

SCTMG 2020

International Scientific Conference «Social and Cultural Transformations in the Context of Modern Globalism»

COGNITIVE AND CREATIVE POTENTIAL OF THE TEXTBOOK IN THE PEDAGOGICAL HERMENEUTICS PARADIGM

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Abstract

The article is devoted to the problem of creation of textbooks with high cognitive and creative potential in interrelation with the corresponding potential of the student, which creates conditions for the replacement of the installation for the intuitive construction of the textbook by the installation for the development of methods of mastering the content, providing individualization of the development of intellectual abilities of students. The aim of the article is to present a new approach to textbook creation with a modified structure that includes technologies for working out theoretical texts and independent work presented in text and interactive forms using author's computer programs. It is based on the following approaches: the systemic one, which implements the connection between the textbook content, the genesis of scientific theory, the model of knowledge consistency; the hermeneutic one, which aims at creating technologies for understanding scientific texts through reflexive mental activity. It is shown that the development of the latter is conditioned by the specifics of the textbook with the dominating forms of independent work and reflexive activity. The concept of creating an innovative textbook model with high cognitive and creative potential is substantiated. The article presents the indicators of students' creative work on the creation of technologies and thematic resources for e-learning, performed on the basis of an innovative model of the textbook. An innovative textbook model can provide a new quality of the educational process as it creates conditions for the development of students' intellectual abilities.

2357-1330 © 2020 Published by European Publisher.

Keywords: Interactive textbook, cognition, potential, application, hermeneutic, interactive education.



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1. Introduction

The problem of textbooks, as the main sources of normative knowledge, has always been a central one in pedagogical theory and practice. They were mainly concerned with properties that could effectively provide opportunities to stimulate students' intellectual development, i.e. the level of cognitive and creative potential, rather than increasing knowledge. Different aspects of this problem were considered in theoretical and practice-oriented research.

The process of creating variable textbooks is ongoing, with many authors declaring their editions as new generation textbooks. Many of the textbooks are equipped with electronic applications. However, the analysis shows that they are distinguished by innovations in style, external design, distribution of training topics within sections, in the selection of practical tasks. Their structure (paragraphs, questions, exercises) remains traditional; there is no extended apparatus for mastering the subject content through hermeneutic teaching methods and reflexive technologies. Electronic applications include a traditional set of interactive technologies: presentations, tests, moves. Electronic textbooks, which are essentially digitized copies of traditional textbooks, have become widespread. Most existing textbooks can be called informative because their main role is to present learning information, cognitive and creative potential (CPC) of such textbooks is extremely low. In contrast to this model, the innovative model of a textbook (technological) is focused on organizing independent reflexive activities using the technologies of active learning presented in traditional (paper) and electronic forms of the textbook. Therefore, the problem of creating textbooks on the basis of the innovative model of a technological textbook with high cognitive and creative potential through the inclusion in their structure of an extended apparatus for mastering the subject content is relevant. Therefore, the relevance of the study is justified by the presence of contradictions between the following:

- The increasing need for innovative learning tools to stimulate students' reflective thinking and to support the creation of textbooks with the installation of "ready knowledge", bypassing the process of understanding as organized reflection;
- the process of continuous modernization of the computer resources used in education and the application of conservative methodological schemes, which have been used for many decades to develop the structure of existing textbooks that present learning information in the absence of technology for its assimilation;
- state measures of stimulation of innovative activity in the sphere of creation of educational materials and preservation in construction of the basic textbook, textbook, traditional structure of the apparatus of assimilation of the theory consisting of a standard set: questions on the text of the paragraph, exercises, tests; the similar structure is characteristic for electronic applications to operating textbooks;
- increasing in the domestic and world practice of education the tendency to provide electronic applications to textbooks and their extremely insufficient number, placed in the free access on the Internet.

The solution of the above mentioned contradictions required the use of the following approaches as a methodological basis for the research: systematic, considering the phenomenon of the textbook structural construction as a complex self-developing system; hermeneutic, considering the methodological component of the textbook (training blocks) as a tool for organizing the process of understanding scientific texts by means of reflexive mental activity, cultural-historical, considering the textbook teaching technology as a means of development of higher education. The analysis of the existing textbooks testifies to the fact that their authors adhere to the paradigm of "ready knowledge", which led to the dominance of the dogmatic style in the texts of scientific theories. In addition, the implementation of the "ready knowledge" paradigm essentially leads to the fact that the teacher's function is limited to the translation of educational information, i.e. he becomes the executor of normative knowledge, losing the role of the creator of innovative learning. Overcoming of this factor actualises the hermeneutic approach, both to textbook creation, and to working out of the electronic application corresponding to it.

Hermeneutical methods of educational activity play an important role in the formation of such a quality of knowledge as consistency, which is the primary development of a systemic style of thinking. The quality of systemic knowledge nowadays acquires a special relevance, because only systemic knowledge can enrich the mental experience of students, creating a basis for the preservation and increase of knowledge during the whole active period of ontogenesis. Moreover, it is the knowledge system, rather than its conglomerate, that is the condition for successful practical solutions in any activity, since it is based on strong and branched out reflection carried out within the framework of the hermeneutic approach. For a long time, the latter has not been recognized by domestic pedagogy, which was dominated by the dogmatic style of teaching, which orients teachers towards communicating ready-made knowledge to students. However, it is the process of understanding that provides an opportunity to develop the mental abilities of students and pupils, as it aims at active thinking activity through reflexive technologies. Therefore, it can be argued that the two didactic problems – the formation of the quality of knowledge systems and the organization of learning through a hermeneutic approach – are closely interrelated.

Recently, much more attention has been paid to hermeneutic technologies in pedagogical research (Zakirova, 2011). For example, the design of a technological textbook on how to work with scientific text takes place in accordance with the method of the hermeneutic circle, which determines the direction of the process of understanding from the whole to the constituent parts, then from them to the whole, i.e., the thought moves in a peculiar circle, and the meaning of the text is revealed only in this circular movement between the whole and the parts (Schleyermacher, 2004). Besides, the peculiarity of the process of comprehension is important for learning, which is that any understanding of the text depends on the activity of the interacting subject, a pupil or a student (Gadamer, 1988). Therefore, TU teaching blocks and technologies cover various types of cognitive activities: analytical, systematizing, creative, research, communication, controlling, modeling, and game activities (Pichkurenko & Arkhipova, 2016).

The systematizing activity in the textbook of the new model is organized by interactive technologies, reflecting in the aggregate the regularities of the system approach, according to which the system knowledge should be formed adequately to the structure of scientific theory. "The process of scientific creation appears to be cyclical, consisting of links: facts – hypothesis – consequence –

experiment" (Razumovsky & Mayer, 2004, p. 58). The practical materials accompanying the study of theory also correspond to the specifics of the theory under study, forming a system of repertoire (reference) problems and variative: inverse, similar, reformulated, with redundant, insufficient, latent data, with the dynamics of the situation, on building a model of an object or phenomenon.

The heuristic reception of reduction ("backward motion") is effective for tasks of increased complexity. Each complex problem is accompanied by a number of auxiliary tasks, and each subsequent task is based on the solution of previous problems. This method is used in the interactive technology "gaps in knowledge". Another way to create systems of problems is to use a common game scenario, for example, computer training games "Pedestrians and Cars", "Climbing the Peak of Knowledge", "Physical and Mathematical Football", "Battle of the Sea", etc., to create a system of problems.

Thus, the construction of theoretical texts of the innovative model of the textbook and the formation of practical tasks focused on providing a high level of cognitive and creative potential, so the textbook is called "technological", as most of its volume is made up of innovative learning technologies. The theory of the new textbook is developed in researches of Arkhipova (2014). The innovative model of the textbook was the winner of two federal contests on informatization of education.

2. Problem Statement

In recent years, school textbooks have been systematically criticized by teachers, the scientific community and the media. It is pointed out that they are overloaded with secondary material, overcomplicated, imperfect and conservative in form. Naturally, there are questions: why the development of the textbook content should not be accompanied by the development of its form, change of its structure; why textbooks for schools copy the form, on which textbooks for higher education institutions are made; what should be the form of presentation of the material in the textbook: forever given, stuck or flexible, dynamic, as well as its content; why the existing textbooks do not contain elements of problem, self-preparation and self-control, algorithmic, programmed material, game elements, including the use of computers. These questions should be answered in the theory and practice of developing new generation textbooks, where the problems should be solved: the textbook and the educational process (the textbook is a basic model of educational process); the textbook and the pupil (the textbook should not simply show the information to the pupil, but help to master it); the textbook and the teacher (the textbook should give guidelines for lesson construction); the textbook and pedagogical innovation (the textbook should demonstrate pedagogical innovations); the textbook and the higher education institution (the textbook should "throw a bridge" to the higher education institution content and methods); the textbook and the computer (the textbook should have computer support in any form). Therefore, an approach where the textbook structure is subject to various modifications on a fundamentally new basis, which is implemented in a technological textbook, may be considered optimal.

Consequently, the problem was to find answers to the questions:

- what should be the structure of the textbook so that it is not neutral to the learning process, but allows it to be modeled using the texts of the textbook paragraphs, a system of learning blocks and an electronic application, providing a high cognitive and creative potential with a focus on the student and the teacher;

- would not only demonstrate the learning information, but also organize its independent assimilation;
- would encourage students to reflexive cognitive activities on learning information that require active work of the mind;
- would promote the transformation of textbook information into knowledge in the minds of students, and then into structures of intellectual experience, which would create a psychological basis for continuing education;
- motivates students to engage in active cognitive activities, fascinating them with examples of interesting facts and playful learning situations and creating the conditions for preventing mental fatigue;
- would be linked to the computer, managing it and bringing the student into the space of a world knowledge system that enriches his or her mental experience;
- would not only teach but also educate the student, including information in subject areas that enhances positive personality traits;
- would realize the continuity between school and university courses, eliminating the "barrier" that students may find difficult to overcome;
- would implement a systemic approach, creating conditions for the formation of systemic knowledge according to the model of systemic levels;
- would include methods and techniques of pedagogical hermeneutics based on the theory of understanding, the main principle of which is that "understanding is the organization of reflexion, and interpretation is the expressed reflexion" (Bogin, 2001, p. 55). (There is an opinion that the world's most powerful economy was created in a country where a generation of intelligent people were brought up through the application of hermeneutic interpretation methods at school).

So, summarizing the above, we can formulate the research problem: how to ensure high BCC of theoretical texts of the textbook in order to develop students' humanitarian thinking, based on the technologies of formal-logic and semantic processing of scientific texts and hermeneutic techniques; how to activate and motivate students' learning and cognitive activity with the help of innovative didactic technologies of teaching blocks; how to orient the BCC of the electronic textbook application to prepare the teacher for the use of hermeneutic techniques).

With the expansion of distance and online learning, there is now a need for new models of educational process and appropriate learning tools. It is possible that the classroom and lesson system will soon pass. The proposed innovative textbook model, implemented in technological textbooks, can be successfully used both in classical models of the educational process, and in modern, in particular, creative education of the future. However, an essential condition for the application of this model should be considered an effective psychological service based on the developed infrastructure of electronic methodical and software support.

The concept of developing cognitive and creative potential of students can be extrapolated to the sphere of educational work. At the same time, it is necessary to rely on the structure of the generalized model of personal potential, which besides BCC includes creative potential (creative abilities), communicative (ability to cooperate), moral (values, motivation), aesthetic (aesthetic abilities). For purposeful and personally oriented educational work it is necessary to form such means of pedagogical activity that would be analogues to the technological textbook, i.e. include materials reflecting the structure of the student's personal potential. At present, however, educational work in educational establishments is planned and carried out on a haphazard and intuitive basis.

3. Research Questions

In light of the above, the subject of the study was to build a concept of cognitive and creative potential of the textbook, focusing on the structure of a generalized model of cognitive and creative potential of students of a certain age, which may create conditions for personalization of the latter's development through the selection and correction of educational materials textbook. The concept is built through the synthesis of two models – the generalized model of cognitive and creative potential of a student of a specific age parallel and the corresponding potential of the textbook innovation model. The construction of the above concept includes several stages, each of which solves certain tasks and then integrates them into an integral structure. The sequence of stages is presented below.

- Justification of the methodological basis of the concept, including hermeneutic, systemic and cultural-historical approaches.
- Based on the provisions of cognitive and creative psychology, relating to the BCC of a student of a certain age, to build a generalized model of this potential, to identify its structure for subsequent targeted planning of the composition of cognitive operations, which should be incorporated into the didactic components of the textbook.
- Determine the composition of target learning orientations using a specific learning model. For example, the Blum model is based on seven learning objectives: comprehension, memorisation, application, generalisation, analysis, synthesis, assessment.
- Identify cognitive operations appropriate to each of the target learning orientations. For example, generalization corresponds to the operations: systematize, make a rule, establish a pattern, find common features, identify features, combine, group, create an algorithm.
- Compiling the structural components of the textbook in such a way that they contain all the necessary cognitive operations included in the student's BCC.
- Organize monitoring of each student's BCC development with the help of the educational institution's psychological service, for which purpose electronic procedures should be developed and databases of relevant data should be created and updated regularly.
- Development of personal strategies to improve student BCC through subject-based learning tools, of which the technological textbook is the main one.

- Selection of textbook didactic materials for each student that organize cognitive operations aimed at personal BCC development.

Consequently, the didactic and electronic support of the technological textbook should be formed not only based on methodological approaches, but also on the basis of a generalized student's BCC model, which for each of them is specified and subjected to permanent diagnostics. Therefore, the apparatus for mastering the textbook subject content should be redundant, including a full set of cognitive operations in accordance with the generalized model of student BCC. From this set, the teacher makes a personal selection of educational technologies for each student in accordance with the personal characteristics of his or her intellect (Kuo, Walker, Schroder, & Belland, 2014). The implementation of the outlined concept will create conditions for optimal and individual development of each student, replacing the intuitive average approach to solving the problem of creating learning tools with an approach that is scientifically sound, and the application of the textbook with an individually oriented one (Littlejohn, Hood, Milligan, & Mustain, 2016). The structure of the new textbook should therefore be flexible and constantly updated through an electronic application. Figure 1 shows the invariant structure of the technological textbook.

With the expansion of distance and online learning, there is now a need for new models of educational process and appropriate learning tools. It is possible that the classroom and lesson system will soon pass. The proposed innovative textbook model, implemented in technological textbooks, can be successfully used both in classical models of the educational process, and in modern, in particular, creative education of the future. However, an essential condition for the application of this model should be considered an effective psychological service based on the developed infrastructure of electronic methodical and software support.

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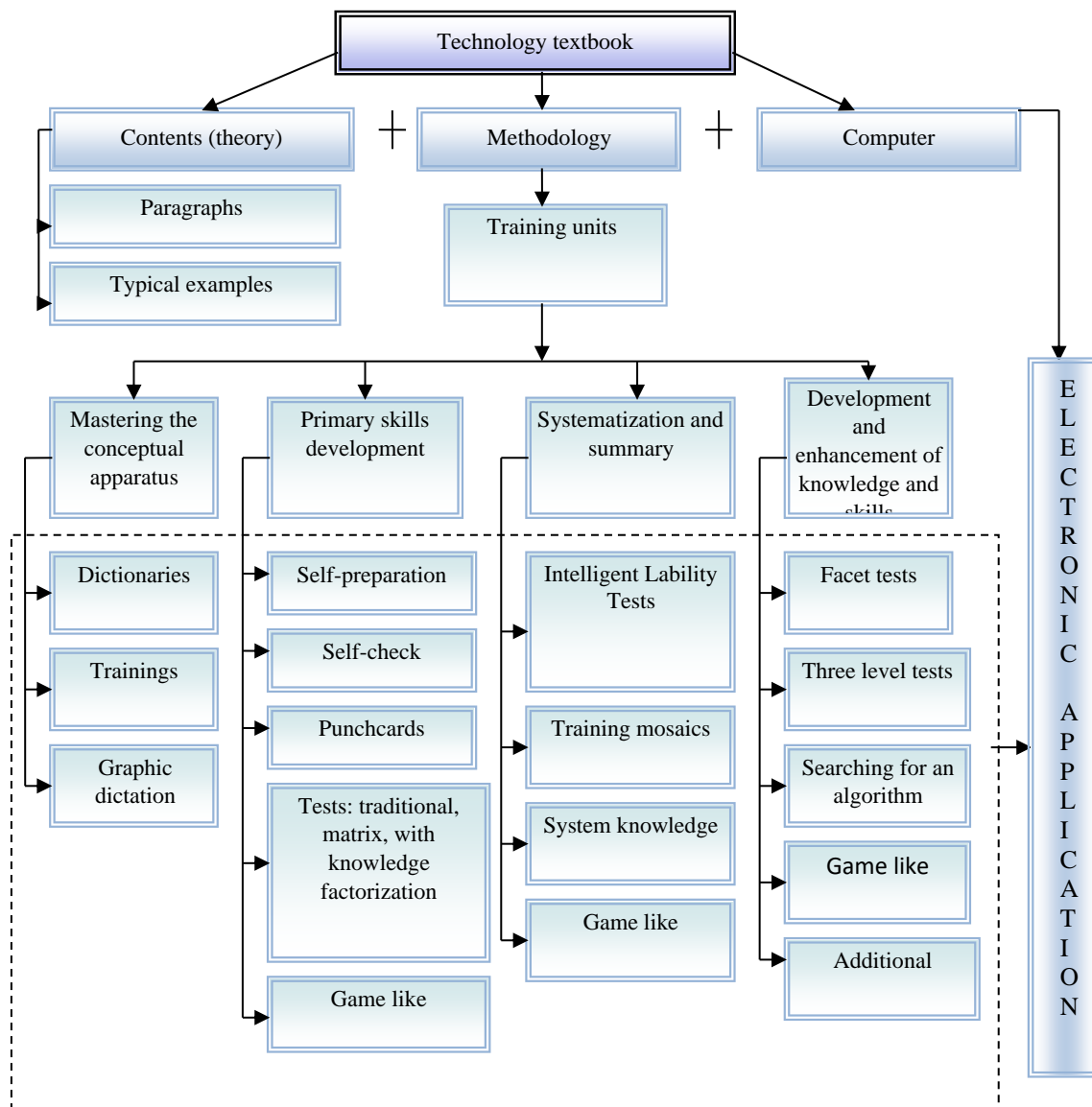


Figure 01. Invariant structure of the technological textbook

4. Purpose of the Study

The first version of the innovative textbook model with an extended self-study unit in the form of training blocks was created back in the "pre-computer" period. The goals were to create pedagogical conditions with the help of various didactic technologies of the textbook in order to significantly increase the level of motivation of teaching in the team of students and to help the teacher in designing the learning process by demonstrating new methods and techniques of teaching. The model was constantly evolving, enriched by new methods. With the introduction of computer resources into education, methodological systems have been drastically improved thanks to the possibilities of new information and communication technologies. A new set of priorities and challenges has emerged. The beginning process of digitalization of education actualized the task of replacement of the average mass educational process with training individually oriented, taking into account personal characteristics of each student's intellect with the prospect of its improvement. This specificity is reflected in the notion of cognitive and creative

potential, the meaning of which is revealed in cognitive psychology and the paradigm of creative education as a systemic phenomenon that integrates the abilities for productive mental activity. In this regard, there was a need for a new educational and methodical support for the educational process corresponding to the new tasks. At the same time, the former and well-proven pedagogical models are not rejected, but modernized on the basis of new opportunities for their practical implementation.

Thus, the model of the technological textbook was improved by projecting it on the structure of the generalized model of cognitive and creative potential of the student. In connection with the above mentioned, the purpose of the work is to ground on the cognitive psychology provisions about cognitive and creative activity of students, theoretically justify the necessity of modernization of teaching means, first of all, the model of the technological textbook, in order to bring them in accordance with the specifics and structure of the generalized model of cognitive and creative potential of students and subsequent planning of individual BCC development prospects of each student.

5. Research Methods

Theoretical and empirical methods include: analysis of psychological and pedagogical literature and pedagogical experience in creating e-learning tools, study of regulatory documents, pedagogical observation, survey methods and questionnaires, cognitive modeling, methods of mathematical statistics, pedagogical experiment and testing, method of network expert evaluation. Along with general science, specific methods are used: hermeneutic circle method and method of quality analysis of knowledge systems. The first of them directs the process of studying scientific texts to their structuring in order to distinguish separate, logically separate parts and the subsequent consideration of their content in the direction from "the whole to the component parts, and from them to the whole". Thus, comprehension of meanings occurs within the limits of an expanding circle. The second method is based on using the recursive model of system knowledge. In it, at the first level of systemic knowledge is located the knowledge included in the core of the studied theory (models, concepts, laws); at the second level to the knowledge of the first level are added knowledge about the initial facts and preconditions leading to the construction of these forms of thinking; at the third level to the volume of knowledge of the second level are joined by knowledge about the consequences of theory; the fourth level integrates knowledge of all previous levels, adding knowledge about the practical applications of the studied theory. The use of the stated model creates conditions for the formation of knowledge adequate to the structure of the scientific theory, to which the property of consistency is inherent from the beginning.

6. Findings

6.1. The article explains the necessity to modernize the model of the technological textbook with the focus on cognitive and creative potential of the student, since initially this model was created for the purpose of presentation of activity learning technologies and included a set of their original and variative versions. With the inclusion of an e-application in the model, it was possible to add new technologies to the previous model through the use of network technologies. Implementing this opportunity, the authors have focused on the cognitive and creative potential of the student. Since this concept determined the

change in the didactic orientation of the textbook itself, the corresponding concept of "cognitive and creative potential of the textbook" as a toolkit for developing the student's intellectual potential was introduced.

6.2. The concept of "cognitive and creative potential of the student" has been introduced. Cognitive psychology lacks a clear definition of the concept of "cognitive and creative potential of the student", indicating only the signs of the student. For example, in the structure of cognitive potential some authors include both mental functions (memory, perception, imagination) and the properties of thinking (fluency, flexibility, sharpness, originality), while others include the properties of personality (motives, volitional qualities, emotionality), while creative potential is a structural component of personal potential (not vice versa). In this regard, we have come to the conclusion that it is necessary to clarify the key concept of "cognitive and creative potential" of a student by giving him a didactic interpretation. Cognitive and creative (intellectual) potential of the student characterizes the intellectual ability of the student to perform cognitive and creative operations. In this case, cognitive operations are those that provide comprehension of the content of the studied scientific texts, and to the cognitive ones, through which there is a modification, transformation of texts (changing the structure, shape, sequence of parts, etc). For example, to the operations of the first type we refer to the structuring of the text, identification of keywords, drawing up an algorithm of actions contained in the text, the choice of words from the text, which constitute the definitions of concepts, etc. Creative operations can be considered transformation of a text into a table, into a specific symbolic form, into a structural and logical scheme, into a pictogram and other operations of collapsing text information. Such differentiation of cognitive operations provides conditions for the development of appropriate didactic technologies and their interactive versions on the basis of traditional and author's computer programs.

6.3. The concept of "cognitive and creative potential of the textbook" has been clarified in order to characterize the property of the textbook to ensure the ability to perform cognitive and creative operations that are part of the structure of students' intellectual potential. This possibility should be included in the methodological component of the textbook, i.e. in its teaching units and technologies of electronic application. Thanks to this approach, the intuitive construction of the textbook methodology is replaced by a theoretically sound one. For example, if the content of the textbook paragraph is based on previously studied elements of theory, then the teaching block "Repetition" is formed, if the theory provisions need to be experimentally confirmed, then the block "Experiments and observations" is formed. In this case, the blocks use not a declarative style of presentation of the text, and give guidelines for performing cognitive and creative operations. Thus, the connection between the textbook BCC and the student's intellectual potential is realized.

6.4. It is shown that the use of the hermeneutic and systemic approaches as a methodological basis for the study of all components of the textbook innovation model is dominated by the attitude to the organization of reflexive mental activity of students instead of the traditional attitude to "ready knowledge". It is the methods and techniques of this activity that provide a comprehensive understanding of scientific texts; therefore, in hermeneutics the thesis works: "understanding is the organization of reflexion". The system approach orients the authors of educational books to the use of such technologies, thanks to which knowledge adequate to the structure of scientific theory is formed. At the same time, the

tool of diagnosing the quality of knowledge consistency is their model of four levels, in which knowledge develops from the "core of theory" to the "exit" of theory into practice.

6.5. Guidelines for building a textbook concept of cognitive and creative potential are given, which can be summarized in the form of a chain of stages: choice of methodological basis → analysis of the student's intellectual potential (BCC) in cognitive psychology → choice of learning model → identification of cognitive operations in accordance with the components of the learning model → development of the methodological component of the textbook (didactic and electronic) → development of the textbook (didactic and electronic) → building a model of intellectual potential (BCC) of students of a specific age parallel → selection of technologies for each student in accordance with BCC → building a trajectory of personal BCC development → inclusion of the textbook BCC concept in the structure of the creative education paradigm. So, the innovative model of the textbook, brought into conformity with the model of cognitive and creative potential of the student, can become the basis for the creation of learning tools in the system of creative education.

6.6. It has been shown that the BCC of an innovative textbook model effectively influences both the process of intellectual development of students and the improvement of methodological training of teachers by stimulating the process of mastering new didactic and computer technologies of teaching. This provision was confirmed by the results of the educational process in groups of students and masters from the pedagogical department of the Faculty of Mathematics and Computer Sciences of Kuban State University. As part of the Modern Technologies in Mathematics and Computer Science Teaching course, students and graduate students created innovative interactive technologies as well as comprehensive electronic educational resources for subject training. In doing so, they used the author's network designer of technologies "Power of Knowledge", posted on the same department website. Table 1 shows examples and e-mail addresses of some technologies in mathematics. High KKP innovation model of the textbook was experimentally confirmed in 2016–2018 by the practice of teaching mathematics in the groups of "Russian State University of Justice" on the example of the study of the section "Linear algebra" with the use of interactive methods of the technological textbook and with the dominance of forms of independent work (Pichkurenko & Arkhipova, 2016). Detailed description of the experiment and its results is given on the portal of Kuban State University.

Table 01. Technologies of Internet constructor "Power of knowledge"

No.	Name of the technology	Main hermeneutic objective	Number of technologies	Topic	Address
1	Knowledge test	Selecting the variant of interpretation of meaning for text fragments	85	Matrixes	http://ya-znau.ru/znau_sorevn/pr_zn/291
2	Facet test	Test task creation from frame structure elements, topic summary	24	Derivative	http://ya-znau.ru/znau_faset_test/pr_ft/49
3	Field of knowledge	Selection of alternative answers, graphical presentation of knowledge by selected characteristics	49	Equations	http://ya-znau.ru/znau_pole_znani/pr_pz/118/
4	Knowledge Matrix	Correlation of text fragments with key issues of the topic	19	Trigonometric	http://ya-znau.ru/znau_matr_znan

				equations	ii/pr_mz/11/
5	Knowledge Formula	Awareness of the structure of notions and rules in drawing up with the help of logical links	28	Ordinary fraction	http://ya-znau.ru/znau_formula_znanii/pr_fz/1/
6	Dictionary of Knowledge	Correlation of terms and their lexical meanings	54	Elements of linear algebra	http://ya-znau.ru/znau_slovarzn/pr_slova/101/
7	Gaps in knowledge	Step-by-step deployment of text or complex task	36	Vectors	http://ya-znau.ru/znau_probeli_znanii/pr_pr/21/
8	Knowledge Crossword	Concentration of text information to the size of one word	52	Systems of linear equations	http://ya-znau.ru/znau_crossv_znanii/pr_cr/195
9	Knowledge Relay	Passing a number, symbol, word between text fragments, checking the last answer	1	Raising the numbers to a degree	http://ya-znau.ru/znau_estafet_znanii/pr_est/7/
10	In search of knowledge	Variant repetition game situation	1	Equation systems	http://ya-znau.ru/znau_vpz/pr_vpz/12/

7. Conclusion

In the initial period of digitalization of education, the structure of textbook construction used no longer corresponds to modern realities. Creative processes are gaining strength in the world, and scientific and technological progress is increasingly moving into the intellectual sphere. Of course, previous ideas and approaches will not give up their positions at once, so the process of digitalization, the formation of creative education and other new ideas will meet resistance from conservative forces, adherents of traditional methods and indifferent officials. For example, even the student project "Immortal Regiment comes to school", in which fifth grade students described the exploits of the heroes of their family, posted notes and photos on the Internet and brought them to the Immortal Regiment column was not approved by the moderators of the Moscow Electronic School. It is no accident that the innovative model of the textbook, created back in the 90s, after winning the first competition on the informatization of education, could not break its way into wide practice, although it was supported by the teachers of several regions, who independently published two technological textbooks on physics. Therefore, in the conclusion of the article we moved away from the common practice and did not describe the summary of our project, but decided to address our colleagues' teachers with a proposal to support our ideas.

Acknowledgments

Article is prepared with financial support of Russian Foundation for Basic Research and administration of Krasnodar region within the limits of the scientific project No. 18-413-230033/18 "Design of the interactive learning environment in mathematics for the general and higher education as a basis for creation of regional cluster of pedagogical innovations".

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