

The Role of Information Technologies in the Development of Creative Thinking in Gifted Children: Pro ET Contra

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Abstract- The article is devoted to the analysis of ambivalence of the role of information technologies in the educational process. On the one hand, a gradual transition to digital learning is inevitable. Instead of traditional static teaching materials, the so-called dynamic educational materials are widely used in the process of teaching gifted children. It is difficult to overestimate the impact of technologies on innovations in the education system and on development of new ways of learning. Nevertheless, the impact of the use of multimedia teaching materials and digitalization on the development of creative thinking of gifted students is an urgent issue. It is especially important that in the scientific literature there are data from specialists studying the cognitive characteristics of children and adolescents of the “generation of gadgets”, from which it follows that excessive informatization is able to change students’ cognitive profiles and to form a special way of thinking that impedes the development of creative component, especially its non-visual side. High levels of digital workload can lead to attention deficit, hyperactivity, learning disabilities, and even to a number of autism spectrum disorders. Thus, for gifted children there should be created a special educational environment in which the positive aspects of informatization are used most efficiently and the negative ones are prevented and neutralized. On the example of N.V.Lobachevsky Lyceum (Kazan Federal University), the authors consider one of the strategies for organizing such educational environment.

Keywords: information technology, creative thinking, gifted children, cognitive style, digital education.

1. Introduction

In schools, modern information technologies are used to a greater extent in the educational process, the influence of which is ambivalent: on the one hand, they bring the quality of subject teaching to a new, higher, level due to the individualization of materials and approaches [10, 18]; on the other hand, a high level of informatization and automation of the educational process in some cases can influence negatively the development of creative approach to solving problems. This leads to various discussions in the educational environment such as a) the appropriateness of using tests with variants of answers and test system in general as measurement materials; b) the pros and cons of online courses and virtual environment of learning; c) the development of so-called “clip” thinking in a new generation of children, which arises from a decrease in the ability to think creatively, to analyze the results because visual information and hypertext technologies form a specific cognitive profile; d) the risk of development of different disorders connected partially with high digital workload during the educational process [16, 19, 20].

All these questions acquired special significance for the educational process, especially for gifted children, since modern information technologies in special schools (especially mathematical lyceums) are the leading educational tool. We should work out a model which helps to use these tools with benefit without depriving students of the ability to think creatively and comprehensively and without any other cognitive problems connected with e-learning. This issue in the modern digital environment is relevant for students, teachers and parents, it touches upon secondary and high schools first of all, but primary schools and kindergartens face with it as well.

2. Materials and Methods

The research was conducted at N.V.Lobachevsky Lyceum (Kazan Federal University) within the project connected with creation of optimal educational sphere for gifted children by means of new forms of intra-school control and in the laboratory "Clinical Linguistics" (Kazan Federal University) in the frame of the series of projects connected with speech and developmental disorders in children [3].

The authors used the methods of empirical research – observation and comparison. The specificity of the studied material led to the application of the methods of pedagogical monitoring and specific tests, such as The Torrance Test of Creative Thinking (TTCT), Index of Learning Styles (ILS) – as well as analysis and synthesis.

3. Results

The literature review shows the ambivalent nature of using electronic media by children and adolescents. On the one hand, researchers show that computer technologies and personal gadgets can optimize the processes of training and even the processes of diagnosis – for instance, prognosis of psychiatric disorders through personal gadgets [6], on the other hand, it is underlined that the usage of electronic media in children can provoke developmental disorders (such as ADHD – Attention Deficit & Hyperactivity disorder [5,9,15, 25]). The American Academy of Pediatrics continues to be concerned by evidence about the potential harmful effects of media messages and images, and several researches about how ASD is associated with screen use and exposure are conducted in Germany [13], USA and Israel [11]. According to H. Bruggeman’s et al. research, frequent use of digital media by young children (9-12 years) has an adverse impact on their psychological status, but the mild use of such media has very limited effects in this respect [2] – so it is necessary to use the pros and minimize the contras.

N.V.Lobachevsky Lyceum at Kazan Federal University uses modern methods of developing creative thinking in gifted children:

- a) the use of *virtual educational environment (e-learning)* for the development of creative thinking in accordance with the recommendations of foreign researchers who have identified mechanisms by which the virtual environment can be used effectively for these purposes [4, 12, 24];
- b) the definition of *cognitive profile* of students in order to determine the individual strategy for the development of created thinking according to his/her learning style;
- c) the implementation of the elements of the *reverse engineering* methodology – it develops creative thinking, visual-spatial gnosis, the ability to analyze using different points of view;
- c) *multisensory lessons* that are aimed at including all the human senses in the process of mastering the topics – this is feasible in a virtual environment;
- d) *the project approach*, which includes not only the student conducting research activities under the guidance of school and university teachers, but also further protecting the project results both as part of school lessons for discussion with classmates and at research conferences for schoolchildren and students;
- e) the methodology of *problematic training* which is included in the educational process. This methodology has been actively used in Russian education since the 1970s, but in N.V.Lobachevsky Lyceum it is transformed according to new information conditions.

So, in N.V.Lobachevsky lyceum the validity of control and measuring materials used in the educational process is measured using appropriate tools, including statistical data processing; an individual approach to the formation of a set of tasks for each student both in the learning process and in the control process is carried out using automated methods and software.

Due to the high percentage of the contribution of information technologies to training at the Lyceum there was also developed a program for transforming intra-school control in order to increase the level of self-awareness and self-regulation among students, which made it possible to balance of “automatic” and creative in the educational process. The main directions of the transformation of training and monitoring system were identified taking into account the requirements of the Federal State Educational Standards to the results of the development of educational programs of primary and secondary general education:

1. Changing the nature of intra-school control: traditional, functioning, gradually, in several stages, reformed and reached the level of *reflective*, which makes it possible for students to develop self-esteem and self-analysis of their strengths and weaknesses, successes and failures.
2. Stimulating students to *systematic self-development* and achieving success in learning through their own efforts and their own motivation as part of the implementation of creative tasks. Creative thinking and creativity do not remain “overboard” in the educational process at the lyceum and are subject to the same monitoring with the formation of a further development plan, as well as educational subjects.
3. *Individualization and differentiation* of diagnostic and control procedures – this is a good way to direct automated systems specifically to the development of the creative component of thinking due to the ability to select tasks in accordance with the cognitive profile of the student, and to differentiate them according to the principle of developing missing knowledge, skills in the learning process, as well as on the principle of selecting the most relevant indicators for a particular child in the control process.
4. Implementaion of international instruments for *assessing the quality of education* (PISA, TIMSS, etc.) into the structure of assessment procedures and intra-school control.
5. Meta-subject and personal learning outcomes are included in the composition of measured indicators, which allows motivating students to develop creative thinking.

4. Discussion

The impact of technologies, e-learning, internet and digital methodological approaches in transforming education is huge and contradictory. It touches upon higher, secondary and even primary education. However, the questions whether this impact a) does not influence negatively on the learning abilities, b) can really lead to

meaningful learning; whether traits such as creativity (creative thinking) can be developed with the help of these new types of learning are still being widely researched and debated.

In order to prove or disprove different statements regarding creative thinking, it is necessary to use modern tools to diagnose its level in students in the educational process. The Torrance Test of Creative Thinking is actively used in USA and European countries. It consists of Forms A and B. The Form B is written and the most appropriate for the secondary school. It evaluates fluency according to the number of interpretable, meaningful and relevant responses; flexibility according to the variety of categories of relevant responses and originality according to the number of rare, original responses [8, 23]. Also Index of Learning Styles (ILS) is actively used – it is based on the Felder-Silverman [17] model of learning styles and implies the following styles: active–reflective, sensing–intuitive, visual – verbal and sequential – global. It is proved that the use of multimedia technologies develops creative thinking in students with an *active, reflective, intuitive* and *visual* style of thinking [8]. So it is necessary to work out other appropriate, less multimedia, technologies for the representatives of other style – first of all it leads to the need to identify the cognitive profile of students, which is practically absent in Russian schools. This approach allows teachers to avoid the negative influence of digital technologies on the developing brain.

5. Conclusions

The role of information technologies in the development of creative thinking in gifted children have positive sides and different risks which can lead to the negative consequences including attention deficit, developmental disorders and decrease of psychological well-being. That is why in modern digital education a reasonable, well-thought-out and based on psychometric data balance of the inclusion of information technologies in the educational process, especially in the formation of creative thinking, is urgent.

A successful modern student cannot rely solely on knowledge of digital technologies. He/she needs such skills as non-standard problem solving, creative thinking, a high level of written and oral communication in his/her subject area and the ability to work in a team [14, 21, 22]. The development of creative thinking is studied separately when teaching STEM areas (science, technology, engineering, mathematics) [7], for which special master classes and learning environments, virtual laboratories are developed (for example, Second Life), which use the latest technologies, such as “investigation” lessons in virtual space, etc. [1].

Diagnostic tests show that a) work with cases in the frames of problem education by gifted students positively affects the scale of their creative potential; b) problem-based learning has a significant effect on the development of creative thinking in the virtual sphere, and this advantage must be used in the modern educational information space. It should be noted that information/digital technologies play an important role not only in the process of learning and self-development, but also in the process of intra-school control and self-control.

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