Methodology of Teaching Educational Disciplines to Second (Master's) Level Graduates of the "Computer Science" Educational Program

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Abstract: Purpose and objectives of the article. To substantiate the unified methodology of teaching the discipline of educational components to applicants of the second (master's) level of higher education of the educational program "Computer Science" of the field of knowledge 12 Information Technologies of the specialty 122 Computer Science of full-time and part-time forms of study. To achieve this goal, the following tasks are set: 1. Analyze the current state of research and publications; 2. To substantiate the unified methodology of teaching the discipline of educational components to applicants of the second (master's) level of higher education of the educational program "Computer Science" of the field of knowledge 12 Information Technologies of the specialty 122 Computer Science of full-time and part-time forms of education on the basis of a computer game. Research result. The unified methodology of teaching the discipline of educational components to applicants of the second (master's) level of higher education of the educational program "Computer Science" of the field of knowledge 12 Information Technologies of the specialty 122 Computer Science of full-time and part-time forms of education on the basis of the teacher's game is justified. Through the application of the reverse transformation of a student into a teacher, the educational and developmental goal of students acquiring primary educational quasi-professional teaching experience has been achieved. The scientific novelty lies in the fact that the first developed a unified methodology for teaching the discipline of educational components to applicants of the second (master's) level of higher education of the educational program "computer science" on the basis of a game (gamified) approach interested in acquiring educational quasi-professional experience in teaching. Thus, the method proposed by the authors for teaching educational disciplines of educational components to students of the second (master's) level of higher education of the educational program "Computer Science" of the field of knowledge 12 Information Technologies of the specialty 122 Computer Science provides a practical implementation of the theory of "anticipatory learning". As a result of its application, a large reserve of time budget allocated for independent work will allow students to deeply study the educational material, prepare for a lecture class and, as a final result, acquire educational quasi-professional experience for

future activities. In the case of applying the methodology based on gamification, it allows to create such an informational and educational environment that contributes to the independent, active pursuit of higher education students to acquire knowledge, professional skills and abilities, such as critical thinking, the ability to make managerial (managerial) decisions, work in a team, be ready to cooperate; helps reveal abilities and motivates self-education. The methodology reveals excellent properties in the case of a mixed application of distance education and advance training, which will not only ensure the implementation of the curriculum for mastering the educational component, but also provide maximum opportunities for students to preserve life and health in war conditions.

1   Introduction

1.1   Problem statement

According to the conditions of intensive growth in the amount of scientific and technical information, rapid change and updating of the system of scientific knowledge, there is a need for a qualitatively new theoretical training of future highly qualified specialists (master's) level of higher education of the educational program "Computer Science" in the field of knowledge 12 Information technologies, specialty 122 Computer sciences. These qualified specialists will be capable of independent creative work, implementation of knowledge-intensive technologies in production and adaptation to the conditions of market relations.

Knowledge of the methodology of scientific research, methods and organization of scientific research activity will help masters of the specialty 122 Computer sciences to easily get involved in professional activities, to translate scientific knowledge into a practical plane and will contribute to the development of rational and creative thinking.

Scientific activity in higher educational institutions is an integral part of the educational process and is carried out with the aim of integrating scientific, educational and industrial activities in the higher education system. The Law of Ukraine "On Higher Education" (2014) [1] defines the main tasks of scientific activity in higher educational institutions, including:

• organic unity of the content of education and programs of scientific activity;

• direct participation of the subjects of the educational process in scientific and research works conducted in the higher educational institution;

• organization of scientific, scientific-practical, scientific-methodical seminars, conferences, competitions of scientific research, coursework, diploma and other works of participants in the educational process.

The COVID 19 pandemic created an unprecedented challenge to the education system, intensively prompted the use of distance education in institutions of higher education (HEIs) across the country, and became more active and the subject of widespread use [2]. The existing traditional methods of teaching do not allow

providing high-quality training. Rote teaching-learning methods are not as effective as far as the curriculum design in the computing field is concerned [3].

In this regard, there was a need to substantiate a unified author's method of teaching the educational discipline of educational components to students of the second (master's) level of higher education of the educational program "Computer Science" for the implementation of effective distance learning [4].

1.2 Literature review. Analysis of recent research and publications

Students' and cadets' motivation for traditional teaching methods began to fade paradoxically with the advent of computer technology. Game methods of teaching adults and gamification technologies in education came to the fore. These ideas were reflected in the publications of both foreign and domestic researchers. We will conduct a historical outline of the main works.

This paper [5] explores the application of active learning pedagogy to help achieve maximum learning in a limited period of time. Active learning has warranted great promise in improving student engagement and learning. It is not a new thought and has been promoted and encouraged as early as the 1980s. Due to the many benefits of active learning it is being practiced by many faculty in their classrooms. Faculty are urged to self-reflect on their teaching styles and work on improving the pedagogies to capture and maintain student interest by increasing student engagement. Although active learning has been used as an instrument to engage students and ultimately increase learning, it has seldom been implemented to directly impact learning relative to time. The active learning method employed in this study is grounded in classic pedagogies that have been developed based on various psychological theories of learning, motivation and engagement. After the employment of a series of this active learning technique a survey of the students revealed an increase in student learning.

The world today has witnessed the evolution imposes on researchers in the field of education to review the methods and strategies of teaching, since the teaching and learning system is not a collection of information and knowledge that stuffed in mind. One of the recent trends is the use of educational teaching games. Games increase the motivation of the learner and ensure the interaction with educational material which, in turn, offers fun and enjoyable manner in order to achieve the desired objectives. The authors of the article [6] try to draw attention to the need to use games to improve learning in active ways and increase the level of the educational process in an interactive environment for students and teachers. A survey methodology was used to evaluate the proposed solution in this paper, and the results are very encouraging for professionals working in academia.

The prototype of the development of the methodology of teaching certain disciplines in a game form was the justification of the methodology of teaching electrical engineering disciplines by the method of a virtual computer game [7], which was further developed in the concept of independent training of cadets of the Ground Forces on educational and training tools by the method of a game on a virtual computer [8].

Further practical steps in the gamification of teaching based on game methods and strategies of teaching and education can be found in the work of K. Kapp [9].

V. Bugaeva rightly notes that gamification is an educational technology which is rapidly developing, having a huge potential to positively influence the effectiveness of the educational process [10, p.135].

From the point of view of our research, it is relevant for the preparation of future highly qualified specialists (master's) level of higher education of the educational program "Computer Science" of the field of knowledge 12 Information Technologies of the specialty 122 Computer Science to consider gamification: as a way of forming the active professional behavior of future specialists in the IT industry [10]; as formal and informal space [11]; as an innovative pedagogical educational technology [12; 13] and learning technology in educational activity [14].

This confirms the opinion of N. Volkov that gamification is one of the trends of modern higher education [15].

1.3 Highlighting aspects that are not sufficiently studied

The analysis of previous studies revealed that in modern pedagogy in terms of the development of this topic, there is no unified method of teaching educational disciplines of educational components to students of the second (master's) level of higher education of the educational program "Computer Science" of the discipline. Based on this, the authors have chosen this current direction of research.

1.4 Purpose of the article

The purpose of the article is to substantiate the methodology of teaching the discipline of educational components to students of the second (master's) level of higher education of the educational program "Computer Science" of the field of knowledge 12 Information Technologies of the specialty 122 Computer Science of full-time and part-time forms of education.

1.5 Research objectives (goals)

To achieve the goal, the following tasks are set:

1. To analyze the current state of research and publications.

2. To justify the methodology of teaching educational disciplines of educational components to students of the second (master's) level of higher education of the "Computer Science" educational program of the field of knowledge 12 Information technologies of the specialty 122 Computer sciences of full-time and part-time forms of education based on the teacher's educational game.

2 Research methods

2.1 Research Tools

Basic research tools include methods of theoretical analysis and generalization of scientific literature on the topic of the research; generalization to formulate conclusions and recommendations for effectiveness.

2.2 Reliability and accuracy of results

Reliability of the results of the study is ensured by the correctness of the use of mathematical apparatus and research methods.

2.3 Methodological basis of the study

The object of scientific and theoretical research is not just a single phenomenon, a specific situation, but a whole class of similar phenomena and situations, their totality.

The methodological basis of the research is the ideas of L. Vyhotskyi, P. Halperin, Y. Babanskyi, S. Rubinshtein, (pedagogical psychology), V. Bespalko, Y. Mashbits, (cybernetic approach in pedagogy, programmed learning and automated training systems). Thus, the basic theory for effective learning is proposed by the theory of "advanced learning" (M. Nechkina, 1984 [16]; S. Lisenkova, 1988 [17]) or the "inverted class" theory (J. Bergmann, A. Sams, 2012 [18]). Blended learning can be carried out well if it is supported by good content. Good content consists of the subject, performance assignments, discussion forums, and quiz questions that are packaged in an interesting and structured manner. Good content must also be used to measure students' abilities in the cognitive, affective, and psychomotor domains [19].

3 Research results

3.1 Theoretical foundations of the construction of teaching methods

Scientific and research activities in higher education institutions of Ukraine are carried out on the basis of the current laws of Ukraine "On higher education" [1], "On scientific and scientific and technical activity" [20], statutes of higher education institutions and provide for the wide involvement of students to research work, enrichment of their knowledge with new scientific data, development of abilities for creative thinking, scientific analysis of phenomena, processes, which is a fundamentally important task not only for the department of "Computer Sciences".

The methodology of teaching the educational discipline of educational components to students of the second (master's) level of higher education of the educational program "computer science" is based on the understanding of the students of higher education of the concept of "methodology" as a study of the organization of activities. The innovators of this point of view are leading scientists such as A. Novikov [21], L. Marakhovskyi, B. Sus, S. Zabara, I. Kozubtsov, I. Gevko, A. Stepaniuk, H. Tereshchuk, Yu. Khlaponin, etc.

The combination of forms of conducting classes is a mandatory element of the successful assimilation of the educational material of the educational components of the students' discipline of the second (master's) level of higher education of the educational program "Computer Science" (the field of knowledge 12 Information Technologies of the specialty 122 Computer Science of full-time and part-time forms of education). It should be noted that currently the choice of pedagogical learning technologies is a key problem for the teacher – the subject of the educational process

[22]. At the same time, the lack of recommendations regarding formalization in their selection expands the lecturer's degree of freedom in creative search and experimentation.

As can be clearly seen from Table 1 the following learning methods are the most accepted for the formation of knowledge: didactic games; practical training; teaching others (mutual learning) and independent work.

Table 1. Comparative characteristics of different teaching methods

Teaching methods		Solved tasks					
		form		develop			gaining experience
		knowledge	skills	thinking	memory	language	
Verbal	(lecture)	5% ++	−	−	−	++	
	reading	10%					
	listening	20%					
Visually	Work with multimedia (audiovisual)	20% +	++	+	+	−	
	Viewing the drawing	30%					
	Demonstration	30% +	+	+	++	−	
	Video viewing	50%					
Practical	Working with a book (reading)	10% +	+	+	+	+	
	Educational discussions	50% ++	−	++	+	++	++
	Didactic games	70% ++	−	++	+	++	++
	Practical training	75% +	++	++	+	−	++
	Teaching others is the application of what has been learned	90% ++	−	++	+	++	++
Independent work		80% ++	++	++	+	+	
Oral and written control		++	−	+	+	++	
Note:	Note: ++ – solve very well; + – solve partially; – – solve poorly.						

The author's method of teaching the educational disciplines of the educational components provides for the creation of positive pedagogical conditions for students of the second (master's) level of higher education of the educational program "Computer Science" (the field of knowledge 12 Information Technologies of the specialty 122 Computer Sciences of full-time and part-time forms of education) to encourage them to acquire the primary practical experience in the process of educational quasi-professional activity.

Educational quasi-professional activity enriches students with the ability to direct them to self-development in the direction of future professional activity, which includes: management (managerial) activity; scientific (research) activity; pedagogical (teaching) activity.

Educational quasi-professional management (managerial) activity is formed in students through a responsible attitude to the self-organization of independent work.

Independent work is the main means of mastering educational material in the time free from standardized educational classes, that is, lectures and practical classes

(auditory work). During independent work, students should pay attention to: work on processing and studying the recommended literature; preparation for discussions and other tasks proposed by the teacher; work on an abstract (educational article, theses, report); work on an individual research project, etc.

The methods of conducting classes in the educational disciplines of the educational components with indications of approximate time are given in Table 2.

Table 2. Methods of conducting classes

| Type of lesson | The structure of the lesson | | | | | | Methodical support |
| | Introductory part | | t, | Main part | | Final part | |
	t'	method		main	additional	t'	method	
Lecture	10	C		EL	S, Cl, D	5		The text of the lecture
Practical class	20	C		E	IW	10	C	Methodical development. Software tasks
Independent work	–	–	–	IW	–	–	–	Methodical development. Tasks in the IW

3.2 Peculiarities of the methodology, application of teaching methods and tools

Features and methods of conducting classes with indications of estimated time are given in Table 2. The table uses the following abbreviations: C – conversation; EL – educational lecture; S – story; Cl – clarification; D – demonstration; DS – display; E – exercise; IW – independent work.

The introductory lecture is conducted by the leading lecturer, one of the professors. The goal, task structure of the educational discipline is explained to the students at this lecture. Besides, it is justified in the professional need for its study by future teachers and scientists in the field of Information technologies.

The lecturer must practically show the method of conducting the lecture, demonstrate at the highest level his/her own pedagogical skill, methodological culture, which should be reflected in the students as a certain standard to which one must go and try to exceed over time by forming his/her own pedagogical skill and methodological culture.

The professional activity of students as future scientific and pedagogical workers begins with the scientific understanding of the object, subject and purpose of the work and the final result. Besides, the very course of work is a project. For students of the specialty 122 Computer science, in most cases, the presentation is interesting in a game form with an illustrative example in the form of an algorithm of the reporting stages of the academic discipline [23].

After a few lectures (these are usually 4-6 lectures depending on the methodology), it is suggested to actively involve students in the role of future lecturers (teachers). This pedagogical method gives students the opportunity to overcome their own fear of the audience, to try to realize themselves in a

quasi-professional educational activity. In this case, we can talk about the pedagogical component. To do this, the "full-time lecturer" on the eve of the lecture sets students tasks for independent work through the head of the study group, determines the topics of the lesson, educational questions that must be worked out by students. Students who are preparing for lectures, study information search, analysis, validation, generally gain practical experience in scientific activities, etc.

The technology of preparing and conducting lectures by students was worked out in the context of a scientific and methodical seminar at the department [24].

Incoming reports, the lecturer observers the practical phase of the development of professional experience, methodological culture of the student.

The lecturer's interaction with students in the process of lecture-scientific-methodical support is based on the model of subject-object interaction. According to the educational component of the scientific and methodological support of students, the theoretical basis is Disterweg's fundamental idea. Disterweg notes that a bad teacher presents the truth, a good one teaches to find it [25, p. 161]. This idea emphasizes the special importance of creating such an educational atmosphere in which the student himself/herself will begin to find answers to questions.

To realize this truth, the principle of independent work of students in the technology of scientific and methodological support should be followed, and the interaction between the lecturer and students according to the algorithm [26], directing its further development and interpreting to solve the task of acquiring quasi-practical experience.

If necessary, the full-time lecturer manages and makes corrections in the pedagogical process. Moreover, this lecturer determines the rotation of the speaker to another student with the continuation of the report on the essence of the educational issue. Thus, the principle of attentiveness of listeners is realized.

3.4 Discussion of research results

The lecturer's work methods and students' activities are based on the use of pedagogical technologies such as project; programmed training; problem-based learning by transforming ideas [27-30].

The method of teaching educational disciplines of educational components involves assessing the level of formation of the applicant (master's degree) as a future teacher in the field of Information technologies (Computer sciences). Approximate evaluation points are given in Table 3.

Table 3. Assessment of the level of teaching by the recipient

Characteristics	Implementation in the activities of the lecturer
Formulation of the topic and definition of the goal	sufficiently clear and understandable for the students and Somewhat blurred They remained unclear to the students
Plan and structure	The structure is clear, meaningful parts are highlighted and

	interconnected
	The general plan is defined, but the transitions from one semantic part to another remain unclear
Content	It is difficult to follow the development of the topic, the main ideas were expressed inconsistently
The ability to arouse interest in the topic	Theoretical positions were argued, supported by facts and examples
	Scientific, evidential, but very difficult to understand
	Very popular, empirical material prevailed
	The meaning of the topic is revealed convincingly, the material was connected with the personal experience of the student
	Only the need to study the topic was indicated, examples were used, there was no reliance on the personal experience of the students
	The importance of studying the topic was not motivated in any way, the material was not supported by examples
Problem statement	The lecturer drew attention to contradictions, formulated problematic issues, and encouraged the audience to discuss
	The lecturer formulated problematic questions and answered them himself/herself
	The lecturer expressed the theoretical material as something universally recognized, which does not require proof
Contact with the audience	The contact was complete, all students worked, the lecturer took into account "feedback"
	Sometimes the lecturer lost contact with the audience and the students started to get distracted
	The lecturer failed to establish contact with the audience and take into account "feedback"
Culture of the lecturer's language	Clear diction, optimal pace of speech, emotional presentation
	The diction and pace of speech are normal, but the emotional component was missing
	There were problems with diction, language pace, emotionality of presentation
The behavior of the lecturer	He/she held himself /herself confidently, reasoned freely on the topic, did not use the lecture notes
	He/she held himself/herself confidently, but he/she did not possess the skill of fluent speech, he/she relied on the lecture notes
	He/she kept himself/herself rigid, practically did not tear himself/herself away from the text of the lecture
Use of visual aids	Graphic methods of presenting the material and other visual aids were actively used
	A blackboard was occasionally used
	There were no visual aids
Good conclusion	The conclusion logically concluded and summarized what was presented
	The conclusion was unclear
	There was no conclusion

A large reserve of time budget allocated for independent work will allow students to deeply study the educational material, prepare for the lecture and, as a final result, acquire educational quasi-professional experience for future activities [16-18]. This is confirmed by the results of the study. Student success in studies depending on the time spent on extracurricular activities [31].

We definitely agree with the opinion of the authors that to improve teaching

and learning, it is necessary to use assistive technologies [32]. For example, the use of gamification, but in such a way that the method of learning through the game does not turn into a pure game [9; 11; 12; 22].

4   Summary and Conclusion

Thus, the method proposed by the authors for teaching educational disciplines of educational components to students of the second (master's) level of higher education of the educational program "Computer Science" of the field of knowledge 12 Information Technologies of the specialty 122 Computer Science provides a practical implementation of the theory of "anticipatory learning". As a result of its application, a large reserve of time budget allocated for independent work will allow students to deeply study the educational material, prepare for a lecture class and, as a final result, acquire educational quasi-professional experience for future activities. In the case of applying the methodology based on gamification, it allows to create such an informational and educational environment that contributes to the independent, active pursuit of higher education students to acquire knowledge, professional skills and abilities, such as critical thinking, the ability to make managerial (managerial) decisions, work in a team, be ready to cooperate; helps reveal abilities and motivates self-education. The methodology reveals excellent properties in the case of a mixed application of distance education and advance training, which will not only ensure the implementation of the curriculum for mastering the educational component, but also provide maximum opportunities for students to preserve life and health in war conditions.

4.1   Expanding the boundaries of the scientific field

The scientific result obtained by the authors expands the boundaries of pedagogical sciences in the part related to the scientific specialty "teaching theory and methodology".

4.2   Scientific novelty. Scientific justification

For the first time, a methodology was developed for teaching educational disciplines of educational components to students of higher (master's) education majoring in "Computer Science" educational program of the field of knowledge 12 Information technologies major 122 Computer science full-time and part-time forms of study based on a game approach, interested in acquiring educational quasi-professional experience pedagogical activity for with the possibility of its application in war conditions due to mixed education.

4.3   Practical use

The proposed technique is fully ready for practical application as advanced anticipatory learning. Since the education system of Ukraine from February 24, 2022, like the entire country, functions in extreme conditions, it is necessary to adapt to the

reality of war, during which it is necessary to continue the educational process of training students of higher education for the needs of the national economy.

Thus, the use of distance education and advanced training will not only ensure the implementation of the curriculum for mastering the educational component, but also provide maximum opportunities for students to preserve life and health in war conditions.

For the first time, lecturer I. Kozubtsov at the Department of "Computer Sciences" of the Lutsk National Technical University developed a methodology for teaching educational disciplines of educational components to students of the (master's) level of higher education of the "Computer Science" educational program of the field of knowledge 12 Information technologies of the specialty 122 Computer sciences of full-time and part-time forms of education based on a game approach, interested in acquiring educational quasi - professional experience in teaching activities.

4.4 Prospects for further research and study

The research is expected to bring more academic and applicable value.
The methodology needs further improvement if it is necessary to conduct laboratory or practical classes on the use of stationary equipment of higher educational institutions and it is not possible to practice it at home.

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