RESEARCH ON FUNCTIONAL MATHEMATICAL LITERACY OF PUPILS WITH MODERATE SPECIAL EDUCATIONAL NEEDS LEARNING IN MAINSTREAM SCHOOLS

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Abstract

The article deals with the research on functional mathematical literacy of pupils with moderate special educational needs (SEN) learning in eighth forms of mainstream schools. Research data were collected applying quantitative approach. The article describes aspects of research structure, material selection and received research results. The questionnaire survey was employed to find out how pupils with moderate SEN learning in eighth forms of mainstream schools are able to apply existing mathematical knowledge in real-life situations and solving practical type problems, their functional mathematical literacy abilities are assessed.

Key words: *functional abilities, mathematical achievements, mathematical literacy, pupils with moderate special educational needs.*

Introduction and problematics

Reforming the system of education of Lithuania, teaching becomes increasingly centred on the learner who is preparing to live in the modern society, which cannot be imagined without quickly changing information, productive thinking and the ability to apply subject knowledge acquired at school in various areas of life and education. It is accentuated in the analysis of educational problems "National Strategies of Education 2013-2022: Aims, Problems, Fields of Improvement[1]" (2012) that international researches into learning achievements (TIMSS, PIRLS, PISA) demonstrate different work quality in different levels of schools: achievements in primary education are assessed as good but achievements of senior class pupils (particularly 15-year-olds) are significantly lower than the mean of European countries. This is confirmed by the data of the National Agency for School Evaluation, stating that dominating achievement levels of Lithuanian pupils in all assessed areas – abilities of reading, mathematics and natural sciences – on an international scale were second and third (in total there are 6 levels), whereas there were particularly few pupils of Lithuania who had reached highest – fifth and sixth – levels, their shares were smaller that corresponding means of countries who took part in the research.

[1] Valstybinė švietimo strategija 2013–2022 m.: tikslai, problemos, tobulinimo kryptys. (2012).

All of it shows that it is necessary to assess and compare pupils' achievements and their shift on the basis of received results, look for new forms, methods, aids of education that help to improve senior class pupils' Lithuanian language, cultural, mathematical, natural science, informational, etc. literacy. Because the role of mathematics, natural sciences and technologies in the modern world is very important, pupils just have to be literate in these areas. The comprehensive school faces a task both to convey knowledge, experience accumulated by the society and help every pupil to form the system of values, learn to learn and solve problems, develop personal competencies which would help to actively act in the society and adjust to changing social, economic conditions through constant self-development (General Curricula for Primary and Basic Education[2], 2008). It is sought that the pupil should be able to use existing knowledge and information in everyday life (Bulotaitė & Gudžinskienė, 2004; Šiaučiukėnienė, Visockienė, & Talijūnienė, 2006; Baranauskienė, Geležinienė, Tomėnienė, Vasiliauskienė, & Valatkienė, 2010, Tomėnienė, 2012 et al.).

In research literature (Briggs, 2002; Būdienė, 1998; Cibulskaitė & Sičiūnienė, 2007; Cuban, 2001; Dudaitė, 2006, 2008; Madison, 2003 et al.) mathematical literacy is defined as the ability to recognise, understand mathematics and apply its knowledge, make grounded decisions about the existing and future role of mathematics in the person's private, professional life and communicating with peers, relatives, participate in mathematical activities in such ways which correspond to the life needs of the individual as a constructively acting, interested and conscious citizen. Functional mathematical literacy is effective practical usage of mathematics, seeking to implement general life needs at home, at work and participating in the life of the community and society (Siemon, 2000); the ability to understand and use numbers and data analyses in everyday life (Madison, 2003). This demonstrates that General Curriculum of Mathematics for Basic Education (General Curricula for Primary and Basic Education, 2008) pays much attention to the factor of functionality, to the development of functional mathematical literacy because comprehension of familiar mathematical concepts, comprehension and application of mathematical methods provide preconditions for every pupil (both more gifted and weaker and with SEN) to both cognize and freely orientate in practical and everyday life.

The review of research literature of recent years enables to state that development of mathematical literacy of pupils with moderate SEN is insufficiently discussed and there is no information about academic abilities and achievements of pupils with moderate SEN who are integrated and are learning in mainstream schools as well as about their functional abilities to apply acquired knowledge in practical activities. In 2009-2010, seeking to improve this situation and disclose manifestation of mathematical literacy abilities of senior class pupils and youngsters with moderate SEN, the authors surveyed mathematics teachers of mainstream schools and profession teachers in vocational education centres. Research data (Baranauskienė & Tomėnienė, 2010, 2012; Tomėnienė, Tamutytė & Geležinienė, 2011; Tomėnienė, 2012) disclosed pedagogues' opinion about the importance of functional mathematical literacy of pupils and youngsters with moderate SEN, the necessity to improve these pupils' mathematics teaching process in the mainstream school, review the content of the curriculum, developed abilities, attitudes, applied strategies and methods. Research results demonstrated that development of functional mathematical literacy has to become an important constituent of SEN pupils' preparation for self-sufficient life (Baranauskienė & Tomėnienė, 2010, 2012; Tomėnienė, 2011, 2012). According to respondents, the level of mathematical literacy of SEN pupils who come to learn to vocational education centres is insufficient for learning the future speciality; they find it difficult to apply knowledge of mathematics acquired at school in everyday, professional activity and real-life situations. However, in addition to teachers'

[2] Pradinio ir pagrindinio ugdymo bendrosios programos. (2008).

opinion, better development of mathematics of these pupils requires knowledge of the level of these pupils' functional mathematical literacy. Only suitable familiarisation with the pupil's interests, abilities, talents and possibilities will enable to start formation of practical mathematical abilities (Tomėnienė, 2011). It is evident that such knowledge of academic and practical abilities of senior age pupils with moderate SEN educated in mainstream schools is missing; therefore, relevance of this research is determined by the wish to evaluate real situation of development of SEN pupils' mathematical literacy and identify manifestation of functional mathematical literacy of pupils with moderate SEN learning in eighth forms of mainstream schools.

Research aim: to explore the manifestation of functional mathematical literacy of pupils with moderate SEN learning in eighth forms of mainstream schools.

Research subject: assessment of functional mathematical literacy of pupils with moderate SEN.

Methods and methodology of the research. Research instrument was prepared: the questionnaire for testing the ability of pupils with moderate SEN learning in eighth forms of mainstream schools to apply existing mathematical knowledge in real-life situations and solving problems. Data necessary for the research were collected performing quantitative survey in the written form. The questionnaire used during the survey was drawn up on the basis of survey data of mathematics and profession teachers of 2009-2010, of proposals of 6 experts' group, of curricula described in General Curricula for Primary and Basic Education (2008), Curriculum of the Special School (Štitilienė, 1999), National Methodology for Assessment of Pupils' Achievements in Mathematics and for Presentation of Tasks (the permission to use these data was received from the head of the Education Development Centre) and later in Recommendations for Adjustment of General Curricula of Basic Education for Education of SEN Pupils with Low (Limited Intellect) and Very Low (Mild Learning Difficulties) Intellectual Abilities[3] (2010). The notebook of tasks (questionnaire) consisted of explanation how to fill in the questionnaire, collection of mathematical formulas necessary for doing the tasks, questions to find out demographical data about respondents and 5 practical type rubrics of tasks. At the end of the academic year 2009-2010, the pilot study was conducted. It was attended by 100 pupils with moderate SEN. All tasks were reviewed, results were discussed with the experts' group, scopes of problems were reduced, and 37 problems were selected for the main study, which took place at the end of the academic year 2010-2011. The questionnaire consists of two parts. It was recommended to fill them in at different time or after a break so that pupils do not get tired and suitably do all tasks. The first part of the questionnaire consisted of 3 blocks of questions and problems (rubrics "Questions about You", "Test if You Can Measure" and "Test if You Can Apply Knowledge of Geometry Practically"), and the second part of the questionnaire consisted of 3 blocks of problems (rubrics "Test if You Can Apply Knowledge of Geometry Practically", "Test if You Can Apply Knowledge of Mathematics in Professional Activity" and "Test Your Existing Economics Skills"). Pupils with moderate SEN had to solve 37 selected practical type problems in order to find out the peculiarities of applying knowledge of main analysed topics of mathematics. These were problems for evaluating pupils' factual knowledge, understanding, skills, their application in everyday and well familiar subject-based, real-life context. Respondents were given the notebook of problems-questionnaire, made up of main topics of mathematics: *Numbers and Calculus, Geometry, Measures and Measurements, Statistics, Foundations of the Probability Theory*. The content of all conditions of problems is related to the environment that is familiar to the pupil, everyday situations and professional activities. The majority of groups of tasks contained several problems so that it

[3] Pagrindinio ugdymo bendrųjų programų pritaikymo rekomendacijose specialiųjų poreikių žemų ir labai žemų intelektinių gebėjimų mokinių ugdymui (2010)

could be possible to evaluate pupils' mathematical abilities more objectively. All tasks were different: some of them were simpler, easier, others, more difficult.

Drawing up a questionnaire, the format of the problem was also considered. One fourth of problems contained an answer that could have been chosen (pupils had to circle the chosen answer). Solving problems with short answers (solution) (15 per cent), pupils had to write in the answer. The questionnaire also contained problems requiring giving both the answer and the derivation. During the main survey every pupil was given a notebook with problems, which they could solve during several lessons. Pupils were allowed to use additional aids; i.e., calculators, tables of measures, etc. There was space left next to given problems for derivations, so pupils were encouraged to do all derivations in the sheets of the notebook.

The results of solving problems were analysed in three aspects: of *knowledge and skills* (main concepts and procedures, their knowledge, comprehension and solving); *communication* (comprehension of the condition of the problem, rendering of the solution of the problem, usage of mathematical symbols and terms); *solving of practical problems* (choice of the way of solving the problem, writing the answer, making elementary conclusions). All research participants were familiarised with the content of the questionnaire and rules of filling it in. Besides, pupils were warned that data about their personalities would not be recorded.

Empirical data were managed applying quantitative data analysis and descriptive statistics. Results were calculated using SPSS Program version 17.0 and Microsoft Office Excel 2007 software. The results of pupils' general achievements by areas of the curriculum of mathematics are given indicating percentages of correctly done tasks whilst the relation of doing tasks with the difference of equations is analysed employing Chi-square criterion (χ^2).

Participants of the research. Choosing the participants of the research, targeted sampling method was employed, "when the very researcher decides which respondents it is more purposeful to select" (Luobikienė, 2000). In this case the quantitative research target group was SEN pupils of eighth forms learning in mainstream schools of Lithuanian cities and regions. The research sample consisted of 391 respondents who corresponded to the following criteria: the eighth form pupil of the mainstream school with moderate SEN, educated according to adapted curriculum of mathematics (after the issue of Order No. V-1795 of the Minister of Education and Science of the Republic of Lithuania, dated 2011-09-30, according to adapted or individualised curriculum).

Research Results and their Interpretation

Before doing the tasks pupils had to give several data about themselves in the rubric "Questions about You" (the demographic block); i.e., to write gender, age, form, to indicate who helps to do homework, learn mathematics). Conducting the research, respondents were not selected according to gender or age. The main criterion of selection was that respondents had to be eighth form pupils with moderate SEN learning in mainstream schools according to adapted (currently adjusted or individualised) curriculum of mathematics. Having calculated research results, it was found that more boys than girls were questioned; i.e., 60,4 % of boys and 39,6 % of girls. Respondents were from all regions of Lithuania.

The age of pupils who participated in the research ranges from 13 to 16 years. The majority of respondents were aged 13-15, which makes up 85,3 % (40,9% aged 13-14 and 44,4% aged 15) of all respondents. Interest was taken in who helped to do homework, learn mathematics, if pupils attended additional mathematics classes. Based on these data, later received research results – pupils' achievements – were compared. The received data demonstrate that the majority of respondents (N=291) no longer attend additional mathematics lessons, only one fourth of pupils use the possibility to learn additionally what is more difficult for them in the

areas of mathematics after the lessons (13,6%). Main forms of assistance learning mathematics are assistance provided by the mathematics teacher (37,3%) and the special educator (34,4%) during lessons. One tenth of pupils indicated that both the mathematics teacher and the special educator assisted them during mathematics lessons. Only eight pupils attend additional private classes. It has been found that parents no longer regularly help children to do their homework, girls more often ask for assistance (38%), boys, less often (25%). However, more than half of pupils (68%) often or sometimes nevertheless address adults for assistance doing homework tasks. Assistance doing mathematics homework is provided often for one fourth of pupils, sometimes, for 42% of eight-formers.

It has been aimed to find out what type of general mathematical and knowledge application abilities had been developed among SEN pupils. The research demonstrated that pupils with moderate SEN did tasks differently. The majority of application problems were moderately difficult and difficult for pupils.

Research results demonstrated that pupils with moderate SEN most successfully did tasks of the areas *Numbers and Calculus, Measures and Measurements*. The area *Numbers and Calculus* contained operation series related to the environment familiar to the pupil, everyday situations, professional activity. Pupils achieved best doing these tasks because they could use calculators. The first part of the questionnaire consisted of two blocks of tasks: "Test if You Can Measure" and "Test if You Can Apply Knowledge of Geometry Practically".

The biggest share of problems in the questionnaire (two rubrics in the questionnaire) was from that area of content of mathematics the knowledge of which pupils often need in everyday activities: the area of *Measures and Measurements.* However, doing certain problems one also has to use knowledge of the area *Numbers and Calculus*. Pupils achieved differently doing these tasks.

Research results of the rubric "Test if You Can Measure" are given in Figure 1.

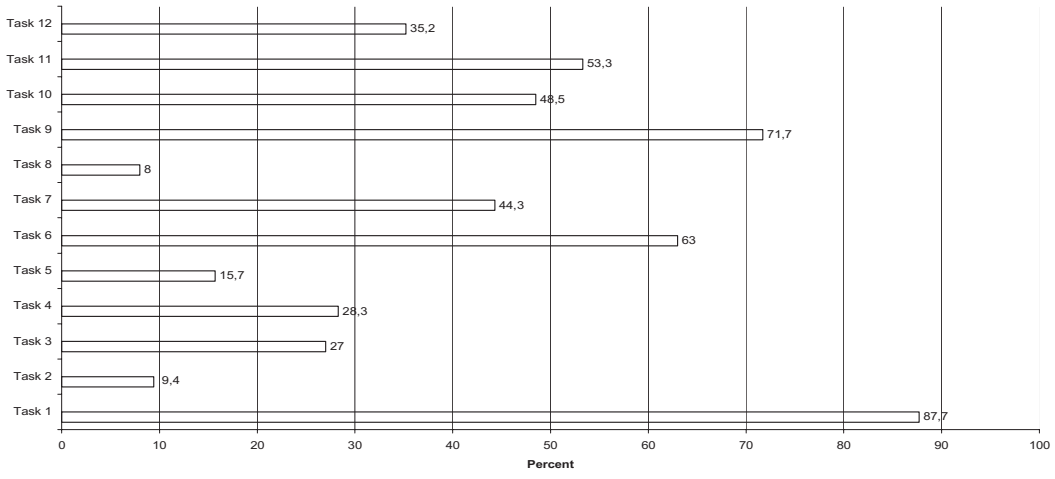


Figure 1. Results of Correctly Solved Problems of the Rubric "Test if You Can Measure", in Percents

As it can be seen in Figure 1, respondents achieved well doing the task where they had to identify the length of the segment according to the given ruler (Problem 1, 87,7%), the value of shown angle (Problem 6, 63%), to calculate how long it took for the employee to go to work (Problem 9, 71,7% of correct answers), to write how many grams the tape recorder

shown in the picture weighed (Problem 11, 53,3%). Pupils were also quite good at doing the task, where they had to indicate what time the electronic clock showed (Task 7, even 85,3% of respondents indicated correctly), to calculate the readings of the thermometer (Problem 10, 48,5% of correct answers). Respondents faced difficulties doing problems where they had to write the length of the strip in millimetres (Problem 2, 9,4% of correct answers), to write the diameter of the circle in centimetres (Problem 5, 15,7% of correct answers), draw the hands of the clock so that they show the written time (Problem 8, only 8% of correct answers), indicate what time mechanical clocks showed (Task 7, 28%).

In the second rubric "Test if You Know Concrete Units" 6 tasks were given where according to the example pupils had to write numerals mentioned in the sentence in numbers, combine or break apart concrete numbers, write them in decimals or vice versa, compare values written in different concrete units, identify temperature changes. Survey results are given in Figure 2.

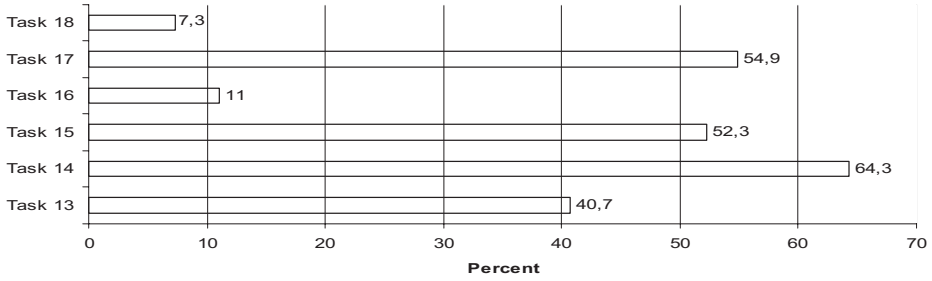


Figure 2. Results of Correctly Solved Problems of the Rubric "Test if You Know Concrete Units", in Percents

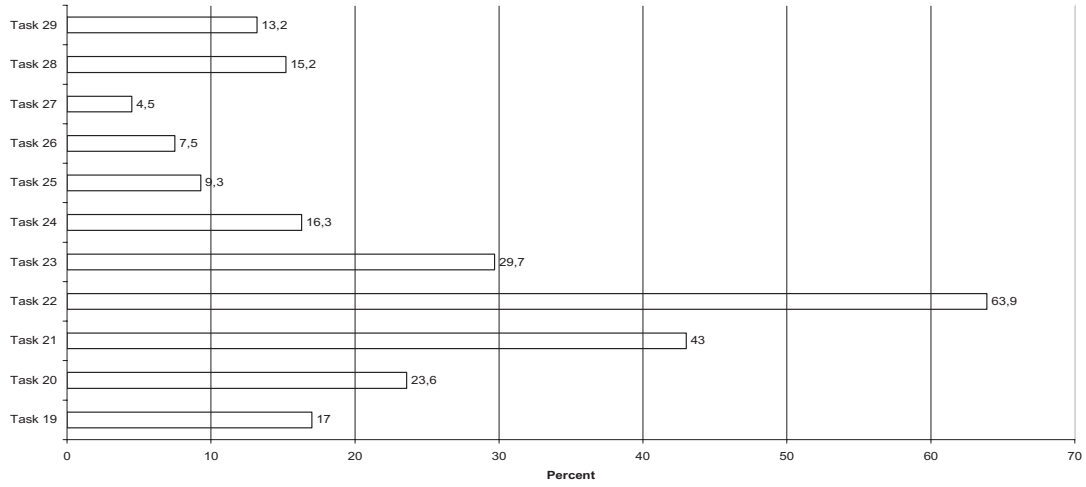
As it can be seen in Figure 2, respondents were doing well where they had to combine or break apart concrete units (Task 14 and 15), identify temperature changes in the room (Task 17, 54,9%). Pupils found it most difficult to write decimals in concrete numbers or vice versa, to express concrete numbers in decimals (Task 16). There were particularly many problems with the task where it was necessary to compare the length of planks written in decimetres, centimetres or metres (Task 18, 7,3%).

To sum up knowledge of pupils with moderate SEN and their application abilities doing tasks of the rubrics "Test if You Can Measure" and "Test if You Know Concrete Units", the following has been noticed:

- Eighth form pupils did best identifying the length of the segment, measuring the value of the angle according to the given protractor, solving time calculation problem, calculating the weight of the thing in grams according to the drawing, combining or breaking apart simple concrete numbers according to the example.
- It was most difficult to comprehend the mechanical clock and the clock with Roman numerals. It can be assumed that pupils better know digital clock because they more often see it in their everyday life. In order to know the time, many pupils used their mobile phones, computers, digital clocks of institutions.
- Like during the pilot study, respondents most often made mistakes converting the decimal into the concrete number; for example, for 2 t 15 kg learners most often wrote 2,15 kg instead of 2,015 kg. The forgotten zero was namely the mistake of the majority of pupils.

In the second part of the questionnaire three blocks of tasks were given: "Test if You Can Apply Knowledge of Geometry Practically", "Test if You Can Apply Knowledge of Mathematics in Professional Activity" and "Test Your Existing Economics Skills".

The rubric "Test if You Can Apply Your Knowledge of Geometry Practically" contained eleven tasks from the area of *geometry*. Pupils had to draw the strip of the corresponding length, segment it into parts; draw angles of the corresponding value, connect geometrical figures with their involutes; using the scale, to draw the plan of the car park; to remember the existing knowledge of this area while solving problems the conditions of which are related to professional (hairdresser's, carpenter's, builder's, knitter's, land-surveyor's) activities. The results of correctly done problems are given in Figure 3.



Fiure 3. Results of Correctly Solved Problems of the Rubric "Test if You Can Apply Your Knowledge of Geometry Practically", in Percents

Data in Figure 3 demonstrate that pupils achieved best doing Task 22, in which they had to connect 4 geometrical figures with their involutes and draw angles of the corresponding value. Pupils were especially good at drawing the 90° angle. Almost one third of pupils who took part in the research (29,7%) managed to draw the car park plan correctly; to draw the stripe of the corresponding length and divide it into equal parts (Problem 20, 23,6%); to use aids (the given formula for calculating volume) and to calculate how many cubic metres of ground the workers dug (Problem 28, 15,2%); what the volume of the pool was (Problem 29, 13,2%). Respondents found it more difficult to calculate areas of the rectangular, circle (Problems 27, 26). Eighth form pupils found it extremely difficult to correctly calculate the length of linoleum for the living room (Problem 25, 9,3% of correct answers).

To sum up knowledge and its application abilities of pupils with moderate SEN doing problems of the rubric "Test if You Can Apply Knowledge of Geometry Practically", it should be noted that:

- Problems of the area of *Geometry* were quite difficult for pupils, particularly solution of word problems;
- A more detailed analysis enabled to find out that in the main study, like in the pilot study, pupils quite well recognised main geometric figures of plain and space, their key elements but they found it difficult to do such problems which required to ground something or use concepts of perimeter, area, volume, scale (as it has been

mentioned, misunderstanding of these concepts particularly showed up at the level of knowledge as well). Many respondents were not able to use formulas which were given in the beginning of the rubric and only one sixth of pupils were able to use the formulas for calculating volumes of cube or parallel-piped rectangular which were given in the condition of the problem, they did not name tallies.

Solving three tasks of the rubric "Test if You Can Apply Knowledge of Mathematics in Professional Activity", pupils had to remember existing knowledge of mathematics from the areas of *Numbers and Calculus, Statistics* and *Probability Theory* (Fig. 4). About two thirds of pupils did not manage to fully solve these problems. The results of correctly done problems are given in Figure 4.

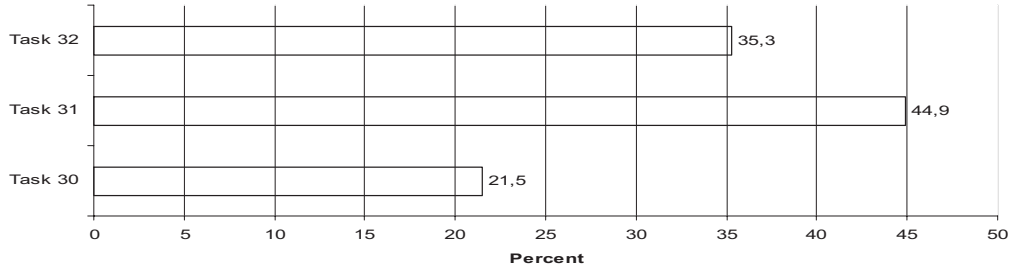


Figure 4. Results of Correctly Solved Problems of the Rubric "Can You Apply Knowledge of Mathematics in the Professional Activity", in Percents

As it can be seen in Figure 4, respondents were doing best where they had to read chart data and find out how many employees worked in "Svajonė" hotel (Problem 31, 44,9% of correct answers). Problem 30 was aimed at finding out if pupils understand how to calculate the mean of the sample; Problem 31, if pupils can read information, presented in the chart, analyse, make conclusions, answer questions related to data given in the chart, Problem 32, if they are able to apply knowledge of combinatorics, probability theory. Only one third of pupils managed to make up 6 kinds of sandwiches correctly. Many variants of sandwiches were contrived; their composition and names were related to the kinds of sandwiches which are most popular at the moment: *hamburgers, burgers, etc.*

Conducting the research, respondents were also given 5 tasks from family economy, calculation of percentages while shopping during sales. The results of correctly solved problems of the rubric "Test Your Existing Economics Skills" are given in Figure 5.

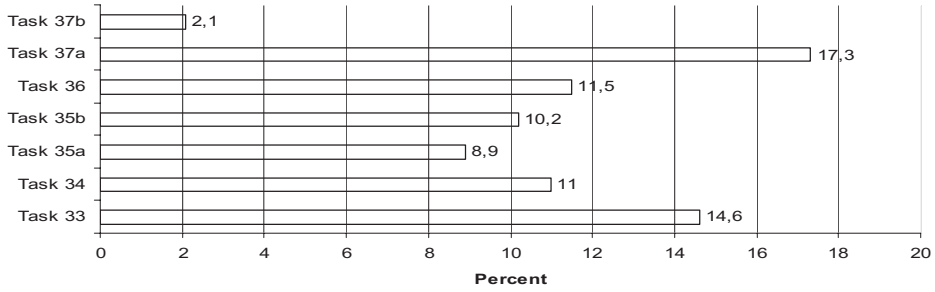


Figure 5. Results of Correctly Solved Problems of the Rubric "Test Your Existing Economics Skills", in Percents

As it can be seen in Figure 5, pupils achieved better calculating how much money remained for the family after paying municipal taxes (Task 33, 14,6%) and calculating how many kWh of electrical energy the family used during February (Task 37a, 17,3%). Doing Task 33, pupils achieved calculating family budget; i.e., how much money the family spends for taxes, but many forgot to calculate how much money remains for them after paying all taxes. Respondents encountered difficulties working out problems where they had to calculate the amount of interest for the given credit (Problem 34, 11%), the discount of the camera and the existing price with the discount (Problem 35, 9,6% of correct answers), do banking: calculate currency exchange from Lithuanian Litas to Latvian Lats (Problem 36, 12% of correct answers). There were particularly many difficulties doing Task 37b (2,1% of correct answers) where pupils had to finish filling in the bill in the electricity billing book.

Quite many difficulties arose to the respondents calculating the discount (percents) of the camera and finding out the current price with the 20% discount. Quite mane pupils made mistakes in this problem, choosing the operation incorrectly. Some pupils did not distinguish between the sum of the discount and the given price of the thing; therefore, they divided the price by the percent number. Research results demonstrated that knowledge of these pupils about percentages was still not consolidated, that is why they found it difficult to calculate partial price of the thing when it is reduced by several percents. The results of Problem 36 demonstrated that only a small share of pupils were able to calculate the amount of exchanged currency although in these times when people are fond of travelling every modern person must know how to do such operations. To solve this problem pupils had to think of the way of solution (multiply and then add), perform multiplication and addition operations (could use a calculator) and make a conclusion. The most frequent mistakes were: incorrect choice of the first operation, some pupils multiplied correctly but forgot to add the fee for currency exchange or sales operation. The aim of Task 37 was to find out whether pupils were able to calculate readings of the electrical meter and to fill in the receipt of the bill. The majority of pupils made mistakes incorrectly choosing the operation, some hesitated to do it at all. Task 37b aimed at finding out if pupils could read data given in the table and calculate municipal taxes. The received results demonstrate that 38,8 per cent of respondents managed to fill in at least part of the columns of the bill table correctly but 61,2 percent of pupils filled in the table incorrectly or even did not try to fill it in.

To sum up the results of solving problems of the rubric "Test Existing Economics Skills", it can be stated that like in case of the pilot study, during the main study Tasks 33-37 were quite tricky for pupils with moderate SEN because only a small share of respondents managed to do them correctly. It can be assumed that during mathematics lessons more time should be spared for solving similar type tasks and for organisation of practical projects and excursions. This fact should be considered by mathematics teachers and textbook authors, preparing practical (real-life) type tasks for mathematics lessons.

Received results demonstrated that boys achieved better than girls doing mathematical tasks. Statistically significant differences between girls and boys were identified doing 11 tasks. Boys significantly better achieved finding out the length of the pencil (χ^2=10,399; df=2; p=0,006); solving the problem of time calculus (χ^2=8,352; df=1; p=0,004); combining and breaking apart concrete numbers (converting kilograms into tons and kilograms; χ^2=4,988; df=1; p=0,026); finding out temperature changes in the room (χ^2=5,609; df=1; p=0,018); calculating the length of the strip necessary for sowing around the edges of the knitted napkin (χ^2=3,893; df=1; p=0,048), and calculating the number of hotel employees (χ^2=6,598; df=2; p=0,037). Girls achieved better calculating the weight of the depicted thing (χ^2=19,069; df=1; p=0,000), writing figures mentioned in the sentence in numbers (χ^2=5,787; df=1; p=0,016); expressing a concrete number into a decimal (χ^2=8,456; df=2; p=0,015); calculating the area

of the detail (χ^2=6,017; df=2; p=0,049) and filling in the bill (χ^2=6,235; df=2; p=0,044). Doing other tasks, there is no statistically significant difference between girls' and boys' results. It has been noticed that girls achieved better than boys solving problems requiring reproduction of mathematical knowledge and procedures.

Conclusions

1. Research results have demonstrated that the level of functional mathematical literacy of pupils with moderate special educational needs learning in eighth forms of mainstream schools who participated in the research is insufficient, pupils lack practical abilities and perception how and where existing knowledge can be applied in everyday activities. This as if contradicts the prevailing opinion that problems with actual content should be solved more easily because they are closer to the pupil's everyday experiences. Hence, it is necessary to constantly pay considerable attention to teaching to solve such type problems.
2. Pupils who participated in the research have most knowledge of mathematics in the areas of *Numbers and Calculus, Measures and Measurements.* Pupils achieved best doing arithmetical operations, calculating simple arithmetical series, combining and breaking apart easy concrete numbers, solving time calculus problems. Pupils were quite good at elementary problems in the area of *Statistics* when information given in the chart had to be analysed and simple questions had to be answered.
3. The main problems that pupils encountered doing tasks of the areas of *Numbers and Calculus, Measures and Measurements* were insufficiently developed skills of operations with fractional and concrete numbers, proportional values, proportions, percentages, relations of measures.
4. The biggest number of difficulties for pupils with moderate special educational needs arose solving word problems of *geometry* the condition of which required to justify something or use concepts of perimeter, area, volume, scale (incomprehension of these concepts particularly showed up at the level of knowledge as well) and doing *Economics* problems. Respondents were not able to use given formula, insert numbers and calculate an expression; they found it difficult to fill in the receipt, calculate discounts, credit sum, prices with discounts.
5. The problem characteristic to all areas of the curriculum of mathematics is that doing the test many pupils did not solve word problems and those pupils who were solving them experienced difficulties reading conditions, choosing the way of solution, writing derivation and answers. The aspects of mathematical activity requiring more attention in the educational process are as follows: the analysis of the condition of the problem, discussion of possible ways of doing the problem, modelling of real-life situations and imitation of solution operations of corresponding problems.
6. During the research girls better than boys solved standard problems which had a clear algorithm, whilst boys better than girls solved problem-orientated problems requiring more mathematical thinking.
7. Research results demonstrated that ways to achieve better functional mathematical literacy results should be searched. It should also be noted that it is important to improve attitude of pupils with moderate special educational needs to mathematics and its value in everyday and professional life.
8. In the process of teaching mathematics theory should be more often related to practice, it should be taught to apply mathematical knowledge solving practical type problems, to teach and accustom to use learning strategies, paying more attention to visual and practical demonstration and explanation of every separate step, using only such context of problems which pupils are familiar with and which is close to real-life situations, to teach to use supporting materials and supplementary calculation aids.

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RESEARCH ON FUNCTIONAL MATHEMATICAL LITERACY OF PUPILS WITH MODERATE SPECIAL EDUCATIONAL NEEDS LEARNING IN MAINSTREAM SCHOOLS

Summary

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Functional mathematical literacy is effective practical usage of mathematics, seeking to implement general life needs at home, at work and participating in the life of the community and society (Siemon, 2000); the ability to understand and use numbers and data analyses in everyday life (Madison, 2003). This demonstrates that General Curriculum of Mathematics for Basic Education (General Curricula for Primary and Basic Education, 2008) pays much attention to the factor of functionality, to the development of functional mathematical literacy because comprehension of familiar mathematical concepts, comprehension and application of mathematical methods provide preconditions for every pupil (both more gifted and weaker and with SEN) to both cognize and freely orientate in practical and everyday life.

The review of research literature of recent years enables to state that development of mathematical literacy of pupils with moderate SEN is insufficiently discussed and there is no information about academic abilities and achievements of pupils with moderate SEN who are integrated and are learning in mainstream schools as well as about their functional abilities to apply acquired knowledge in practical activities. The article deals with the research on functional mathematical literacy of pupils with moderate special educational needs (SEN) learning in eighth forms of mainstream schools. Research aim: to explore the manifestation of functional mathematical literacy of pupils with moderate SEN learning in eighth forms of mainstream schools.

Research data were collected applying quantitative approach. The questionnaire survey was employed to find out how pupils with moderate SEN learning in eighth forms of mainstream schools are able to apply existing mathematical knowledge in real-life situations and solving practical type problems, their functional mathematical literacy abilities are assessed. The results of pupils' general achievements by areas of the curriculum of mathematics are given indicating percentages of correctly done tasks whilst the relation of doing tasks with the difference of equations is analysed employing Chi-square criterion (χ^2).

The research sample consisted of 391 respondents who corresponded to the following criteria: the eighth form pupil of the mainstream school with moderate SEN, educated according to adapted curriculum of mathematics (after the issue of Order No. V-1795 of the Minister of Education and Science of the Republic of Lithuania, dated 2011-09-30, according to adapted or individualised curriculum).

Research results have demonstrated that the level of functional mathematical literacy of pupils with moderate special educational needs learning in eighth forms of mainstream schools who participated in the research is insufficient, pupils lack practical abilities and perception how and where existing knowledge can be applied in everyday activities. Pupils who participated in the research have most knowledge of mathematics in the areas of *Numbers and Calculus, Measures and Measurements*. Pupils achieved best doing arithmetical operations, calculating simple arithmetical series, combining and breaking apart easy concrete numbers, solving time calculus problems. Pupils were quite good at elementary problems in the area of *Statistics* when information given in the chart had to be analysed and simple questions had to be answered. The biggest number of difficulties for pupils with moderate

special educational needs arose solving word problems of *geometry* the condition of which required to justify something or use concepts of perimeter, area, volume, scale (incomprehension of these concepts particularly showed up at the level of knowledge as well) and doing *Economics* problems. The problem characteristic to all areas of the curriculum of mathematics is that doing the test many pupils did not solve word problems and those pupils who were solving them experienced difficulties reading conditions, choosing the way of solution, writing derivation and answers. During the research girls better than boys solved standard problems which had a clear algorithm, whilst boys better than girls solved problem-orientated problems requiring more mathematical thinking.

Research results demonstrated that ways to achieve better functional mathematical literacy results should be searched. It should also be noted that it is important to improve attitude of pupils with moderate special educational needs to mathematics and its value in everyday and professional life.