

Implementing the Zone of Proximal Development: From the Pedagogical Experiment to the Developmental Education System of Leonid Zankov

Liudmila G. GUSEVA ^{a*}

Mark SOLOMONOVICH ^b

^a *Nosov Magnitogorsk State Technical University, Russian Federation*

^b *MacEwan University, Canada*

Received: 12 March 2016 / Revised: 30 May 2016 / Accepted: 7 June 2016

Abstract


This article overviews the theoretical and applied works of the psychologist and pedagogue Leonid Zankov. Zankov's model of teaching is based on Vygotsky's theory that appropriate teaching methods stimulate cognitive development, whose core notion is the Zone of Proximal Development. This educational psychology research was verified by large scale pedagogical experiments conducted in 1970s at public schools in Russia. Over several decades L.V. Zankov with co-workers and followers created the comprehensive system of developmental education for elementary school. The Zankov education system is used now at public schools in Russia. Its main principles and properties are described.

Keywords: Leonid Zankov, Lev Vygotsky, Pedagogical experiment, Developmental education, Elementary school, Zone of proximal development, Cognitive learning.

Zone of Proximal Development

In the early twentieth century the renowned scientist Lev Semyonovich Vygotsky (1896-1934) revolutionized the psychological science (Newman and Holzman, 1993). He created new approaches in cognitive psychology and psychology for dealing with learning disabilities. The research legacy of Vygotsky is still not fully assessed yet as many works and facts became available for study relatively recently (Yasnitsky and van der Veer, 2016). Education within the framework of his theories is the subject of our paper.

Among his many interests, Lev Vygotsky studied the relationships between teaching and child's development, and he concluded that teaching leads development. According to Vygotsky, teachers should promote child's development by stimulating capabilities. In order to be effective, teaching needs to anticipate development. In this connection, Vygotsky proposed his theoretical concept known as the "Zone of Proximal Development"

*  Corresponding author: Liudmila G. Guseva, Professor, Institute of Humanities Education, Nosov Magnitogorsk State Technical University, Lenin Ave. 38, Magnitogorsk, Chelyabinsk region, Russian Federation 45500, E-mail: liudmila.guseva@gmail.com

(ZPD): “in studying what the child is capable of doing independently, we study yesterday's development. Studying what the child is capable of doing cooperatively, we ascertain tomorrow's development. The area of immature, but maturing processes makes up the child's zone of proximal development” (Vygotsky, 1998:202), (Vygotsky, 2001:200). This famous notion first appeared in Vygotsky's lectures on pedology that were transcribed and first published after his death, therefore, there is insignificant discrepancy with the words in the six volume collected works of L.S. Vygotsky. Quoting further from there, Vygotsky emphasizes: “research demonstrates that the zone of proximal development has more immediate significance for the dynamics of intellectual development and the success of education than the actual level of development” (Vygotsky, 1982:247). Vygotsky explains that: “The main function of education is to teach a child something new. Therefore, the zone of proximal development, which defines this area of transitions accessible to a child, presents the main moment with respect to education and teaching” (Vygotsky, 1982:250). The well-known concise definition of ZPD as “the distance between the actual developmental level determined by individual problem solving and the level of development as determined through problem solving under guidance or in collaboration with more capable peers” appeared in Vygotsky's first English translation (Vygotsky, 1978:86). The revolutionary idea of L.S. Vygotsky was that “the zone of proximal development has more immediate significance for the dynamics of intellectual development and for the success of teaching than the actual level of development” (Vygotsky, 1982:247). Therefore, if the aim of education is to promote the learner's development, teaching in classroom should address not to what is manifestly achieved, but to those capabilities, functions and skills that a child has neither yet expressed nor attained. “The teaching is not development, but the correctly organized teaching leads a child's intellectual development by giving rise to processes that would be impossible outside of the education. Thus teaching is the internally necessary and holistic process of the development of not innate but rather social traits of a child” (Vygotsky, 1991:388).

Leonid Vladimirovich Zankov (April 10 (23), 1901 – November 27, 1977) was among the first and closest disciples of Lev Vygotsky (Vygotskaya and Lifanova, 1996). This fact was overshadowed by Zankov's distance from the Vygotsky circle (Yasnitsky, 2009) and by his independent research program in education. L.V. Zankov did the ground breaking research on memory of school pupils (Zankov, 1944) and worked with children with the anomalies within the program of the Institute of Defectology. In 1951-1977 at the Institute of Theory and History of Pedagogy of the Academy of Pedagogical Sciences of Russian Federation, Zankov worked on practical applications of Vygotsky's theories. Obtaining rigorous scientific facts in the fields of psychology and education became the main trait of Zankov's research work. Leonid V. Zankov was first to conduct large scale pedagogical experiments (Zankov, 1963a). This was “a comparative study of the development of school pupils and the learning of knowledge under conditions of the experimental system and of the traditional methodology of primary education” (Zankov, 1968:43). He did this in order to test at school Vygotsky's theory of learning. Zankov's aim was to determine the nature and degree of influence that teaching methods on general development of the early years students. Prior to this research there had been no scientific comparison of the “teaching to stimulate development” versus the “teaching in response to preparedness” perspectives in cognitive psychology. The goal of elementary school education according to the Zankov education system is the general development of each child, i.e. the development of fundamental elements of a child's psyche, mind, will and emotions. Leonid Zankov with his students and co-workers transformed Vygotsky's theoretical ideas into a cohesive system of curriculum and practice and tested it at public schools. On September 1, 1957 Moscow public school N 172 opened an experimental class, where ordinary school pupils in the first grade were taught according to the principles of new educational psychology. By this

historical event, the developing education system of L.V. Zankov was born. After the first class went through all elementary school years, 1957-1960, this system became more widely used, although it was still experimental with the three stages (Zankov, 1963a). In the last stage of 1973-1977 more than one thousand classes participated. The pedagogical experiment was conducted under various conditions, in rural and city schools, in ethnically diverse or single language schools. The Zankov teaching system always reliably delivered the expected learning results. In 1963-1967 new methodological instructions for teachers were prepared and experimental textbooks for elementary school in the subjects of Russian language, reading, mathematics and the natural science were worked out and published.

However, the system was still experimental and existed outside the state approved teaching methods. After the death of Zankov, his educational system was removed from public schools. The works of Leonid Zankov have been in obscurity for decades, as his books became bibliographic rarities. The first, limited and edited, collection of Zankov's pedagogical works appeared long time ago (Zankov, 1999). Only in 1993 the Ministry of Education opened the L.V. Zankov federal research-methodological center. The core of research staff consisted of Zankov's students and collaborators: I.I. Arginskaya, N.Ya. Dmitrieva, M.V. Zvereva, A.V. Poliakova, Z.I. Romanovskaia and others. The Center prepared a new generation of textbooks that finally became state approved for teaching. Around 2000, almost one third of Russia's elementary schools used the Zankov developing education system.

Zankov's Views on the Child's Development

The goal of elementary school education in the Zankov system is general development of each child. Zankov writes already in his early works: "General development, as well as comprehensive, is opposed to the one-sided, unilateral development. An analysis of the general development in psychological terms is done through certain forms of the mental activity. If we keep in mind the traditional division of the psyche into the mind, will and feelings, the general development includes all three of these lines. We are convinced, however, that this threefold division is doomed to become extinct" (Zankov, 1963b). Mind, will and emotions are the fundamental elements composing the psyche. The development of mind occurs not only through the acquisition of knowledge, but also through its repetition, which involves various kinds of brain activities, such as logical thinking, observation, memory, and imagination. Mind development is linked to the development of will, the ability to motivate oneself to achieve a desired goal. Will grows out of the wish, desire, and it develops with achievements. The development of emotions, intellectual ones, e.g. the joy of learning, ethical ones, e.g. gratitude, conscience, decency, the allegiance to principles, and aesthetic ones, e.g. the understanding of harmony of colours, forms, and sounds composes the human mental richness. General development of a child, when these three aspects are inseparable, is the primary goal of education. Development is a complex process, which depends on both inner and outer factors. Development is determined by the appearance of new mental formations, which are not set directly by teaching. Teaching results in development, as Zankov maintained, yet it influences a child not directly, but through his or her own inner world, his or her personality.

As any teaching method, Zankov system aims at developing children's knowledge, skills and habits, creating favourable conditions for the growth of child's potentials, meeting and developing these potentials. Its author points out that "the integral connection between the task of the general development and the accomplishment of teaching and social education bring forward a need to give students of early grades a general picture of the world on the basis of science, literature and art that is nature, people's life and labour" (Zankov, 1970). According to Zankov mastering of reading, writing and of other skills

should not be understood as some special trained operations, but as a part of mastering of general human culture. In Zankov's educational system, the development is achieved upon realization of many components, which constitute this system. The directing and regulating role in this system is played by its didactic principles, which "grow out of its guiding idea: to make teaching as effective as possible in promoting the general development of school pupils" (Zankov, 1977a).

Principles of the Zankov Education System

Leonid Zankov formulated the main ideas of his new education system in five major principles (Zankov, 1968, Zankov, 1977b). Even though this distinct separation is convenient to discuss, one should always understand them in their unity as not one can be removed or underestimated.

- 1) Teaching at an optimal level of difficulty
- 2) Emphasizing theoretical knowledge
- 3) Proceeding at a rapid pace
- 4) Developing students' awareness of the learning process
- 5) The purposeful, systematic development of each student

1) The principle of teaching at an optimal level of difficulty

L. V. Zankov wrote that "among the didactic principles of our experimental system a decisive role belongs to the principle of education at the high level of difficulty. The concept of 'difficulty' ['trudnost'] is used in didactics in different contexts and in different meanings. One aspect of this concept - is 'overcoming obstacles" (Zankov, 1975). In elaborating this notion, Zankov followed the works of great pedagogue Konstantin Ushinsky. His 19th century monograph, which laid down the very foundation of the modern school system in Russia, emphasised the importance of overcoming the difficulties or obstacles for the human development, thus it underlies this principle. Ushinsky wrote "We love the work, but we do not love the difficulty of the work, not realizing that the work is not possible without the difficulties, because the difficulty presents the meaning of the work, regardless of the goals, which are being achieved by this work" (Ushinsky, 1948:249).

Leonid Zankov continues explaining the meaning of this founding principle of the developmental education system: "The principle of learning at the optimal level of difficulty is characterized by not what raises some abstract 'average level of difficulty', but above all by what reveals the spiritual powers of a child, gives them the direction and the scope. If the teaching material and methods of its learning are such that there is no obstacle for students to overcome, then the development of children is sluggish and weak" (Zankov, 1975). Teaching according to the Zankov system proves that if the process of learning does not include overcoming the difficulties, i.e. does not involve any mental tension, then students' development moves slowly and inertly. And vice versa, overcoming the difficulties, not any difficulties but only those that are possible to overcome for children, those that are placed in the zone of their proximal development, results in the students' spiritual growth and strengthens their belief in own abilities. The teacher has to teach at the optimal level of difficulty because only teaching, which systematically supplies material for the complex mental activities, stimulates the intensive development of children.

2) The principle of emphasizing theoretical knowledge

"This principle requires that the cognitive side of learning was highlighted as a powerful tool for the development of pupils, and as a reliable basis of the true mastery of skills and

abilities" (Zankov, 1968:36). Zankov writes further, "The decisive role in elementary education should be played by the cognitive aspect, the theoretical knowledge and not the cultivation of skills in language and mathematics. It is necessary to develop these skills on the basis of valuable general development, on the basis of deeper understanding of language regularity and mathematical connections and dependencies. "During the process of learning in the Zankov system, students make various observations related to the material studied. The teacher directs their attention and leads them toward finding the existing connections and dependencies in the studied material themselves. Students are led toward explaining specific dependencies and making conclusions. Educational practice shows that children are fond of research work. They like to discover connections and make conclusions on the basis of their own observations. Mathematics in the traditional education system is a subject that often gives troubles to school pupils. In the Zankov system it is made easy to understand and to get practical skills because "in the experimental program pupils of the first grade learn about the relationship between numbers directly adjacent in magnitude. Children learn the concepts of equality and inequality, as well as the corresponding symbols. Students learn about the composition of the first ten numbers, are introduced to the arithmetic operations of addition and subtraction, as well as learn the names of their components. Calculations are introduced in writing as soon as children learn how to write digits. The connection of subtraction with addition is also the subject of cognition" (Zankov, 1975).

The textbooks of mathematics have been substantially edited and updated since the time of Zankov's experiment nonetheless they adhere to the original plan outlined in his monograph. "Geometric material is introduced in an organic connection with the arithmetical operations to deepen their understanding. The program includes the following knowledge: straight line, segment, equality and inequality of the segments, right angle, rectangle and some of its properties, the perimeter of the rectangle. Laboratory works are performed: addition and subtraction with two product lines, increase and decrease of the segment several times, the construction of the rectangle according to its sides, calculating the sum of the rectangle sides. Students get acquainted with the measures of length, weight, vessel capacity, and perform laboratory works on the measurement" (Zankov, 1975). Here we see that the theoretical knowledge about arithmetic and geometry is being created in the classroom by the way of discovery, and it is presented at the end in a mathematically rigorous form.

3) The principle of proceeding at a rapid pace in the study of the curricular material

The rapid pace of study suits children's needs. They are more interested in learning something new rather than repeating many times the material previously studied. In Zankov's own words: "The point is not that during the lesson children solve as many as possible examples, do so many exercises, and so on. To go forward at fast pace does not mean to rush in the classroom, in a hurry to give as much information to school pupils. Rushing and seeking the records are profoundly alien to our experimental system. Equally unacceptable is the repeated, monotonous repetition. The fast-paced learning allows to organically reveal different sides of the acquired knowledge, and to deepen and associate them" (Zankov, 1975).

In Zankov system the process of learning is constructed in such a way that a rapid pace of study and going back to previously covered material take place simultaneously. Learning new knowledge alternates with repeating the previously learned. This kind of curriculum material set up in the textbooks of the Zankov system commonly called 'the layered pie'. It is impossible to order a child's mind to develop faster. Thus, the system is not meant to force the development. It is meant to create favourable conditions for awakening and unfolding of child's potentials. Zankov used to say that 'one has to hurry without haste'. He

emphasized that one should spare no time during the class for solving various contradictions arising during learning, for example, between correct and incorrect solutions of a problem, the old and new methods of solving problems.

For example, in the mathematics curriculum there is a strong emphasis on geometry beginning from grade 1. Geometrical properties of figures naturally appeal to the vivid imagination of young learners. All classroom work and exercises are directed to discovering the mathematical properties of geometrical figures.

4) The principle of developing the students' awareness of the learning process

This principle is directed inwards, i.e. toward the students' awareness of the learning process taking place within them, the awareness of what they have known before and what new is being learned during the process of studying certain subject, phenomenon, or story. As a result, the awareness of the learning process and the realization of one's own process of learning - the dynamics of learning - are related to different mental activities.

Zankov emphasizes, "When the children are studying spelling rules (for example, the rules prescribing the change of a word or the selection of a 'native' word), their similarity often leads to confusion. In our experimental system, children are warned that they must be especially careful in such cases, because the rules are similar to one another and can be confused. Thus, the process of mastering knowledge and skills itself becomes the object of awareness to a certain extent. How is the knowledge to be learned linked together? What are the various aspects of mastering spelling or computational operations? What is the mechanism underlying errors and the prevention of errors? These and many other questions relating to the mastery of knowledge and skills are the subject of unflagging attention on the part of school pupils" (Zankov, 1975).

For example, at the geography lesson a teacher asks children to find answers to questions like these: How did people learn what the Arctic Ocean and its nature are? How did people learn about the lands surrounding the Southern pole? And how can we learn about this?

A math teacher guides the thinking of kids by the questions: How did the digits arise? Why are there so few of them? How was invented the sign for zero? What led people to invent this sign? And how can we learn all this?

During the history class and while studying historical facts during the reading class, children realize which sources give them some particular historical information.

5) The principle of purposeful and systematic work on the development of each student

Zankov considers any isolation, division of students according to their progress, or creation of classes on the basis of students' thinking similarities as contradictory to the principles of development and to the very nature of teaching. If there are no pathological deviations, all children should be able to progress in their development. The process of development takes place either slowly or unevenly, depending on individual potentials, characteristics of nervous systems, personal experiences, etc. Weak and strong students should learn together. Vygotsky also emphasized: "Any high level mental activity in the process of development of a child appears on the scene twice - at first as a collective, social activity, as an intermental function, the second time as an individual activity, as a child's own thinking, as an intramental function."

The Zankov system accepts a child the way he or she is, with his/her own peculiarities, mind setups and characters. The system believes in every child and their potentials. All the activities of a teacher in the Zankov system are directed toward the realization of students' intellectual potentials, development of their dispositions and inclinations. In the Zankov system the teaching should be set up in such a way as to achieve the optimal progress in

the development of all students, including the strongest and the weakest. The progress in the development of strong and at-risk students was studied in mixed ethnicity schools, by comparing the results of the traditional and experimental systems. In the experimental classes the significantly higher percentage of weakest pupils achieved the expected level of the learning progress by finishing the elementary school (Zankov, 1975).

Conditions for Learning and Development

The didactic principles in the Zankov system are realized through the education content and the methods of teaching. Teaching according to Zankov distinguishes itself by the richness of curriculum and by the emotionally engaging atmosphere of the classroom. This condition follows naturally from the educational psychology of Vygotsky: "Emotional reactions have significant impact on all forms of our behaviour and moments of the educational process. If we want to achieve the best memory on the part of students or more successful work of the thought, we should make sure that both these actions were stimulated emotionally" (Vygotsky, 1991:141).

Children's thinking begins with astonishment. A spark of thought is emotionally charged. Vygotsky said that "emotion is no less important agent than thought." "It is the emotional reactions that should form the basis of the educational process. Before communicating this or that knowledge, the teacher should call on the appropriate emotion of a student and make sure that the emotion is associated with the new knowledge. Only that knowledge can be grafted, which has passed through the senses of a student. All the rest is dead knowledge, killing any live relationship to the world" (Vygotsky, 1991:142).

A child is astonished and emotionally involved only if he or she feels comfortable, when the relationships between the teacher and students are sincere, friendly, and warm. Consequently, the atmosphere of trust and care supports the development of the self-respect and self-acceptance of children, strong will and belief in own abilities. In such conditions even the weakest student, receiving support of peers and a teacher, participates in the joint creative work.

Summarizing, everybody in the classroom is encouraged to follow the following rules:

- 1) listen and hear,
- 2) look and see,
- 3) think and ponder,
- 4) enjoy and experience.

To provide this learning environment and engage young pupils into this learning process is not an easy task for any teacher. It requires great efforts and commitment from a teacher. But teaching results will be rewarding for a teacher as well as for students.

Properties of the Zankov System

Four major properties characterize the teaching methodology of Leonid Zankov:

- 1) Broad focus
- 2) The progressing nature of teaching
- 3) Confrontations
- 4) Variation

Broad focus means the wide use of various functional potentials of the material studied. It serves not only as a means to acquire extensive knowledge and skills, but also to bring into the process of learning a diversity of students personal experience - emotional, intellectual, volitional, and aesthetic. This property distinguishes itself by the richness of both content and form of children's activities.

The progressive nature of teaching represents a continuous interdependent progress in learning, the growth of each and every element is studied as later elements are mastered and comprehended as a whole. In the process of acquiring new knowledge, elements learned earlier are not isolated. They enter into broader formations and as a result the progress takes place. The progress in learning does not tolerate isolation. The processing of knowledge is realized in time. New knowledge is gradually included into the previously learned material.

Confrontations property confirms that it is necessary to utilize oppositions coming into conflict when the previously learned meets the new (old and new activities, experiences, etc.) in order to stimulate students' intensity of learning. The inclusion of conflicting facts, events, and methods into the studied material and then the leading of students to their theoretical comprehension promote deeper acquisition of knowledge and develop students' thinking abilities. The property of confrontations reveals the contradictions of full and incomplete knowledge, worldly and scientific ideas and notions. It supports research activities and helps develop such skills as reflection, dialectical and critical thinking.

The property of variation depends on diverse and concrete conditions, especially individual characters of students. Taking into consideration students' individual abilities may result in variations in the studied material's level of difficulty. Also the teaching method cannot be understood as the methodology of teaching a certain subject. It is a part, a subsystem of the entire didactic system whose typical features are common for overall methods used in teaching all subjects.

L.V. Zankov made a significant emphasis on physical activity of young pupils not only as a way to maintain their health but also as a part of the whole educational system, which includes the personal interaction among the class and the teacher. "From grade 1 we recommend a large number of excursions as well as practical classes on the ground, so the time students spend in the open air significantly increases. Consequently, this realized a sharp turnaround compared with the status quo, when during school hours children were indoors almost all the time. We also recommend that a teacher, as far as possible in the after-school hours, go with the children for a walk. As one of the recreational activities, walking at the same time contributes to the rapprochement of the teacher with the children, teambuilding of the students, and acquiring the information about the environment" (Zankov, 1963b). To some extent, in the outdoor activities Zankov has the foresight of modern ecological education, whose importance was not fully understood at that time.

Conclusion

The research legacy of Lev Vygotsky lives on and draws attention of educators and pedagogues at the present time even more than in the past. The treasures of the Vygotsky theories have been assessed by the educational psychology community since the publication of the pioneering book (Vygotsky, 1978). The notion of the zone of proximal development has been known as a core concept for the learning development (Giest and Lompscher, 2003). It was valued and used for teaching (Hedegaard, 1990), (Wood and Wood, 1996), when the studies of Zankov were not known yet worldwide. Two other followers of L.S. Vygotsky, D.B. Elkonin and V.V. Davydov, created another developmental education system, which is also one of three systems approved by the state authorities in Russian Federation for elementary education in Russia. Two systems of developmental education, Elkonin-Davydov vs. Zankov, were once the subject of early comparison (Otte, 1976). The didactic system of L.V. Zankov was a great success due to the close intense collaboration of researchers in psychology and pedagogy with teachers and education

authorities in conducting the pedagogical experiments. The Zankov system reduced the number of years of elementary school in Russia from four to three, because “the intensive progress of students in their general development made it possible to study the curriculum of elementary school much deeper than usual and in shorter time” (Zankov, 1975).

The research for efficient training strategies to improve students’ learning of mathematics has been conducted for decades; it is correlated with the development of cognitive skills (Özsoy and Ataman, 2009) in accord with general principles of educational psychology. Meanwhile the Zankov system has been implemented for teaching mathematics at several schools in Norway (matematikklandet.no), and the mathematics textbooks were published in Norwegian language (Arginskaya et al, 2014, Arginskaya et al, 2015). The successful program made one of the schools the top school in mathematics in Norway. This is another confirmation of the high effectiveness of the Zankov system in mathematics education, which was noted from the time of early pedagogical experiments. We should note that L.V. Zankov wrote the very first textbook of mathematics for the first grade in 1965. An attempt to begin teaching mathematics according to the Zankov education system was also done in Canada as a pilot project by the Edmonton public schools. Therefore, the mathematics textbooks for the three grades were translated into English (Arginskaya et al, 2001). These textbooks of mathematics for elementary school are rather different from the textbooks of standard school programs, both in Canada and in Russia. They may look theoretical and difficult, but all pupils were able to understand and learn the teaching material, if teaching was done according to the above listed rules of the Zankov education system. Its general principles will be illustrated with the examples from mathematics textbooks and lessons in future publications.

One of us had significant experience of working according to the Zankov developmental education system at elementary school and then of teaching the school teachers and students at the pedagogical faculty how to work according to its principles. Here we exposed the system of L.S. Zankov, which deserved deep appreciation of teachers and school pupils. The system of L.V. Zankov was barely reviewed in international journals since the appearance of Zankov’s original papers, e.g. (Zankov, 1977b). Only two monographs by L.V. Zankov were translated into European languages, one into English (Zankov, 1977a) and one into German (Zankov, 1973). The monograph “Teaching and development” was later translated into Chinese language (Zankov, 1985) along with two other books by L.V. Zankov, which means Zankov’s works are more freely available now in China than in any other country beside Russia. The purpose of our paper is to begin uncovering the Zankov developmental education system that has remained hidden behind the language barrier.

The Zankov education system is spreading around the globe. It naturally supplements a number of other approaches to developmental education, that are based on the idea of a teacher as the guide of active and creative class students, such as ‘smart schools’ in several countries (Firoozi, Kazemi, Jokar, 2017). Educators in Brazil also showed significant interest in the works of Russian psychologists and pedagogues, including Vygotsky and his followers (Aquino, 2014). We hope that this paper will start disseminating the knowledge about the Zankov system of developmental education and L.V. Zankov and that growing interest would bring to life new teaching projects based on the Zankov system.

• • •

References

- Arginskaya, I.I., Benenson, E., Itina, L., Blank, N., Melhus, K., Moe, G.E. (2014). *Matematikk 1: Grunnbok 1*. Kirkenes: Barentsforlag (in Norwegian).
- Arginskaya, I.I., Benenson, E., Itina, L., Blank, N., Melhus, K., Moe, G.E. (2015). *Matematikk 2: Grunnbok 2*. Kirkenes: Barentsforlag (in Norwegian).
- Arginskaya, I.I., Guseva, L.G., Solomonovich, M. (2001). *Mathematics. Grades 1-3*. Edmonton, Alberta: Edmonton School Board.
- Aquino, O.F. (2014). Leonid Vladimirovitch Zankov: contribuições para a pesquisa em didática desenvolvimental. In: Longarezi, A.M. and Puentes, R.V. (eds.). *Ensino desenvolvimental: vida, pensamento e obra dos principais representantes russos* (pp. 245-273). Uberlândia, MG: EDUFU (in Portuguese).
- Hedegaard, M. (1990). The zone of proximal development as basis for instruction. In L.C. Moll (Ed.). *Vygotsky and education: Instructional implications and applications of sociohistorical psychology* (pp. 349-371). Cambridge: Cambridge University Press.
- Firoozi M.R., Kazemi, A., Jokar, M. (2017). The role of socio-cognitive variables in predicting learning satisfaction in Smart Schools, *International Electronic Journal of Elementary Education*, 9(3), 613-626.
- Giest, H. and Lompscher, J. (2003). Formation of learning activity and theoretical thinking in science teaching. In: Kozulin, A., Gindis, B., Ageyev, V. and Miller, S., *Vygotsky's educational theory and practice in cultural context* (pp. 267-288). Cambridge: Cambridge University Press.
- Nechaeva, N.V. and Roshchina, N.N. (2009). Milestones of the developmental education system of L.V. Zankov. Moscow: Zankov Center. Retrieved from <http://zankov.ru/about/history/article=820/>
- Newman, F. & Holzman, L. (1993). *Lev Vygotsky: Revolutionary scientist*. London: Routledge.
- Otte, M. (1976). Die didaktischen systeme von V.V. Davidov / D.B. Elkonin einerseits und L.V. Zankov andererseits. Skizze einer kritischen Auseinandersetzung. *Educ. Stud. Math.* 6(4), 475-497 (in German). DOI: 10.1007/BF00411093
- Özsoy, G., Ataman, A. (2009). The effect of metacognitive strategy training on mathematical problem solving achievement, *International Electronic Journal of Elementary Education*, 1(2), 67-82.
- Ushinsky, K.D. (1948). The man as a subject of education: Pedagogical anthropology. Vol. 2. In The collection of works. Vol. 9. Moscow: Academy of Pedagogical Sciences of RSFSR. Available from <http://elib.gnpbu.ru/sections/0100/ushinskij/>
- Vygotskaya, G.L. and Lifanova, T.M. (1996). *Lev Semyonovich Vygotsky. Life, work, strokes for the portrait*. Moscow: Smysl (in Russian).
- Vygotsky, L.S. (1978). *Mind in society. The development of higher psychological processes*. Cambridge, MA: Harvard University Press.
- Vygotsky, L.S. (1982). Thought and speech. In Vygotsky, L.S. The collected works in 6 volumes. Vol. 2. Moscow: Pedagogika (in Russian). First published (1934). Moscow: Sotsekgiz.
- Vygotsky, L.S. (1991). The problem of teaching and intellectual development at the school age. In Davydov, V.V. (ed.). L.S. Vygotsky. *Educational Psychology*. Moscow: Pedagogika. First published in Zankov, L.V., Zh.I. Shif, Elkonin, D.B. (eds.). (1935). The intellectual development of children in the process of education. Moscow: Uchpedgiz.
- Vygotsky, L.S. (1997). *The collected works of L.S. Vygotsky. Vol. 4. The history of the development of higher mental functions*. New York, NY: Springer Science+Business Media.
- Vygotsky, L.S. (1998). *The collected works of L.S. Vygotsky. Vol. 5. Child psychology*. New York, NY: Springer Science+Business Media LLC.

- Vygotsky, L.S. (2001). Korotaeva, G.S. (ed.). *The lectures on pedology*. Izhevsk: Udmurtsky universitet (in Russian).
- Wood, D. & Wood, H. (1996). Vygotsky, tutoring and learning. *Oxford Review of Education*, 22(1), 5-16.
- Zankov, L.V. (1944). *Memory of school pupils, its psychology and pedagogy*. Moscow: Uchpedgiz (in Russian).
- Zankov, L.V. (ed.). (1963a). *Development of students in the process of education: 1-2 grades*. Moscow: Academy of Pedagogical Sciences of RSFSR (in Russian).
- Zankov, L.V. (1963b). *On the elementary education*. Moscow: Academy of Pedagogical Sciences of RSFSR (in Russian). <http://www.zankov.com/works-ogl.htm>
- Zankov, L.V. (1968). *Didactics and life*. Moscow: Pedagogika (in Russian).
- Zankov, L.V. (1970). *Conversations with teachers*. Moscow: Prosveshchenie (in Russian). Available from <http://www.zankov.com/works-ogl.htm>.
- Zankov, L.V. (1973). *Didaktik und Leben*. Hannover: Schroedel (in German).
- Zankov, L.V. (ed.). (1975). *Teaching and development* ['Obuchenie i razvitie']. Moscow: Pedagogika. Available from <http://www.zankov.com/works-ogl.htm>.
- Zankov, L.V. (1977a). *Teaching and development*. White Plains, NY: M.E. Sharpe.
- Zankov, L.V. (1977b). Principles of the experimental didactic system. *Soviet Education*. 19(4-6), 52-64. DOI: 10.2753/RES1060-939319040652
- Zankov, L.V. (1985). *Teaching and development*. Yu Xianghui, Du Diankun translation. Beijing: People's Education Press (in Chinese).
- Zankov, L.V. (1999). *The selected pedagogical works*. Moscow: Dom Pedagogiki. Available from <http://www.zankov.com/works-ogl.htm>.
- Yasnitsky, A. (2009). Vygotsky circle during the decade of 1931-1941: Toward an integrative science of mind, brain, and education (PhD thesis, University of Toronto). Available from <http://hdl.handle.net/1807/19140>
- Yasnitsky, A. and van der Veer, R. (2016). *Revisionist revolution in Vygotsky*. New York, NY: Routledge.

www.iejee.com

This page is intentionally left blank