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# Using Educational Technology in Applications as Element of Teaching for Special Disciplines

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**ABSTRACT**

The relevance of research problem due to high growth of information technologies roles in industrial activity and low level of teachers professionalism in topics related with information technology. Purpose of article is to show main components of a learning technology aimed at improving level teachers skills to solve didactic problems associated with computer technologies and issues in field of IT private industry. Main strategy to resolve of this problem are: system and activity approach, which allow model a structure activities of future specialist and activity model which required for learning technologies working with application programs (AP); hermeneutic approach which allows to establish a system of semantic interpretation of the conceptual apparatus of the user interface taking into account the level of users ' perception on different levels of using of applied programs; integrative approach which establish a single semantic component for group of disciplines related to information technologies, allowing to optimize learning process inside framework of application software that underlies this technology. In article presents main components of a learning technology, which works with application software: diagram of activities, which works with PC in office, methods of formation of conceptual apparatus in the field of creation of AP algorithms, minimizing of users algorithms. Article will useful for IT teachers, which implement program of preparation of bachelors of vocational training (by industry), as well as business coaches, which will be create a instructional card for user training.

**KEYWORDS**
Education models, instructional maps, IT in education, vocational training of bachelors

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## Introduction

Fast development of information technology in modern society has led to a situation of active development of information technologies by teachers in field of design, economic and engineering sciences. Permanent using of personal computer (PC) affect activity of the teacher in role of a subject teacher or didact.

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This fixed in standard of professional learning teacher and in Federal state standard of higher education in direction of training 44.03.04 "Professional training (by branches)".

These standards describes a teacher activities in General terms, whereby there is a need for a detailed study of the activity of the future teacher in order to reflect all points of interaction with a PC in the learning process and to prepare educational trajectory.

This is necessary to ensure the realization of work functions for future teachers that involve use of a PC for maintenance and development of software and for methodical support of educational disciplines. Statistical studies data shows that teaching staff are currently insufficiently complies with the previously mentioned requirements. This trend is marked by russian (Bykov, 2008; Gendina, 2015; Dudina, Khamatnurov & Trubetskaya, 2016)) and foreign researchers (Surej, 2015; Oyarzo, 2011).

Development of techniques of IT learning for future teachers of special subjects separately were not considered, although there is a sufficient number of Russian developments on the methods of teaching information technology. We reviewed methodological developments many authors, like M.P. Lapchik, I.G. Semakin & E.K. Henner (2005), L.I. Doliner (2004), I.V. Robert (2010), E.S. Polat & M.Y. Bukharkina (2010). Works of above mentioned authors reflect general aspects of learning information technology in education.

For solve a professional problems associated with the use of a personal computer, it is necessary that at the starting level, all students possess identical vocabulary. It is necessary for implementation of modular technology in educational process (Zeer & Streltsov, 2016). The basic principle of this concept can be modify, to deepen and reinforce that lead to creation of information blocks in accordance with hermeneutic approach. In this article, we propose to consider learning technology for using of application program. This technology is a shifting experience of educational process in organization, which accounts pedagogical, but also psychological aspects, humanistic approach, as well as peculiarities of formation of conceptual apparatus in this subject area.

## Materials and Methods

### *Research Methods*

During research, following methods used: theoretical (analysis, synthesis, simulation, thought experiment); diagnostic (analysis of results, statistical method); experiential (projective method, surveys, questionnaires); experimental (method of observation); methods of mathematical statistics and methods graphical display of results.

### *Experimental Basis of Research*

Experimental base of the research was Russian state vocational pedagogical University.

### *Stages of Research*

The research problem consisted of 3 stages:

First stage - there was held the analysis of learning technologies and of results of their application;

At second stage was used project method as a way of increasing the level of awareness in the development of software for pedagogical purposes;

Third stage - we introduced concept of perception levels in project activity and peculiarities of its use taking into account of hermeneutic approach.

## Results

### *Heuristic conditions defined*

Main objective of research was creation of such learning technologies work with application programs that would operate on the level of ideology in didactic engineering (Choshanov, 2013). In this case, student will study not only conceptual apparatus of application interfaces, but also features of its description in learning materials.

### *Selected methods suitable for research*

For develop of methodological aspect of the technology has been used the hermeneutic method, which describes transition from simple to complex when using applications programs. At time of researchers was used system-activity techniques, which allowed the researcher to study a student model, a model of trainee and potential activity of student in future workplace. Excluding this component from educational technology, we will always get critical feedback from employers saying that student are poorly prepared for practice.

The integrative approach allowed us to focus on content of disciplines predecessors, starting with the discipline "Informatics". The progressivity of our technology is that we are expanding the range of applications of knowledge to students. At time of using extended conceptual framework for training of new teachers, we are expanding use of knowledge in the application of specialized software for organization of educational activities for both part-time and distance learning.

### *Definition of procedural aspect of research and creation of scheme of technology introduction in educational process*

Discipline "Information technologies in education" initially designed for providing knowledge to students about how to create software and methodical complexes for educational purposes, and how create methodological tools to organize information and training activities. However, to explain education technology with using of application programs, teacher needs to apply specialized knowledge. It is desirable that teacher know basics of adaptation software program to level of student's literacy.

Within discipline "Information technologies in education," student must create a project that is a final product considered in this study. Inside project, future teachers will be acquainted with technology of instructional cards that contain an algorithm-specific function used for application program.

In terms of psychology of perception any process of obtain of knowledge have a bifurcation basis. Therefore, process of knowledge reproduction takes time. The bifurcation process was described in works of L.I. Doliner (2004), where there was an indication on mandatory use of modular technology within adaptive methodical system. It is expected that student should be prepared to write programs and poses of knowledge related with PCs by natural language.

The student must be able to work with application algorithms, when using concepts defined by PC interface. Such a relationship of knowledge and action describes in works of G.A. Atanov (2001). Through previously mentioned connection implemented by a set of practical student knowledge.

Fast development of distance learning has led to emergence of new didactic materials associated with mastery of new information technologies. Especially sharply, this question will be in the field of economy and management, because this sector is fully computerized. Some authors have following views on issue of computerization in education: Educational methods (educational technology) in collaboration with latest educational tools and objects have well-known expansion of process quality. Cybernetic technology operating in field of education requires a number of conditions leading to restructuring of instructive content. The last factor leads to that learning process acquires a features of technology service (Chapaev & Weinstein, 2007).

Modern vector of studies in education field aimed at independent work of students, which considered an important factor of personal work. Role of students' independent work has been highlighted in numerous articles. Most relevant is the work on the organization of activities in the framework of the competence-oriented approach. The authors of the method examined the quality of the acquired knowledge, creation of individual educational trajectory and development of self-government students education process (Ualiyeva & Murzalinova, 2016). In our study, we make an attempt creation such element for educational technology, which will use tests for self-control of students and e-learning modules for updates of missing knowledge.

Thus, this research work has been oriented to combination factors, which will have a positive impact on improving the quality of didactic developments made by future teachers.

## *Definition of technology's basic models*

The leading method in this study is systemic-activity approach. Analysis of method to instructional design was discussed in a previous article (Neupokoeva & Chapaev, 2016). Method includes application of following principles of selection of material, with emphasis on models analysis:

— Model of student activity (Figure 1): Student activity in IT education is considered as a system of interrelated elements that can be represented in the form of a diagram. The aforesaid elements constitute a system, interrelated to students competence of secondary specialized educational institutions, future employees and mid-level professionals;

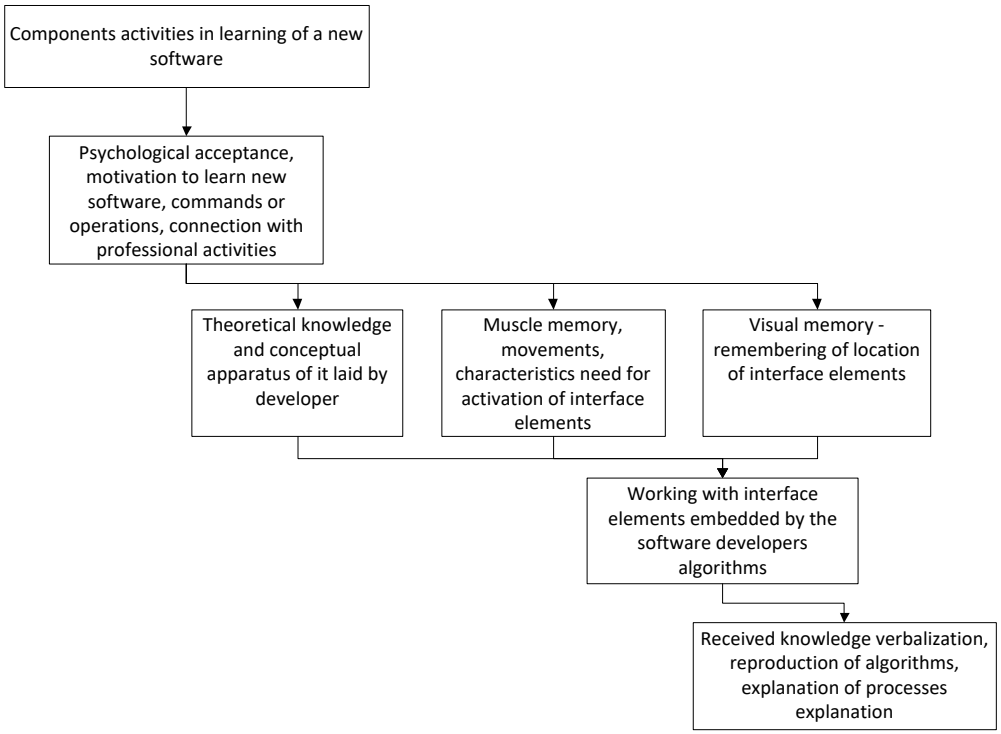


**Figure 1.** Activity model of process of developing a new software

— Model of Creativity (insight). Student is regarded as a complex psycho-physiological system. Knowledge accumulation process regards as system capacity, which led us to assumption that with onset of knowledge assimilation begins process of revitalization of the whole complex of learned material. Under certain conditions, this process leads to reconsideration of knowledge system. This process can be called insight, since it activity equal to a pedagogical creativity.

— Office workers and mid-level professionals models (Figure 2). This model analyzes structure of activity of mid-level professionals, whose training will be provide by a teacher trained under the direction 44.03.04 Vocational training (by branches);

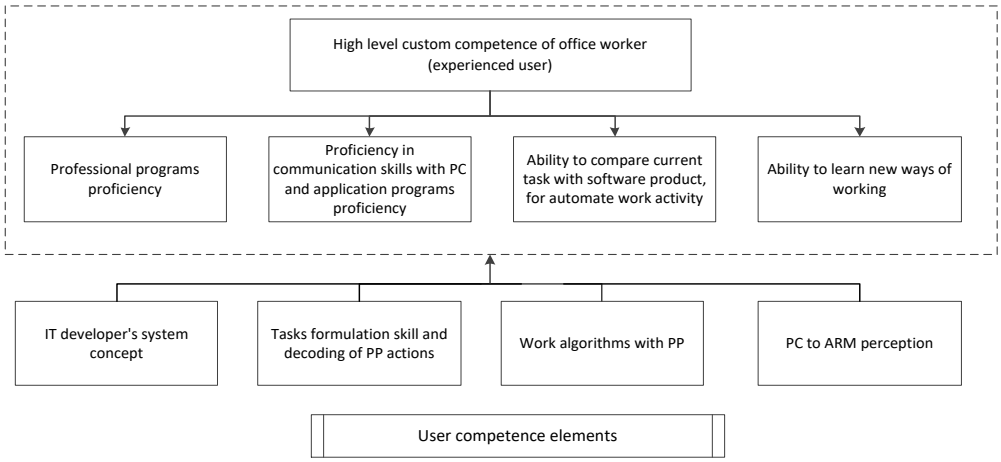


**Figure 2.** The relationship of IT training and it basic components in office work of staff member

— Model of education technology. Teacher model need to build on a worker's activity model. This model should be focused on early formed components. Model should be have a selected targets, methods, forms and means. For the model it is necessary to develop educational methods and new software.

— Model of project activity. It is necessary to develop project activities of future teacher. It is important to describe each component of project technology.

— Thus, creation of models of activities of students, based on real patterns of professional activity, allows to clarify substantial part of elements represented in this program. Studying publications on this subject, especially want to highlight an article that raises issue of formation of competencies required at workplace (authors of article call this type of competencies as a "competence at work") (Verbitskaya et al., 2007). This article said that the development of competences at work is a result of solving non-standard, irregular, excessive task. We propose to solve with the students such tasks, maximally facilitating the path to their solution. Such an approach will lead to universalization of approaches to formation of internal structure of competencies, gradual formation of system elements and primary skills, gradual sophistication of educational and project tasks.

## *Refine contradictions on which built hypothesis*

After analyzing activity patterns of all subjects of learning process with regard to projection of competence in the future, it can be argued that in the scheme there are elements that affect on activities in educational space. Examples of such elements are: knowledge about application areas of PC, their verbalization, besides implementation of professional activities. In fact, we are trying to understand how future teacher will be talk about his work with software and what a terms he will be use during theoretical explanations. Is there a similar problem?

Therefore computer competence of special subjects teacher should include more disclosed components in direction of language skills, ability to generate algorithmic chain of actions adapted for different levels users.

Consider skill level from psychophysiology point of view. Level of competence in Federal state educational standard implies a willingness to formation of professional competence of worker (professional) appropriate qualify level (PK-34). The standard requires shaping skills with a personal computer for office workers in terms of a shared network space. Skill should include a well-developed conceptual apparatus and ability to shape instructional card for PC users.

The problem of computer competence development among teachers and students was raised both in Russian and foreign publications.

Consider a concept, which, in our opinion, is most controversial choice in information educational technology – "the intuitive interface". This term means that user can understand interface alone, but, as experience shows, an action logic of software product is clear not always. The article states that creating a UI, developers use their own ideas about design, assuming who will be their end user (Mercado & Chavez, 2015). This approach imposes restrictions on design menu and main buttons. The articles emphasize importance of studying typology of users, which gives opportunity to more fully take into account the perception of end user. Indeed, traditionally developers and authors of educational books divide users into beginners, intermediate and advanced classes.

Since importance of study IT conceptual apparatus often questioned, we must refer to publications describing long-term goals of professional education. For example, authors N.K. Chapaev & O.B. Akimova (2012) emphasize deep integrative nature of pedagogical impact, and acmeological basis of professional training framework. Thus, it is important that future teachers themselves had a custom culture that would give them opportunity to demonstrate a high level of PC skills.

In previously mentioned issue was discussed in Russian and foreign publications. Thus has been described the fact that teachers of special subjects dont' have a good command of personal computer at the user level. Didactic activities present the most difficulty for teachers at time of using PC systems. Many teachers have are serious problems with conceptual apparatus of UI. The latter suggests that teacher can show any UI element but cannot describe it using natural language.

When teacher uses PC in educational process, he must consider following group factors:

– for explanations he must use conceptual apparatus of study of interface of application program;

– for implementing of synchronous operation concept it is desirable to give students a printed version of algorithm with additional conceptual and illustrative material.

Custom algorithms must be adapted to the user – if a software product has been studied and exanimated, it instructions for expert users must be on a higher level than instructions for novice user.

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Also teachers of special subjects will be faced with resistance from students. This resistance caused by fear of new and confusing terminology, which software developers "impose" to users. Computer anxiety and learning difficulties of novice users (especially for complex applications) described by foreign researchers (Surej, 2015). Analysis of research in learning systems has given the opportunity to hypothesize about the importance of user acceptance of new technology. One of the new factors of effectiveness is computer self-efficacy, which enhances user confidence to PC. The reduction of computer anxiety can be achieved only if a systematic approach to this issue with evolving of methodological support for novice users.

The problems of teachers' user competence, which is often defined as information-communication competence, lately have been widely considered in publications, in particular S.A. Bykov (2008) views ICT competences of the future elementary school teachers as an element of the easier integration into professional sphere as a mean of easing the professional adaptation.

O.B. Akimova (2011) pointed out the following: the study and generalization of teaching experience of communicating with virtual environments and informational-computer technology (ICT) research results, as the factors, stopping the development of information-communicative skills, were both the low proficiency with PC and the low motivation to use ICT, the lack of standards for ICT skill levels in the educational institution, the lack of instructions on using the new information technologies. This shows us that it's crucial to work with all aspects of the education process creation system – from motivation to the level of preparing instructional maps.

Foreign author's publications point out, that it's essential to differentiate teachers' and students' competences and focus on: for the students to become "experts in studying", for the teachers to become "experts in teaching", which will help the students "for life" (Oyarzo, 2011).

This publication goal is to show that our hypotheses are actually based on factological data. For example, preparing the students for the individual work of creating instructions maps, can be reinforced by the idea of education organizations', that have prospects in developing a general information foundation for conducting educational process, network communication (Akimova & Dorozhkin, 2015) in developing remote and digital education, which requires advanced computer technologies competences.

Elementary users often ignore the conceptual apparatus of working with PC, demanding to be taught the actions, that can be blindly repeated later on. But as J. Apps (1991) pointed out, it's important to teach not what the audience asks, but be ahead of the curve and teach them what they might require in the future, not only here and now. This aspect is especially crucial for teachers, who are transmitters of knowledge. Even if the planted into the teaching method idea of sharpening the skills to transmit PC working knowledge is long-term, isn't this trait characteristic for all branches of pedagogy?

This idea has been developed by E. M. Dorozhkin (2006), who pictured the situation of preparing a narrow specialist-contractor, who is unable to adapt to "the constantly changing technical and social-economic situation in the society.

After covering the key aspects, that motivated us to start this research, we consider the key elements of the method in the next block.

## *The elements of suggested technology – picking for, means, approaches and teaching methods*

It's essential to use the following forms of organizing students' activities during their education: tests for self-control, oral advocacy, tests on practical-laboratory works and final control after completing the blocks in the form of tests. Self-control tests have a special role. As the experience of implementing self-control tests into the educational process shows (both conducted in the classroom and given for self-study), big numbers of question forms coerce students to re-think the majority of clichés, that have already formed in regard to informational technologies conceptual apparatus, practical software products especially.

While picking the tools of education we have to settle for a combination of visual methods and written instructions, oral control and test covers, e-books and educational websites. Our goal is to familiarize the students with various types of providing information, so it's easier for them to create didactical materials by themselves in the future.

In the process of education we picked personality-orienteered method with coaching elements. It's essential to develop a student's personal educational program together with him after identifying his baseline knowledge.

After that it's important to create an "equalization" atmosphere on the group, using specific methods. For example a ban on helping neighbors by interacting with their mouse and keyboard directly works well. Only the oral explanations and instructions are permitted.

Basically we practice all types of personal computer skills, trying to form an environment as close to work conditions as possible, where the competent professional's prime qualities are independence, preparedness to enter the production cycle, communicate with his colleagues, an ability to use program means in education or any other vocational activity. It's especially important that the teacher is able to use the software on a high professional level. Considering the teacher's competences from pedagogical acmeology point of view, we can assume that our students can face teaching adults too, in which case their qualification must be high, so it's our responsibility to establish the base of that qualification. This topic is touched upon by N.K. Chapaev & K.V. Shevchenko (2012). They point out the different edges of low qualification problems and outline the acmeological importance of the present problem, raising a question of creating an educational technology, which implies the use of pedagogical program means, informational-subjective environments with integrated educational technologies. However the question immediately arises: who exactly will create the informative part of the educational courses, develop the instructional part and generate the elements of profile-oriented tasks. Most likely those people are our current students, who come to get the basics of science-intensive technologies, to cultivate self-education skills and to form an idea about the qualification level, based on the teachers qualification, the requirements and the difficulty levels of completed tasks.

## *Research stages, in-between conclusions and hypothesis*

Also, according to out practical experience (the observation had been conducted for 3 years), the more computer disciplines before the educational project are conducted using this method, the higher percent of students realize the practical part of the tutorial.

The work on forming the hypothesis of the project started in 2010, when using the traditional method of teaching the basic ways of applying information technologies in education we got unsatisfactory results with regard to their attendance, the quality of realized projects in terms of pedagogical design and the commitment of students.

In 2011 the accent was for the first time shifted from studying the technology of information technologies application in education to the technology of an individual project as a fragment of the training resourse complex of the professional cycle discipline creation. The stage showed satisfactory results, our hypothesis proved viable – the projects' quality rose from the pedagogical design point of view, the amount of material became satisfactory, and the students showed readiness to fix the flaws of the project. In total the amount of students to reach medium and high grade increased by 30%. For comparison before that only 2-3% of the students reached the medium grade, the rest would settle for the lowest passing grade.

In 2012 the experiment was conducted. Its main goal was to determine, whether it was possible for the students to take interest in personal formulation of user algorithms, e.g. to pick a computer discipline as their project's discipline. During the experiment we found out, that 50% of members in 2 groups started their work on the practical part of their information technologies projects. More than a half of them coped with their task.

In 2014 we hypothesized that the students could formulate the algorithms for user work by themselves, when the content of all the computer disciplines were integrated, where the process of introduction to the rules of formulating user algorithms would be the core. The sets of didactical developments were created and work in the classes were organized so, that the direction of educational process shifted from students' introduction to practical interface actions to the gradual involvement into the process of replicating, not only actions with a program, but replicating the algorithms with desirable verbalization of knowledge system. Без переосмысления разбить на меньшие части и не потерять смысл нереально, а так получилось очень уж громоздко

30 % of students successfully coped with their respective projects, if they had at least one predecessor discipline, which means they were prepared for project activities. 50 % of students were able to creatively revise existing algorithms, borrowed from the global web. Only the small percent of students were not prepared for the project activity, most of them were so-called foreign students.

However the students, who never worked using this method previously (in different disciplines) showed much worse results. There were cases, when even having sufficient OS Windows interface knowledge, the students couldn't formulate the simplest algorithms by themselves. So, the results of the discipline showed that in that case the percent of successful projects dropped to 5-7 %, the percent of revisited already existing algorithms rose to 50%, and the other students couldn't understand the essentials and didn't have a practical part.

By 2015 we hypothesized that it was essential to implement the hermeneutical component, which would let us explain the ambiguity of the approach to creating algorithms for beginners and for advanced users, in the discipline, and which is designed for serving the tasks of students' information technologies in education teaching. So the data we got, while implementing this idea, showed that this kind of information simplifies the instructions creation, and overspecification of instructions is not valid.

The implementation project activity results showed, that the students project work intensifies when they work with the projects, that contain a part requiring independently working on the informative part. We also hypothesized that the work with conceptual apparatus of information technologies should be practiced separately, so we added a new section to the discipline, designed for studying the conceptual component in the area of interfaces' definitions. The conceptual apparatus and speech constructs, used for describing the interface are very specific, and the phrasing is primarily algorithmical, so it's essential to explain the patterns of using those constructs. So we approach the hermeneutical component of working with computer algorithms.

Unfortunately the experiment also uncovered the following problem. The teaching staff of the department was unready to support the crosscutting interdisciplinary training which was most likely caused by the department's high average age. The study shows (Oyarzo, 2011) that higher age qualification negatively influences the acceptance and use of computer technologies by the teaching staff. It influences "Information technologies in education", where WEB 2.0 is used, the most.

Thus, current work considers an individual case of the system-activity approach. A creative process transformation into a technology, an object of

didactical engineering without which, as M.A. Choshanov (2015) noted, its widespread use is impossible, gives us the opportunity to replicate the current toolkit. That would be impossible within the limitations of the standard approach, and only the system-activity approach makes it possible to widen the disciplines' meaning field to sensible limits of integration. This allows us to optimize the teaching in such a way, that the level of the informational competence completion becomes possible to identify.

As a result, during the experiment (from 2010 to 2016) in which was based on observation method we identify the following:

The higher the independence level of a didactical project preparation, the more the student is involved in the process of content preparation, with regard to the market level of electronic developments for studying quality.

When raising the level of independence we can set a new quality of works bar – creating instructions for using practical software for students

It's important that we receive a program-methodical complex as a result of our project work, which is based on integrative activity, and can actually show the level of proficiency in a variety of competences. In particular this is written about by the authors of the research, dedicated to the evaluation of professional activity – the same competence can be developed in the process of studying different disciplines, that's why for the evaluation of competences development level interdisciplinary approach is required. However it's essential to consider the organizational side of education technology, informational support (Leontyev et al., 2016). Practically, this research only solidifies the accuracy of interpretation of the experiment's results.

### *Results of research*

By the end of the primary stage of research methodological materials for various user levels formulation instructions were formed. Also, the methodological materials for the future educators were developed, that are to help them get acquainted with the folding of speech constructs technology. A set of examples was formed and a number of methodological tutorials were created, allowing to realize the projects with integrated content, designed for the basic notions of the course drill based on disciplines-predecessors: digital textbooks, test blocks with the accent on tests with self-check.

The projects are also unique in a way, that the use of creative component, which also allows us to determine the student's readiness (at this point) for completing the tasks, such as designing, adaptation and execution of a set of didactic means (Federal state educational high education standard, 2015).

## Discussion

There are plenty publications and textbooks about the methods of informatics teaching. Notable authors: M.P. Lapchik, I.G. Semakin & E.K. Henner (2005), E.S. Polat & M.Y. Bukharkina (2010), I.V. Robert (2010), L.I. Doliner (2004).

One of the most notorious works in the field of teaching information technologies methods is M.P. Lapchik's, I.G. Semakin's & E.K. Henner's (2005). The textbook reviews informatics teaching methods for general education middle schools. Many aspects are usable for higher education. The authors thoroughly

studied all the primary informatics matters in the area of applications for the basic level of understanding of the material. However it's evident that the school student and university student have a different level of proficiency in information technologies knowledge and skills. These authors' methods don't take that into consideration.

L.I. Doliner (2004) outlined a model of the adaptive methodological system, That reflects processability of the teaching process, gives the opportunity to empathize the modularity, and gives the possibility to create an individual educational trajectory. Practically we completely agree with all the author's ideas, however during the experiment we found some patterns which we defined as illustrative-explanatory problems – how to teach the students themselves to build a modular system in the process of education.

I.V. Robert (2010) describes pedagogical software as the important part of the informatizating education system, the creation of classification of pedagogical program means and methodological side of instrumental program means application are accentuated. What's important to us is the author's accent on practically programmed education even though it's never declared. This very part is important today, and we encourage the students to realize it as a fragment of program-methodological complex.

It should be noted that our design differs from the other authors' in the following way: it realizes another methodological approach, another edge of technology, with an accent on teaching users with the emphasis on gradual folding of the linguistic constructs in the area of conceptual apparatus of applications interface; it lets us optimize the process of user manual reading and facilitates the studying of technical literature. Basically we search for the solution to the lacking computer competence problem by reinforcing the work with the meaning/essence. It will help us to educate experienced and confident users, who should be the majority in universities and companies. Hence our technology in no way copies other authors' research.

## Conclusion

Conducted research allowed us to form the following summary:

1. It is possible to determine a set of parameters reflecting the peculiar properties of learning the applications as a technology with innovation elements.

2. It is possible to form the students' vision of building educational modules principle with regard to hermeneutical method which helps to accelerate the learning process.

3. The use of the integration principle gives us the opportunity to employ additional time reserves, assists with the higher-difficulty projects completion and aids with their realization.

4. The use of systematically-active principle helps with the improvement of the organizing the educational trajectory process and enables the modification of educational technology, conduces to the expansion of goals.

5. The use of hermeneutical method stimulates the new aspects of educational technologies uncovering, at the same time it simplifies the process of some patterns of user algorithm formulation explanation and facilitates the regularization of the content, increases the illustrativity of data.

## Recommendations

The paper is of value to high school teachers, engaged in future special subjects educators training, and for improving the skills of pedagogical staff with the focus on special subjects teaching technologies.

## Disclosure statement

No potential conflict of interest was reported by the authors.

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