Developmental Teaching and Learning Technologies

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Abstract

This research investigates the theoretical and practical issues related to the theoretical analysis of the problem of developmental teaching technologies, characterizes the main goals of developmental teaching, specifies the hypothesis, selects the content of education, determines the features of the development of critical thinking in students, and studies in detail such pedagogical technologies as portfolio, pedagogical workshops, and game technologies. The research gives a concrete methodological description of the methods of various technologies: developing critical thinking through reading and writing, portfolio, pedagogical workshops, and game technologies, which will allow using the tried and tested experience as a theoretical and practical framework in various pedagogical cultures.

The theoretical analysis and generalization of experience of implementing effective technologies in the pedagogical process found that the formation of the main concepts in students in each academic subject takes place in a spiral-shaped manner – from the center to the periphery, where the center is occupied by the abstract and general notion of the formed concept, which is concretized on the periphery, enriched with individual notions, and thus transformed into a scientific and theoretical concept.

Keywords: technologies in the learning process, filling of the learning process with information technologies, changes in educational technologies, implementation of technologies in the teachers' work.

Introduction

In the late 1950s, the scientific research team headed by D.B. Elkonin and V.V. Davydov(1996) commenced the verification, substantiation, and specification of L.S. Vygotsky's(1991) developmental education hypothesis on an extensive experimental basis.

Upon receiving respective facts from his fellow researchers, D.B. Elkonin(1996) concluded that the regularities in the formation of a holistic learning activity in schoolchildren were not studied by psychologists (only certain aspects thereof were studied), which is why its objective structures, formation process or leading role in the mental development of junior schoolchildren were not discovered (Davydov 1996).

The term "developmental education" is based on L.S. Vygotsky's(1991) theory of cultural-historical psychology (Vygotsky 1991). V.V. Davydov's(1996) research titled "The Theory of Developmental Education" describes in detail the originality of the genetic-modeling method and its intrinsic connection with educational design. Thus, the question regarding the transition from experimental models of developmental education to its holistic technological system was raised.

Modern studies show that a technologically reasonable educational process, which is based on interactive teaching methods, makes the developmental teaching of schoolchildren and students easier (Lakhana 2014; Cook et al. 2014; Anisimova and Krasnova 2015). Thematic studies show that pedagogical technologies start with a preliminary check of the information's authenticity. At that, they reflect a mutual relation between the technology and intelligence (Howard et al. 2015; Ospanbekova et al. 2016; Zhakhina and Stukalenkoa 2016). In particular, T. Wallace emphasizes the importance of coordination between teacher training programs and practical experience of proper use of educational technologies in teaching (Georgina and Wallace 2014).

M. Markova argues that the involvement of technologies in the teachers' work in the higher education system will lead to numerous difficulties and problems (Markova and Mariya 2014). The purpose of her work was to help students to adapt to technologies during the learning process. Various problems related to the application of educational technologies in the learning process and to leadership in educational institutions have been investigated.

Researchers developed a theoretical model, with a view to studying how educational technologies should be applied in the higher education system. The offered model consists of five main blocks. In addition to the analysis of existing problems of higher education at the faculty, this research also investigates the problem of applying them in a specific educational institution (Markova and Mariya 2014).

D. Akhmetova studied similar problems – continuous diagnostics of the components of the educational environment, such as teachers' skills, level of students' factual knowledge, filling of the educational process with information technologies, accessibility and quality of electronic resources, correct choice of teaching technologies, and educational policy in the field of vocational training computerization (Anisimova and Krasnova 2015).

Numerous changes in educational technologies have been described in various professional and popular literary sources (Yueh et al. 2012; Lakhana 2014; García-Martínez et al. 2015). Less attention was paid to changes in the nature of programs and training of specialists in the field of a career in a broad interdisciplinary area of educational technologies. In particular, Y. Spektor made the first attempt to analyze how educational technology programs developed over the last 50 years and proceeded to predict how they might develop in the future. Special attention was paid to the integration of theory and practice, which became a compulsory requirement for technological higher educational institutions. The use of educational technologies in addition to conventional pedagogical approaches made a considerable contribution to the accomplishment of this objective (Verena and James 2015).

The main problem of using educational technologies is that teachers themselves are reluctant to use them in teaching, communication, and research. Therefore, researchers argue that using a wide range of educational technologies could be of use when enhancing students' understanding of educational concepts (Verena and James 2015).

Presently, the use of social networks in education has become a common occurrence in modern higher education (Georgina and Wallace 2014; Markova and Mariya 2014; Verena and James 2015). Modern IT equipment allows teachers and students to create and share various content, interact, and cooperate within the framework of the learning process. The pedagogical advantages of social technologies have been covered extensively in studies. However, less is known about the processes and the teachers that look to integrate social technologies in their pedagogical activity.

In order to develop practical guiding frameworks, various recommendations are considered, which lecturers should follow when using social technologies for teaching purposes. S. Hamid, based on empirical conclusions, offers a concept that could be used to guide teachers towards a systematic implementation of social technologies (Hamid et al. 2014).

S. Eristi argues that the effective use of technologies in the educational environment and their successful integration improves the effectiveness of learning processes. An important aspect in the integration of technologies in educational institutions is their implementation and continuous high-quality support of teachers (Erişti et al. 2012).

According to K. Courville(2011), managerial educational technologies have had a significant effect on education, since efficient managers require extensive knowledge about management and respective theories to integrate technologies efficiently, with a view to improving academic performance in school (Courville 2011).

In her research. S. Howard analyzed the investigation of interconnections between subjects, with a view allowing teachers to integrate various technologies. It was found that educational technologies were often identified with the problem of "culture conflict" to explain their differences in the use of technologies across various domains of professional activity. These conflicts often emphasize the basic features, values, and attitudes in the domains of different cultures when analyzing the relationship between knowledge domains (Howard et al. 2015).

The analysis of scientific sources shows how important it is, from the professional perspective, to implement pedagogical technologies in the teaching process, which is a way of optimizing the value-conceptual resources of the occupational knowledge of teachers, researchers, students, and educational institution employees. Therefore, attention is focused on the need to develop the best national pedagogical traditions of creating a necessary technological environment of pedagogues and their professional development, including the use of information and communication technologies in the teaching process.

Methodology

The methodological framework of this research included:

- the postulates of the dialectical materialism philosophy regarding the theory of knowledge, the leading role of activity in personal development, and the dialectical unity of theory and practice;

- methodological concepts of formation of a teacher's personality in the pedagogical education system.

A set of methods relevant to the studied problem was used. Theoretical methods: study and analysis of special philosophical, psychological, pedagogical, scientific, and methodological literature on the studied subject; analysis of academic methodological documents, general theoretical methods of analysis, synthesis, and theoretical modeling. Pedagogical experience of the studied problem was investigated and generalized; educational practice was conceptualized. Methodological provisions predetermined by the information paradigm and the theory of self-organization were used.

Data, Analysis, and Results

Consider the methodological description of various technologies: "Developing critical thinking through reading and writing", "Portfolio", "Pedagogical workshops", and game technologies, which will allow interested persons to use the generalized tried and tested experience.

The process of teaching is a process of connecting new information with known information. Each specific technology (method) obviously has its intended purpose, since it is oriented at a specific object, with regard to its age- and sex-specific features and the environment the technology is used in. This research assumed that a method also requires a special training of professionals.

Trainees build new notions based on previous knowledge and notions. In particular, this provision is an essential condition for the use of the "Development of critical thinking through reading and writing" technology.

In order to let students to work actively with the acquired knowledge, the authors of the technology offer to organize the academic hour according to the traditional scheme: "introduction – main part – conclusion". This scheme also applies to the solution of problems: "introduction to the problem – approaches to its solution – reflection on the result".

Within the framework of the "Developing critical thinking through reading and writing" technology, these stages have slightly different names and functions.

Stage one – invocation – goals (functions):

- to actualize and analyze the available knowledge and notions about the studied subject;

- to arouse interest in the subject;

- to stimulate the trainees by giving them an opportunity to think purposefully and express their thoughts in their own words;

- to structure the subsequent study of the material.

Stage two – contemplation – search for the strategy to solve the set problem and draft a specific plan of action; theoretical and practical work on the realization of the chosen path of solution. Functions:

- to acquire new information;

- to contemplate said information (in particular, it is necessary to reread a part of the text if the trainee stops understanding it, perceiving the message, asking questions or writing down the parts that were not understood to clarify them in the future);

- correlation of new information to one's own knowledge. The trainees conscientiously build bridges between new and old knowledge to create a new understanding;

- maintenance of activity, interest, and momentum that was created during the invocation stage.

Stage three – reflection:

- expression of new ideas and information in one's own words;

- holistic reflection on and generalization of acquired information based on exchange of opinions between trainees and between the teacher and the trainees;

- analysis of the entire process of study of the material;

- development of an individual attitude to the studied material and its re-problematization (new "invocation").

This approach not only provides for a deeper assimilation of information by young people, but also realizes the idea of material connection (within one discipline, interdisciplinary, theoretical with practical) and structuring by the students.

In particular, the combination of techniques allows achieving the *ultimate goal of the "Developing critical thinking through reading and writing" technology* – to teach students to use this technology *independently*, so that they could become independent and literate thinkers and enjoy lifelong learning.

The "Developing critical thinking through reading and writing" technology

The "Developing critical thinking through reading and writing" technology appeared in America in the 1980s. In Russia, the technology has been known since the late 1990s under a different name – "Reading and Writing for Critical Thinking".

It is based on the ideas and postulates of J. Piaget's theory of stages of cognitive development and L.S. Vygotsky's(1991) theory of the zone of proximal development and general intellect development (Table 1).

Table 1: Description of methods used in the "Developing critical thinking through reading and writing" technology

Stage	Teacher activity	Student activity	Possible techniques and methods during this stage
Invocation stage	Invokes available knowledge; asks questions he/she would like answered. Information acquired during the first stage is listened to, written down, and discussed; work is individual, in pairs or in groups	- Recall and analyze available knowledge on the subject; -Systematize information before studying it; - Ask questions they would like answered; - Make assumptions regarding the content of the text based on the title, highlighted words; - Demonstrate their knowledge in public through oral or written speech	1. Compilation of a list of known information on the subject 2. Story – activation by key words 3. Systematization of material (graphic: clusters, tables) 4. Correct and incorrect assumptions, erroneous logical chains, etc.
Contemplation stage	Maintains interest in the topic with direct work with new information. Direct contact with new information (text, film, lecture, paragraph); work is individual, in pairs or in groups	- Read and listen to the text using active reading methods offered by the teacher; - make footnotes or notes during the contemplation of new information.	Active reading methods: 1. Marking with signs "v", "+", "-", "?" (in the margin while reading). 2. Making various notes like double diaries or logs. 3. Searching for answers to questions set during the first stage.
Reflection stage	Takes students back to their initial assumptions, establishes cause-and-effect connections between information blocks; Creative processing, analysis, interpretation of acquired information; work is individual, in pairs or in groups	- Correlate new information to "old" information using knowledge acquired during the contemplation stage; - classify and systematize the emergence of new attitudes for further independent work; - express their ideas and thoughts in their own words; - exchange opinions and argue in favor of their point of view; - analyze their own thinking operations and feelings; - self-assessment and self-identification.	1. Fill in tables, clusters; make changes and additions developed during the first stage. 2. Return to the key words, correct and incorrect assumptions. 3. Answers to set questions. 4. Organize oral and written roundtable discussions. 5. Organize various discussions. 6. Write creative works: pentastich, cinquain, essay. 7. Research on certain questions of the topic. 8. Creative research or practical tasks based on the reflection on the studied information.

"Portfolio" technology

The Portfolio technology originates from economics and art. In economics, it denotes a grouping of financial assets by sources; in art, it denotes a collection of techniques and means through which the artist can demonstrate the entire scope of his/her work and his/her achievements (for instance, an architect may have a folder with a collection of pictures of finished projects, models, installations, layouts, etc.).

A portfolio can be assembled for different purposes, which is why a single definition of this technology is lacking (Table 2).

Table 2: Portfolio types

Portfolio type	Purpose
Document portfolio	To create a collection of documents required during work
Presentation portfolio	To demonstrate the process and achievements of one's activity according to pre-selected sections
Evaluation portfolio	To allow oneself or (more frequently) others to evaluate one's activity
Work portfolio	To show the diversity and level of one's activity (for instance, designers, architects, models…)
Process portfolio	To show the process and dynamic of the work aimed at achieving set goals
Subject, thematic portfolio	To show the process and result (or dynamic) of the work aimed at solving set problems or on a specific topic

The content of a Portfolio depends on its type and purpose. There is no clear list of materials to be included in a Portfolio. Each person who uses this technology selects the means of demonstrating his/her works and achievements individually. If the Portfolio is created by all student groups, then the teacher should work with the students to determine and record the list of materials required to present the Portfolio and receive this or that evaluation. This process welcomes any initiative that expands this list or offers an equal substitution for listed materials. All materials should be divided into four sections (Table 3).

Table 3: Portfolio sections

Section name	Section purpose	Section content	Methods and techniques used
Portrait	Description of oneself and one's "relationship" with the Portfolio topic, goal-setting	Collector	Materials the student uses in work
Achievements	Demonstration of the student's achievements in accordance with the set goal and tasks	Students' individual works, grouped in accordance with the set tasks	Work materials

A teacher can use a portfolio to analyze and assess his/her own professional development. In this case, the above sections are filled with different content, depending on the goal. A goal could be

to help in career advancement, to create a methodological bank or to prepare for official evaluation (Table 4).

Table 4: Example of a sheet for a Portfolio evaluation

I believe that (general argument evaluation).	
It is especially fortunate that (list and evaluation of positive moments)	
Don't you think that (recommendations)	
At the same time, I would advise (list and evaluation of moments the teacher considers unfortunate or ineffective)	

If the teacher intends to use this technology in an academic group to accumulate and analyze materials in this or that subject, it is worth bearing in mind that a Portfolio is created by the students to evaluate their progress, while the teacher only helps students to organize this process and evaluate their achievements. Hence, the motivation of students at the start of and during the creation of a Portfolio should be high. In order to increase motivation, the teacher and students should take a creative approach to the process.

The Portfolio is evaluated by the students together with the teacher about once per term. For the purpose of developing self-assessment and reflection skills in students and saving the teacher's time, each student should prepare before the Portfolio evaluation class. During preparation, the student reviews the set goals and tasks and selects the material that demonstrates the achievement of set goals or work in this direction. Students can arrange the material in appropriate order or simply make marks in their notebooks. The most effective way is to conduct a written analysis of achievements according to the set goals and attach work materials. It is necessary to offer students this type of work.

The "Pedagogical workshop" technology

Modern educational technologies that were reviewed in the previous sections take into consideration the current requirements to the organization of student education. Virtually any of the above technologies implies a subjective position of intelligence in the learning process, allows for freedom of choice, individual aspirations, and personality development. Pedagogical workshops are the best in providing for a reasonable combination of technological actions of the teacher and creative freedom of students. It is no coincidence that the term "workshop" came to pedagogy from the field of art, where it originally meant a place where something new and previously nonexistent was created. The task of a master-pedagogue is to include intelligence into the individual creative cognitive activity, to make a discovery, to give the joy of creating new and individually acquired knowledge.

The "Pedagogical workshop" technology was created in France in the 1920s by psychologists Paul Langevin, Henri Wallon, Jean Piaget, and others. Kazakh pedagogues started studying and using the workshop technology since the late 1990s.

Game technologies

A *game* is a type of activity in arbitrary situations, which is aimed at recreating and learning social experience.

A *game* is a type of students' activity that consists in recreating the actions of persons and relationships between them, which is aimed at learning and understanding the objective and social reality, a means of physical, mental, and moral education of students.

In theoretical literature, the game is viewed as:

- a special attitude of a person to the surrounding world;
- a type of activity (or attitude to the world) that was assigned to a child socially and learned by him/her;
- a type of activity, during which various content is learned and the intellect psyche is developed;
- a socio-pedagogical form of organization of the children's life.

The features of games are as follows: active participation, entertainment, collectivity, modeling, problematicity, creativity, emotional coloring.

The functions of games are as follows:

1. Educational – consolidation of knowledge, development of skills and abilities, including general academic ones, development of memory, attention, and thinking;

2. Entertaining – creation of a favorable atmosphere in class;

3. Communicative – unification of a team of students, establishment of emotional contacts;

4. Relaxing – relief of stress caused by a load on the nervous system during studies;

5. Psychotechnical – development of skills of preparing one's physiological state for a more effective activity.

Classification of games.

Groups of games used during the educational process:

1. Socio-dramatic role-play,

2. Physical games,

3. Didactic games.

A *didactic game* is a game with special rules that were developed to educate students. A didactic game has a pedagogical and game task, rules of action, and result. The didactic task is not disclosed openly, but rather is realized indirectly via the game task, game actions and rules.

The procedure of game design in the learning process:

1. Analysis of the topic and content of the class, specification of the goal: determination of pedagogical and game tasks;

2. Selection of game type (role-play, business game, journey, auction, competition, etc.);

3. Development of the game plot (for instance, a problematic situation at a company and ways to solve said problem, in case of a business game; main points on the route and types of assignments, in case of a journey, etc.);

4. Development of means of disposition to the game, setting of the game task, techniques for the stimulation of students' activity;

5. Development of assignment handout forms;

6. Determination of the role assignment principle, explanation of rules;

7. Development of a detailed game plan – algorithm or scenario with a detailed description of all the stages and types of participants' activity, content of assignments, graphic model of participants' interaction;

8. Prediction of results;

9. Determination of criteria and forms of final evaluation (self-assessment, mutual assessment, score), means of work generalization (systematization, determination of the main moments, prioritization);

10. Preparation of equipment (demonstration, laboratory), handout of materials, reference materials, guides, and other necessary items;

11. Organizational preparation: familiarization of participants with the game (using imitation games).

At first glance, the organizational principles of workshops differ from those of conventional pedagogy; however, they do not contradict the main postulates of didactics. Rather, they improve and bring conventional postulates in compliance with the changing society.

The atmosphere that is created in a class organized according to this technology facilitates and stimulates the creative self-development of an intelligent person. Such postulates as "everybody is capable", "everybody has the right to express his/her opinion", "respect your partner's opinion", "no official evaluation", and "not only that which we learn is important, but also the feelings and emotions we experience in the process" create conditions for a comprehensive self-expression of students on the one hand and require the teacher to pay special attention to the emotional sphere of intellect on the other hand, since the main goal of the master is to give the student the joy of discovery.

The goal of the master within the framework of this technology is determined by the organizational principles and conditions of the workshop; it implies a stance that higher educational institutions and conventional pedagogy find somewhat unusual. The teacher acts not as a lecturer or supervisor, but rather as a "guide" that accompanies the student on the road to knowledge.

Junior and senior students will certainly be interested in different phenomena. The teacher will be able to realize this stage correctly only if he/she attempts to perceive the problem through the eyes of intellect and understands what may interest the student and create an emotional experience and the need to be involved in the research. This stage of the technology can be regarded as the basic one, which predetermines the success of the entire workshop, since this stage should motivate the participants to engage in active work. All subsequent actions of the teacher are aimed at maintaining interest in the problem and creating conditions for its creative solution.

Discussion

Foreign studies have clear general trends of analysis of pedagogical technologies:

- modern vocational training is not aimed at the conveyance of ready knowledge (Anisimova and Krasnova 2015);

- pedagogical technologies allow checking acquired knowledge effectively, since they reflect the dependence between the technology and the intellect (Courville 2011);

- it is important to ensure continuity between teacher training programs and practical experience of using educational technologies (Georgina and Wallace 2014). At the same time, the implementation of technologies in the work of teachers in the higher education system creates numerous difficulties and problems (Markova and Mariya 2014); therefore, it is necessary to create conditions for the trainees to adapt to technologies in the learning process. It is necessary to introduce systematic diagnostics of the educational system components, such as teachers' skills, level of students' factual knowledge, filling of the educational process with information technologies, accessibility and quality of electronic resources, correct choice of teaching technologies, and educational policy in the field of vocational training computerization, while simultaneously taking into consideration the nature of specialist training programs in the field of a career in a broad interdisciplinary area of educational technologies and to pay special attention to the integration of theory and practice.

It is worth bearing in mind that modern IT equipment allows teachers and students to create and share various content, interact, and cooperate within the framework of the learning process, since the effective use of technologies in the educational environment and their successful integration improves the effectiveness of the learning process. At that, it is important, from the professional perspective, to implement pedagogical technologies in the teaching process, which is a way of optimizing the value-conceptual resources of the occupational knowledge of teachers, researchers, students, and educational institution employees and to analyze systematically the results of training during the implementation of information and communication technologies and respective methods in the educational process.

In general, the implementation of pedagogical technologies in the teaching process requires an effective integration of technologies, with a view to improving academic performance in school. At that, it is inexpedient to identify technologies with the "culture conflict" to explain their differences in the use of technologies across various domains of professional activity.

At that, the main international problem of using educational technologies is that teachers themselves are reluctant to use them in teaching, communication, and research.

The present theoretical study of modern technologies of developmental teaching emphasizes the importance of such teaching and the methods of its organization. The research gives a concrete methodological description of the methods of various technologies: "Developing critical thinking through reading and writing", "Portfolio", "Pedagogical workshops", and game technologies, which will allows using the tried and tested experience as a theoretical and practical framework in various pedagogical cultures.

Conclusion

The practical use of the results and the value of the theoretical review offered in this paper is that the research analyzed modern pedagogical approaches to the implementation of educational technologies to determine the ideas regarding the methods for implementing and analyzing the effectiveness of pedagogical technologies that are common for different countries; this can serve as a theoretical framework for comparative studies and further investigation and determination of the specificity of this problem in different countries.

The theoretical review of scientific sources and practice on the subject of developmental technologies shows that there are many different definitions of pedagogical technologies of developmental teaching and approaches to their classification.

From the academic perspective, these technologies are aimed at developing competence by students and teachers, which implies a mastery of the methodology and terminology appropriate for pedagogical knowledge and the system of interconnections inherent in this field.

In general, development technologies in modern professional practice allow effectively solving problems of professional activity in accordance with set standards.

When generalizing various approaches to understanding developmental technologies, it is worth distinguishing two main interpretations:

- the human ability to act according to technological standards;
- the characteristics of a personality that allow it to achieve results in work.

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