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THE INFLUENCE OF HIGH TECHNOLOGIES ON THE FORMATION OF HIGH-ORDER CONSCIOUSNESS

Introduction

The formation of a critical mass of able-bodied population that owns modern technologies (at least, at the user level), able to use them effectively to achieve success (in professional and economic terms), and competently managing both technologies and themselves (their business, work), is one of the conditions necessary for a technological breakthrough. In this regard, today, the question of what features of thinking are important for a person to become more popular and to adapt easily to the dynamically changing conditions of life is becoming urgent. Novikov writes that the dominance of certain characteristics of an individual's thinking is determined by the type of leading activity or the type of organizational culture. The historical sequence of changes in these types explains changes in society as a natural evolution of technology: traditional › corporate craft › professional (scientific) › design and technology (Novikov 2008, pp. 15-16).

Active discussions on the development of a new type of thinking in the educational systems of many countries emphasize the importance such changes not only for society, but also for education systems waiting for at least a rough description of the desired portrait of the "hero of the future", so that they can begin to build learning technology adapted to the goal.

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Problem

This article raises the problem of identifying the relationship between the development of high-order thinking in individuals and high technology, as a factor determining this process and future prospects for the development of education systems.

Methodology

Ten years ago, reflection was the defining feature of modern thinking: "critical thinking", "reflexive thinking". However, M. Lipman, the founder of the Institute for the Advancement of Philosophy for Children (IAPC), trying to explain the value of critical thinking development in the course of learning how to be independent in analysis and decision making, postulated new requirements for learning, expressed in the rejection of reproductive technologies. In one of his papers, he introduced the concept of "higher-order thinking". The concept differentiates between lower- and higher-order cognitive skills depending on the complexity, scope, and organization of the field of activity, recognition of causal or logical necessities, and qualitative intensity (Lipman 1991, p. 94). This concept may have been derived from the theories of higher-order consciousness (higher-order theories of consciousness) explaining the nature of conscious states, i.e., seeking an explanation that makes mental states conscious mental states.

Focusing attention on the need to realize automatically perceived objects is not a new idea. In the works of S. L. Rubinstein, the concept of "thinking 'is defined' ... as the movement of thought, revealing the relationship that leads from the individual to the General and from the General to the individual. Thinking is mediated-based on the disclosure of connections, relationships, mediations – and generalized knowledge of objective reality" (Rubinstein 1989, s.361).

The authors of this article believe that a new understanding of the theories of higher-order consciousness were rather suggested by the teachers who tried to instrumentalize this concept to obtain the desired result. Bloom (1994) demonstrated this through the pyramid chain of building educational goals to the desired abilities of students. But the form of the pyramid was changed following social values transformation. The pyramid built by Bloom was revised under the influence of changes in the attitudes to sociocultural processes that occurred in the second half of the twentieth century. While in 1956 Bloom (1994) considered development, i.e., changes that occur under the influence of learning, as the peak of human evolution, in 2000, the peak was creativity, the ability to create. The activity approach, which began to dominate in the second half of the twentieth century, has influ-

enced the views of representatives of the cognitive direction in psychology and pedagogy. Those representatives could not end with the study of changes that occur under the influence of various factors in human knowledge, and preferred to establish the factors through the analysis of the activity products.

The principle of assessing the quality of training has changed as a result of an active implementation of the activity-based approach to the development of thinking in the theory and practice of training. The use of knowledge has become determinative, and its accumulation has ceased to be an end in itself. The revision of the attitude to the purpose of training has led to the transition from the concept of knowledge to that of competence, understood as synthetic qualities that individuals must develop. Therefore, the concept of "high-level thinking" (higher-order thinking skills) has begun to be understood as a cognitive complex which includes the ability to build hypotheses and find the necessary information, analyze and synthesize it, interpret and draw logical conclusions, build evidence, critically process facts, competently present research results (Bradley et al. 2007; Newman 1991). Together, this set shows the level of development of analytical, creative, project, and reflective types of thinking.

Foreign researchers, such as Moti Frank (2006), Jihyun Lee, and Hyosung Choi (2017), are more likely to use the term "higher-order thinking", considering it to be more accurate. Later, the concept of "higher-order thinking" began to be understood as a way of thinking that goes beyond memorizing, reminding and understanding information for the analysis, evaluation and formation of knowledge and artifacts (Bartlett 1982; Newman 1990; Resnick 1987), etc.

As analogous to the concept of "higher-order thinking", Russian scientists developed the concepts of: "engineering thinking", "technical thinking", "project thinking", and "technological thinking". Synthesizing consists in "design, and technological thinking", and as such may be related to the term "thinking of a higher order". The foundation for the concept is the criterion of consistency, focus on self-development of man, his more effective self-realization, and the desire to create something new. One of the embodiments of "new" technologies are modern high technologies.

The concept of "high technology" leads to the comparison with two other types of technology, i.e., traditional and conventional ones, viewed through the prism of the concept of "technology core". In high technology, the core leads to the evolutionary development of the existing system, while in conventional, it only affects operational efficiency. The core of traditional technologies allows the existing system to function steadily, set everyday

tasks, and solve them in the traditional way. The main goal of traditional techniques to preserve the existing forms of systems, i.e., to reproduce known models.

There are different, sometimes contradictory, definitions of the concept of "high technology", but with common criteria for the allocation to this type of technology:

- the level of knowledge necessary for the development of high technologies;
- the efficiency of implementation, causing not only innovation in the field of application technology, but also an increase in economic efficiency.

High technologies change the quality and performance of tasks, information, energy and material flows. They also affect management styles, roles, skills and even organizational culture. These technologies require not only solving different tasks, but also finding innovative solutions, and thus define new criteria for personnel training, productivity, and efficiency.

Results

Educational systems do not keep pace with the revolutionary changes in modern technologies caused by intensive developments in "high technologies". The challenges faced by today's education instigate the search for new educational technologies. In the field of education, technology as a procedural category reflects the specificity of organizational changes in education systems, aimed at achieving specific and potentially reproducible pedagogical results (Mitchell 1978).

Given this, within the framework of the philosophy of technology and education, the concept of "high educational (pedagogical) technologies" can be considered as a determinant of possible forms of radical transformations in education systems that occur under the influence of high technologies being introduced into educational processes. Thus, the emergence of "high pedagogical (educational) technologies" depends directly on the emergence of "high technologies", and their introduction into the educational process significantly changes the scheme of the usual work of the teacher and scientist. Due to their novel character and importance, students' interest in high intellectual technologies increases. Such technologies offer a variety of learning methods that enhance concentration, and allow comparison between new technologies and the traditional focus on the individual aspects of a process (Krasheninnikov 2013).

It can be assumed that the existing delay in training is caused rather by the conservative character of the current system of formation of standards in education, than by the lack of demand for the educational system to directly include high technologies in the pedagogical process. It is also important to realize that only with the growth of the number of teachers ready to use high technology in their teaching practice, who understand the mechanisms of technology functioning and are ready to impart this knowledge to students, can one assume that the quality of teaching activities will improve.

The experiment was conducted at Novosibirsk State Pedagogical University (NSPU) at the Faculty of Technology and Entrepreneurship. It involved the second- and third-year B.A. students of 44.03.04 "Vocational training". There were 136 students in the control and 136 in the experimental groups.

Under current conditions, the most relevant thing is to create a flexible technology for the training of undergraduate students who are ready to perform production, organizational, and design activities in a situation of uncertainty and lack of funds available for its implementation. To solve this problem, it was necessary to analyze the possibilities of the educational process, to find reserves for the development of organizational and pedagogical support for the undergraduate students of vocational training as well as for the development and use of high technologies.

For the effective development of high-order thinking, first of all, it was necessary to change the learning process. In this altered process, the pedagogical technologies based on reproductive learning, typical for the traditional model, should give way to the use of high technologies (Abramova et al. 2017).

For a successful implementation of this condition, the optimal methods of training are "problem search methods of training", in particular, Dewey and Kilpatrick's project method. These methods help update knowledge and skills, form the necessary competencies and apply them to create new ones, increase the activity and independence in the choice of solutions, and initiate search activity. In the project method of training, the trainee recreates the activities carried out by a specialist in development technology, i.e., B.A. students master all the stages in the process of obtaining a new solution and developing technology for its implementation.

Also, one of the important organizational and pedagogical conditions for the introduction of high technologies in vocational training was the revision of the content of disciplines and their technological support, and consideration of the potential of interdisciplinary connections. The use of science-intensive technologies actualizes students' knowledge and skills obtained in

different disciplines, which causes the general creation of prerequisites for more conscious material perception and activation of search activity.

Another significant organizational and pedagogical condition is the creation of a favorable communication environment. In such an environment, the process of learning has a collaborative character, and the teacher and the B.A. student co-create each other. To solve this problem, it was necessary to revise the model of interaction between the teacher and the B.A. students. The model should help implement an individual approach by providing opportunities to determine the means and methods of training tailored to each student's interests and inclinations, as well as by enhancing independence in the application of high technology in the learning process.

The development and implementation of the structural and functional model of organizational and pedagogical support for the process of the B.A. students' professional training contributed to the synergetic effect of the implementation of the above-discussed organizational and pedagogical conditions. In this article, a model is understood as an artificially created sample that reflects and reproduces in a simpler form the structure, properties, interconnection, relationships between the elements of the phenomenon (or object). The need to develop a model results from the need to ensure the relationship between the organizational and substantive components of the educational process.

The target block of goals and objectives is the first structural element of the model of organizational and pedagogical support for the professional training of the B.A. students of technical profile at NSPU. The purpose of the development and implementation of the model is: the creation of conditions for preparing B.A. students of vocational training to the use of high technology. In the course of constructing the course of vocational training, pedagogical principles were taken into account, i.e.,: consistency and logicality, individualization of training, focus on practice-oriented learning.

Based on the identified conditions and principles, the following stages were performed regarding development of the content and organizational and pedagogical support for the professional training of the B.A. students' of technical profile who use high technology:

1. identification of the structural components of the content of training, based on the analysis of federal state educational standards of higher education, which allow revealing the value of high technologies and including them in the process of training;
2. identification of a variety of high technologies to optimize the learning process and to create conditions allowing students to achieve a creative level of professional training;

3. development and implementation of integrated courses, training and methodological support, selection and use of methods, forms of training;
4. diagnostic stage, i.e., intermediate and final control to provide feedback and obtain data on the success of the introduction of high technologies and ensure the quality of professional training for the B.A. students.

The content component of the model provided not only for the definition of implemented copyright courses that have an integrative nature, but also for the definition of principles, forms and methods of training. The next stage of revision of professional training, namely the organization of didactic processes, is according to V. V. Guzeev a "fragment of the educational period, characterized by the parameters of the educational process: ways, methods, means and elements" (2001). The purpose of the article is not to describe the selected methods, means and methods of training, it should be stated, however, that problem search methods, the heuristic research, etc., were identified adequately to the nature of the mastered technologies. Such an identification helped activate the B.A. students, increase their motivation, recreate the stages of research activities related to the development and implementation of technologies.

A three-part model, i.e., theory, abstraction (modelling), and design, was used in the process of drawing up the training courses. This distribution helps functionally and meaningfully determine the goals, objectives, the venue of the educational course, as well as the controlling materials that could be used in the final certification. The theoretical course is focused only on the description and identification of the evidence proving the existence of relationships between study objects. The course is focused on the construction of abstract models, including the creation of a formalized model reflecting the object of study on the basis of identified relationships. The third component involves the use of the results of theory and modeling to obtain practical results.

The criteria for assessing the effectiveness of the training in the use of high technologies on the B.A. students were differentiated into the following groups:

1. to determine the level of high technology ownership,
2. to determine the level of the training in the use of high technologies in vocational training for the B.A. students.

The differentiation was based on the activity approach. The assessment of technology proficiency suggested the answer to the question: "can a B.A.

student of vocational training use this technology in various activities and at what level?".

The organizational and pedagogical support for the training in the use of high technology for the B.A. students of vocational training was developed and tested at NSPU. The quantitative and qualitative analysis of the results of the implementation of the organizational and pedagogical support led to the conclusion that the process of the B.A. students' training enabled the creation of conditions for enhancing their readiness to develop and use high technologies. The students who participated in the experimental training achieved good results at the International Youth Competition "Future Aces of computer 3D modeling" in St. Petersburg; the 3rd Junior Hi Tech Skills National Championship within the 3rd National Championship in end-to-end working professions in high-tech industries implementing the method of World Skills Hi-Tech in Ekaterinburg; the all-Russian Student Olympiad with international participation in engineering and computer graphics in Novosibirsk; the all-Russian student Olympiad in robotics for pedagogical universities in Krasnoyarsk, etc.

Summary

The results of the study allow the conclusion that B.A. students of vocational training at pedagogical universities can and are ready to master high technologies. The level of technological training can be improved through the optimal organization of the educational process, created as a result of the introduction of the developed organizational and pedagogical support. It was also found that the development of high technology has significantly influenced the development of design and creative thinking, which are one of the main components of high-order thinking. This, on the other hand, justifies the conclusion about the existing relationship between the development of high thinking and students' ability to master high technology.

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Keywords: high-order thinking, development of thinking, education system, digital technologies.

The authors address the problem of the development of high-order thinking. The article offers an overview of approaches to actualizing the transformation of the concept of reflexive design thinking to higher-order thinking. The authors concluded that society's demand for higher-order thinkers can be solved by reviewing the construction of the learning process. This hypothesis was tested on the example of the B.A. students of vocational training at Novosibirsk State Pedagogical University (NSPU). The results of the experiment led to the conclusion about the possibility of using high technology as a factor contributing to the development of high-order thinking (including self-consciousness).

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WPŁYW TECHNOLOGII ZAAWANSOWANEJ NA KSZTAŁTOWANIE MYŚLENIA WYŻSZEGO RZĘDU

Słowa kluczowe: myślenie wyższego rzędu, rozwój myślenia, system edukacji, technologie cyfrowe.

W artykule autorzy zajmują się problemem rozwoju myślenia wyższego rzędu. Tekst zawiera przegląd podejść do transformacji koncepcji refleksyjnego myślenia projektowego na myślenie wyższego rzędu. Autorzy doszli do wniosku, że droga do odpowiedzi jak zaspokajać zapotrzebowanie społeczeństwa na osoby o wysokim poziomie myślenia, rozpoczyna się od analizy procesów uczenia się i nauczania. Hipotezę tę przetestowano na przykładzie grupy studentów Państwowego Uniwersytetu Pedagogicznego w Nowosybirsku. Wyniki eksperymentu doprowadziły do wniosku o możliwości zastosowania zaawansowanej technologii jako czynnika przyczyniającego się do rozwoju myślenia wyższego rzędu (w tym samoświadomości).