VI International Forum on Teacher Education

Specifics of Formation and Development of Students' Independence in the Digital Educational Environment

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Abstract

The relevance of the study of the problem of formation and development of students' independence is due to the active formation of the digital educational environment in the conditions of unknown consequences and risks of students' adaptation to the conditions of life in the digital world.

The purpose of the study is to identify the risks of students' adaptation to the conditions of life in the digital world in the context of formation and development of their independence in the digital educational environment, as well as to search for possible solutions to these problems.

The study was based on the analysis of changes that have occurred in the communication sphere and educational environment due to the widespread use of electronic means of communication and information technologies. The solution is being searched when students activate the reserves of various models of information perception.

The paper discusses the trends and consequences of the students' constant use of information support of the Internet, which ambiguously influences the development of their creative abilities. The study also revealed changes in the content and the transformation of teachers and students' ideas about self-educating activities. It states the problem of formation and development of students' autonomy in a digital learning environment.

Aiming at solving the identified problem, the materials presented in the paper allow us to offer not only interactive opportunities and a variability of tasks aimed at the subject-oriented motivation of students, but also the use of material sign-symbolic models that require individual manipulative activity. The authors developed the method of using contour objects and models, the scale and design of which provide for various operations with them using fingers, which helps to concentrate students' attention on their actions with objects. They also initiate individual creative activity and independence of actions.

Fragments of training programs were prepared; experimental courses were conducted in the format of additional education in groups of students using specialized sets for constructing sign and symbolic models in the form of contour shapes.

Keywords: independence, digital educational environment, informational tool, motivation, sign-symbolic models, manipulative activity, contour models.

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Introduction

The relevance of the problem is explained by the fact that in recent years there has been an active formation of the digital educational environment. The digital transformation of education is taking place in accordance with implemented global trends and strategic decisions of the government: the national project "Education" (Passport of the Federal Project "Digital educational environment"), Decree of the President of the Russian Federation of May 9, 2017 No. 203 "On the strategy of the information society development in the Russian Federation for 2017 – 2030". In the process of creating a digital educational environment, new learning tools are emerging: informational tools, tools for searching and storing information, communicators, and social networks. Informational tools are constantly updated and new ones are invented, which leads to the appearance of new elements of the educational content, which are mastered by students and affect the content of educational disciplines. That is, under the influence of education informatization, there are not only changes in the organization of the educational process and methods of educational work, but also the formation of new cultural informational tools and the changing content of education.

Russian pedagogical encyclopedia (1993) defines independence as "one of the leading qualities of a person, expressed in the ability to set certain goals and achieve them independently. Independence provides for a responsible attitude of a person to his/her behavior, the ability to act consciously and proactively not only in a familiar environment, but also in new conditions, including those requiring non-standard decisions" (Russian pedagogical encyclopedia, 1993). In Professional Education dictionary, independence is defined as "a personal quality expressed in the ability to think, analyze situations, develop one's own opinions, make decisions and act on one's own initiative, regardless of the imposed views and ways to solve certain problems. Independent actions are effective in the presence of high competence" (Vishnyakova, 2007, pp. 292-293).

The requirement for the effectiveness of independent action in professional education is the presence of high competence. In school education, we do not require students to "have high competence", since it is only being formed in the course of training. This means requiring the students to demonstrate "independent actions effectiveness". Yet the independence of an individual is manifested in initiative, criticism, adequate self-esteem and a sense of personal responsibility for their behavior and activities. Independence is not an innate trait, it can be formed and it needs to be developed. This task has always been relevant in the sphere of education. In the new digital educational environment, we need to be clear about some key questions:

What does independence mean in the digital world, in general, and in the digital educational environment, in particular?

How can independence be formed in a digital educational environment?

What means will be used to create this "one of the leading personal qualities" – independence in the digital educational environment?

In addition to these main or basic questions, which may not have unambiguous "simple" answers, we also encounter some applied questions, such as:

Is searching for a ready-made solution on the Internet considered the student's independent work?

The process of searching for answers to these questions reflects the peculiarities of the students' independence formation and development in the digital educational environment.

Purpose and objectives of study

The purpose of the work is to identify the risks of students' adaptation to the conditions of life in the digital world in the context of formation and development of their independence in the digital educational environment, as well as to search for possible solutions to these problems.

In the paper, we set the task of identifying the features of students' activities in the new conditions of the digital educational environment, their independence development in the learning process and using new informational tools.

The research of students' autonomy formation and development specifics in the new digital educational environment was conducted relying on the analysis of changes in the communication field and in the educational environment due to the wide use of electronic means of communication and information technologies.

Literature review

We understand that the students' activities in the new digital educational environment will be associated with unknown consequences. The changes that are taking place today will have long-term consequences and there is no certainty whether they will be positive. Digital educational environment has a huge potential, but it will be used for the first time, so it will not be possible to compare it with something similar, there is a risk of a negative result. It is necessary to identify and assess the risks and potential problems of students' adaptation to the conditions of activity in the digital educational environment. In addition to problems related to the standards and procedures for the use of electronic learning tools (duration, regulations for its safe use in education, accreditation, and specific features), the introduction of a digital educational environment brings other threats and risks that are not yet fully defined:

- Limitations of space for creativity: difficulties and paradoxical situations contribute to the development of creative abilities (Cutchlow, 2014), but most information technologies exclude the possibility of independence in such creative conditions; electronic versions have software limitations, which can make the students' creativity a template.
- Weak socialization: at school, the child receives not only knowledge, but also acquires friends, learns to interact with the society, in other words, gets into a new society, different from the previous one; isolating the student from the society, the information system significantly reduces the level of his/her socialization, which can affect the further development of the individual.
- Possible decrease in mental activity: when you lose the need to independently extract information, the motivation to think disappears; creative search can be replaced by search activity on the Internet, which potentially leads to a weakening of thinking abilities for the child's developing consciousness.
- Potential problems with physical development: prolonged exposure to screens leads to eye fatigue and neurological stress, poor development of fine motor skills; working with a keyboard and a tablet leads to changes in the physiology (fingers).

- Total control: digitalization of the society will lead to the collection of detailed information not only about the student, but also about the entire family, while the child him/herself will not be able to hide anything from adults — an electronic diary will not allow the pupil to hide the teacher's assessment or comment; a sense of constant and inevitable control will affect the formation of the child's inner world and independence, since in the process of learning, the child must face problems and make independent attempts to solve them in different, even if not always correct, ways.

- Information "infantilism": constant digital control and habitual use of information support from the Internet can lead to a lack of opportunities to express oneself in a free form, not limited by the given digital environment framework, and it can unpredictably affect the development of the student's creative abilities and his/her independence.

Based on the consideration and analysis of risks and potential problems of students' adaptation (children and adolescents) to activities in the digital educational environment, we have come to the conclusion that as a result of the constant use of electronic tools as new conditions of life, there is a problem of forming and developing students' independence. This problem can be split into several aspects:

- weakening of individualization processes in the digital world;
- lack of mechanisms for self-reliance fostering in the context of digitalization;
- loss of independence of thinking or a personal position formation ("digital slavery").

Taking into account these threats or negative trends is in itself the direction of applying the efforts of didactics, methodologists and developers of the digital educational environment (Lyubimova, 2019).

The digital educational environment has a great potential and various tools for developing the student's independence:

- Interactivity of digital educational environment;
- Subject-oriented motivation of the student;
- Variability of tasks (providing individual test works);
- Ability to check and self-check the solution of tasks;
- Safety of virtual work.

In this context, we understand safety more broadly than the safety of the student only: "Virtual reality models allow trainees to safely and without fear of possible mistakes form skills that are fraught with dangers or face other restrictions (availability of equipment, high cost of work, danger to other people, etc.). For example, MR-applications are already used in training in the field of medicine" (Uvarov et al., 2019, p. 160).

Developers of various training portals and platforms are working on the above and other tasks (Volodina & Sholomitskaya, 2019). The main emphasis is placed on the development of students' educational independence in a digital school, on the students' motivation to self-study and ways to organize a digital educational environment.

It should also be noted that in conditions of students' low educational independence, even the use of the best prepared digital educational environment, rich in various opportunities, will not be a sufficient condition for organizing a

pedagogically effective educational process. There is a need for a system of organizing students' activities in this environment, implementing an activity-based approach to learning, as well as motivation, since "the presence of a digital educational environment and digital learning tools alone is not a sufficient means to maintain educational motivation in students with a low level of academic independence" (Blinov et al., 2020, p. 26).

Methodology

The new opportunities of the digital educational environment give a great positive impact on students: its creation, taking into account the specific features of students' communications in the digital world can and should contribute to the development of their independence, using a variety of tools, methods and forms of learning. Following the principle of continuity in the teaching methods development created by classics of didactics (such as Lerner, Galperin, Kraevsky, Babansky), we must observe a reasonable combination of new features of the digital educational environment with traditional methods of teaching. The traditional teaching methods can be implemented more succinctly and effectively using such new features of the digital educational environment as:

- feedback in the process of completing training tasks;
- use of a wide range of social and emotional methods of managing educational motivation, including the use of game entourage (gamification), interaction with partners in the network;
- qualitatively new opportunities for submitting educational material and educational activities organization;
- formation of training teams;
- group discussions;
- scenarios of rapid transition from team to individual activities and back, and many other things that lead to an increase in the degree of intelligence and creativity of the activities performed.

Individual tasks that require the direct participation of the student in the activity, aimed at making the necessary informed choice and addressing the student's personality directly, initiate his/her communication with other students and contribute to the development of independence.

The social and communicative image of a modern person is changing, but biologically the person him/herself has not changed so much: there are still sense organs, tactile feeling, hands and fingers. This provides us with an additional resource for interaction, communication, and support for the student. To strengthen the targeting and emphasize the motive of independent activity, it is possible to use material objects and models in pedagogical technologies: to save time and the pace of learning, they can even be very simple or symbolic.

Depending on the age of students, various objects and tools for modeling and construction can be used as material objects and models. Their qualitative composition can be very different: from counting sticks, sets of modeling clay and various DIY materials to specialized sets for modeling complex objects such as atoms, molecules or crystals. For the full implementation of material objects and models in pedagogical technologies, methodological training is required, which ensures not only the availability and evidence of their use, but also their inclusion in the educational process, which is possible not only in various academic disciplines of primary classes, but also for students of different ages. For example,

multi-functional sign-symbolic manipulative[*] contour models allow illustrating, demonstrating and explaining a variety of topics in certain academic disciplines literally "with the fingers": from arithmetic and geometry, physics and chemistry to history, sociology and social science.

There is a steady tendency to increase the proportion of tasks aimed at developing abstract thinking and, accordingly, to reduce the time for completing tasks for associative thinking when the age of students increases. The accuracy of the model execution of any modeled object requires painstaking work with the requirement of its accuracy maintaining. Yet the goal of this activity is not to develop perseverance, patience or replicative functions, but to create an image, even if inaccurate and even abstract. In terms of "saving time" allocated to work with material objects and models, the emphasis is placed on symbolic models that are quickly assembled and transformed.

The existing subject-oriented pedagogical technologies allow you to use different practices for initiation and indexing of certain elements of independent thinking. To do this, you can use not only material, but also virtual learning tools and models. Activities with simple sign-symbolic models that require the student's personal individualized participation in the educational process have a direct impact on the student's independence development through his/her manipulative activity.

Creating imaginary symbolic models that accompany the fulfillment of individual tasks must be pedagogically verified, i.e. meet not only the subjective characteristics of the student, but also his/her level of mastering specified learning activities.

To test the performance of sign and symbolic models, Kozhevnikov prepared methodological materials in the form of the following programs in the format of additional education: "Game contour constructors", "Game contour modeling", "Curved contour modeling", which were used for training courses using specialized sets for the construction and modeling of curved contour shapes with groups of primary school students.

The experimental bases of the study were: "Vorobiyovy gory" State Budgetary Professional Educational Institution (in 2015-2016) and "Intellectual" School State Budgetary Professional Educational Institution (in 2016-2017).

Results

In the process of studying the structure of flat and three-dimensional geometric shapes, students assembled them or their fragments, parts, or modules, not in the usual form, but in a contour and not always linear form. A simplified flexible extended structural element is the main supporting structure when creating symbolic models of not only geometric shapes, but also any arbitrary study of the subject: plants, animals, household items, any object, including the planet and the solar system (such works were made by students) (Kozhevnikov, 2012; Kozhevnikov, 2020).

To facilitate and master the methods and techniques of working with symbolic models and objects, an introductory course on how to use them was conducted, including the students' study of various types of symmetries when making figures in a convex or concave version (and even a more complicated – ring-sided and wave-sided shape). When using game

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[*] Manipulative sign-symbolic models are material objects and models which scale and construction involve various fingers operations with them. The content and meaning they convey largely depend on manipulations with symbolic models that can be quickly transformed.

technologies, there was a rapid assimilation of the symmetry features of contour shapes and objects. This educational activity was also propaedeutics of studying school subjects related to geometry. The use of sign-symbolic models facilitated the assimilation of more complex educational topics related to the intersection of three-dimensional figures (both with each other, including dual figures, and with a hollow sphere) (Kozhevnikov, 2013; Kozhevnikov, 2015). The use of the tactile mode of perception significantly increased not only the motivation of students, but also the speed of further educational information assimilation.

Discussions

Parents of students are actively involved in solving actual learning tasks. However, in a digital educational environment, the student is more likely to stay in the process of learning facing a monitor, tablet or smartphone. At the same time, he/she is not only highly distracted or deprived of live communication (online communication can hardly be compared to that), but also is subjected to the challenge of attention scattering to other functions of a smartphone or another digital device that are not intended for specific training.

Considering the issue of students' communication and independence, we come into close contact with the problems of "computer addiction and games addiction". These problems generally remain unresolved and continue to deepen. While the development and improvement of smartphone features have turned them into a source of quick information and tips, ensuring that users are represented or constantly present in social networks (and online games). The problems of computer and games addiction are significant, although they are not a direct subject of this study. However, in a situation of such communications' domination in students we see the background to mitigate the isolation of a human personality and, as a consequence, manifestations of his/her autonomy as the conditions of the individual maturation.

According to Prof. Borovskikh: "Independence is formed as a result of students' overcoming certain problems in situations of choice, in situations of activity-based conflicts – conflicts of motives, requirements, conditions, etc. Such situations, of course, can occur spontaneously, but they can also be specially organized as a pedagogical tool. It is in the latter case that we can talk about teaching independence and discuss the technology of construction and pedagogical support of such situations as a pedagogical technology. Unfortunately, currently there is no such technology or any system of introducing independence in our pedagogy. Therefore, whether we want it or not, it will still raise slaves – slaves of machines, slaves of knowledge, slaves of computers" (Borovskikh, 2015, p. 9). This acute problematic reflects the relevance of the problem of independence all over the world. It is also supported by the modern mass media pressure on the student's psyche. Its impact, in the words of Delokarov, is terrible: "The media is a mirror of the complex and contradictory processes that are taking place in the country ... we deal with the cynicism and irresponsibility of the content of those programs that fill TV screens every day and are the most influential component of the younger generation's worldview formation" (Delokarov, 2007, p. 169).

In the conducted experimental courses, various materials and kits for modeling and construction were actively used, but the main emphasis was placed on symbolic contour models. This reflected the task of forming the students' image of the object being studied using easily and quickly assembled contour models. As noted by Zinchenko, "the eye moves along the contour and there is almost no movement on the surface of the figure. The eye builds an image, an internal model of the shape of the object under consideration" (2017, p. 52).

Conclusion

A variety of contour models were used in working with students: some of them were illustrative, drawn or shown on a monitor, but mostly material models were used. This is due to the fact that the subjectivity of models perception and their symbolic character contribute to fixing attention on the surface and even inside the constructed object. The subject who deals with them – the student – finds him/herself in a dialogue with him/herself, with the actions of the fingers. In this action, the student is for some time distracted from social communication and "receives an invitation to one's inner world".

Through the use of sign-symbolic contour models, we achieve that the student finds him/herself in a dialogue with him/herself, his/her consciousness and the actions of his/her hands, which draws attention away from social communication and directs it to his/her inner world, initiating creative activity. For this purpose, we used not only virtual, but also material means of teaching, in particular interactive models and teaching tools that require personal participation of the student in the educational process, appealing directly to the individual or his/her subjectivity.

The implementation of a student's personal-oriented participation in the educational process can be implemented not only with the help of various organizational forms and information tools (reports, presentations, project activities, "inverted learning" and others), but also with the use of material sign-symbolic models that require individual manipulative activity from the student.

Acknowledgements

References:

Blinov, V. I., Bilenko, P. N., Dulinov, M. V., Yesenina, E. Yu., Kondakov, A. M., & Sergeev, I.S. (2020). *Didactic concept of digital professional education and training*. Moscow. Retrieved from https://firo.ranepa.ru/files/docs/spo/cifrovaya_didactika/pedagogicheskaya_koncepciya_cifrovogo_prof_obr_i_obu ch_jan2020.pdf

Borovskikh, A. V. (2015). The computer and the void, or to the problem of independence in the issue of computer slavery. *The Moscow University Bulletin. Series 20. Pedagogical Education, 2*, 3-10.

Cutchlow, T. (2014). *Why some kids try harder and some kids give up*. Retrieved from https://www.huffpost.com/entry/why-some-kids-try-harder-and-some-kids-give-up_b_5826816

Decree of the President of the Russian Federation No. 203 (2017, May 9). *On the strategy for the information society development in the Russian Federation for 2017-2030*. Retrieved from https://base.garant.ru/71670570/

Delokarov, K. Kh. (2007). *Synergetic paradigm. Synergetics of education*. Moscow: Progress-traditsiya.

Kozhevnikov, D. N. (2012). Use of game design and modeling for the development of children's cognitive abilities. *Primary Education, 6*, 36-43.

Kozhevnikov, D. N. (2013). Game contour modeling for propaedeutics of studying school disciplines of the natural science cycle (geometry and basics of stereometry, physics, chemistry). In *Proceedings of Moscow Interregional Scientific and Practical Conference "Game and Modern Social Conditions of Its Development"*. Moscow.

Kozhevnikov, D. N. (2015). Using modeling in training in the context of understanding and mastering the complexity category. *The Moscow University Bulletin. Series 20. Pedagogical Education, 3*, 21-34.

Kozhevnikov, D. N. (2020). The value of model visibility tools in the organization of educational and cognitive activity of primary school children. *Primary Education, 1*, 21-26.

Lyubimova, V. V. (2019). *The main directions of digital educational environment development*. Retrieved from https://nsportal.ru/sites/default/files/2019/10/17/1osnovnye_napravleniya_razvitiya_tsifrovoy_obrazovatelnoy_sre dy.pdf

Passport of the Federal Project "Digital educational environment". Retrieved from https://edu-frn.spb.ru/files/iiMBxQ4cNH1BCsaWn2WqDgFinWeU3rVYpmO6sd33.pdf

Russian pedagogical encyclopedia: In 2 vols. (1993). Moscow: Bol'shaya rossiyskaya entsiklopediya.

Volodina, M. N., & Sholomitskaya, A. V. (2019, March 18). *The development of academic independence by means of the digital environment* [Video]. YouTube. https://www.youtube.com/watch?v=NztFUeI-ugU

Uvarov, A. Yu., Gable, E., Dvoretskaya, I. V., Zaslavsky, I. M., Karlov, I. A., Mertsalova, T. A., … & Frumin, I. D. (2019). *Difficulties and prospects of digital transformation of education*. Moscow: Higher School of Economics Publ. House.

Vishnyakova, S. M. (2007). *Professional education: Dictionary. Key concepts, terms, relevant vocabulary*. Moscow: NMTs SPO.

Zinchenko, V. P. (2017). *Perception and visual culture* (A.I. Nazarov, T.G. Shchedrina, Eds.). Saint Petersburg: Tsentr gumanitarnykh initsiativ.