

DEVELOPMENT OF FUNCTIONAL MATHEMATICAL LITERACY OF PUPILS WITH MODERATE SPECIAL EDUCATIONAL NEEDS

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Abstract

The article deals with modelling of the system of functional mathematical literacy development of eighth form pupils with moderate special educational needs, learning in mainstream schools. Applying the action research method, the measurements of the participants of the (self-)educational process are analysed and, based on them, the possibilities of developing functional mathematical literacy of pupils with moderate SEN in the mainstream school, grounded on the approaches and ideas of pragmatism, social constructivism, social participation and empowerment theories, are revealed.

Key words: *action research, development of functional mathematical literacy, empowerment, moderate special educational needs.*

Problem of research

There are still numerous discussions in Lithuania as to what modern mathematical education should be like, what would be the best way to reform it and how to develop pupils' mathematical literacy in different stages of education. General Curriculum Framework for Primary and Basic Education¹ (2008) state that mathematical education at school has to be reformed in such way that pupils both acquire formal mathematical knowledge and skills and self-develop their flexible application, mathematical thinking and mathematical communication abilities. The attitude to teaching and learning is changing. There is increasingly more focus on the development of pupils' general and special competencies. General Curriculum Framework for Primary and Basic Education (2008) already orientate not that much to the importance of providing academic knowledge but to the development of pupils' general competencies and essential subject-based competencies, enhancement of individualised education and curriculum integration. Mathematical literacy is more defined by functional aspects of mathematical knowledge; i.e., individual's competencies to use mathematical knowledge practically, functionally. This is particularly relevant working with pupils who have bigger special educational needs.

The situation of self-development of skills necessary for integration of pupils with moderate SEN educated in the mainstream school during mathematics lessons could be positively changed creating empowering educational settings (systems), orientated to pupils' development of functional mathematical literacy, activating the pupil's interaction with peers and adults in various educational and life situations, encouraging the involvement of all educational participants, purposeful interaction, cooperation and experience sharing. In this process the teacher and the special educator perform several functions: the function of the mediator (the educator must help the child to concretise experience, cognise environment and structure it; he/she is creating a dialogue between the child and environment); and the function of behaviour modifier (he/she helps the pupil to change behaviour, improve the interaction

¹ *Pradinio ir pagrindinio ugdymo bendrosios programos.* (2008). Vilnius: Švietimo aprūpinimo centras

between the pupil and environment, and improve adaptation possibilities (Capul & Lemay, 1996; qtd. in Ruškus, 2002). Individual planning of education and partnership between the learner, his/her parents, teachers and other specialists are emphasised by modern conceptions of special and particularly inclusive education (Booth, Ainscow, Black-Hawkins, Shaw, & Vaughan, 2000). Researches (Gerulaitis, 2007; Geležinienė, 2009; Makauskienė, 2008; Melienė, 2009; Miltenienė, 2004; Miltenienė, Ruškus, & Ališauskas, 2003; Baranauskienė, Geležinienė, Tomėnienė, Vasiliauskienė, & Valaikienė, 2010; Baranauskienė, Tomėnienė, 2012; Jurevičienė, 2012 et al.) demonstrate that purposeful individualised education, based on pragmatic, constructivist education and empowerment approaches, orientated to the child's experience, helps to achieve better results.

The scientific literature analysis enables to state that purposeful and tantamount cooperation between all participants of special education, involvement of pupils with moderate SEN of senior forms in general class activities, and development of educational interaction and system, which empower (self-) development of functional mathematical literacy, are still missing in the practice of Lithuanian mainstream schools.

Object of the research: development of functional mathematical literacy of pupils with moderate SEN in the mainstream school.

Aim of the research: applying action research method, to analyse measurements of participants of the (self-) educational process and, based on them, to disclose possibilities of developing functional mathematical literacy of pupils with moderate SEN in the mainstream school, grounded on approaches and ideas of pragmatism, social constructivism, social participation and empowerment theories.

Methodology and methods of the research

In the process of initiating changes in (self-) education of mathematics, designing the system of functional mathematical literacy development for pupils with moderate SEN (foreseeing activities, measures, methods and measuring their effectiveness), *action research* was applied (Kemmis & McTaggart, 1988, 2005; Charles, 1999; Burns, 2000; McNiff, 2002; Baranauskienė, Ruškus, 2004; McNiff, Whithead, 2009; Reason, Bradbury, 2006; Geležinienė, 2009 et al.). Planning this research, foreseeing activities, factors discovered in previous stages of the research, related to the conception of functional mathematical literacy, manifestation of abilities and educational situation while meeting SEN in the mainstream school, were considered. Designing the model of functional mathematical literacy development of pupils with moderate SEN, the action research was organised, including group discussions, observation, document analysis and interviews with research participants. Research data were processed employing content analysis (Merkys, 1995; Burns, 2000, Белановский, 2001, Rupšienė, 2007 et al.) and statistical data analysis methods. It was sought to ensure feedback criterion by planning and discussing the research process and comparative characteristics of the written questionnaire, performed at the beginning and at the end of pupils' survey, with all research participants.

It was decided to process the data collected during test-retest employing statistical methods. Data collected during group discussions of educators and all participants were analysed and interpreted employing content analysis method.

This research differs from other scientific researches as it is attended by specialists-practitioners, who are seeking to improve their practical activities, while research results are straightaway implemented in that social setting, in which they had been obtained (Denscombe, 2003). In thesis research specialists-practitioners (mathematics teachers and special educators) pursue to improve mathematical education process of pupils with moderate SEN, enhancing it by the functionality factor.

It was sought to ensure equality among all participants of the action research process (the researcher, specialists-practitioners, pupils and their parents), their involvement in every

stage of the process (Kemmis & McTaggart, 1988); democratic relationships; and that none opinion (even the researcher's) is treated as superior.

The change of the action research under implementation is treated as an integral constituent of the action research, unifying two parts of the action research: solving of practical problems and new facts about the phenomenon of the social setting under investigation (Denscombe, 2003). Conducting the action research, certain progress and changes in the existing reality are pursued; it is expected that participating persons' professional features will also improve (Denscombe, 2003).

The action research took place periodically and encompassed the feedback loop, creating preconditions for changes of initial discoveries. Because action research is grounded on cooperation, it was important to create a general opinion about the performed activity, developing functional mathematical literacy of pupils with moderate SEN. Reflection enabled to generate ideas, share opinions, consider every participant's experience and other valuable information, which can be used for positive changes, and to form general opinion about improvement of practical activities. During every intermediary (working) meeting with educators and during the last group discussion involving all action research participants it was sought to get answers to the questions which help to perceive success/failure of (self-) education.

In order to help teachers to differentiate the educational process, increase pupils' interest in practical application possibilities of mathematics, the researcher gave her own developed examples of practical type tasks related to each mathematical chapter (word problems, project activities, practical tasks, etc.). These tasks focused on practical application of knowledge, subject integration and IT usage. SEN pupils were offered to develop their abilities through work, investigation, doing things with their hands, discussions with family members, peers and educators or engagement in certain practical activities. Such lessons make it easy for the teacher to answer the question "Why do I need it?" and to explain how performed tasks, acquired mathematical knowledge and formed skills will help in life. During every working meeting the researcher's offered tasks were reviewed and the suitability of these tasks for the development of functional mathematical literacy of pupils with moderate SEN was evaluated.

During the course of action research we maintained that pupils with moderate SEN had to be educated together with their peers, adapting the mathematics curriculum of the eighth form of the general education school, refusing some topics that are not understandable for pupils, applying active methods and focusing more on the application of practical knowledge. During the research educators were offered to follow King-Sears' (2008) statement that children with learning difficulties can learn the same as their peers but it is very important how this is being done (qtd. in Ališauskas, Ališauskienė, Gerulaitis, Kaffemanienė, Melienė, & Miltenienė, 2011).

During working meetings educators identified the situation of the development of functional mathematical literacy of pupils with moderate SEN in the mainstream school, discussed foreseen mathematical education strategies, got familiarised with the experience of meeting SEN abroad and in Lithuania, discussed interim activity achievements, observations, reflected, projected further activity landmarks (re-planning), then repeatedly acted, observed and reflected on action.

Participants of the research. The action research was attended by 3 eighth form pupils with moderate SEN, 3 parents of these pupils, 4 teachers of mathematics and 2 special educators. The main principle which was followed selecting action research participants was the principle of voluntary resolve. The age of all pupils who took part in the research (2 boys and a girl) was 14 years. All pupils with moderate SEN receive special educator's support (once per week).

Six educators (all females) agreed to take part in the educators' (mathematics teachers' and special educators') group, the mean age of which was 44 (the youngest was 35 and the oldest, 53). Action research was attended by 2 participants with 5-10 years of service, one, with 11-16, two, with 21-26, and one, with over 25 years of service. Three mothers of eighth form pupils were involved in the activities of the group, their mean age was 40 (the youngest was 38 and the oldest, 41). Two of the mothers live with a spouse and one is divorced and raises the child alone. Two mothers worked in services sector in shifts and one mother did not work anywhere, was a housewife. As to education, two mothers have secondary education and one, vocational.

Research results and their interpretation. In order to measure the effectiveness of the system of functional mathematical literacy development, constructed during the research, comparing the level of functional mathematical literacy of pupils who took part in the research at the beginning and at the end of the action research (test-retest), pupils were given the same notebook of diagnostic mathematical tasks (37 tasks), which they performed at the beginning of the research. The diagnostic test was done in parts (chapters) so that pupils do not get too tired and could reveal mathematical abilities that were self-developed in the course of research. The performed research data analysis and discussion of results took place in the last meeting of all participants.

The results of measurement of pupils' functional mathematical literacy abilities by content and activity areas and by cognitive ability groups are given in Tables 1 and 2.

Table 1. Comparative Summary of Distribution of Pupils' Mathematical Achievements by Content and Activity Areas, in Points (at the Beginning and End of the Action Research) ($N=3$)

Chapters of the diagnostic test, number of tasks and maximum number of points	Pupil J.'s results in points (collected/possible)		Pupil D.'s results in points (collected/possible)		Pupil O.'s results in points (collected/possible)		
	Before	After	Before	After	Before	After	
Chapter 1. Check if you can measure (11 tasks, 19 points)	5/19	4/19	6/19	13,5/19	9/19	11/19	
Change	- 1 points		+ 7,5 points		+ 2 points		
Chapter 2. Check if you know measurement units (6 tasks, 18 points)	2/18	7,5/18	3/18	7/18	8/18	7/18	
Change	+ 5,5 points		+ 4 points		-1 points		
Chapter 3. Check if you can apply knowledge of geometry practically (11 tasks, 24 points)	5/24	10/24	8/24	13/24	7/24	11/24	
Change	+ 5 points		+ 5 points		+ 4 points		
Chapter 4. Check if you can apply knowledge of mathematics in professional activities (3 tasks, 7 points)	1/7	1/7	2/7	1/7	1/7	3/7	
Change	→		- 1 points		+ 2 points		
Chapter 5. Check existing economics skills (5 tasks, 20 points)	2/20	2/20	5/20	9/20	4/20	12/20	
Change	→		+ 4 points		+ 8 points		
(37 tasks, 88 points)	In total	15/88	24,5/88	24/88	43,5/88	29/88	44/88
Change	+9,5 points		+ 19,5 points		+ 15 points		

Obtained research results demonstrated that systematic, purposeful functional mathematical literacy development, based on the combination of pragmatism, social constructivism, social participation, empowerment theories and the conception of mathematical literacy, resulted in considerable improvement of all three pupils' mathematical achievements, the ability to apply mathematical knowledge in practical activities (see Table 1). Final number of collected points has increased in all cases: in case of pupil J., by almost 10 points; pupil D., by almost 20 points; and pupil O., by over 15 points. Pupils much better managed to collect their thoughts, read and understand the condition of a problem, use additional aids, supporting boards and the collection of formulas. Performance of tasks in chapters "Check if you can apply knowledge of geometry practically" and "Check existing economics skills" has improved significantly. Measuring every child's performance of tasks by content and activity areas separately, we notice that there are almost no big negative changes (reduction of the number of correctly done tasks), only pupil J., doing tasks of Chapter 1 "Check if you can measure" collected one point less (drew arrows of the mechanical clock of equal lengths); pupil D., performing tasks of Chapter "Check if you can apply knowledge of mathematics in professional activities", incorrectly calculated answers in first word problems.

Comparison of the distribution of pupils' mathematic achievements by groups of cognitive abilities also enables to state that teaching mathematics in a complex and active way through practical activities, cooperation with the pupil, his/her family and other teachers throughout the academic year resulted in positive outcomes (see Table 2).

Table 2. Comparative Summary of Distribution of Pupils' Mathematical Achievements by Groups of Cognitive Abilities, in Points (in the Beginning of the Action Research) ($N= 3$)

Mathematical (cognitive) abilities, number of tasks and maximum number of points	Pupil J.'s results in points (collected/ possible)		Pupil D.'s results in points (collected/ possible)		Pupil O.'s results in points (collected/ possible)	
	Before	After	Before	After	Before	After
Knowledge of mathematics and understanding (procedures) (19 tasks, 44 points)	11/ 44	18,5/ 44	15/ 44	27,5/ 44	23/ 44	25/ 44
Change	+ 7,5 points		+ 12,5 points		+ 2 points	
Application of mathematics (18 tasks, 44 points)	4/ 44	6/ 44	9/ 44	16/ 44	6/ 44	19/44
Change	+ 2 points		+ 7 points		+ 13 points	

All pupils' mathematical cognitive abilities in both areas have improved, compared with the results at the beginning of the academic year. Performance skills of pupil D., who has general learning difficulties, and of pupil J., who has mild learning difficulties, have improved in the group "Knowledge of mathematics and procedures". The most considerable progress has been achieved by pupil D. with general learning difficulties. We again notice that during the action research achievements in the group "Application of mathematics and mathematical thinking" have improved. Pupil O. did particularly well. We can assume that the measurement and comparison of mathematics achievements at the beginning and at the end of the research can be treated as one of the indicators of measuring efficiency of applied methodology. Close cooperation between educators and parents, the very child's active involvement in modelling of functional mathematical literacy development encouraged to investigate the environment more actively and apply mathematical knowledge in practical activities.

Results of group discussions of action research participants. Generalised results obtained during initial group discussions demonstrated that educators encountered least difficulties in the chosen school *perceiving their roles while developing SEN pupils' mathematical literacy and cooperation with colleagues*. Both general education educators and specialists often emphasised the importance of individualising education and support for the pupil (*of course, this individuality is badly needed; I organise practical sessions, having discussed it with the mathematics teacher; my goal is to plan the time of the lesson so that I could come up to each pupil individually at least little*), the child's empowerment (*to teach the child to use all information, tables*), promotion of his/her activeness and learning motivation (*we want to ask them too in order to arouse the wish to learn; I am doing my best to involve them in the lesson together with all pupils so that they don't "stay aside", sometimes I prepare the simplest question specially for them so that they can and are not afraid to speak in front of others, so that they can stand up, say their opinion and be heard*), and the initiative, maintaining relations with specialists/educators (*if they don't succeed I again run to look for another problem; I feel such responsibility to speak with teachers and consult whether something has to be done or not*). Specialists emphasise the importance of the creation of learners' social relationships (*to help the child to socialise in the class*). Subject teachers acknowledge that their role is important creating a favourable atmosphere for learners in the classroom (*I feel responsible for that atmosphere in the class so that they feel safe, can work, are not bullied; so that the child doesn't feel discomfort*), socialising with parents (*to be able to tell parents that the child has problems and he/she needs us all: parents', family members', teachers', special educator's support*). Sometimes educators of general education tend to focus on knowledge and curricula requirements and not on the child's practical needs, abilities (*there is a lack of time and sometimes you would like but you can't help there or give something. The closed circle, curriculum is also to be blamed, standardised tests are awaiting, points, you can't play*). Quite often both educators and specialists particularly emphasise the importance of identifying the child's problems (disorders) (*I have to notice such children who have language, writing deficiencies; my most important role is to notice the problem in time, notice all these disorders as soon as possible, what he doesn't manage to do and to ask for assistance as soon as possible; we have to see, analyse, how they are doing*), little is spoken about the pupil's abilities, strengths and there is more focus on difficulties (*he finds it difficult to learn, maybe it is a little easier for him to add and subtract ..., it is difficult to say what he is able to do... maybe it would be quicker to name what he finds it difficult to do...*). It is acknowledged that it is necessary to cooperate with parents (*this is important, if parents take care, help, then homework is done, he/she is able to do easy tasks...*); however, they do not quite imagine how they could help such pupils whose parents "rarely visit school" (*I doubt if the pupil's parents will cooperate, they always work, the pupils stays alone,... the mother said that she herself found it difficult to solve mathematical problems ...*). There is insufficient belief in pupils' ability to act as an assistant and tantamount partner, organising development of functional mathematical literacy (*well, but he speaks little, I doubt if he will be able to say anything during the meetings, .. he will be at a loss, feel not at ease, maybe we better ourselves can plan activities and involve him in the discussion of results of performed activity?... It would be good if he promised to learn more independently and responsibly but I doubt whether he himself will be able to say how and what should be taught...*).

Special educators emphasised close cooperation between educators and specialists. In educators' community, there is an abundance of informal communication with teachers (*communication takes place all the time: at lunch breaks, in the canteen, while eating; we share experiences with colleagues whether there are similar children, how they find ways out of a situation, how they act in such situation, what they can advise. This is our work either during*

breaks or during lessons or after lessons, during holidays), individual communication (we consult, discuss with assistants: special educators, the speech therapist), lectures, seminars for educators, taking place at school (certain information is given in methodical meetings, papers are read on some topic of SEN children's education; we invite from the city, specialists from the Pedagogical-Psychological Centre read papers; in our reading room we have a section on SEN children), meetings of the child welfare commission (teachers, with whom we have agreed and discussed and know why, are invited to take part in them, but sometimes teachers come themselves, having read a notice in the staff room, if they have some questions and then we discuss), an important role, initiative of the class tutor is emphasised (class tutors always know the child and his family better, communicate more; first of course the teacher addresses us), educators of general education expressed their trust in specialists working at school (our specialists are competent), an important parents' role in the child's educational process is noted (parents are important; we are pleased that the very parents come to talk or we succeed in inviting them to school), it is regretted that quite often parents leave children's education for teachers (we want to get them familiarised with adapted curriculum, common activity trends but quite often they say that they don't understand, have no time, that they "rely on teachers"). Designing the system of functional mathematical literacy development, there were questions how to better share functions: what mathematics teachers will do and what special educators will do (if the special educator, then during the lesson she should both teach what I am teaching and help him considering the difficulty; if I teach a new lesson today and during the lesson I am teaching to involute, and that little child has left and is learning, say, measurement units, what he doesn't know, then he comes to the next lesson, he further has to listen what we had been doing but he even doesn't know..., so when shall I give tasks for him? Maybe he should solve them with special educator? And maybe it is better to do it together: both in the classroom and with the special educator?). Later we arrive at the opinion how to share functions and that it is better to coordinate actions in advance and give practical type tasks for the child together (yes... we'll talk in advance, think how to relate the topic of the lesson to practice ... Several heads are better... As you have said, I'll try to involve the pupil in class activities, when we will be working on our own, I'll give tasks related to life... and I'll try to explain theoretical material to all, elaborating on examples from pupils' close setting).

One of the noticed problem areas is **difficulties organising/providing support**, related to lesson planning and organisation (*it is very difficult to help them when you are working with the whole class and this is like a problem; you'll help that child, then others won't work...; there are also gifted children among those thirty, who deserve corresponding attention, there are children who don't have special needs but they also need assistance; it is very difficult to organise group work, he is not accepted*), time management (*it is necessary to spare more time in the lesson explaining, showing, somebody doesn't need this, but they need ...; as to me, I lack time in the lesson; I need even more of that time to prepare materials*), lack of necessary competencies (*we haven't been trained ... to work with senior class pupils; we lack methods, this method is good; it is easier with mild SEN ...*), peculiarities of organising special support (*is not considered during the exams at all. We are taking care of them till the tenth form, we follow the curriculum and later, the exam; even speaking with parents ... you are explaining the system that it is necessary to help the child and here the order changes and these pupils have to write tests... so what is the benefit for the child?; in senior classes this is very difficult because they come once per week and we have to deliver what they are learning in the class because you take the child from the lesson and there is no time left for anything else*), lack of pupils' learning motivation (*you can wish to help the child as much as you want but if he doesn't want, well, how will you help him.*). Issues of educating senior class pupils are particularly topical (*the higher the form, the more problems*).

Another very relevant problem is *cooperation with parents*.

Research results demonstrated a considerable diversity of educators' opinions and intensive discussions on this topic confirmed the relevance of the problem. As it has already been mentioned, educators acknowledged parents' initiative (*sometimes parents demonstrate the initiative themselves, call and ask themselves to be accepted*), the importance of parents' involvement (*to achieve results there should be a chain connecting school and family, involving the child, the teacher, otherwise there'll be no results; but if parents help, then it is very easy to work...*), demonstrated empathy (*this unwillingness of theirs initially is very natural because every parent thinks that his/her child is good and wishes that good for him/her; well, yes, she returns already being tired, that child is also tired...*), wished parents' trust and acknowledgement of educators' competency (*they at least should perceive the child's problem and rely on specialists so that they work*), psychological support for the child at home (*so that they support morally, praise that you have done well, that you have done your best, so that they induce by something more*). Anyway quite often parents were blamed for passiveness, indifference (*another problem is to invite a parent to school, it is even difficult to contact them; if you organise the lecture, how many of them will come, those come whose children don't have problems, and where problems exist, it is impossible to invite those parents*), blamed for children's problems (*often they themselves have special needs or have had them. They find it difficult to evaluate and tell because they don't quite understand themselves ...; rarely any of them understands that he has problems himself, how he will understand that the child has problems...; genes, here genes...*), parents' unwillingness to take a part of responsibility for the child's education is emphasised (*also those come who pay little attention, I know that there is a problem, your problem, if it is difficult to work with a child, I let the child go to school and you have to work with him, they also have most of claims and appear most rarely*). Quite often educators resent parents' negative reactions. These include accusations for educators, non-acknowledgement of the child's problem (*the biggest pretensions from parents' side, did not see, did not look, that my child is OK, the teacher romances, is biased*), unrealistic expectations (*do not measure their children and then want what is unreal...*). Educators noticed parents' fears regarding the child's exclusion, which can appear when special educational support provision is initiated (*they are very much afraid of being included into the curricula... because anyway they are easier... know that anyway the child is excluded in some way; more than once I heard what relatives, neighbours will say, what a shame*).

Relevant issues of *attitude to the SEN child* and his/her participation in problem solving. Research participants spoke about the lack of purposefulness of SEN pupils' social-teaching activity (*are engaged in their own matters, do what they want*), bad physical-emotional self-feeling (*can work for 10-15 minutes, in the fifth form he used to do his best but often did not succeed and that is why became so reserved*), often underlined their problems and disorders (*can't listen, tell, can't distinguish the most important points, ...*), expressed disbelief in the child's abilities (*there are cases when he raises his little hand, you already know that he will not answer, but I know very well, you know, that's why you don't ask because that child will say a nonsense*). Educators notice peers' negative attitudes and alienation (*if he answers incorrectly, he is laughed at..."; everyone wants to use another pupil's results and they are often alienated, if you try to give another type of work, even when they are senior, they don't want ...better choose not to do anything ...*), acknowledge lack of educators' attention (*they lack communication ... really in the class very little time is left for them, most often you are happy if you come up to them 2-3 times during the lesson, and he needs that ...is often diffident...*).

Speaking about children's possibilities to take active part in solving functional mathematical literacy development problems, educators acknowledged certain senior class

pupils' powers to get involved and actively participate in a team (*because these are senior class pupils, parents consider their opinion and we consider; I think why they couldn't ...we don't say anything bad...*), stated that they even had such experience (*with senior pupils we speak who thinks what both individually and together, even parents and we, the pupil; we only don't invite officially*) but these were more spontaneous, episodic and unplanned meetings (*there is no such kind of tradition*). **Educators' negative emotions and bad self-feeling were identified** educating pupils with SEN: dissatisfaction with oneself or one's work results (*when you work with SEN pupils, you always feel that you haven't given something; I feel I haven't given something to the child throughout all lesson...*), helplessness (*you don't give not because you don't want but because this is not possible*).

Teachers approved of the necessity to model the system of functional mathematical literacy development: *it's a good thing, functionality must be developed, these pupils particularly need*; all participants agreed that it was necessary to actively teach pupils (*yes, active methods can help to develop literacy; it is more interesting for pupils this way; it is good that there will be tasks for project activities; I like to give tasks for work in pairs, then they can teach each other, group work is interesting, we often go to the park, museum to do some small project work, children enjoy it*). However, three educators imparted worry about frequent organisation of group work in mathematics lessons (*the SEN child is often an observer in the group; not all topics suit for this, much noise, this turns only into something like a game...*). Educators approve the usefulness of the application of teaching strategies, organising functional mathematical literacy development in the mainstream school (*yes, all strategies mentioned by the author are necessary because here learning and educational factors are also mentioned, very needful methodical aids*). A share of educators distinguished weaknesses of organisation of the educational process (*there is a lack of teaching aids, methods for teaching senior class pupils; it is not always possible to apply peers' assistance, if the atmosphere in the class is insufficiently good, the child doesn't have friends; we are trying to help but we don't always succeed; this depends on the class. I find it difficult to teach SEN children, relate knowledge of certain topics to practice; maybe it is necessary to refuse them? But if these are included in the tests? We lack computers in the classroom to give tasks for work with the computer for the SEN pupil...*)

Analysing the data obtained during teachers' working meetings, it was noticed that after the meetings educators were more positive about the involvement of pupils with moderate SEN and their parents in the educational process, possibilities of developing mathematical abilities. Educators acknowledged the importance of the pupil's participation in the discussion of his/her (self-)educational achievements and of his/her ability to discuss it, get involved in common class activities, applying suitable (self-)educational strategies focused on active knowledge and skill application and on relation with life experience. There were also discussions about application of teaching/learning methods in mathematics lessons, developing functional mathematical literacy of pupils with moderate SEN. It was underlined that it was really beneficial to include practical work when the very pupils could formulate the rule and understand main mathematical truths, which often have to be used in life (*it was fun for them to try out, formulate a conclusion, observe ... they did a lot of project work ... homework*), it was only regretted that *such activities could not take place every day*. During the last discussion educators and pupils indicated that active teaching/learning methods were most efficient. These included the method of cooperation (*work in pairs really suited me but it was more difficult to organise group work*), project activity (particularly for pupils: *they enjoyed it immensely, I didn't think it would be such fun ... great, I did a lot of tasks, investigations ...during project work I made friends not only with my classmate but also with family members; with mother like friends ... and I am not afraid to say that something failed ...I couldn't imagine that there was so much*

mathematics in life: projects demonstrated this...). Everybody noted the importance of such learning strategies as peer support (teachers: *they started keeping company after the lessons, even no need to say, helps him himself, if O. doesn't understand...; both come to consultations, which was not the case earlier*), (pupils: *I found a friend..., I started to understand better... and if I don't know something, J. helps; it is quite fun to go to consultations, when your friend is going next to you, who will explain ..., the teacher explains well but the friend somehow more clearly explains and I understand*).

During the last discussion we asked pupils' mothers whether it was useful to organise functional mathematical literacy development, involving not only educators but also parents and pupils into its planning. The mothers were pleased that [*I saw the school in different eyes, I found out more about my child, I found it quite interesting*], [*in the beginning I felt quite timid, I thought that I wouldn't be able to help the child in any way but I succeeded ...*], [*Now I go to school looking at it very differently, I willingly communicate with teachers, I try to listen carefully to pieces of advice and advise myself...*].

Together with all members of group discussion we discussed the system of functional mathematical literacy development of pupils with moderate SEN. All participants noted that this was a very changeable interactive process, which has to reflect both the very **didactic mathematical process** and **tantamount cooperation** among all participants of the educational process [*this way we enable both pupils to participate in planning and organisation of their learning and parents and us, teachers*], both **the link between theoretical knowledge and practice** and appropriate **application/individualisation of mathematics curricula**, focusing on the necessity of topics for the development of general abilities, also considering that **the pupil has to take part in the lesson together with all class pupils** [*contextuality is very important, ... not all mathematical topics suit, you have to select ..., it was interesting to select together with teachers and the mother, what will I need, where I will be able to apply mathematical knowledge in life*]. According to educators, philosophical grounding of education is very important [*during action research I understood how important it was to perceive the essence of pragmatism, social constructivism theories, social participation and particularly empowerment ... It is of utmost importance to be able to select your own activity, organise the educational process in the right direction... this was what gave good results... It is fun to see that pupils are also happy...*].

Conclusions

1. Action research enabled educators to consider and regroup priorities of methods, activities of mathematical education, developing functional mathematical literacy of 8 form pupils with moderate special educational needs: focus on knowledge and outcome, emphasis on the disorder were replaced and supplemented with the pursuit of acknowledging the child's individuality, the learner's cognition, focus on support, considering the pupil's strengths and purposeful usage of teaching/learning strategies, orientated to practical application of mathematical knowledge in the educational process and life.
2. Teaching methods, aids, ways of work, which were chosen considering special educational needs, determined pupils' active and independent participation in the lessons. This affected the achievements of pupils with special educational needs. Therefore, it is important to consider this criterion choosing teaching methods.
3. Referring to pragmatism, social constructivism, social participation and empowerment theories, we achieved that all participants of the educational process (the pupil, parents, educators and specialists) cooperated as tantamount partners, seeking common goals.

4. Seeking empowerment of children's parents and more effective support to the very child, it was efficient to draw up individual support and individual education plans for pupils, involving both the child, his/her parents and all family members in this process.
5. It was noticed that the participation in the research affected educators' and parents' general competencies related to personal growth and the person's general abilities as well as subject-based abilities in the area of special education. Changes in value approaches towards the pupil with moderate special educational needs are observed (acknowledgement of SEN child's individuality, the pupil's cognition, positiveness, etc.).

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RESULTS OF ACTION RESEARCH FOCUSED ON DEVELOPMENT OF FUNCTIONAL MATHEMATICAL LITERACY OF PUPILS WITH MODERATE SPECIAL EDUCATIONAL NEEDS

Summary

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There are still numerous discussions in Lithuania as to what modern mathematical education should be like, what would be the best way to reform it and how to develop pupils' mathematical literacy in different stages of education. The scientific literature analysis enables to state that purposeful and tantamount cooperation between all participants of special education, involvement of pupils with moderate SEN of senior forms in general class activities, and development of educational interaction and system, which empower (self-)development of functional mathematical literacy, are still missing in the practice of Lithuanian mainstream schools.

Aim of the research: applying action research method, to analyse the measurements of participants of the (self-)educational process and, based on them, to disclose possibilities of developing functional mathematical literacy of pupils with moderate SEN in the mainstream school, grounded on the approaches and ideas of pragmatism, social constructivism, social participation and empowerment theories. Object of the research: development of functional mathematical literacy of pupils with moderate SEN in the mainstream school. The action research was attended by 3 eighth form pupils with moderate SEN, 3 parents of these pupils, 4 teachers of mathematics and 2 special educators.

In the process of initiating changes in (self-)education of mathematics, designing the system of functional mathematical literacy development for pupils with moderate SEN (foreseeing activities, measures, methods and measuring their effectiveness), *action research* was applied. Planning this research, foreseeing activities, factors discovered in previous stages of the research, related to the conception of functional mathematical literacy, manifestation of abilities and educational situation while meeting SEN in the mainstream school, were considered. Designing the model of functional mathematical literacy development of pupils with moderate SEN, action research was organised, including group discussions, observation, document analysis and interviews with research participants. Research data were processed employing content analysis and statistical data analysis methods. It was sought to ensure feedback criterion by planning and discussing the research process and comparative characteristics of the written questionnaire, performed at the beginning and at the end of pupils' survey, with all research participants. During working meetings educators identified the situation of the development of functional mathematical literacy of pupils with moderate SEN in the mainstream school, discussed foreseen mathematical education strategies, got familiarised with the experience of meeting SEN abroad and in Lithuania, discussed interim activity achievements, observations, reflected, projected further activity landmarks (re-planning), then repeatedly acted, observed and reflected on action.

Obtained research results demonstrated that systematic, purposeful functional mathematical

literacy development, based on the combination of pragmatism, social constructivism, social participation, empowerment theories and the conception of mathematical literacy, resulted in considerable improvement of all three pupils' mathematical achievements, the ability to apply mathematical knowledge in practical activities. All pupils' mathematical cognitive abilities in both areas have improved, compared with the results in the beginning of the academic year.

Action research enabled educators to consider and regroup the priorities of methods, activities of mathematical education, developing functional mathematical literacy of 8 form pupils with moderate special educational needs: focus on knowledge and outcome, emphasis on the disorder were replaced and supplemented with the pursuit of acknowledging the child's individuality, the learner's cognition, focus on support, considering the pupil's strengths and purposeful usage of teaching/learning strategies, orientated to practical application of mathematical knowledge in the educational process and life.

Teaching methods, aids, ways of work, which were chosen considering special educational needs, determined pupils' active and independent participation in the lessons. This affected achievements of pupils with special educational needs. Therefore, it is important to consider this criterion choosing teaching methods. Referring to pragmatism, social constructivism, social participation and empowerment theories, we achieved that all participants of the educational process (the pupil, parents, educators and specialists) cooperated as tantamount partners, seeking common goals. Seeking the empowerment of children's parents and more effective support to the very child, it was efficient to draw up individual support and individual education plans for pupils, involving both the child, his/her parents and all family members in this process. It was noticed that participation in the research affected educators' and parents' general competencies related to personal growth and the person's general abilities as well as subject-based abilities in the area of special education. Changes in value approaches towards the pupil with moderate special educational needs are observed (acknowledgement of SEN child's individuality, the pupil's cognition, positiveness, etc.).