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PSYHODIDACTIC PRINCIPLES OF INTERACTION BETWEEN ELECTRONIC AND PAPER TEXTBOOKS

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Abstract

The article is devoted to the theoretical and practical development of psychodidactic principles of interaction between electronic (ET) and paper (PT) textbooks. The problem of the proportion of the two textbook formats is considered from the standpoint of the psychodidactic approach; the need for not replacing, but supplementing PT with ET is justified. On the basis of interdisciplinary theoretical and methodological analysis, three key principles are defined aimed at developing students' cognitive and personality spheres during the learning process involving PT and ET: 1) the complementarity principle, implemented in the alternating changes in the used textbook format depending on the purpose of the work to be carried out and the nature of the tasks to be done; 2) the principle of collectively distributed activity, implying an optimal distribution of learning activities among the participants of the educational process in a psychologically comfortable environment; 3) the principle of interactivity, considering an effective subject-to-subject interaction in the system "teacher-student(s)-PT-ET". The problem of using PT and ET as a means of communication, including providing feedback to improve learning achievements at each stage of learning, is raised. The practical realization of these principles in textbooks of psychodidactic type developed by the group of authors under the guidance of G.G. Granik is revealed. One of the topics of the Russian language course (Composite sentence) is used to show how to competently organize the learning process with the help of both textbook formats.

Keywords: Psychodidactic principles, paper textbook, electronic textbook.

1. Introduction

The transition to electronic textbooks is a global trend. Every year the demand on such textbooks is increasing due to the immense amount of their inherent functions and potentialities. Electronic (digital or computer) textbooks (ET) meet the utmost needs of digital education, psychophysiological and personality characteristics of the "digital" children. Development, distribution and implementation of the ET in educational institutions are associated with hopes for improving the quality of school education, offering access to self-education for various groups of students, especially those who study at home (e.g. children with special needs on home and family education).

However, before the widespread adoption of the ET it is necessary to study the influence of the new textbook format on mental and personality development of the students, evaluate the appropriateness of using ET in the educational process along with the paper textbook (PT), estimate the contribution of psychological research to a new area of pedagogical science, called digital pedagogy.

The need to address the problem of psychodidactic principles of interaction between PT and ET is conditioned by the following:

in the general-theoretical aspect: insufficient research of the actual psychological problems of creating ET, in particular, issues considering the characteristics of perceiving textual and visual information from the screen, the specifics of digital reading and the psychological processes and phenomena connected with it (thinking, perception, attention, comprehension, memorization, imagination and others), the usage of experimental ET and their fragments as a tool for investigating the process of knowledge acquisition (Granik's (2017) idea); lack of studies of the psychodidactic issues of the optimal proportion between PT and ET during the learning process;

in the practical aspect: absence of full-fledged ET designed on the psychodidactic foundation. By the full-fledged ET we mean not those nowadays widely spread electronic forms of textbooks (so-called EFT), but a principally new learning tool. We will use the following working definition: electronic textbook is a digital educational book which contains a full and systematic presentation of the school subject in accordance with the curriculum, integrates textual, visual, auditory, animation and other information and is officially accepted for usage in the educational process.

During two decades of the ET existence (the first digital textbooks appeared in the late 1990s), a long way from digitizing a paper textbook and designing EFT, including multimedia content, to creating a full-fledged ET, has been covered. The current paper refers to this modern format, moreover, to the prospective development of an "ideal" ET compatible with various electronic media.

2. Problem Statement

The problems of the ET are considered by researchers from various fields of knowledge. Among the numerous groups of studies connected with the digitalization of educational tools the following can be singled out:

didactic, aimed at defining the conditions for ET creation and application, contributing to the greatest efficiency of the educational process;

medical, including sanitary and hygienic, which investigate the impact of ICT on children's physical and mental health, justify the necessity of fulfilling the hygienic requirements to the hardware and work schedule when working with ET;

design and ergonomic, which develop the requirements for the navigation system, the layout of the pages on the screen, the proportion of textual and visual information, etc.;

psychological, which explore those aspects of designing ET that are connected with various mental processes and their role in the learning activity. This direction was formed in the 1990s within the framework of the psychology of computer education and is actively developing nowadays.

As a separate group, we would like to mark out psychodidactic studies of the influence of digital technologies, including ET, on the development of students' cognitive abilities. Let us clarify that the general point of psychodidactic concepts is the idea of interaction between various spheres of knowledge: psychological, didactic, methodological and subject-related – with the priority of applying psychological laws of personality development (Borisenko, Mironova, & Shishkova, 2019). Particularly, in the frame of this approach the following studies have been carried out: developing psychological criteria for ET evaluation (V.I. Panov, T.V. Krupa), defining psychodidactic foundations of the influence of digital technologies on the development of students' cognitive abilities when using ET in teaching physics and chemistry (N.K. Hannanov et al.); creating the psycho-pedagogical model of ET, including the theory of digital education, ET structure and functions, ET design, criteria for assessing ET use and development, etc. (Railean, 2015).

However, many issues concerning the psychological problems of ET creation and application still remain insufficiently studied. Meanwhile, in the early 2000s, when the total digitalization of education had been considered only at a far perspective, Granik (2007) introduced the proposition that the defining value is not in the fact "in which form an educational book will appear: in its usual present paper variant or on electronic data medium", but in "those content, that psychological, didactic and physiological foundation on which the educational programs will be built-up" (p. 6). This thesis is the decisive one in our work.

Nowadays four scenarios for the application of paper and electronic textbooks can be singled out:

(1) learning using only PT (traditional variant);

(2) PT + ET (transitional phase with a different proportion of the two textbook formats);

(3) ET only (in a more or less distant future);

(4) neither of the two (learning without textbooks).

The most common variant is still the first one: the vast majority of schoolchildren learn with the PT. According to the data obtained by the developers of the educational platform LECTA, ET are available only for 9.5% of the Russian teachers (Praktika, p. 29), while in developed countries such as Australia, the United Kingdom, Singapore, USA, Finland, Sweden, Estonia, the number of educational institutions which are active users of the ET exceeds 40-50%. It's obvious that the number of schools using ET will increase every year. But today one can assert that the most promising scenario of interaction between the old and the new formats of school textbooks is the second one, named the blended learning practice. Many researchers support this model (see, for example, (Boelens, Wever, & Voet, 2017)). We would like to cite the opinion of Ivanova and Osmolovskaya (2016): "It is the electronic

textbook that enables to organize blended learning which is regarded as a combination of the conventional lessons, when a teacher and a student can communicate directly in the classroom, and the lessons conducted using information and communication technologies" (p. 197).

The transition period has not only a scientific justification but also an official one, confirmed by the documents of the Ministry. According to the Order of the Ministry of Education and Science of the Russian Federation, the availability of an electronic form is a necessary requirement for a textbook included in the federal list (Order, 2016). It is supposed that by December 2020 paper textbooks will be replaced by the digital ones in eleven subjects of the school curriculum. Meanwhile, it is noted that a full transition to ET is not planned and the electronic formats are introduced in schools on a voluntary basis.

3. Research Questions

The following key issues are included in the problem field of the current research, carried out in the frame of the psychodidactic approach:

organizing psychodidactically correct interaction between the participants of the educational process when using PT and ET;

providing mental and personality development of the students by means of PT and ET;

creating conditions for activating, with the help of PT and ET, perception, thinking, reconstructive imagination, memory, and other mental processes, as a result of which a qualitatively new level of mastering the subject is achieved;

defining psychological features of reading from the screen in comparison with reading the paper text;

developing a psychological basis for the application of PT and ET as a means of communication, including using them to provide effective feedback.

4. Purpose of the Study

The main purpose of this study was to define the psychodidactic principles of interaction between electronic and paper textbooks. Speaking of interaction, we mean not the textbooks only, but also the subjects of the educational process, who deal with the textbooks directly: the student, the students (class), the teacher.

5. Research Methods

In the course of the study the following methods have been applied: interdisciplinary theoretical and methodological analysis; methods of systematization and generalization of scientific knowledge in the field of creating ET; analysis of the existing Russian language ET for basic school; the method of modelling the ET (i.e. its fragments, on one of the topics of the Russian language course – Composite sentence).

6. Findings

As a result of the analysis, generalization and systematization of knowledge on the research problem, we identified three key psychodidactic principles of interaction between PT and ET: complementarity, collectively distributed activity and interactivity. By the principles, we understand the main statements that serve as the requirements and guidance in the activity aimed at developing students' cognitive and personality spheres in the learning process using different formats of educational books.

As the initial one, we consider the complementarity principle. This is the most important general scientific methodological principle which originated from the quantum mechanics postulates introduced by N. Bohr and describes a phenomenon in mutually exclusive, complementary systems. The application of this principle to the interaction between the two textbook formats – PT and ET – is connected, firstly, with the transition period mentioned above, i.e. the parallel existence of both formats with the current dominance of the PT; secondly, with the SanPin (Sanitary Rules and Norms) requirements, according to which the students of 12-13 years old can use the computer no more than twenty minutes per lesson, and 14-15 years old – no more than twenty five minutes; thirdly, with the change of the reading model (transition from analogue data media to the electronic ones), which is now being referred to as the "reading revolution".

Based on modern data obtained from the comparative studies of the specifics of reading PT and ET, one can formulate the key requirements for the implementation of the complementarity principle when working with the two textbook formats. As the studies show (Ackerman & Lauterman, 2012; Kretzschmar et al., 2013; Mangen, Walgermo, & Brønnick, 2013; Myrberg & Wiberg, 2015; Singer & Alexander, 2017), the choice of the format should be determined by the reading goal, the complexity and the length of the text (the learning material). Thus, if the information is rather simple and requires a fairly superficial and quick comprehension, then working with the ET is preferable; if a deeper understanding is necessary and/or the text is of considerable length, then the usage of the PT will be more efficient. So, the realization of the complementarity principle means alternately changing the format of the textbook depending on the purpose of the work to be carried out and the nature of the tasks to be done.

The principle of collectively distributed activity implies an optimal distribution of the educational activity between the teacher, the student, the PT and the ET in a psychologically comfortable environment. According to Rubtsov's (1996) concept, to create a shared environment of the joint learning activity, the distribution of the initial actions and operations, the exchange of actions, mutual understanding, communication, planning of common actions and reflection are necessary. The main components of such an environment are the joint activity of the teacher and the students; the joint activity of the students; means of organizing joint activities.

It should be noted that we consider textbooks not as "technical educational tools", but rather as full-fledged participants and even organizers of the collectively distributed activity. This becomes possible when they contain not a "reference" system of knowledge, but a kind of scenario of the learning process, constructed with consideration of the regularities and mechanisms of students' mental development. In this case, the PT and ET define the strategy and tactics of the joint activity modelled in the textbook, alongside with performing the traditional functions of knowledge transition, reinforcement and training. As a result, the dependence of the success of learning on teacher's mastership weakens,

which is especially important for those students who for one reason or another cannot attend classes at school.

The principle of interactivity: nowadays there are two key lines to consider the notion of interactivity: as interpersonal interaction involving information exchange between people and their mutual influence on each other; and as human interaction with technology consisting in the active message exchange between the user and the information system in real-time mode. In both cases, the integral part of interactivity is feedback. Concerning ET, interactivity also means supporting the multimedia and interactive control elements which allows screen sharing, streaming multimedia, presenting data on learning outcomes, etc. (GOST R 57724-2017, 2017, p. 6).

Speaking of interactivity as a principle, we mean an effective subject-to-subject interaction in the system "teacher-student(s)-PT-ET". Sometimes pedagogues' anxiety arising from the lack of knowledge in the sphere of innovation or from probable increasing workload becomes a serious obstacle on the way of organizing such interaction. Special training, as well as support from the school administration, can facilitate overcoming this state (Chiu, 2017; Railean, 2015). The realization of the principle of interactivity presupposes a dialogue between the participants; therefore, it becomes very important to create on paper and electronic pages of the textbooks an atmosphere of calm trustful communication based on respect for the student and his or her opinion. Since the educational interaction is aimed at students' cognitive and personality development, the team of authors led by Granik (2007) has created a whole range of psychodidactic techniques that promote the development of thinking, attention, imagination, help to arouse and maintain cognitive interest with the assistance of PT and ET. These techniques include the usage of "imaginative grammar", consideration of the texts under study in the context of personal and general cultural meanings, activation of the psychological mechanism of cognitive processes awareness, etc. (Kak uchit' russkomu yazyku i literature sovremennyh shkol'nikov? Shkol'nyj uchebnik segodnya, 2018).

To provide feedback in the PT the answers (keys) to the tasks and questions are given. Students first answer the questions themselves and then study the answers presented in the textbook. In this sense the ET opens up more opportunities for learning: when performing training exercises and diagnostic assessments the ET provides instant feedback which is the basis for correction in order to improve student achievement at every stage of the educational process. Such application of feedback is the foundation of formative assessment, aimed at contributing to the development of the student in the frame of current activity (Duckor & Holmberg, 2017).

The defined principles are closely interconnected, interdependent and in many aspects derive one from the other. We would like to dwell on the issue of their realization when teaching the Russian language using both textbook formats. Let us consider this problem on the material of the textbooks of a new – psychodidactic – type, edited by G.G. Granik: the already existing PT and the ET being designed (we are talking about the course "Russian Philology", which consists of the Russian language textbooks for grades 1-9 and educational books on literature; the team of authors led by G.G. Granik includes S.M. Bondarenko, L.A. Kontsevaya, O.Z. Kantarovskaya, N.A. Borisenko, O.V. Gvindzhiliya, G.N. Vladimirskaya, S.V. Shishkova, K.V. Mironova, and others).

As an example, we will take the topic "Composite sentence", which is included in the unit "Syntax and punctuation" (grade 5). It is one of the key themes in these textbooks since the main distinction of the course is its structuring on a syntactic basis, which, in turn, is conditioned by the psychological laws of knowledge acquisition. Namely, according to the studies of N.I. Zhinkin, G.G. Granik, insufficient learning of syntax leads to considerable losses in the development of students' literate oral and written speech and, ultimately, negatively affects their overall intellectual growth.

Mastering the syntax and punctuation using the PT and ET takes three stages. At the first one, students make themselves familiar with the theoretical material presented in the PT. The sequence will be as follows: the subject-predicate unit, the types of sentences according to the number of subject-predicate units, the types of composite sentences, the disposition of the parts of the composite sentence are studied; finally, a general algorithm of placing the punctuation marks in the constructions is introduced. After that, students make two or three exercises for primary consolidation of the material. At this stage, the processes of comprehension and involuntary memorizing play a central role.

The second stage begins with the transfer from the PT to the ET (the command "Switch to the electronic textbook") and entering the unit "Test your knowledge" – a special type of assessment when the voluntary memorization and abstract-logical thinking, based on the assimilation of rules and concepts, are working. Further work is planned according to the results of the task performance. If a student passes it, he or she switches to the stage of training and consolidating the material. One of the definite advantages of the ET over the PT is the opportunity to provide a wide range of training exercises. Every task is instantly being checked using online-keys, and depending on the presence/absence of errors and their nature, the student gets a new set of tasks.

At the end of studying the topic (the third stage), the student performs a final online test and again receives instant feedback: learns the obtained score, the nature of the errors, etc. Thus, if a student makes mistakes related to not knowing (or forgetting) a certain linguistic fact, he or she switches to the ET section "Remember". Based on the information given in the pop-up windows, the student can revise the theory presented in a condensed form.

These are the main stages of the alternate work organized by the textbooks themselves to study one of the most important parts of the Russian language – syntax and punctuation. In a similar way, a collectively distributed activity is constructed while mastering other course units.

7. Conclusion

Thus, the application of ET can significantly enrich the educational process. However, the best results can be achieved if the ET is used not as a sole means of learning, but as an addition to the PT. We have introduced three key principles underlying the use of both textbook formats at school: 1) the complementarity principle, implemented in the alternating changes in the used format of the textbook depending on the purpose of the work to be carried out and the nature of the tasks to be done; 2) the principle of collectively distributed activity, implying an optimal distribution of learning activities among the participants of the educational process; 3) the principle of interactivity, considering an effective subject-to-subject interaction in the system "teacher-student(s)-PT-ET".

The prospects of the research are connected with designing the interactive ET on the Russian language from the standpoint of the psychodidactic approach, which, in turn, requires reliance on interdisciplinary studies in the fields of educational psychology, developmental physiology, didactics and methodology.

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