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MODELING THE PROCESS OF PREPARING FUTURE COMPUTER SCIENCE TEACHERS FOR THE GAMIFICATION OF THE EDUCATIONAL PROCESS IN MIDDLE SCHOOL

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Abstract

Relevance : Modern realities demand that teachers possess innovative thinking and the ability to implement new approaches, as well as create and apply new educational technologies, among which gamification holds a prominent place.

Objective: To theoretically substantiate a model for preparing future computer science teachers for the gamification of the educational process in middle school.

Methods: Modeling – to develop the model for preparing future computer science teachers for the gamification of the educational process in middle school; mathematical statistics – to process the experimentally obtained data.

Results: A model for preparing future computer science teachers for the gamification of the educational process in middle school has been developed. The effectiveness of the developed model was verified through a formative stage of an experiment, which involved a step-by-step mechanism for the model's implementation and consisted of three stages (motivational-introductory, implementation, and evaluation-and-adjustment). The author's educational and methodological materials, aimed at organizing and operating a gamified educational environment, were tested.

Conclusions: The training of future computer science teachers under study is presented as a holistic process of purposeful interaction between instructors and learners within a gamified educational environment, aimed at improving learners' mastery of the educational material through the application of a game context with the involvement of modern digital technologies. The proposed model delineates several blocks: an objective-oriented block (goal, tasks, scientific approaches, principles), a motivational-needs block (motives, interests, needs), a content-procedural block (content of training, its organizational forms, methods, tools, the gamified educational environment, stages of forming the future computer science teacher's readiness for gamification of the educational process), and a resultative block (criteria, indicators, levels of readiness of the future computer science teacher for gamification of the educational process). The effectiveness of the model's implementation is confirmed by the positive dynamics in the development of the future computer science teacher's readiness for the gamification of the educational process.

Keywords: *professional training of a future computer science teacher, gamification, educational process, modeling.*

Introduction. The development of society today is inextricably linked with technology. Digital tools have become an integral part of our lives and professional activities, requiring specialists to continuously improve their knowledge and skills in this area. Therefore, there is an urgent need for high-quality training of future specialists, starting from school age.

A key role in this process is played by the training of future computer science teachers. They are the conduits of digital technologies in general secondary education institutions. To meet modern

challenges, teacher training must be updated, in particular, through the introduction of innovative educational approaches. One such tool is gamification – the use of game elements in the learning process, which helps students and teachers stay abreast of the latest educational trends and digital technologies.

Gamification has significant potential as it allows students to perceive information not as separate facts, but as part of a holistic system. Instead of rote memorization, games help to see the interconnections between different subjects and phenomena, and each task acquires meaning as it becomes part of a large, interconnected system.

Research Sources. The elements of gamification have been studied as an effective method for optimizing and enhancing the effectiveness of learning by many domestic scientists, including D. Verbovetskyi, Yu. Moiseiuk, O. Pasichnyk, S. Petrenko, S. Tolochko, and S. Churko. Researchers have studied the possibilities of using gamification at various educational levels: in primary education (L. Zhydilova, O. Karabin, and K. Liashenko); for studying individual subjects in secondary school (I. Borysiuk, M. Marienko, O. Pinchuk, N. Yaskova); as a tool for teaching specific disciplines and forming professional skills (in teaching English – K. Halatsyn; in the training of future teachers – H. Kobernyk; in the formation of professional competence of foreign language teachers – S. Denhaieva; in the use of computer didactic games for the training of mathematics and computer science teachers – N. Kyrylenko). However, despite sufficient interest in the problem of gamifying the educational process in general secondary schools, we believe that teachers currently lack proficiency in the tools of gamification of the educational process, which requires certain improvements in their professional training.

The purpose of the article: to theoretically substantiate the model for training future computer science teachers for the gamification of the educational process in basic school.

Research Methods. To achieve this goal, we applied the modeling method, which has become widespread in pedagogical research (Lodatko, 2010) as an important cognitive tool used extensively in various fields of science, technology, and production, including mathematical, physical, or computer modeling (Kalapusha, 1982, p. 68).

Results and Discussion. Gamification of learning is currently viewed by researchers as a modern educational trend, which actualizes the issue of preparing future computer science teachers during their studies at a higher education institution for implementing a gamified approach. In a general sense, gamification can be defined as the use of game elements and techniques in non-game situations to engage people in solving problems in various fields by motivating their behavior. Unlike a regular game, gamification orients participants toward achieving a specific result rather than the game process itself. In education, gamification is seen as a special way of organizing learning where the game is a key element. Students acquire knowledge and skills by participating in games that have clear rules set by the teacher. Special incentive systems are used for motivation. Summarizing the approaches of various researchers, gamification of the educational process can be defined as the application of game mechanics and elements in learning to motivate students to learn using a game context, often involving modern digital technologies (Antonov, 2024, p. 3).

In accordance with the logic of the research, we analyzed the state of readiness of practicing and future computer science teachers for the gamification of the educational process in basic school. The presence of problems and shortcomings was identified, related to the insufficient provision of general secondary education institutions with trained teachers capable of implementing a gamified approach to learning, the limitation of educational and methodological tools, and the insufficient mastery of relevant technologies by teachers. At the same time, future and practicing computer science teachers recognize the relevance and need for gamification of the educational process in basic school, which actualizes the need for additional training of students for this type of activity and the development of appropriate scientifically-grounded methodological support.

By applying the modeling method, a model for training future computer science teachers for the gamification of the educational process in basic school was developed. In a scientific context, modeling is a cognitive method based on the use of scientific models that reproduce the key characteristics of a certain object and are created specifically for its study. A researcher can model both existing objects and phenomena, as well as those that are only being constructed. This means that modeling involves the creation of artificial or natural systems that imitate the essential properties of the original (Palamarchuk, 1999).

In pedagogy, modeling has become popular due to its cognitive functions. It allows for the analysis of educational phenomena and processes by creating an intermediate link – a model – between the researcher and the object of their research. With the help of a model, it is possible to isolate individual characteristics that are subject to study, evaluation, and managerial influence (Lodatko, 2010). Most researchers believe that the best definition of a model is offered by philosophers as a mentally imagined or realized system that reflects the object of research and can replace it, providing new information about it (Lodatko, 2010). However, a model is not just a substitute, but a working tool that helps the researcher see the internal structure of an object, determine influencing factors, and select resources. The model summarizes the essential connections between the elements of the object, creating a holistic structure. This is a special form of abstraction where key relationships are visualized in connections that are easily perceived and imagined. A model can be a diagram, a physical construction, a symbolic form, or a formula that reproduces the structure and properties of the object under study in a simplified way (Polishchuk, 2013).

In pedagogy, both the content of education and learning activities are subject to modeling. Particular attention is paid to the creation of models for teaching specific disciplines. The object of pedagogical modeling is the content of education and methods of teaching subjects, which include methodological solutions at different stages of learning. The most common in pedagogy is considered to be the structural-functional model, which takes into account the needs of society in training specialists and their demand in the labor market. Such a model includes four main components: value-motivational; content-based; practical; and reflective-evaluative. In accordance with the presented logic, the modeling of the training of future computer science teachers for the gamification of the educational process included: defining the purpose, content, methods, and means. This process encompassed the formation of needs, interests, motives, as well as the acquisition of knowledge, skills, and the creation of an appropriate educational environment.

The result of this work was a model (Fig. 1) consisting of several components: target (defines the goal, objectives, scientific approaches, and principles), motivational-needs (focuses on the motives, interests, and needs of students), content-procedural (includes the content of training, organizational forms, methods, means, and stages), and resultative (involves criteria, indicators, and levels of formation of the future teacher's readiness for the gamification of the educational process).

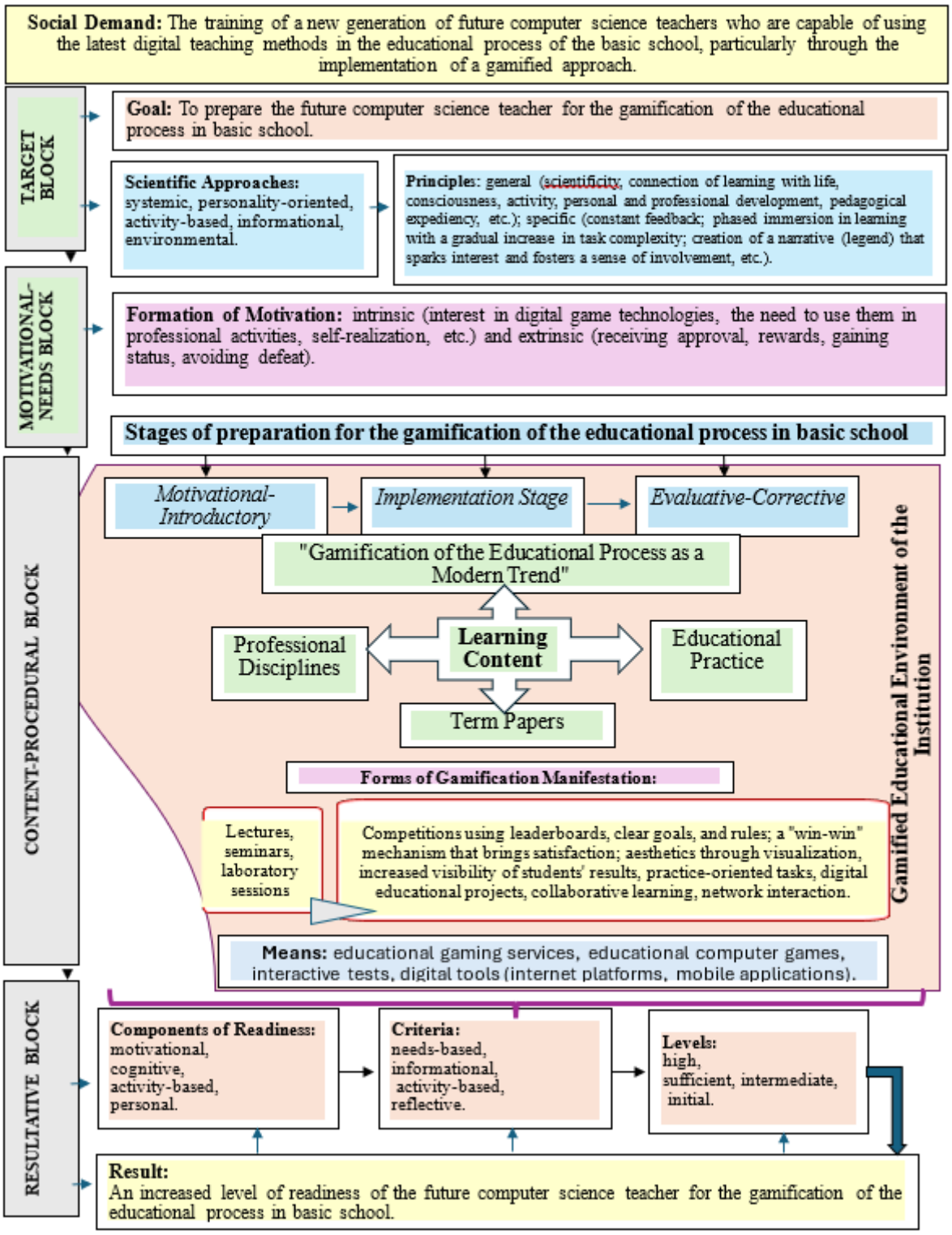

Fig. 1. Model for training future computer science teachers for the gamification of the educational process in basic school.

The traditional training of computer science teachers in higher education institutions is focused on mastering theoretical foundations and teaching methodology. However, modern society requires a future teacher not only to have subject knowledge but also the ability to generate and implement innovative technologies, such as gamification. Improving the quality of training for such specialists requires the enhancement of the educational process, bringing it closer to the real conditions of the school environment, as well as strengthening attention to the formation of students' readiness for professional activity.

Thus, there is a clear social demand in society for the training of a computer science teacher capable of applying the latest teaching methods.

Therefore, the goal of the proposed model is defined as the need to form the readiness of the future teacher for the gamification of the educational process in basic school.

The proposed model is based on several key methodological approaches, namely: systemic (considers training as a holistic system), personality-oriented (focused on the development of the student's personality), activity-based (emphasizes the formation of skills through activity), informational (takes into account the role of information technologies), and environmental (highlights the importance of the educational environment).

The construction of the educational process on the principles of gamification is based on the following interconnected principles: engagement through play (students learn information better through game elements); a sense of success (the use of points, statuses, levels, and ratings creates a sense of progress and achievement); social interaction (gamification promotes a sense of community and partnership, which is possible only with the active participation of the teacher); balance and expediency (game elements should be integrated appropriately to guide students toward the learning goal, not just to entertain). It is important that the effectiveness of gamification is achieved only with the comprehensive application of these principles. Using them separately will not bring the expected result (Kazarian; Kovalenko, Palamarchuk, 2023).

The motivational-needs block of the model for training future computer science teachers for the gamification of the educational process focuses on external and internal motivation according to the approaches of researchers who identify three main groups of motivation formed through the gamification of learning (Kovalenko, Palamarchuk, 2023):

1. Motivation for activity in a game environment. This type of motivation is supported by tracking the student's activity, which leads to a change in their status, helps them adapt to various electronic resources, and changes their social status within the group.
2. Motivation to study the academic discipline. Students receive points for quick results, which contributes to the acquisition of knowledge and skills on specific topics and the discipline as a whole.
3. Motivation to master collective skills. Students derive satisfaction from teamwork and competition, which contributes to the formation of collaboration skills, deepens their understanding of their future profession, and various professional roles.

Ultimately, this approach facilitates the assimilation of educational material and forms practical skills and abilities in working with software, which is necessary both for successful exam performance and for future professional activity.

The content-procedural block involved the introduction of gamification elements into the study process of both socio-humanitarian disciplines (Pedagogy) and professional ("Computer Architecture and Configuration of Computer Systems," "Computer Graphics") and practical ("Educational Practice in the Production of Multimedia Software as Elements of Methodological Support") training. This block is implemented in three consecutive stages: motivational-introductory (at this stage, students get acquainted with the concept of gamification and its possibilities in the educational process, which creates the necessary motivation for further learning), implementation stage (students apply the acquired knowledge and skills in practice, creating gamified educational products and scenarios), and evaluative-corrective (at the final stage, an analysis of the results, an assessment of the effectiveness of the developed solutions, and the necessary adjustments for their improvement take place).

The motivational-introductory stage aims to organize and motivate students to master gamification as a tool for their future pedagogical activity. Its goal is to provide organizational and methodological preparation at the university and to create a special gamified educational environment. This will allow for the formation of students' readiness to implement gamification in school and to arouse their interest in this activity. The goal is realized through the following tasks: to create the necessary educational environment; to promote students' motivation to use gamification in their future work; to form a stable interest in this type of activity. The content of this stage involves conducting introductory conversations with students, where they become acquainted with the essence, content, organization, and ways of implementing gamification in the educational process. As a result, an initial level of readiness of future teachers is formed, motivation to use gamification arises, interest in studying professional disciplines develops, and the first elements of a gamified educational environment are created.

The implementation stage aims at the practical application of the gamified approach in the training process of future computer science teachers by involving students in the use of gamification during the study of professional disciplines and practical training. The main tasks of this stage include the formation of students' knowledge, abilities, and skills in gamification. This involves using well-known educational game resources, enriching one's own experience in implementing gamification, and developing one's own game content for organizing learning. Gamification elements are integrated into the learning process by developing a plot for each lesson, creating a game atmosphere – presenting material in parts, gradually increasing complexity, moving to a new level when studying a new topic, interaction between students and the teacher, as well as prompt feedback, and developing an assessment system (using points, badges as awards for achievements, and rating tables (leaderboards)). As a result of this work, a sufficient level of readiness of future teachers for gamification is formed, motivation to use gamification is maintained, and the need to apply a gamified approach in future professional activity is actualized.

The final stage in the preparation process was the evaluative-corrective stage, the purpose of which was to analyze the learning outcomes, assess their quality, and identify the advantages and difficulties of the gamified approach.

The tasks of this stage included completing the formation of the future teacher's readiness for gamification and determining the level of its formation; creating an educational environment in the higher education institution that would promote further game-based activity and prepare students for using this approach in their future profession; stimulating students to independently develop game content, in particular, creating game characters.

The implementation of these tasks was carried out by diagnosing students' readiness to organize gamified learning, their performance of creative and innovative game tasks, the application of modern gamification technologies in learning, the use of educational gaming platforms, and the actualization of interest in developing their own game content, including the creation of game characters.

As a result, students demonstrated a sufficient or high level of readiness for the gamification of the educational process, showed a stable interest in this activity, and identified prospects for further self-improvement.

The developed model was implemented by improving the content of professional training and using gamified methods, such as quests, webquests, and game projects.

For the successful implementation of the model, we consider it necessary to take into account the relevant organizational-pedagogical conditions for optimizing learning (Sahan, 2022), namely: to use a clear assessment scale for all types of activity, avoiding frequent rule changes; to apply tools for counting points, creating a "hall of fame" and leaderboards (it is important that the gap between the best and average students is not too large, so as not to demotivate them); to create an opportunity for players to track their progress and move to a new level by using open educational resources and free applications; to provide for the possibility of students receiving bonuses for activity, including for independent study of topics.

All the above-mentioned components in their unity create the model for training future computer science teachers for the gamification of the educational process in basic school.

Conclusions. Thus, as a result of applying the modeling method, a model for training future computer science teachers for the gamification of the educational process in basic school was developed, which has the following components: a target block (goal, tasks, scientific approaches, principles); a motivational-needs block (motives, interests, needs); a content-procedural block (content of training, its organizational forms, methods, means, gamified educational environment, stages of forming the readiness of the future computer science teacher for the gamification of the educational process); a resultative block (criteria, indicators, levels of readiness of the future computer science teacher for the gamification of the educational process).

In the proposed model, the studied training of future computer science teachers is presented as a holistic process of purposeful interaction between teachers and students within a gamified educational environment aimed at improving students' mastery of educational material by applying a game context with the involvement of modern digital technologies.

We consider the following to be promising areas of work: the development of pedagogical tools for forming teachers' readiness for the gamification of the educational process; the creation of a holistic

gamified educational environment in the higher education institution aimed at further improving the future teacher's readiness to implement a gamified approach in the educational process.

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МОДЕЛЮВАННЯ ПРОЦЕСУ ПІДГОТОВКИ МАЙБУТНЬОГО ВЧИТЕЛЯ ІНФОРМАТИКИ ДО ГЕЙМІФІКАЦІЇ ОСВІТНЬОГО ПРОЦЕСУ ОСНОВНОЇ ШКОЛИ

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Реферат:

Актуальність: реалії сьогодення вимагають від вчителя інноваційного мислення та вміння впроваджувати нові підходи, створювати та застосовувати нові освітні технології, серед яких гейміфікація посідає чільне місце.

Мета: теоретично обґрунтувати модель підготовки майбутнього вчителя інформатики до гейміфікації освітнього процесу основної школи.

Методи: моделювання – для розробки моделі підготовки майбутнього вчителя інформатики до гейміфікації освітнього процесу основної школи; математичної статистики – для опрацювання експериментально отриманих даних.

Результати: розроблено модель підготовки майбутнього вчителя інформатики до гейміфікації освітнього процесу основної школи; здійснено перевірку ефективності розробленої моделі шляхом проведення формувального етапу експерименту, який передбачав поетапний механізм упровадження моделі і складався з трьох етапів (мотиваційно-ознайомлювального, реалізації, оцінно-корегувального); апробовано авторські навчально-методичні матеріали, спрямовані на організацію і функціонування гейміфікованого освітнього середовища.

Висновки: досліджувана підготовка майбутніх учителів інформатики представлена як цілісний процес цілеспрямованої взаємодії викладачів і здобувачів у межах гейміфікованого освітнього середовища з метою покращення опанування здобувачами освіти навчального матеріалу шляхом застосування ігрового контексту із

залученням сучасних цифрових технологій; у запропонованій моделі виокремлено блоки – цільовий (мета, завдання, наукові підходи, принципи), мотиваційно-потребовий (мотиви, інтереси, потреби), змістово-процесуальний (зміст підготовки, її організаційні форми, методи, засоби, гейміфіковане освітнє середовище, етапи формування готовності майбутнього вчителя інформатики до гейміфікації освітнього процесу), результативний (критерії, показники, рівні готовності майбутнього вчителя інформатики до гейміфікації освітнього процесу); результативність реалізації моделі підтверджується наявністю позитивної динаміки розвитку готовності майбутнього вчителя інформатики до гейміфікації освітнього процесу.

Ключові слова: *професійна підготовка майбутнього вчителя інформатики, гейміфікація, освітній процес, моделювання.*

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