary schools.
– Determining the conditions for effectively forming subject teachers' competencies.
– Disclosure of the content of general competencies of subject teachers.
– Disclosure of the concept of IC competence.
– Determination of the components of IC competence.
– Development and approbation of software modules.
– Diagnostics of learning outcomes.

The author S. Lytvynova[38] distinguishes the following conditions for the effective formation of subject teachers' IC competence: increasing the level of formation of IC culture; training system for teaching subject teachers;

[31] Дубасенюк О.А. Компетентнісний підхід у професійній підготовці вчителя. *Формування естетичної компетентності особистості засобами народознавства* : зб. наук. праць молодих дослідників / за заг. ред. О.С. Березюк, Л.О. Глазунової. Житомир: Вид-во ЖДУ ім. І. Франка, 2010. С. 10-16.

[32] Жалдак М. І. Педагогічний потенціал комп'ютерно-орієнтованих систем навчання математики. *Комп'ютерно-орієнтовані системи навчання*: зб. наук. праць. К. : НПУ ім. Драгоманова, 2003. Вип. 7. 263 с.

[33] Морзе Н. В., Воротникова І. П. Модель ІКТ компетентності вчителів. *Scientific Journal «ScienceRise: Pedagogical Education»*. 2016. №10. С. 4–9.

[34] Lytvynova S. Bilingual approach in forming students competence in natural mathematical subjects based on computer modeling. *Physical and Mathematical Education*. 2019. Issue 3(21). P. 84-92.

[35] Карпова Л.Г. *Формування професійної компетентності вчителя загальноосвітньої школи* : автореф. дис. на здобуття наук. ступеня канд. пед. наук : спец. 13.00.04. Харків, 2004. 27 с.

[36] Семчук С. Інформаційна компетентність як складова професійної компетентності майбутнього фахівця дошкільної освіти. *Problems of Modern Teacher Training*, 2019. Vol. 16. P. 100–105. https://doi.org/10.31499/2307-4914.16.2017.163481.

[37] Proskura S., Lytvynova S. Future Bachelors Of Computer Sciences Professional Competency Formation. *Physical and Mathematical Education*. 2019. Issue 2(20). P. 137-146.

[38] Proskura S., Lytvynova S. Future Bachelors Of Computer Sciences Professional Competency Formation. *Physical and Mathematical Education*. 2019. Issue 2(20). P. 137-146.

systematic use of acquired skills in pedagogical practice; participation in competitions, conferences, seminars; and lifelong learning.

According to L. Karpova[39], a competency-based approach to the design and implementation of the educational process should be a priority in training a future physics teacher. This approach involves orienting all its components to the acquisition by a future specialist of competencies, the presence of which allows you to effectively carry out professional activities and improve them, taking into account the prospects for development.

In modern research, the IC competence of a physics teacher is considered an integral characteristic of professionalism, which combines many personal and professional qualities. In many cases, the structure and content of IC competence are determined by the specifics of the professional activity performed and its belonging to certain professions.

We believe a physics teacher should master a system of ICT-related particular competencies. These include the following:

– be able to acquire and use new knowledge in physics using modern ICT;

– be able to develop and use electronic educational resources and electronic Internet technologies in physics, create databases, and use Internet resources in the process of teaching physics;

– be able to develop elements of the educational and methodological complex in physics using modern ICT;

– be able to create and process textual and graphic information in physics;

– be able to create and use dynamic tables, in particular in practical tasks and when performing laboratory work in physics;

– be able to visualize educational material in physics into bright static or dynamic models;

– be able to create presentations based on templates, set the structure of a slide, adjust animation effects, use sound effects, and insert tables, diagrams, and videos with physics information.

The professional activity of a modern physics teacher has specific differences from the activities of teachers of other subjects. It determines special requirements for the individual: adaptability, flexibility, and high professional motivation. Among the features of the professional activity of a physics teacher, it is worth noting the need to track and independently master new digital devices, digital laboratories and virtual laboratories, specialized software; frequent updating and variability of school physics curricula; development of educational materials using new IT, assistance to

[39] Карпова Л.Г. *Формування професійної компетентності вчителя загальноосвітньої школи* : автореф. дис. на здобуття наук. ступеня канд. пед. наук : спец. 13.00.04. Харків, 2004. 27 с.

colleagues in mastering and implementing ICT in the educational process of a comprehensive academic institution.

Based on the analysis, we clarified the concept of information and communication competence of a physics teacher.

IC competence of a physics teacher characterizes the ability to solve typical professional problems that arise in real pedagogical activity situations using various computer tools, electronic and virtual resources, and Internet technologies. Such ability includes knowledge of ICT, including physics, skills in using ICT in professional activities, and the desire to improve in this area.

To clarify the structure of a physics teacher's IC competence, we conducted a comparative analysis of approaches (Table 1).

Table 1

Comparative analysis of approaches to determining the structure of teacher's IC competence

Authors-scientists	Components	Source
V. Adolf V. Stepanova	– motivational and value-based – content-operational – research and reflection	[40]
J. Raven	– cognitive – effective – strong-willed – skills – experience	[41]
UNESCO Recommendations "ICT Competency Framework for Teachers"	– worldview – technological – organizational and methodological – self-educational	[42]
L. Karpova	– motivational – subject-practical – self-regulatory	[43]
O. Dragaitsev	– subject – object – subject	[44]
L. Sobko	– cognitive	[45]

[40] Adolf V., Stepanova V. Metodolohichni pidkhody do formuvannya informatsiynoyi kul′tury pedahoha. *Інформатика та освіта*. 2006. № 1. С. 2-8.

[41] Равен Дж. *Педагогічне тестування: Проблеми, помилки, перспективи*: пер. з англ., 1999. 144 с.

[42] *Структура ІКТ-компетентності вчителя. Рекомендації ЮНЕСКО.* URL: http://iite.unesco.org/pics/publications/ru/files/3214694.pdf.

[43] Карпова Л.Г. *Формування професійної компетентності вчителя загальноосвітньої школи* : автореф. дис. на здобуття наук. ступеня канд. пед. наук : спец. 13.00.04. Харків, 2004. 27 с.

[44] Драгайцев О. І. Складові професійної компетентності майбутнього вчителя в світлі компетентнісного підходу в освіті. *Вісник Черкаського університету. Серія Педагогічні науки*. 2008. Вип. 145. С. 25–28.

Authors-scientists	Components	Source
	– value-motivational – technical and technological – communicative – reflective	
T. Semakova, G. Safonova	– cognitive – value-motivational – communicative – reflective – technological	[46]
M. Holovan	– motivational – cognitive – activity-based – value-reflective – emotional and volitional	[47]
G. Chirva	– motivational – cognitive – activity – axiological	[48]
V. Sharko, N. Kurilenko	– motivational – cognitive – behavioral – value-semantic – emotional and volitional	[49]
Program experts «DeSeCo»	– knowledge – cognitive and practical skills – attitude – emotions – values and ethical norms – motivation	[50]

A comparative analysis of these structures of IC competence gives grounds to assert that the concept of IC competence is multi-component. However, different scientists distinguish different structural components.

[45] Собко Л. Г. Інформаційна компетентність майбутнього вчителя як педагогічна проблема. *Інформаційно-комунікаційні технології навчання*. Матеріали міжнародної науково-практичної конференції. Умань : ІПП Жовтий, 2008. С. 154–156.

[46] Семакова Т. О., Сафонова Г. Ф. Інформаційно-діяльнісний підхід до формування умінь і навичок самоосвітньої діяльності студентів. *Вісник Чернігівського національного педагогічного університету. Серія : Педагогічні науки*. 2017. Вип. 146. С. 88-92.

[47] Головань М. Інформатична компетентність: сутність, структура і ставлення. *Інформатика та інформаційні технології в навчальних закладах*. 2007. № 4. С. 62–69.

[48] Чирва Г. М. *Методика професійно орієнтованого навчання інформатичних дисциплін майбутніх вчителів технологій* : автореферат дис. ... канд. пед. наук : 13.00.02; Нац. пед. ун-т ім. М. П. Драгоманова. Київ, 2016. 20 с.

[49] Шарко В. Д., Куриленко Н. В. Використання інформаційних технологій у процесі формування екологічної компетентності на уроках фізики. *Інформаційні технології в освіті*. 2011. № 10. С. 41 – 49.

[50] DeSeCo. Definition and Selection of Competencies. Nheoretical and Conceptual Foundation (DESECO). *Strategy Paper on Key Competencies. An Overarching Frame of Reference for an Assessment and Research Program – OECD (Draft)*. URL : http://www.deseco.admin.ch.

Table 1 shows that scientists, in one way or another, determine the subject component, operational and personal.

Therefore, based on the analysis of the above structures, we propose the following structure of IC competence:

– The knowledge (subject) component is revealed as the presence of knowledge, skills, and the ability to apply them in professional activities.

– Procedural (operational) component characterizes the ability to analyze, classify, and systematize software and implement it in professional activities.

– The personal (reflective) component provides readiness to find ways to solve professional problems to their creative transformation based on analyzing one's activities.

Such a structure is consistent with the goals of physics teacher training, which also determine the essential components of a physics teacher's IC competence (Fig. 1).

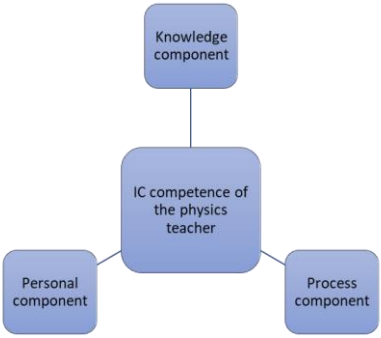

Fig. 1. Components of IC competence of a future physics teacher

The knowledge component characterizes the list of knowledge in the field of IT with a projection on the subject area. The knowledge component's development level is determined by the completeness, depth, and consistency of the physics teacher's knowledge, concepts, and ideas in his subject area.

Knowledge is the highest manifestation of the perception of data and information, which is active and formed based on facts, analysis, and various types of logical inference. According to the classification proposed by I. Shyshenko, T. Lukashova and O. Strakh[51], knowledge is divided into three subgroups arranged in the sequence of increasing universality and

[51] Шишенко І., Лукашова Т., Страх О.Фундуваннязнань у процесі вивчення математичних понять засобами цифрових технологій у фаховій підготовці майбутніх учителів математики. *Фізико-математична освіта*, 2021. Том32. No6. С. 57-63.DOI: https://doi.org/10.31110/2413-1571-2021-032-6-009.

abstraction. This: (a) partial knowledge – terminology and factual material; b) knowledge of how to use partial material – areas of application, classifications and categories, methods of work, and criteria for its evaluation; c) knowledge of general and abstract concepts – principles and generalizations, basic theoretical concepts.

I. Ziaziun, I. Kryvonos, O. Miroshnyk, V. Semychenko, and N. Tarasevych pay special attention to the knowledge component of the teacher's IC competence. They note that a teacher's competence contains knowledge based on developed professional thinking and professional consciousness. The dependence of the teacher's IC competence on professional thinking explains the importance of the knowledge component in various theoretical approaches since the "subject basis of thinking" is considered to be the "composition of knowledge."

The knowledge component contains knowledge of a theoretical and technological nature: a set of knowledge reflecting the system of the modern information society; knowledge that constitutes the informative basis of search cognitive activity; theoretical knowledge of the basic concepts and methods of physics as a scientific discipline; knowledge of IT, its capabilities for solving problems in physical experiments; identification of creativity, flexibility, criticality, consistency, mobility, efficiency of thinking in situations of search and transformation of the necessary data. The knowledge component reflects the processes of data processing based on mental operations of analysis of messages received for processing, formalization, comparison, generalization, synthesis with existing knowledge bases, development of information use cases, and forecasting the consequences of solving a problem situation, generating and predicting the use of new information and its interaction with existing knowledge bases, organizing its storage in memory. The knowledge component also includes the ability to analyze the results of actual physical experiments and laboratory experiments (for example, in spreadsheets, digital laboratories, etc.) and obtain appropriate conclusions; knowledge of the use of ICT in the presentation of the results of their work in the form of multimedia presentations, interactive applications, electronic manuals, etc.

In other words, the knowledge component of a future physics teacher's IC competence contains a system of knowledge that characterizes modern IT, knowledge of specialized software in physics and teaching physics, subject knowledge of physics, and methods of teaching physics.

The completeness and depth of knowledge can characterize the knowledge component in a physics teacher's IC competence system.

The procedural component determines the ability to actively apply modern IT and computer technologies to work with information and solve

various problems as a means of cognition and development of IC competence.

In the procedural component of the IC competence of a physics teacher, there can be distinguished two levels: basic and subject-oriented. The basic level is the invariant of skills and experience necessary for a teacher to solve educational problems, primarily using general-purpose IT. At this level, IC competence includes the use of IT in modern society (computer, multimedia, Internet, electronic media, mobile phones, etc.) to find, access, store, produce, present, and exchange information, as well as communication between people and work on the Internet.

The subject-oriented level involves the development and formation of readiness for introducing specialized technologies and resources into educational activities, as required by the content of a particular subject. The content of a teacher's subject-professional IC competence directly depends on the needs of his subject area. The teacher's needs should determine the study of certain computer technologies and tools in his professional activity. This level of the procedural component also includes the ability to use ICT to create new tools for modeling physical phenomena and processes.

The procedural component characterizes IC competence dually: IT should be perceived by future physics teachers as an object of study and as a tool for implementing their own professional activities. In other words, a physics teacher needs to be able to use various software tools and see ways to use these tools to implement their own professional activities.

Operational and professional skills can characterize the procedural component in a physics teacher's system of IC competence.

The personal component of the IC competence of a physics teacher is determined by the teacher's attitude toward himself and the world, as well as his practical activity in the field of IT and its implementation. It includes self-awareness, self-control, self-esteem, understanding of one's own importance in the team and understanding the results of one's activities, responsibility for the results of one's activities, self-knowledge, and self-realization in professional activities through ICT tools. The personal component includes IT-based self-analysis and self-assessment of professional activities; the ability to adequately assess one's own achievements in the field of physics, one level of IC competence; the ability to identify the advantages and disadvantages of one's competence in the field of physics; ability to reflect in the field of information search and transformation, in mastering and using ICT in physics lessons; ability to regulate one's activities and attitudes towards them; availability of their own position on the use of ICT in educational, cognitive and professional activities to solve various problems; striving for self-actualization, self-development; striving for professional self-improvement based on ICT.

Reflection regulates all components of IC competence. Thanks to reflection, the future subject teacher monitors the goals, process, and result of his activities regarding the acquisition of competencies in the field of teaching, as well as realizes the internal changes that take place in him and realizes himself as a changing person. Reflection allows you to identify and overcome the contradictions in a person's life between knowledge and behavior, the desired, possible, and accurate. Thanks to the reflexive mechanism, a person moves to new levels of development.

The personal component of a physics teacher's system of IC competence can be characterized by the ability for self-improvement and introspection.

These structural components form a single whole and are closely interrelated. The functions of the components interact with each other, passing into each other, and constitute a single complex process that makes it possible to see the problems of educational achievements in a single system of students' knowledge.

Thus, based on the system analysis and the opinions of leading scientists, the IC competence of a physics teacher is understood as the ability to solve typical professional problems and problems that arise in real situations of pedagogical activity using a wide variety of computer tools, electronic and virtual resources, and Internet technologies.

In our research, we distinguish the following components of the formation of IC competence of future physics teachers: knowledge component (characterized by knowledge in the field of IT, including subject direction), procedural (indicates the ability to use modern ICT tools in pedagogical activities) and personal (determined by the attitude to oneself and one's professional activity).

When determining the components of IC competence, it is essential to see the indicators by which it is possible to track its formation level. The following indicators of the formation of the IC competence of future specialists are often used: the presence of interest; formation of motivation; completeness, depth, and scope of knowledge; possession of professionally significant knowledge; skills and abilities for professional work; ability to exercise self-control, introspection, and self-assessment, etc.

Taking into account the approaches to determining the criteria and indicators of the scientists mentioned above, we will formulate the basic requirements for the criteria for the formation of IC competencies: they must be objective, include essential, main points of the phenomenon being studied; cover typical aspects of the phenomenon; be formulated clearly, concisely; measure what is needed for the study. Considering the systematic understanding of competencies, we will define the criteria that describe the structural and functional components that allow us to consider competencies as a state, a process, and a result.

The level of formation of the knowledge component in our study is increased due to knowledge about information resources and work with information objects, knowledge of interdisciplinary connections, etc. The component is defined by a list of expertise in the field of IT with a projection on the subject area and contains:

A system of knowledge that characterizes modern IT.

Knowledge of specialized software in the field of physics and teaching physics.

Subject expertise in physics and methods of teaching physics.

Before formation, this component also includes the ability to analyze the results of actual physical experiments and laboratory experiments to obtain appropriate conclusions and knowledge of the use of ICT in presenting their work in multimedia presentations, interactive applications, electronic manuals, etc. The level of development of the knowledge component is determined by the completeness and depth of the teacher's knowledge in his subject area.

The procedural component is characterized by actively applying IT in professional activities. That involves possessing tools for both general-purpose and specialized physics software to ensure a sufficient level of professional activity. It uses modern IT to search, access, store, process, and present information content and communication skills through Internet technologies.

To characterize the level of formation of the personal component of a physics teacher's IC competence, we distinguish the ability to self-improve and reflect on professional activities related to IT in teaching physics.

Thus, the cognitive criterion is characterized by the indicators "Completeness of knowledge" and "Depth of knowledge," the technological criterion by the indicators "Operational skills" and "Professional skills," and the analytical criterion by the indicators "Ability to self-improvement" and "Ability to introspect."

Completeness of knowledge is determined by the amount of knowledge about the object under study provided by the program. That indicator can be used to assess the entire amount of knowledge of a future physics teacher in the context of his professional activity and the subject of our research. As a rule, the completeness of knowledge characterizes the level of possession of theoretical knowledge.

Depth of knowledge is the number of conscious connections of a given knowledge with others. With the help of this indicator, you can find out how deeply the future teacher operates with expertise and can apply it in non-standard situations. Also, the depth of knowledge shows how skillfully a physics teacher can use the acquired theoretical knowledge in practice.

Operational skills – mastery of software tools. Such skills combine the skills of working with both general-purpose software (word and table processors, working with operating systems, etc.) and specialized software in the field of physics (graphic editors, software for visualization and visualization of information, DS and VL, simulators, emulators, etc.).

Professional skills – the ability to use tools to teach physics. Unlike operational skills, this indicator indicates the level of problem assessment, the correct choice of specialized software, and its adequate use for studying a particular physical phenomenon or demonstration. That is, it shows whether a teacher can use specialized software in physics in their professional activities.

The ability to self-improve is the formation of skills to exercise control and self-control over one's professional activity, analyze the effectiveness of methods, techniques, means of pedagogical activity, and technologies used in teaching physics with the involvement of software, and improve one's pedagogical skills in their use.

The ability to introspection is a feeling of an inner readiness to use tools for teaching physics, the formation of a critical view on the use of individual software, and the formation of the ability to adequately assess the results of the use of software by all subjects of the educational process.

Analyzing the study results on these indicators can help assess the level of formation of the relevant components and the IC competence of the future physics teacher using electronic Internet technologies.

Discussion

The active spread of e-learning emphasizes the importance of the research problem. In recent years, Ukraine has adopted important documents defining strategic plans for developing the information society[52], [53]. For this reason, there are sufficient grounds to address the need to use e-learning, under which we understand all forms of electronic support for the educational process and developing IT [54], [55], [56].

[52] Rudenko Y. O., Semenikhina O. V., Kharchenko I. I., Kharchenko S. M. Distance Learning: Results Of A Survey Of Teachers And College Students. *Information Technologies and Learning Tools*, 2021. Vol. 86(6). P. 313–333. https://doi.org/10.33407/itlt.v86i6.4343.

[53] Rudenko Yu., Naboka O., Korolova L., Kozhukhova K., Kazakevych O., Semenikhina O. Online Learning With the Eyes of Teachers and Students in Educational Institutions of Ukraine. *TEM Journal*, 2021. Vol. 10. Is. 2. Pp. 922-931. https://doi.org/10.18421/TEM102-55.

[54] Yurchenko A., Rozumenko A., Rozumenko A., Momot R., Semenikhina, O. Cloud technologies in education: the bibliographic review. *Informatyka, Automatyka, Pomiary W Gospodarce I Ochronie Środowiska,* 2023. Vol. 13(4). Pp.79–84. https://doi.org/10.35784/iapgos.4421.

[55] Yurchenko A., Proshkin V., Naboka O., Shamonia V., Semenikhina O. The use of digital technologies in education: the case of physics learning. *International Journal of Research in E-learning*, 2023. Vol. 9 (2). Pp. 1–25. https://doi.org/10.31261/IJREL.2023.9.2.02.

[56] Семеніхіна О.В., Юрченко А.О., Сбруєва А.А., Кузьмінський А.І., Кучай О.В., Біда О.А. Відкриті цифрові освітні ресурси у галузі ІТ: кількісний аналіз. *Інформаційні*

Its active implementation is facilitated by Contradictions, which persist in the current education systems (at different levels) and cannot be effectively overcome without e-learning. We note these of them[57].

1. Contradictions of socio-economic and socio-pedagogical nature.

The growing cost of training competent specialists, and on the other hand, the cost and low efficiency of traditional mass training, which is potentially inferior to training with the use of full-fledged electronic technologies.

Accessibility barriers – Some students find it difficult to access traditional education, either due to remoteness or for other reasons.

Obstacles to academic mobility of subjects of study. In the conditions of the usual organizational, educational, and methodological support of the educational space, even the choice and "piloting" of the massive list of academic services the market offers without electronic learning management technologies becomes almost impossible.

Difficulties in ensuring the individualization of education – it is not always possible to entirely create the conditions for a traditional group (or class-lesson) mass education system. Another thing is the possibility of interactive educational content, which allows you to provide tasks while considering the learning subject's characteristics.

2. Contradictions of organizational and methodological nature.

The problem of activating cognitive activity is independent educational activity since it can improve the quality and depth of knowledge assimilation. Traditional methods need to support self-learning more effectively.

The rapid growth in the amount of new knowledge is compared to the "information explosion," the traditional orientation of educational programs is to the list of paper sources rather than the free search for resources on the Internet.

An apparent obsolescence of traditional methods of educational work, in particular lectures. Teachers often continue to give lectures by inertia. At the same time, in the new conditions, meetings with students begin to take the form of consultations that accompany independent work on the involvement and analysis of theoretical sources. It is also necessary to revise many established university forms of certification and control – final classification papers, term papers, etc., which students take from the Internet.

технології і засоби навчання, 2020. Том 75. №1. С. 331-348. DOI: https://doi.org/10.33407/itlt.v75i1.3114.

[57] Арістова Н. Цифрова компетентність у системі ключових компетентностей для навчання впродовж життя. *Освіта. Інноватика. Практика*, 2022. Том 10, No 8.С. 54-60. https://doi.org/10.31110/2616-650X-vol10i8-008.

The impossibility of ensuring whole without the use of e-learning constant monitoring of students' current achievements, and hence the need for a basis for self-motivation of their independent work.

Constraints on the development of new learning technologies. When innovations are introduced in modern education, effective solutions cannot be implemented without e-learning, Internet technologies, and the use of learning management systems.

3. Additional arguments in implementing modern general and vocational education modernization directions are using the competence approach. This approach requires the reorientation of learning technologies to independent research work and the development of creative qualities in the subjects of learning, which, in turn, involves an innovative methodological restructuring of the system for assessing the quality of acquired knowledge, skills, and abilities.

The need for such a restructuring also stems from modern requirements for the educational process, the system of credit units (credits), and the modular-rating system of education—since none of the above can be implemented practically without using electronic technologies. It is also important to take into account the need to use IT in the teacher's professional activity: for visualization [58], [59], [60], animations [61], organization of virtual experiments and simulations [62], for modeling, etc. [63], using special software

[58] Семеніхіна О.В., Юрченко А.О., Удовиченко О.М. Формування умінь візуалізувати начальний матеріал у майбутніх учителів фізики: результати педагогічного експерименту. *Фізико-математична освіта*. 2020. Випуск 1(23). С. 122-128. URL: http://fmo-journal.fizmatsspu.sumy.ua/journals/2020-v1-23/2020_1-23-Semenikhina-Yurchenko-Udovychenko_F.pdf.

[59] Semenikhina O., Yurchenko A., Udovychenko O., Petruk V., Borozenets N., Nekyslykh K. Formation Of Skills To Visualize Of Future Physics Teacher: Results Of The Pedagogical Experiment. *Revista Romaneasca Pentru Educatie Multidimensionala,* 2021. Vol. 13(2). Pp. 476-497. https://doi.org/10.18662/rrem/13.2/432.

[60] Mulesa P., Yurchenko A., Semenikhina O. Diagnostic apparatus of researching the results of preparing teachers to use virtual visibility tools in professional activities. *Науковий вісник Ужгородського університету. Серія: «Педагогіка. Соціальна робота»*, 2023. Вип. 2(53). С. 94-99. https://doi.org/10.24144/2524-0609.2023.53.94-99.

[61] Друшляк М. Г., Юрченко А. О., Розуменко А. М., Розуменко А. О., Семеніхіна О. В. Ефективні форми навчання для підвищення кваліфікації вчителів. Електронне наукове фахове видання “Відкрите освітнє Е-середовище сучасного університету”, 2021. №10. С. 77-88. https://doi.org/10.28925/2414-0325.2021.108.

[62] Semenikhina O., Drushlyak M., Lynnyk S., Kharchenko I., Kyryliuk H., Honcharenko O. On Computer Support of the Course “Fundamentals of Microelectronics” by Specialized Software: the Results of the Pedagogical Experiment. *TEM Journal*. 2020. Volume 9 (1). P. 309-316. https://doi.org/10.18421/TEM91-43.

[63] Semenikhina O., Drushlyak M., Yurchenko A., Udovychenko O., Budyanskiy D. The use of virtual physics laboratories in professional training: the analysis of the academic achievements dynamics. *ICT in Research, Education and Industrial Applications (ICTERI-2020)* : 16th International Conference. October, 06-10, 2020. Kharkiv. P. 423-429 http://ceur-ws.org/Vol-2740/.

[64] and social media [65], building the individual educational trajectory [66], implementating STEM-education [67], [68].

The study found that the formation process of IC competence is multi-level; that is, when it comes to students' acquisition of IC competence, it is formed at a certain level. Scholars often distinguish levels in different ways [69]. For example, G. Fedoruk[70] distinguishes the following levels of formation of IC competence: methodological-creative, conceptual-productive, and elementary-reproductive. A. Kryzhanovsky[71] distinguishes the following levels: high, medium, and low. S. Zelinsky[72] distributes the levels of formation as follows: low, critical, medium, sufficient, high.

Considering the adopted system of assessment of educational achievements on a 4-point scale (excellent, good, satisfactory, unsatisfactory), we have identified four levels of formation of IC competencies of a future physics teacher using electronic Internet technologies: initial, intermediate, sufficient, and high. Thus, at the initial level, the future physics teacher is often not interested in working with modern IT, is poorly versed in the methods and techniques of data processing, at a low level, is aware of the possibility of using ICT in

[64] Drushlyak M., Sabadosh Y., Mulesa P., Diemientiev E., Yurchenko A., Semenikhina O. QR Codes as an Educational Tool for Implementing the BYOD Approach in Physics Lessons. *2023 46th MIPRO ICT and Electronics Convention (MIPRO)*, Opatija, Croatia, 2023. pp. 584-589. https://doi.org/10.23919/MIPRO57284.2023.10159739.

[65] Mulesa P.P., Semenikhina O.V. Social networks as a digital tool for teachers professional activity. *Bulletin of the National University "Chernihiv Collegium" named after T. G. Shevchenko*. P. 145-149. https://doi.org/10.5281/ELModo.5938818.

[66] Yurchenko A., Mulesa P., Semenikhina O. Individual Educational Trajectory Building As A Successful Teacher Skill In The Digital Age. *Pedagogy and Education Management Review*, 2023. Vol. (2). Pp. 64–72. https://doi.org/10.36690/2733-2039-2023-2-64-72.

[67] Semenikhina O., Yurchenko K., Shamonia V., Khvorostina Y., Yurchenko A. STEM-Education and Features of its Implementation in Ukraine and the World. Paper presented at the *2022 45th Jubilee International Convention on Information, Communication and Electronic Technology, MIPRO 2022* – Proceedings, 2022. Pp. 690-695. https://doi.org/10.23919/MIPRO55190.2022.9803620.

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educational activities, has elementary skills in working with general-purpose software (edits textual information, enters experiment data into a table, makes simple calculations), count on outside help.

The initial level is characterized by elementary (at the primary level) theoretical and technological training in the subject area and the use of ICT in the educational process, fragmentary ability to analyze and self-analyze the activities of the subjects of the educational process, lack of desire to improve oneself in one's profession, passive attitude to the use of information tools for teaching others.

Intermediate level. It is characterized by an interest in using IT but a situational interest in using it to implement professional activities. Representatives of this group have incomplete knowledge about the feasibility of using ICT in physics lessons when using various forms and teaching methods; there are isolated skills in using computer tools in training, and there needs to be skills in implementing ICT in professional activities.

A student with an average level of IC competence partially uses ICT in research activities and solves specific practical and professional tasks reproductively but knows and owns the tools of general-purpose software (formatting textual, tabular information, calculations, etc.). They have an incomplete interest in specialized software in physics, but there is no desire to experiment and involve such software in the educational process. There is a single desire for professional growth, counting on a bit of help from the outside.

A sufficient level is characterized by a sufficient level of formation of the teacher's professional qualities before the organization of ICT training, the ability to evaluate the selected tools critically, and the need to study innovations in ICT use in education. Future specialists can work with information (search, storage, transformation, and transfer) in various formats and forms of representation (graphs, schemes, diagrams, etc.), work with specialized software in the field of physics (do schematic physical models, carry out calculations in experiments using appropriate tools, build graphs and diagrams, correctly select and use software for conducting a high-quality physical experiment).

Representatives of this group are generally well acquainted with the theoretical foundations of education, have sufficient knowledge in the subject area (physical education) and IT, and use ICT in their professional activities, but this is only sometimes systematic. Pedagogical reflection can be traced; representatives can often help other participants and have sufficient experience with IT.

A high level is characterized by a conscious and reasoned desire to use ICT in professional activities, thorough theoretical, subject, and technological training in the fields of physics and IT, the ability to critically evaluate the available tools in the context of the chosen forms and methods

of teaching, and awareness of the need for constant analysis of the development of e-learning tools and technologies.

Representatives of this group are actively experimenting with the use of specialized software in the field of physics; they are OK with the practicality of their use since the reflection of professional activity is developed. They willingly discuss their successes and mistakes to comprehend pedagogical innovations. At a high level, they can create new methodological and demonstration materials, including their own multimedia applications, use specialized software, predict possible complications when solving a problem, engage in self-education and self-improvement, are responsible for the consequences of their own activities, use personal experience, and help others.

The transition from one level to another occurs sequentially and continuously from a lower to a higher level. Each previous level is a prerequisite for the formation of the next one, and a timely and objective determination of the level of formation makes it possible to determine the ways of one's own self-development and self-improvement, which is one of the essential professional qualities of a modern physics teacher.

Thus, to determine the level of formation of the IC competence of the future physics teacher by its components, we have chosen cognitive, technological, and analytical criteria, which are characterized by such indicators as completeness and depth of knowledge, operational skills, and professional skills, the ability to introspection and self-improvement. Accordingly, these indicators indicate the components of IC competence at four levels: initial, intermediate, sufficient, and high.

CONCLUSIONS

A characteristic feature of the national education system's development is its competence-oriented basis. That is why one of the priority tasks of higher pedagogical education is to solve the problem of training competent specialists.

IC competence of a physics teacher is considered the ability to solve typical professional problems that arise in real pedagogical activity situations using various computer tools, electronic and virtual resources, and Internet technologies.

The formation of future physics teachers' IC competence through electronic Internet technologies is a purposeful process of influencing the subjects of education for future physics teachers. It involves forming their ability to solve typical professional problems based on the use of electronic Internet technologies.

According to the definition of the concept of IC competence, the requirements of professional training, the educational standard, and the academic program, the following components of the IC competence of future physics teachers are allocated: the knowledge component is revealed as the presence of knowledge, skills and the ability to apply them in

professional activities, the procedural component characterizes the ability to analyze, classify and systematize software, implement them in professional activities, personal component provides readiness to find ways to solve professional problems, to their creative transformation based on the analysis of their activities.

The formation of IC competence can be carried out in different ways. Still, given the trends in the informatization of education, electronic Internet technologies should be considered the leading ones – technologies that, based on the Internet and the appropriate network tools, provide the possibility of creating new, maintaining, and using existing information resources, including electronic educational resources, surfing between them, as well as high-quality communication between users.

SUMMARY

The analysis of the state of physics teaching shows that the level of formation of information-communication competence of physics teachers after graduation doesn't meet the requirements of today. The question arises – what competencies should a physics teacher have when performing professional activities using ICT? The answer to this question determines the direction of our research: to interpret and carry out a structural and logical analysis of the concept of "information and communication competence of physics teachers." The results of the scientific search made it possible to clarify the "physics teacher's IC competence" concept, which is considered as the ability to solve typical professional tasks, solve problems that arise in real situations of the pedagogical activity, using a whole variety of computer tools, electronic and virtual resources, and Internet technologies. Identifying the components of the "IC competence" involved a thorough review of existing literature, consultations with experts in the field, and analysis of real-world examples of physics teaching. Based on this comprehensive approach, we have identified the following components: the knowledge component – revealed as the availability of knowledge, skills, and the ability to apply them in professional activities; the procedural component – characterizes the ability to analyze, classify, and systematize software, to implement them in professional activities, the personal component – provides readiness to find ways to solve professional problems, to their creative transformation based on the analysis of their activities with IT.

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