Problems of Inconsistency and Didactic Functions of ICT Tools in Computer Science Courses

Ainash Davletova
Candidate of Pedagogical Sciences, Associate Professor, Department of Computer Sciences, L.N. Gumilyov Eurasian National University, Satbayev Str., Nur-Sultan, Republic of Kazakhstan.
E-mail: ainash_5@mail.ru

Zhanat Kopeev
Doctoral Student, Department of Computer Sciences, L.N. Gumilyov Eurasian National University, Satbayev Str., Nur-Sultan, Republic of Kazakhstan.

Madina Yermagambetova
Candidate of Pedagogical Sciences, Associate Professor, Department of Computer Sciences, L.N. Gumilyov Eurasian National University, Satbayev Str., Nur-Sultan, Republic of Kazakhstan.

Akmaral Kasymova
Candidate of Pedagogical Sciences, Associate Professor, Institute of Information Technology, Zhangir Khan West Kazakhstan Agrarian Technical University, Zhangir Khan Str., Uralsk, Republic of Kazakhstan.

Gulmira Balgozhina
Master Degree, Senior Lecturer, Department of Computer Sciences, L.N. Gumilyov Eurasian National University, Satbayev Str., Nur-Sultan, Republic of Kazakhstan.

Almira Tazhigulova
Doctor of Education, Associate Professor, National Center of Informatization, Zhandosov Str., Almaty, Republic of Kazakhstan.

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Abstract

The purpose of the study is to consider problems of continuity of computer science education at the school and university levels. This article analyses the main reasons for the lack of continuity at the tertiary level. The continuity of learning providing the interrelation between different levels of life-long learning is one of the approaches to solve the problem of improving the quality and efficiency of the educational process. The results of the study reveal that different levels of computer science training for school leavers are needed to solve this problem. In respect to the analysis of the main conditions for planning the teaching process, differentiated teaching is recommended as a good solution to the situation.

Keywords

Level of Knowledge, The Process of Instruction, School-higher Education Institution, Differentiated Approach, Information Science.

Introduction

One of the strategic directions of development is education and science, which decisively determines the rates of economic, technical, technological progress, political action, and culture and spirituality in society. Over the years of reform, bold steps have been taken to drive innovation. At the present stage of development of the education system in our country, its modernization is brought to the fore to prepare the younger generation for life qualitatively (Abylkassymova and Tuyakov, 2018).

In developing the concept of lifelong learning, special attention is paid to continuity (transitions between school types). In the context of the idea of lifelong learning, great importance should be attached to the continuity of education within the same level and at the junctions of different education levels (Kholmogorova, 2014).

The main problem of continuity at the school-university level is the difference in newcomers' level of training (academic performance) in the subject. This problem might not have arisen if there were exact curricula in secondary and higher schools, and these programs were implemented. The main reasons for the difficulties arising at the school-university level are the low level of knowledge of newcomers and the high requirements for them at the university, and the discrepancy between school control and self-control at the university.

According to the principles of continuity, learning should be built as a logically linked system in terms of goals, content, methods, and means at all levels of education, ensuring the student's personality's progressive development.

In the pedagogical literature, the continuity of educational programs in computer science is often overlooked. The literature pays attention to identifying conditions, factors, teaching methods, and ensuring the continuity of teaching informatics in secondary and higher education (Perez-Rivero et al., 2019).

The problem of the continuity of school and university education is not new to pedagogy and has been well studied in many aspects. However, in practice, many school graduates who find themselves on the student bench experience difficulties in their educational

activities. It may be difficult for them to adapt to new forms of organization of the educational process and teaching methods, i.e., requirements for learning outcomes. In other words, students lack consistency in content, techniques, and means of instruction in school and university (Basurto Velez et al., 2020). There are significant differences in the nature and methods of educational activity between the school and the student (Filatova, 2006; Jedrinovic, Luštek and Ferk Savec, 2019).

Literature Review

A review and analysis of scientific sources on the topic led to the fact that many scientists in their research covered various teaching computer science problems (Basurto Velez et al., 2020; Hudson, 2011). These are the problems:

- Methodology and substantiation of the scientific and conceptual organization of informatics and informatization of education;
- Content and methodological foundations of teaching informatics at school and university;
- Development and use of electronic educational tools, social aspects of informatics, and automated learning systems in the university's educational process.

Many types of studies of local teachers (Baimukhanov and Madyarova, 2009) are devoted to implementing the possibilities of information and communication technologies at the present stage of reforming all spheres of education. In this case, modern researchers attach particular importance to the problems of introducing information and communication technologies (ICT) in education in connection with the possibility of providing a student-centered approach to learning (Loveless, 2011; Calvani, 2009). The organization of various forms and methods of independent activity in acquiring new knowledge in pedagogical research of the problems of using ICT in school education is developing in general theoretical and didactic directions (Baimukhanov and Madyarova, 2009; Dekina, 2004; Leach, 2008).

The problems of development, creation, and application of digital educational resources were considered by Tazhigulova and Davletova (2010).

Verbitsky (2012) defines the visualization process as compiling mental content, including various types of information, into a visual image.

Robert (2010) notes the computer visualization of educational information as one of the essential didactic goals, which is most effectively implemented when using educational software, and defines it as follows:

- Computer visualization of the investigated object - a visual representation on the computer screen of the object, its components, or their models;
- Computer visualization of the process under study - a visual image on the computer screen of this process or its model, including hidden in the real world, presenting a graphical interpretation of the picture of the process under study (Robert, 2010; Vaskivska et al., 2017; Slaby et al., 2005).

One of the ICT tools, an interactive whiteboard, is used to train future teachers of informatics. An interactive course on the subject "Theory and Methods of Teaching Informatics" is being developed, where attempts were made to introduce visualization technology, as well as an electronic textbook for this course, with the help of which students can independently prepare for classes. When preparing future teachers of informatics, techniques such as "ICT in Education," "Theory and Methods of Teaching Informatics," and "Digitalization of Education" are consistently studied. The course "ICT in Education" introduces the didactic foundations of the creation and use of ICT tools, information retrieval systems in education, and the creation of electronic textbooks.

Materials and Methods

Most researchers believe that the practical impact of using a computer as a learning tool is lower than expected. One of the reasons for this situation, in our opinion, is that the computer as a tool for differentiating learning is not used effectively enough. The widespread introduction of a differentiated approach is constrained by the insufficient development of its foundations, including using a computer as a means of differentiating learning (Davletova et al., 2016; Rakhimzhanova et al., 2016; Rinartha & Suryasa, 2017).

The study aimed to substantiate the methods and forms of using the digital educational-methodical complex to differentiate education, creating a methodology for using the digital educational-methodical complex to determine knowledge in secondary school on informatics and experimental verification of its effectiveness. A method of using a digital educational-methodical complex to differentiate teaching in informatics has been developed and implemented. Conditions will be created for enhancing students' independent cognitive activity. It will contribute to the formation of students' interest in the assimilation of knowledge and logical thinking development. Also, it develops various

types of educational activities and students' creative potential and forms elements of information culture.

In order to achieve this goal and confirm the research hypothesis, the following research objectives were identified:

1. Revealing the didactic capabilities of the digital educational-methodical complex as a means of differentiated education.
2. Development of the structure of the digital educational and methodological complex of informatics as a means of differentiated education.
3. Substantiation of the methodology for using a digital educational and methodological complex for differentiated teaching of computer science in general education schools and experimental verification of its effectiveness.

Results and Discussion

This program is designed to teach students in grades 10-11 in the specialized course "Internet technologies. Basics of WEB-design". At the same time, it includes elements of general informatics and links to other subjects within secondary education. The total number of hours (for two years) is 102. The program complies with the standards of informatization of education and meets the State program's requirements for informatization of the Republic of Kazakhstan's secondary education system. The program was developed, taking into account the recommendations for the development of educational programs. The program is designed for a certain level of training of students:

- Basic knowledge in the field of computer science;
- Possession of the primary methods of work in the Microsoft Windows operating environment;
- Possession of the Microsoft Office package;

The program's goal is to give students a complete understanding of the global information space and the principles of obtaining information and creating their information resources.

The main objectives of the program:

- Systematization of approaches to the study of the subject;
- Creation of a unified system of concepts related to the creation, receipt, processing, interpretation, and storage of information;
- Shows the basic techniques of effective use of information resources of the Internet;

- Creation of logical connections with other subjects included in the course of secondary education.

Figure 1 Digital learning and methodical complex

Program "Internet Technologies. Fundamentals of WEB-design" includes general informatics elements, elements of WEB-design, and electronic business management elements. Students gain knowledge and skills in working with modern professional PCs and software tools, including disks, scanners, modems, Notepad text editor, HTML - Dream Weaver document editor, Photoshop, and Paint graphic editors.

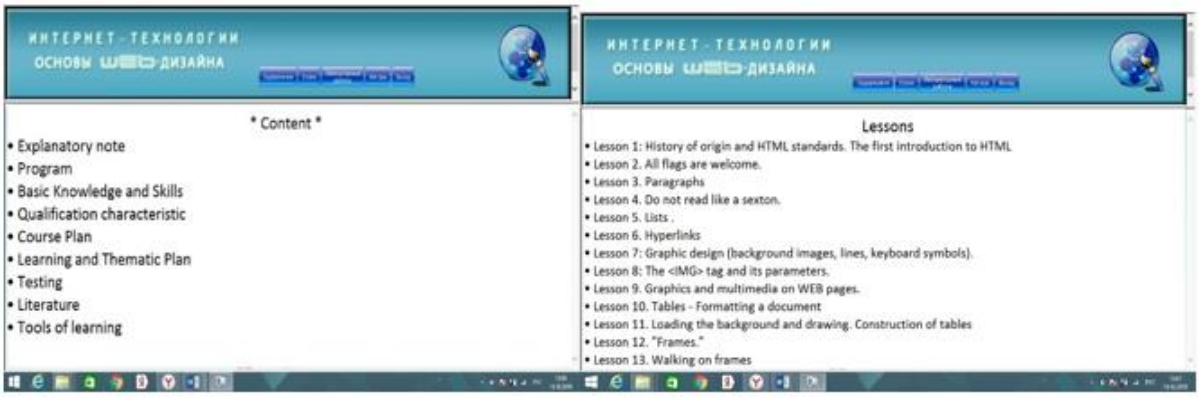

Figure 2 Content of the digital teaching and learning complex

Students should know:

- Features of web graphics.
- Web Design Techniques.
- Professional methods of creating pages.
- HTML language standards.

- The syntax of an HTML document.
- The structure of the HTML document.

To create WEB pages, you can use the standard Notepad program, HTML editor, and other programs specially designed for this purpose. The advantages of these programs include fast visual creation of web pages, even by IT professionals. To learn HTML, high school students should use Windows Notepad, where they write the program's text, save it to disk, and launch the program in an Internet browser. This process of creating web pages is complicated as it requires many intensive intermediate steps. In connection with the above, the author of this manual has developed an integrated framework for developing WEB-pages "HTMLCreate.exe." The program combines a notebook, a file manager (for opening, saving, and launching created WEB pages), a catalog of color constants, and HTML tags with the ability to increase reference data and insert commands from the catalog directly into the program text.

Figure 3 Lessons from the digital learning and methodical complex

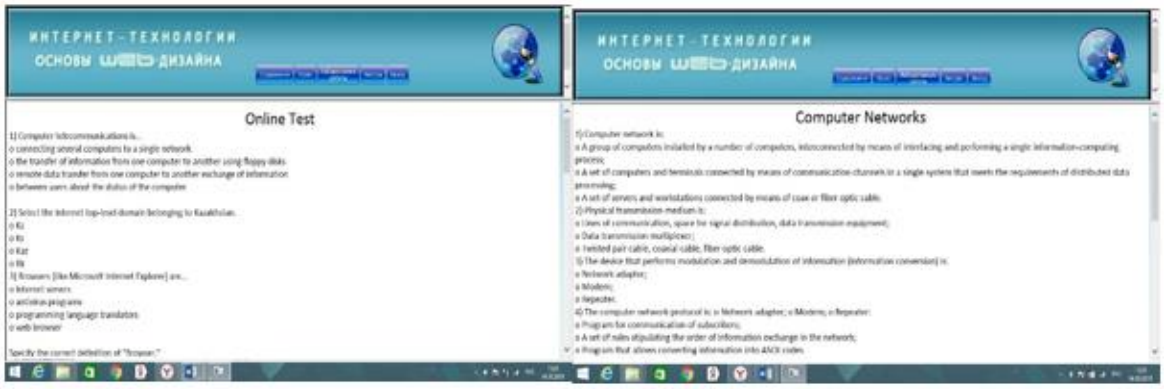

Figure 4 Verification work of the digital teaching and methodical complex

One of the Informatics course's main goals is the formation of practical skills and abilities in the student, which means that the student, in addition to theoretical knowledge in IT technologies, should be able to handle personal computers and work freely with applied

software competently. A student can learn to work in a software environment only in practical lessons. And one of such variants of realization of differentiation training by levels can be used in the application "Google Classroom."

The class helps teachers save time, organize the learning process, and communicate effectively with students. The service is available to all Google Apps for Education users, a free productivity suite that also includes Gmail, Drive, and Docs (Figure 5).

App Classroom allows you to take photos and attach them directly to tasks, share images, PDFs and work without an Internet connection.

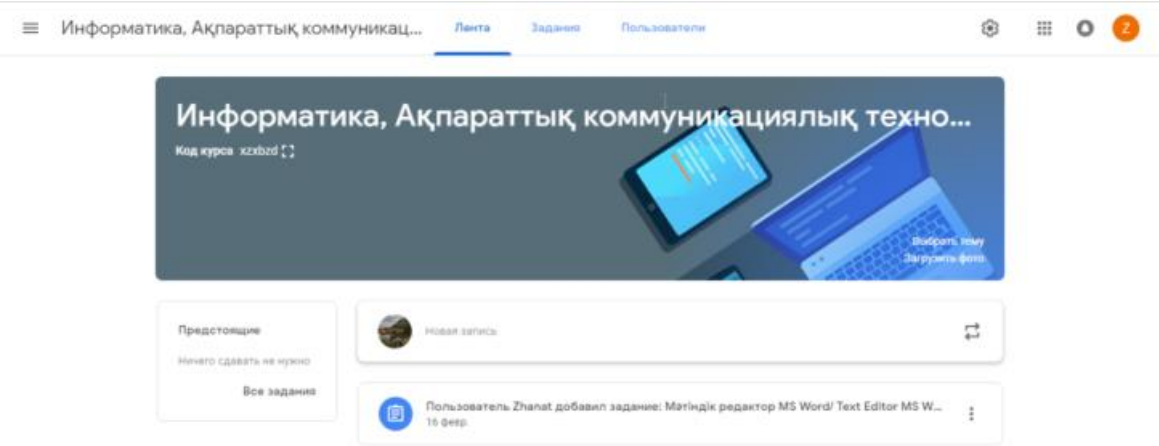

Figure 5 Usage of Google Classroom

Google Classroom features are as follows:

- Convenient addition of students. The teacher can send an invitation to the students for the created course using domain user groups pre-formed by the administrator.
- Collaborative learning - the ability to invite up to 20 teachers to the course;
- Differentiated learning - the ability to create individual assignments for each student;
- Task settings - the ability to add deadlines, change the grade scale and track verified tasks;
- Preparation - the ability to create drafts of notes and assignments or set the date and time for their automatic publication in the course feed;
- Customize Course Theme - Ability to change the default color and themes;
- Student Task Tracking - Google Classroom creates a Google calendar for each course and updates tasks and their due dates. Students can view tasks on the timeline, on the events page, and the course calendar.

- Export Grades - You can export your final grades to Google Sheets or CSV files that you can upload to other apps;
- Google Classroom is also available online, and through the Google Class mobile app for Android and iOS.

However, before introducing this technology into the educational process, one should study the differences between traditional and non-traditional teaching methods (Table 2).

The traditional teaching of a basic computer science course is that teachers work with all students in the same program and use the same tasks for all students (Moiseyev & Stepanova, 2013; Davletova et al., 2017; Nurbekova et al., 2018; Smyrnova-Trybulska, 2017).

Table 1 Comparing teaching methods

Learning process	Traditional	Lesson using "Classroom" service
Lesson management technology	The teacher explains the new material and the students improve their skills.	The teacher directs the students to solve difficult issues and develop their skills.
Learning Technology	The teacher explains the new material and the students improve their skills. At home, the students carry out the tasks themselves.	The students watch the video themselves and prepare questions. The teacher directs the students to solve difficult issues and develop their skills.
Knowledge sharing	Teaching material is being delivered from teacher to student in a passive form.	Knowledge is gained independently with elements of interactive communication.
Technologies	Interactive technologies	Communication, cooperation, partnership
Methods	Differentiated	Differentiated, personalized
ICT	Multimedia and web technologies	Services Office, Google, Web 2, Moodle, etc.
Teaching	Studying the scheme of activity "listen - remember – reproduce." A teacher acts as a mentor, conducts knowledge passing and control, and maintains discipline and order.	A teacher takes responsibility for teaching himself and interacts with all participants in the learning process.
Teacher	A teacher conducts knowledge passing, controls and maintains discipline and order.	A teacher provides the design of learning activities, acts as a mentor.

Based on the table, we can conclude that "Google Classroom" serves as the basis for implementing differentiated, personalized learning; creating conditions for active

learning; using the latest technology and various gadgets. The educational process is organized, taking into account each student, creating conditions for teamwork, developing students' leadership qualities in the framework of academic subjects, and creating conditions for diagnosing the quality of knowledge using computer technology.

The pedagogical experiment was conducted with a common goal: to develop the educational activity of schoolchildren. The particular objectives of the experimental learning were as follows:

- Adjust the content of the educational material included in the students' thesaurus on the topic;
- Define the role of thesaurus components in the educational process;
- Find out the availability of the selected material;
- To study the nature of the influence of the proposed didactic materials on the level of educational activity, the amount of material learned, and information culture.

A learning experiment was conducted to experimentally test the effect of computerized learning differentiation tools on learning differentiation.

At the first stage of the study, a diagnostic experiment was carried out to identify students' computer education, the level of computer science training, individual attitudes, and goals of teaching computer science in general education schools (in the control and experimental groups). At the first stage of the final experiment, the state of computer literacy of students and graduates of general education classes was studied. One of the goals of the modern educational process is the development of computational thinking in students (Heba et al., 2014; Skubała and Smyrnova-Trybulska, 2014).

The purpose of the final stage was to assess the level of students' knowledge of the basic concepts of computer science in traditional education, offering a unique and traditional experience to students:

- The questions below were answered to identify the conditions in which they have studied computer science and determine the future computer science education plan;
- The highest score was given in HTML;
- Students answered a special questionnaire, each answer to which was scored in points;
- For each factor, the points were summed up;

- Obtaining several digital data were checked for normal distribution according to the Cornu test.

Data rows contain values that meet the law of normal distribution of row elements. The obtained data have been processed by the method of multiple and pair correlation (Krupoderov, n.d.).

After statistical processing of data on PC by methods of multiple correlations the equation is obtained:

$У_1$= 6,314953+ 0,486382 x1-1,576093E-04 x2+2,881031E-05 x3, R=0,97

Where R – the total multiple correlation coefficient. The private correlation coefficients were equal to R1=0.99, R2=0.99, R3=0.73 where R1- correlation between y1 and x2, R2- correlation between y1 and x2, R3- correlation between y1 and x3.

Table 2 Results of the student questionnaire

Level of computer education of students	Computer Thinking	Equipment of HT school	Programming language skills
$У_1$	X_1	X_2	X_3
70	39	56	58
36	20	26	35
30	25	74	98
42	31	58	58
38	17	44	50
12	22	38	55
62	23	46	67
18	20	40	40
14	30	47	57
12	31	26	39

Based on the value of individual correlation coefficients, it can be concluded that x1 and x2 play a more significant role in the formation of computer education than the factor x3. It suggests that the most important thing when studying computer science in school is computer labs and knowledge of programming languages, not computational thinking. When defining computational thinking, the ability to turn on a computer and a local network, load Windows, compose Basis and Pascal programs, search and run the necessary programs, work with a text editor, graphics, music editors spreadsheets, and databases.

The dependence of the summary factor (y1) on the factor (x1), (x2), (x3) were tested by the pair correlation method. The researches have shown that each factor separately

insignificantly influences the generalizing aspect, about what small correlation coefficients speak.

The tables summarize the data for schools. The questionnaire showed that the study of computer science in pedagogical colleges, lyceums and other secondary educational institutions is on a low level and does not allow making certain conclusions about computer science. The dependence between x1 and x3 factors, between x2 and x3, expressed in fractional and linear functions, shows that there is a certain connection between the mentioned factors, which needs to be studied in more detail. The values of correlation coefficients within the limits of 0.6-0.8 speak about it.

Table 3 Correlation factors

Factors Dependence	Value of correlation coefficients
$У_1$from x_1	0,24
$У_1$from x_2	0,36
$У_1$from x_3	0,29
$X_1$from x_2	0,42
$X_1$from x_3	0,60
$X_2$from x_3	0,80

The research stage of the experiment was carried out in classes with students of 10-11 grades of secondary school. The task of the search stage was the development of individual methods of teaching computer science, correction and preliminary verification of the availability of educational materials.

In some works (Krupoderov, n.d.; Kommers, 2000), it is noted that the greatest importance among the individual features of students in the teaching of computer science is related to the subject. The best way to take into account the attitude of students to the study of computer science is independence, a voluntary choice by students of the level of study of the subject, that is, level-based differentiation or differentiation by the level of exactingness (Kasymova, 2018; Mukanova et al., 2018; Davletova, 2019). In the educational experiment, there was an increase in students' interest in the subject.

At passing to the second operating system in most cases, some transfer of knowledge from the previous operating system was observed. The main attention was focused on identifying how HTML differs.

In the course of the training experiment, preparation work was carried out to create an explanatory dictionary of topics familiar to students from the lectures. The task of developing practical management skills was set at the laboratory lessons. For this purpose,

students were offered to do laboratory work on HTML. Experimental training was conducted over several years. In particular, the topic was "Web Design. Basic Technology", which combines a reference book, a simulator and an examiner in one program.

The last time high school students were selected as experimental groups. The total number of students and the indicators of the groups are relatively close in terms of such characteristics that are significant in teaching computer science:

1. Attitude to the topic.
2. The level of development of logical thinking.
3. The level of independence.
4. Performance.
5. Speed of work.

The learning experiment's main objective was to teach students using a computer science thesaurus and to reveal the effectiveness of the student's thesaurus model as a means of learning differentiation.

Over the entire period of the experiment, the sample included at least 500 students from secondary schools of the West Kazakhstan region and Uralsk. The obtained indicators of experimental learning did not differ by more than 15-18%. Here are the data from the last series of experiments.

When dividing the groups into different parts, forms, and degrees, we proceeded from the hierarchy of factors obtained in the publication according to the significance of the impact on learning productivity (Marhel, 1990).

- Interest in learning is 92%, that is, the first place.
- Attitude to learning. The needs to learn - 91%, that is, the second place.
- Ability to learn - 90%, that is, the third place.

As a result of the questionnaire for differentiation by levels, the groups of students were divided as follows:

1. Knowledge correction group - 150 people.
2. The minimum required level is 100 people.
3. Advanced level - 30 people.

1. Knowledge correction group - 200 people.
2. The minimum required level is 60 people.
3. Advanced level - 10 people.

When dividing into levels, the following condition was imposed on the students.

In order to achieve different levels of teaching computer science at school and other goals and opportunities for mastering the subject in the future, there is a need to differentiate education.

Based on your abilities and goals, please define your level of study "Web design. Fundamentals of Technology". The requirements for you will correspond to the level of study of the topic you have chosen: the assessment is carried out for knowledge within the selected level framework, not for the selected level.

So, choose your level of study on the topic:

1. Knowledge correction group.
2. The minimum required level.
3. Advanced level.

The construction of educational material for the allocation of three levels of diffusion was carried out at three levels of the formation of academic activity - reproductive, adaptive, and reflexive.

With the group of correction of knowledge, additional work was done to eliminate the backlog on previous topics and smooth the work's pace with the team of the minimum required level. For this, consultations and independent work of students in a computer class were carried out.

The methodology for working with this level consisted of an integrated approach to studying a student's thesaurus on the previous topic (principles of building and operating a computer) and its interaction with the topic "Operating systems". Both oral consultation and work with literature and work in a computer class with a program that implements a reference book and a simulator on OS were used. Individual and group forms of work were combined.

At the first (reproductive) level, students were offered a vocabulary (for identification) and a paradigm for one operating system.

At the second (adaptive) level, students were asked to learn the vocabulary, vocabulary, and paradigm of one operating system (RT11) and migrate the language to another operating system.

Table 4 Results of the experiment

Components of personal development	Experimental Group						Reference Group					
	low		average		high		low		average		high	
	before the ex	after the ex	before the ex	after the ex	before the ex	after the ex	before the ex	after the ex	before the ex	after the ex	before the ex	after the ex
Motivation	25		70	65	5	35	20	15	73	74	7	11
Logical thinking	25	5	65	75	10	20	18	14	71	79	11	7
Self-Determination	17	7	69	78	14	15	16	16	72	81	12	3

The carrying over is marginal when identifying secondary features and attitudes. Working with the paradigm within the second (adaptive) level creates favorable conditions for carrying out the transfer to another OS.

During the learning experiment, the first and second levels studied first OS RT11, the third level - at first OS, refer to the application 4. Then the carrying over to the third level was carried out at the will of students who have successfully mastered RT11, and those who have mastered MS-DOS to study RT11.

The experiment involved a group in which a partial thesaurus model was functioning. At training in this group, the dictionary and lexicon on RT11 were used.

At learning on all three levels, students were given an opportunity at an individual tempo of transition from one level of learning activity to another.

The criteria for transition to the second level were acceptance, mastering, and awareness of the guidelines in the dictionary and paradigm of RT11.

For transition to the third level, the following were taken into account:

- The use of criteria for the second level.
- The ability to transfer to another operating system.
- The ability to set goals independently, plan the training work, determine the ways of action, make adjustments to their own training activities.
- The ability to carry out the transfer of knowledge and ways of action on another operating system.

During the training experiment, the following transitions were made:

- From first to second 13 people, that is, 50%.
- From second to third 8 people, 14%.

So, a total of 35 people made the transition to a higher level of assimilation, which is 64% of all students participating in the final stage of the experiment.

The final stage of the experiment (teaching) set the following tasks:

1. A comparative analysis of the availability of differentiated and standard approaches in teaching the topic.
2. Studying the possibilities of using the developed thesaurus model in computer science teaching.

The training on this topic was carried out using a computer as a tool for differentiation of learning (skills and content) and, at the same time, a trainer. It is possible to draw a conclusion about sufficient efficiency of using a computer and a computer program for differentiation of learning on this subject, as well as about the real correlation between indicators of learning tasks and creativity.

The results of the experiment on reproducing and creativity of students learned by the suggested method for 6 months after passing the topic to find out the degree of absorptive knowledge of the studied material showed that the average index of reproduction (appreciation) was 95%, and the average index for creativity was 80%. The results of the experiment allow making a conclusion on sufficient efficiency of using the computer and the computer program for differentiation of training of the specified subject.

Differentiation of learning assumes:

a. Providing for the needs and opportunities of students in the teaching of a specific subject.
b. Realization of the principle of correspondence of the level of knowledge, skills, and abilities to the requirements of higher education institutions.
c. A definite gradation in the level of complexity of the educational material.
d. Diagnostics of the level of knowledge and readiness to learn a new subject.

The following data were obtained on the average level of students' assimilation of the material of the school computer science course (Table 5).

Table 5 Results on the average level of students' learning of school informatics course material

No.	Computer Science Sections	Correct answer rate
1	Information and information processes	50,6
2	Computer	43
3	Modelling	32,4
4	Algorithmizing and programming	50
5	Information Communication Technologies	34,1
6	Telecommunication	57,4

The results of this analysis are reflected in the chart shown in Figure 6.

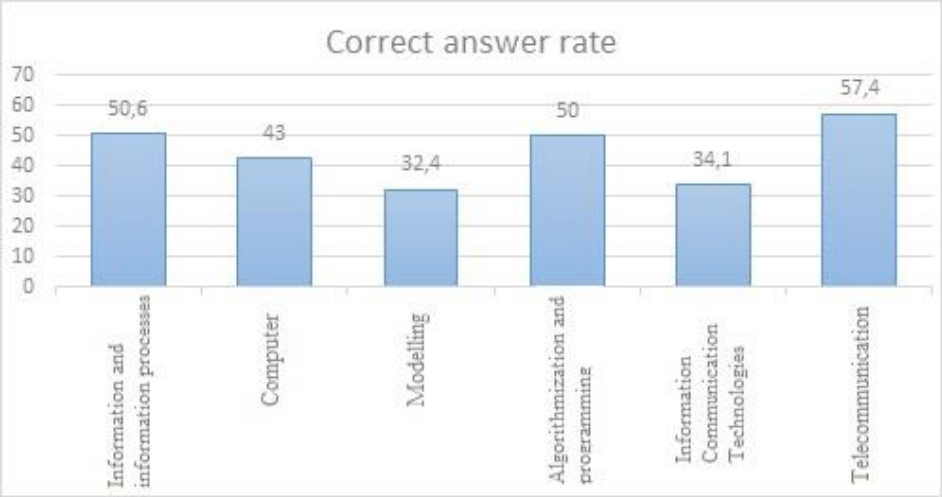

Figure 6 Diagram showing the test results

Research has revealed that the worst learning outcomes are shown under "Modelling" (32.4%), "Information Communication Technologies" (34.1%), and "Computer" (43%). Good material assimilation under the sections "Information and information processes", "Algorithmizing and programming", "Telecommunications". For example, the school program of studying the topic of MS Excel goes no further than charting, at best. In general, yesterday's pupils can perform addition and subtraction in MS Excel. Most of them have no idea how to use even the simplest functions; 90% of first-year students have not even heard about data filtering, summarizing, consolidating data, and finding optimal solutions (Moiseyev and Stepanova, 2013). Analyzing the study results, we can say that there is no continuity in the school-university system in the course of disciplines related to information technology.

Informatics as a subject of study offers especially great opportunities for realizing the differentiation in learning caused by it:

- First, the potential of information technology brought by informatics into the learning process.
- Secondly, broad interdisciplinary connections of this academic discipline.
- Thirdly, a significant applied component of education content is information technology tools and ways of using them in various spheres of human life, a natural sphere of differentiation of the content of education.

Conclusion

The use of level differentiation of informatics in teaching at school and university, based on students' diagnosis and readiness for learning, can improve the quality of education and, thus, significantly increase the level of knowledge, skills, and abilities of students required for learning. It is necessary to balance students' knowledge through the introduction of differentiation technology by levels as a means of successful learning. And for the implementation of level-by-level differentiation, the use of cloud technologies in the educational process will make the learning process more effective and exciting. Teachers will receive a useful tool for building an individual learning path.

The study results confirm the validity of situational hypotheses, the correctness of conceptual provisions and allow us to draw the following conclusions.

The results of the study led to the following conclusions:

1. Differentiated learning in the context of digitalization of education can be considered separation, stratification, dividing the process of transferring and assimilating knowledge, skills, and abilities into different parts, forms, and levels according to the level of development of students. The main functions of the means of differentiating education are to ensure work with conditionally changeable information, a variety of the educational process, as well as to ensure mental development:

- The didactic capabilities of the digital educational and methodological complex as a means of differentiating learning are as follows:
- To implement the differentiation of teaching with the help of goals, content, methods, forms of teaching, adequately to the holistic education and educational process.
- To consider the components of differentiation of learning within the framework of a systematic approach, taking into account the components of the educational process

(goals, content, methods, forms), since the variables are taken individually or in aggregate.

- To consider the differentiation of learning at a quantitative level (the number of differentiation options, the probability of possibilities, obtaining statistical data, predictive data).
- To vary the components of the educational process following the levels of learning and personal development of students.

2. The digital educational-methodical complex as a means of differentiating teaching in informatics includes teaching materials that reflect the content of teaching and technical means that provide this content as necessary conditions for differentiating teaching. The teaching materials are developed at three levels, each of which is built on the principle of "enriching" the educational material, sets goals, and includes specific incentives and motivation by students' development level.
3. The methodology of using a digital educational-methodical complex as a means of differentiating training reflects the components of the learning process: target, stimulating and motivating, informative, operatively active, evaluative, and result-oriented.

In the course of experimental training, it was revealed that the technique of using a digital educational-methodical complex is used, which implements a phased differentiation of activity.

The experiment results make it possible to decide for the sufficient efficiency of using the digital educational-methodical complex to differentiate teaching computer science.

However, the study does not claim to disclose this problem entirely. Scientific and practical interest for further research is the possibility of using a digital educational and methodological complex to differentiate education.

The research results were reported at the 7th International Scientific Conference "Trends and Innovations, Business, Education and Security." The scientific internship made it possible to study teaching methods used in foreign countries, collect materials on the research topic, and conduct various scientific, methodological, and experimental approbations. Also, it contributed to the establishment of scientific contacts for joint research between L.N. Gumilyov Eurasian National University and Bratislava University of Economics.

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