UDC 376.42:372.851
BBC Ч455.622.1-243
GSNTI 14.29.21
Code VAK 13.00.03

E. V. Skira
Moscow, Russia

DIFFICULTIES IN SOLVING ARITHMETIC PROBLEMS BY JUNIOR SCHOOLCHILDREN WITH INTELLECTUAL DISABILITIES

Abstract. The article presents the results of a study aimed at revealing the difficulties of solving arithmetic problems by junior schoolchildren with intellectual disability. It provides a quantitative and qualitative analysis of text reproduction and arithmetic problems solution by junior schoolchildren. The scope of the study covers the skills of solving simple and compound arithmetic problems by pupils with intellectual disability. The aim of research is to study the ability to reproduce texts of simple and compound arithmetic problems by junior schoolchildren; to reveal the correlation between the ability to reproduce and to solve arithmetic problems by junior schoolchildren; and to figure out typical mistakes in reproduction and problem solution by junior schoolchildren.

The results of the conducted research have allowed revealing the peculiarities of problem texts reproduction and the main reasons of incorrect solutions. The author discovered a correlation between the ability to properly reproduce the text of the problem and to solve it correctly. Based on the analysis of the solution quality, four differentiated groups of pupils are singled out. They demonstrate different levels of text reproduction and problem solving.

The obtained results would make it possible to differentiate and raise the level of acquisition of skills to solve arithmetic problems by pupils with intellectual disability. The article presents certain pedagogical techniques to improve the process of teaching solution of simple and compound arithmetic problems by junior schoolchildren with intellectual disability.

Keywords: junior schoolchildren; intellectual disability; children with intellectual disability; oligophrenopedagogy; methods of teaching mathematics; teaching mathematics at a primary school; arithmetic problems; methods of teaching mathematics at a special school; solving problems; difficulties of teaching.

About the author: Skira Elena Vasil'evna, Post-graduate Student.
Place of employment: Department of Oligophrenopedagogy and Clinical Foundations of Special Education, Institute of Special Education and Complex Rehabilitation, Moscow City Pedagogical University.

By their essence and variety of types, word arithmetic problems represent, on the one hand, rather complex mathematical material and, on the other hand, determine and widen rehabilitation, educational, and practical opportunities of teaching mathematics to pupils with disabilities.

One of the main purposes of

mathematical education is to teach junior schoolchildren with intellectual disabilities to solve arithmetic problems [12; 16].

Each problem has its own peculiarities and acquaints the pupils with something new, and also facilitates the development of the competence to select the necessary life, everyday and playing material for the plot of the problem and teaches logical thinking. We can provisionally single out two interconnected stages in the process of teaching solution of arithmetic problems: acquaintance with the structure of the problem and the methods of its solution, and teaching techniques of calculation (E. N. Trafimovich) [17].

Arithmetic problems solution allows disclosing the main essence of arithmetic operations, making them concrete and connecting them with a definite life situation. The problems facilitate acquisition of mathematical notions, relationships and regularities. The target of solution of a problem of any kind consists not so much in their correct solution as in the pupils' skills to single out those terms and word combinations which determine the methods of solution and to translate them into mathematical language, to understand the situation which is implicitly expressed in the problem text, to establish its connection with the problem question, and, finally, to acquire the skills of performing sequential mental operations (V. P. Grikhanov) [7].

Having mastered the problem structure, the child is more likely to analyze it more attentively, which can make its solution much easier. The problem text analysis facilitates the understanding of the given data and the search for the unknown; and the question helps to figure out what is unknown and what should be found. The child's proficiency in solving problems that are more complex depends on how effectively he has understood the structure of a simple arithmetic problem and has learnt to reason and provide arguments for his actions (R. L. Berezina) [2].

In the process of solving arithmetic problems the pupils learn to plan and control their activity, master the techniques of self-control; they develop their will and perseverance (N. D. Boganovskaya, V. P. Grikhanov, G. M. Dul'nev, M. N. Perova, I. M. Solov'ev, Zh. I. Shif, V. V. Ek) [1; 6; 14].

Special literature on methods contains numerous references to the fact that solving arithmetic problems brings about serious difficulties in children with intellectual disabilities. It may be attributed not only to lower learning potential of such children but also to the fact that the specificity of cognitive activity of children with intellectual disability is insufficiently addressed in the process of education, and is often overlooked in teaching the given subject (M. N. Perova, I. M. Yakovleva) [13].

The works by I. V. Zygmanova,

R. A. Isenbaeva, N. F. Kuz'mina-Syromyatnikova, M. I. Kuz'mitskaya, K. A. Mikhal'skiy, N. I. Nepomnyashchaya, M. N. Perova, I. M. Solov'ev, A. A. Khil'ko, V. V. Ek, etc. [8; 9; 10] are devoted to the study of peculiarities of arithmetic problem solving by pupils with intellectual disability and to the search for methods, techniques and means of their teaching.

Practice shows that at present, pupils face serious predicaments in solving arithmetic problems.

We carried out a summative experiment with the purpose of revealing the specific features and difficulties in reproduction and solution of arithmetic problems by junior schoolchildren with intellectual disability and finding a correlation between correct solution of an arithmetic problem and its accurate reproduction.

Fifty third-form pupils of special (rehabilitation) schools of Moscow took part in the experiment: 17 students of the Small Business College # 4 (structural division "School" of the Central Administrative Okrug) and 33 pupils of the Special (Rehabilitation) Boarding School of Type VIII # 108 (school division # 1, school division # 2 of the South-Western Administrative Okrug). All the pupils were enrolled in special (rehabilitation) schools on the basis of decision of the psycho-medico-pedagogical committee with ICD-10-CM Diagnosis Code F70 (Mild Intellectual Disabilities).

Based on the analysis of the second form programs in mathematics (in collection of programs edited by V. V. Voronkova) [15] for special (rehabilitation) education institutions of type VIII and the second form textbook in mathematics (by T. V. Alysheva), we have worked out the summative experiment procedure which included two stages.

At the first stage, those tested were asked to reproduce the text (story) and solve simple arithmetic problems on adding some units to the number or subtracting some units from it.

At the second stage, the pupils were asked to reproduce the text and solve compound arithmetic problems on calculating the sum of two numbers and calculating the difference, calculating the difference and the sum of two numbers, adding some units to the number and calculating the sum of two numbers, subtracting some units from the number and calculating the sum of two numbers, adding some units to the number and subtracting some units from the number, subtracting some units from the number and adding some units to the number, subtracting some units from the number and calculating the difference, adding some units to the number and calculating the difference.

Each pupil was given a problem text printed on a card that was read by the pupil 2-3 times. After that, the pupil orally reproduced the problem

situation and then solved it.

The quantitative analysis of the results of text reproduction and solution of arithmetic problems by junior schoolchildren with intellectual disabilities is presented in Tables 1 and 2.

Table 1

Results of reproduction of the text and solution of simple arithmetic problems

Kind of problem	Number of pupils who scored 5 points		Number of pupils who scored 4 points		Number of pupils who scored 3 points	
	reproduction	solution	reproduction	solution	reproduction	solution
Adding some units to the number	15	12	28	27	7	11
Subtracting some units from the number	13	11	27	19	10	20
Proportion, %	28	23	55	46	17	31

Table 2

Results of reproduction of the text and solution of compound arithmetic problems

Kind of problem	Number of pupils who scored 5 points		Number of pupils who scored 4 points		Number of pupils who scored 3 points	
	reproduction	solution	reproduction	solution	reproduction	solution
Calculating the sum of two numbers and calculating the difference	14	10	33	10	3	30
Calculating the difference and the sum of two numbers	12	7	35	17	3	26
Adding some units to the number and calculating the sum of two numbers	18	16	29	20	3	14
Subtracting some units from the number and calculating the sum of two numbers	26	12	21	23	3	15
Adding some units to the number and subtracting some units from the number	6	4	34	18	10	28
Subtracting some units from the number and adding some units to the number	5	6	37	17	8	27
Subtracting some units from the number and calculating the difference	6	7	36	16	8	27
Adding some units to the number and calculating the difference	18	5	29	24	3	21
Proportion, %	26	17	64	36	10	47

In ***reproducing simple arithmetic problem situations*** containing the relations “greater than/less than … by” the pupils made the following mistakes: they mixed up the words (48%, for example, they said “less” instead of “more” and vice versa), reproduced the text incorrectly or omitted numerical data (13%, for example, instead of “9 sweets”, as it is given in the problem situation, they said “10 sweets”), distorted the meaning of the problem story (20%, the repro-

duction consisted of some disconnected components of the problem situation: for example, instead of "Ann gathered 10 kg of apples and 3 kg less of pears" they said "Ann gathered 10 kg less of apples, and 3 kg less of pears"), inadequately reproduced or omitted the problem question (for example, the original question "How many sweets does Dima have?" was reproduced in the following way: "How many sweets do the children have?", "How many sweets does Masha have?").

Thus, 28% of the pupils reproduced the simple problem situation without distorting the meaning, 55% of the pupils reproduced it with trivial mistakes, and 17% of the pupils reproduced the simple problem situation distorting its meaning.

In ***solving simple arithmetic problems*** containing the relations "greater than/less than … by" the pupils made the following mistakes: they used incorrect arithmetic operation for the solution (for example, instead of "addition" used "subtraction", etc.); replaced or omitted names while writing down the notation; made perseveration mistakes (solved the problem in two steps: the first step was required by the situation, and the other one was superfluous – calculating the sum of two addends; we believe that this mistake was caused by the inadequate transfer of problem solution from the previous lesson when the pupils solved two-step problems and the pupils used this technique on the analogy); were inattentive (put down an operation with numbers absent in the situation); made mistakes in the concise notation; made calculation mistakes (9 к. + 5 к. = 10 к.; 10 kg – 3 kg = = 8 kg).

In solving simple arithmetic problems on diminishing a number by some units the pupils made mistakes while formulating the answer (for example, "Ann had 7 kg of apples left").

The pupils' mistakes in solving simple problems were often caused by a wrong choice of arithmetic operation or incorrect formulation of a concise notation, as well as inability to imagine the situation described in the story.

Thus, 23% of the pupils solved the simple problem correctly, 46% of the pupils solved the simple problem with mistakes, and 31% of the pupils could not solve the simple problem.

As we see, the third form pupils reproduced the situation of simple problems better than they solved them.

We revealed a correlation between the pupils' ability to reproduce the situation of the simple problem and to solve it correctly. There were pupils who reproduced the situation of the problem distorting its meaning but solved it correctly (4%), and there were also pupils who reproduced the problem situation in the

right way but could not solve it correctly (8%).

In ***reproducing compound arithmetic problem situations*** the pupils made the same mistakes they had made in reproducing simple arithmetic problem situations. The following mistakes were made: they distorted the words, mostly prefixal verbs (for example, instead of "vyshlo" many pupils said "voshlo"); distorted the word sequence (instead of "2 old tables were taken away and 6 new tables were brought in" said "2 new tables were brought in and 6 old tables were taken away").

The following mistakes were frequent in reproducing compound arithmetic problem situations: incorrect reproduction of the problem question; incorrect reproduction or omission of numerical data; distortion of the meaning of the problem; replacement of words; distortion of words («vyshli» — «voshli»; «podaril» — «poluchil»; «s"eli» — «sorvali», «polozhili»).

Thus, 26% of the pupils reproduced the compound problem situation without distorting the meaning, 64% of the pupils reproduced it with trivial mistakes, and 10% of the pupils reproduced the compound problem situation distorting its meaning.

In solving compound arithmetic problems the pupils made the same mistakes they had made in solving simple arithmetic problems. They also made mistakes in solving compound problems which had not been made while solving simple problems: they did not understand the essence of the problem; performed superfluous operations (one-step or three-step solution); loss or replacement of the necessary numerical data (did not write numerical data or gave inadequate data in the concise notation); made mistakes while formulating the answer (for example, instead of "Masha read 13 pages during the third day" they wrote "Masha read only 13 pages").

Very often, the pupils' problem solution mistakes were caused by miscomprehension of the meaning of words (for example, prefixal verbs («vyshli» — «voshli» and synonyms «podaril» — «poluchil») and word combinations, wrong choice of arithmetical operation, performance of superfluous operations and inability to imagine the situation described in the problem story.

Thus, 17% of the pupils solved the problem correctly, 36% of the pupils solved the compound problem with mistakes, and 47% of the pupils could not solve the compound problem.

As we see, the third form pupils reproduced the situation of compound problems better than they solved them.

We revealed a correlation between the pupils' ability to reproduce the situation of the compound problem and to solve it correctly. There

were pupils who reproduced the situation of the problem distorting its meaning but solved it correctly (8%). We believe that it is connected with the low level of speech development of these pupils. And there were also pupils who reproduced the problem situation in the right way but could not solve it correctly (32%).

Based on the experiment results, we have singled out four differentiated groups of pupils in accordance with their performance of text reproduction and problem solution.

Group 1 – pupils who reproduced the problem story without distorting its meaning and solved the problem correctly (39%).

Group 2 – pupils who reproduced the problem story without distorting its meaning but could not solve the problem correctly (40%).

Group 3 – pupils who reproduced the problem story distorting its meaning but solved the problem correctly (12%).

Group 4 – pupils who reproduced the problem story distorting its meaning and solved the problem incorrectly (9%).

In order to raise the efficiency of arithmetic problem solution it is necessary to improve the methodological techniques of training problem solving taking into account the above mentioned groups of pupils. It is advisable to carry out coordinated work of the school logopedist and the primary school teacher with the pupils, especially with the pupils of group 3, displaying a low level of speech development, towards enrichment of vocabulary, word building, prefixal words, synonyms and meanings of words and word combinations.

It is necessary to pay special attention to the explanation of the meanings of words denoting certain actions. For that reason, we suggest including a system of rehabilitation-educational exercises aimed at semantic analysis of the arithmetic problem text at the lessons of mathematics.

References

1. Alekseeva, O. A. Obuchenie mladshikh shkol'nikov s zaderzhkoy psikhicheskogo razvitiya ponimaniyu teksta syuzhetnykh zadach : avtoref. dis. … kand. ped. nauk / Alekseeva O. A. — SPb., 2014. — 15 s.
2. Antropov, A. P. Matematika vo vspomogatel'noy shkole : ucheb. posobie / A. P. Antropov. — SPb. : Obrazovanie, 1992.
3. Afanas'eva, Yu. A. Analiz kontingenta obuchayushchikhsya spetsial'nykh (korrektsionnykh) uchrezhdeniy VIII vida / Yu. A. Afanas'eva, I. M. Yakovleva // Korrektsionnaya pedagogika: teoriya i praktika. — 2014. — № 1 (59).
4. Afanas'eva, Yu. A. Spetsial'noe (korrektsionnoe) uchrezhdenie kak resursnyy tsentr inklyuzivnogo obrazovaniya / Yu. A. Afanas'eva, O. V. Bratkova, N. M. Nazarova, O. V. Titova, I. M. Yakovleva // Vestn. Moskov. gor. ped. un-ta. Ser. «Pedagogika i psikhologiya». — 2014. — № 3 (29).
5. Beloshistaya, A. V. Kak pomoch' rebenku v samostoyatel'noy rabote nad zadachey / A. V. Beloshistaya // Nachal'naya shkola. — 2008. — № 8.
6. Volodina, A. S. Zakonomernosti protsessa dekodirovaniya tekstovogo soobshcheniya i puti ego formirovaniya u mladshikh shkol'-

nikov s nedorazvitiem rechi : avtoref. dis. … kand. ped. nauk. — M., 2012. — 15 s.

7. Grikhanov, V. P. Formirovanie u uchashchikhsya vspomogatel'noy shkoly umeniy samostoyatel'nogo resheniya arifmeticheskikh zadach s pomoshch'yu algoritmicheskikh predpisaniy / V. P. Grikhanov // Osobennosti formirovaniya psikhicheskikh protsessov u detey s narusheniyami umstvennogo i fizicheskogo razvitiya / MGPI. — Minsk, 1987.

8. Zygmanova, I. V. Umenie uchashchikhsya vspomogatel'noy shkoly reshat' arifmeticheskie zadachi s oporoy na predmetnye deystviya / I. V. Zygmanova // Defektologiya. — 1993. — № 3.

9. Zygmanova, I. V. Povyshenie effektivnosti obucheniya resheniyu arifmeticheskikh zadach v mladshikh klassakh vspomogatel'noy shkoly : avtoref. dis. … kand. ped. nauk. — M., 1993. — 15 s.

10. Zygmanova, I. V. Priemy obucheniya resheniyu arifmeticheskikh zadach uchashchikhsya mladshikh klassov vspomogatel'noy shkoly / I. V. Zygmanova // Defektologiya. — 1996. — № 3.

11. Kika, E. S. Osobennosti vospriyatiya det'mi s intellektual'noy nedostatochnost'yu logicheskikh otnosheniy usloviya tekstovoy arifmeticheskoy zadachi / E. S. Kika // Ot idei — k innovatsii / MGPU. — Mozyr', 2008.

12. Koloskova, O. P. Formirovanie uchebnykh umeniy mladshikh shkol'nikov v protsesse obucheniya resheniyu tekstovykh zadach / O. P. Koloskova // Nachal'naya shkola. — 2008. — № 9.

13. Perova, M. N. Razvitie metodicheskikh osnov prepodavaniya matematiki v spetsial'noy (korrektsionnoy) shkole / M. N. Perova, I. M. Yakovleva // Innovatsii v obrazovanii. — 2013. — № 9.

14. Petrova, V. G. Psikhologiya umstvenno otstalogo shkol'nika / V. G. Perova, I. V. Belyakova. — M. : Akademiya, 2002.

15. Programmy spetsial'nykh (korrektsionnykh) obrazovatel'nykh uchrezhdeniy VIII vida: podgotovitel'nyy, 1—4 klassy / pod red. V. V. Voronkovoy. — 4-e izd. — M. : Prosveshchenie, 2006.

16. Tomme, L. E. Obuchenie resheniyu arifmeticheskikh zadach detey s tyazhelymi narusheniyami rechi / L. E. Tomme // Defektologiya. — 2016. — № 3.

17. Trafimovich, E. N. Osobennosti ponimaniya predmetnoy i matematicheskoy sushchnosti tekstovoy arifmeticheskoy zadachi uchashchimisya mladshikh klassov vspomogatel'noy shkoly / E. N. Trafimovich // Defektologiya. — 1999. — № 3.