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THE DEVELOPMENT OF POSITIVE ATTITUDES TOWARDS LEARNING MATHEMATICS IN PRIMARY SCHOOL STUDENTS

Ludmila URSU

"Ion Creanga" State Pedagogical University of Chisinau,
Republic of Moldova
https://orcid.org/0000-0003-1096-0665

Abstract
This article approaches the problem of improving the development of attitudes towards learning mathematics in primary school students. It emphasizes the actuality and necessity of research based on educational policies documents, underlines the theoretical-methodological landmarks based on specialized literature analysis, and presents the methodology and the results of an experimental-ascertaining study of the development of attitudes towards learning mathematics in 4th graders. As a result, we underline the main students' difficulties in the development of these attitudes which determine three main directions of their development. Finally, we present a model of didactic strategies of the specified attitudes development which admits different variants of class realization and propose a concrete example.

Keywords: learning attitude, attitude towards learning mathematics, didactic strategy, didactic situation, cooperative learning strategy, metacognition strategy, curriculum, primary education, early school age

The attitudes towards learning mathematics and the process of their development constitute the object of multiple research studies from the fields of psychology and education sciences (D.C. Neale, C.R. Mendes, D. Tully, R. Dunn, H. Hlawaty, M. Otunuku, G. Brown, C. Prostire et al.), since the early school age is recognised as sensitive for the development of learning attitudes (V. Panico, A. Nour et al.).

The development of learning attitudes, including those specific for mathematics, is foreseen in actual educational policies documents of the Republic of Moldova.

- Article 11 (1) from the Education Code emphasizes the development of the attitudes as the component part of competences: "Education has as a main outcome the formation of an upright character and the development of a competences system which includes knowledge, abilities, *attitudes, and values that allow the active participation of the individual within the social and economic life*" [1].
- Emphasising the main attitudes towards learning school subjects is one of the elements of novelty of the primary education curriculum [2, p. 6].
- The didactic concept of the subject Mathematics in primary school provides that the mathematic education outcomes expressed in terms of competences imply "*the development of positive attitudes towards learning mathematics as a relevant field for life*" [5, p. 62].

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Based on the specialized literature and the curriculum for primary education, we specify the following theoretical-methodological landmarks regarding the development of the attitudes towards learning mathematics in primary school students (henceforth abbreviated MA).

- MA can be defined as a set of internal factors of the student personality which determine, orient, organize and support the efforts in learning mathematics. They develop due to the relational systems the student exists in and their experience of learning mathematics.
- MA include the following components in their structure: *cognitive – knowledge, beliefs, opinions about the value of mathematics in people's life; affective – feelings of pleasure or displeasure related to mathematical activities; performance – behaviours within mathematical activities.*
- The main MA are stipulated in the Curriculum for primary education, within the subject specific competences and based on the Primary school graduate profile: *correctness and coherence of the mathematic language; attention and interest for the correct, rational and fluent calculus; critical thinking capitalization for adopting a pertinent plan in problem solving; curiosity and creativity in mathematical acquisition integration with those from other fields*.
- The process of formation and development of the MA is influenced by multiple external factors, among which, the teacher's and parents' attitudes towards mathematics play a special role.
- Problematized didactic strategies based on differentiation and individualization, which stimulate cooperation and metacognition in conditions of age accessibility are the most opportune for the MA formation and development.

For a confirmatory study of the MA development levels, based on the landmarks formulated above, we elaborated three questionnaires which allow for the evaluation of three components of the MA: *cognitive*– knowledge, beliefs, opinions about the value of mathematics in people's life; *affective* – feelings of pleasure or displeasure related to mathematical activities; *performance* – behaviours within mathematical activities, within the subject-specific competences' context.

Questionnaire I (cognitive component)

Circle the letter corresponding to your answer:

A. Not at all. *B. To a certain measure.* *C. It helps a lot.*

How do you think mathematics helps you

1. to face life situations? *A B C*
2. to study other school subjects? *A B C*
3. to choose a profession for the future which will satisfy you? *A B C*
4. to better understand the world around? *A B C*
5. to develop thinking? *A B C*
6. to strengthen your will? *A B C*

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Questionnaire II (affective component)

Circle the letter corresponding to your answer.

1. Do you like mathematics classes?
   A. Not at all.   B. Sometimes I do.   C. It is my favourite subject.
2. Are you happy if the mathematics class gets postponed?
   A. Always.   B. Sometimes.   C. Never.
3. Would you like not to have homework for mathematics?
   A. Yes.   B. Sometimes.   C. No.
4. Do you tell parents about your mathematics classes?
   A. Never.   B. Sometimes.   C. Often.
5. Do you like collaborating with your colleagues at mathematics classes?
   A. Never.   B. Sometimes.   C. Often.
6. What do you like most at mathematics classes?
   A. To observe how other colleagues are answering.
   B. To solve exercises and problems according to a given model/pattern.
   C. To discover how more difficult exercises and problems are solved.
7. Have you ever felt the beauty of solving an exercise or a problem?
   A. Never.   B. Seldom.   C. Often.

Questionnaire III (performance component)

Circle the letter corresponding to your answer.

1. How important is it to learn to do calculus
   a) correctly?   *A. Absolutely.   B. It is not necessary.*
   b) rationally?   *A. Absolutely.   B. It is not necessary.*
   c) rapidly?   *A. Absolutely.   B. It is not necessary.*
2. How important is it while solving the problem:
   a) to get the smallest possible number of operations?
   A. It is not important.   B. It is important to a certain measure.   C. It is very important.
   b) to justify the operations correctly?
   A. It is not important.   B. It is important to a certain measure.   C. It is very important.
4. How important is it for the composition of a mathematical problem:
   a) to have good knowledge of mathematics?
   A. It is not important.   B. It is important to a certain measure.   C. It is very important.
   b) to have good knowledge in other fields connected to the problem topic?
   A. It is not important.   B. It is important to a certain measure.   C. It is very important.

The questionnaires were applied to 82 4th-grade students from four educational institutions from the Republic of Moldova (52 students from urban areas and 30 from rural areas) in April 2021, reserving about 10-15 minutes after finishing classes during three consecutive days. The methodology of administering the questionnaires included the following steps:

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- Questionnaire I was multiplied, attaching a number in a circle in the upper side of the paper. Each student chose a questionnaire. The students were explained the anonymous character of the questionnaire and the importance of the honest responses. The students were asked to write down the number of the filled in questionnaire. Then, the class teacher read each question and the variants of responses. The students circled the variant corresponding to their own position.
- The second day, questionnaire II was multiplied. Each student got the questionnaire according to his or her number. The filling in was realised in the same way.
- The same procedure was applied for filling in questionnaire III during the third day.

In order to appreciate the students' responses a scale was elaborated (table 1): for the most suitable response the highest score possible was appointed, i.e., 2 points; for a suitable, but not optimal response 1 point was given; for an unsuitable response 0 points were given.

Table 1. Scores for appreciating the questionnaire results

No. of the questionnaire	*No. of the item*	*Response – points*
I	1-6	A – 0; B – 1; C – 2.
II	1-7	A – 0; B – 1; C – 2.
III	1	A – 1; B – 0,
	2-3	A – 0; B – 0; C – 1.

As a result of responses processing (fig.1), the following have been determined:

- the differences between the obtained results in the urban areas and rural areas are not significant;
- the MA cognitive component is better developed, therefore leaving much to be desired (46 students at high and medium levels, which constitutes 56% of the 82 students questioned);
- the MA affective component is less developed (36 students at high and medium levels, which constitutes 44% of the 82 students questioned);
- the performance component is the least developed, all the students being situated at reduced and minimum levels.

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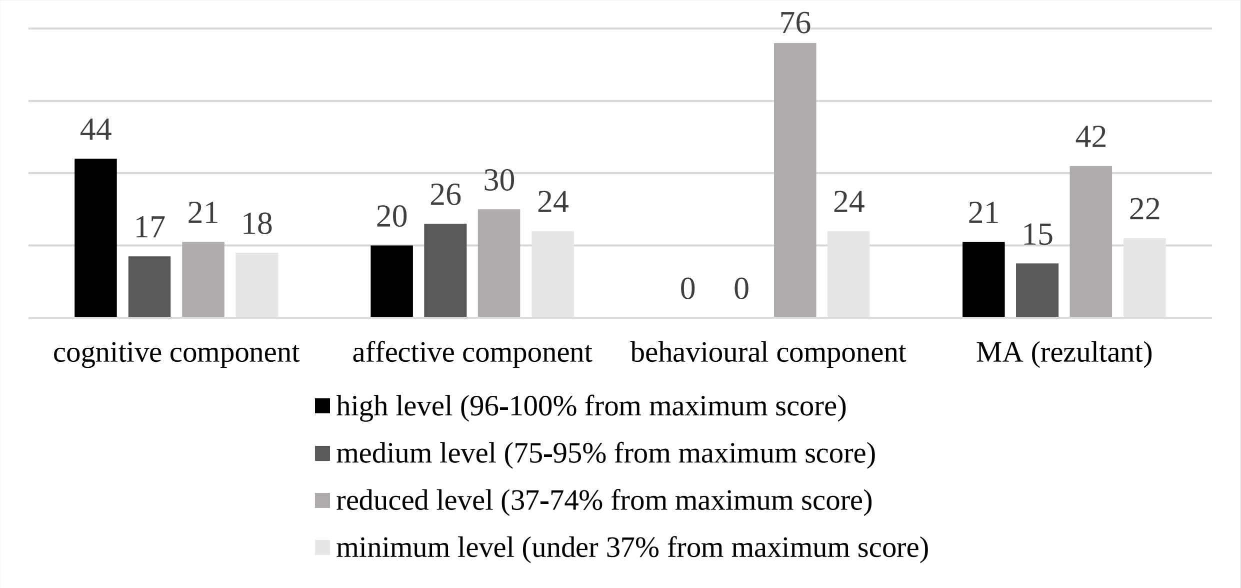

Figure 1. The ascertaining experiment results (%)

In conclusion, we underline the main students' difficulties in MA development, which determine **three main directions in MA development:**

- Students' *awareness* of the fact that mathematics helps them better understand the surrounding world and educates *volition/the will* (*cognitive component*);
- *The understanding* by the students of the beauty of mathematical reasoning and the attractiveness of the heuristic tasks (*affective component*);
- *The assumption* by the students of the tendency to: rational and rapid calculus; approving a pertinent plan of problem solving; integration of mathematical acquisitions with those from other fields (*performance component*).

As a landmark for conceiving effective didactic interventions for the determined directions, we took the interventions classification by learning difficulties area, proposed by T. Dubineanschi:

> interventions of a constructivist manner (in which the student gradually builds mathematical knowledge); behavioural interventions (where the stress falls on the demonstration of calculus algorithm solution and exercising the procedures to the consolidation and automation); interventions of a cognitivist manner (in which the students are endowed with resolvent, but also metacognitive strategies, which they can use while solving problems); interventions that target the development of internal representations of the mathematical concepts; interventions through situational learning [4, p. 144].

In conclusion, we infer that in order to improve the MA development process, we need significant didactic situations, in which context differentiated cooperation/collaboration strategies, followed by metacognitive strategies should be capitalized (fig. 2).

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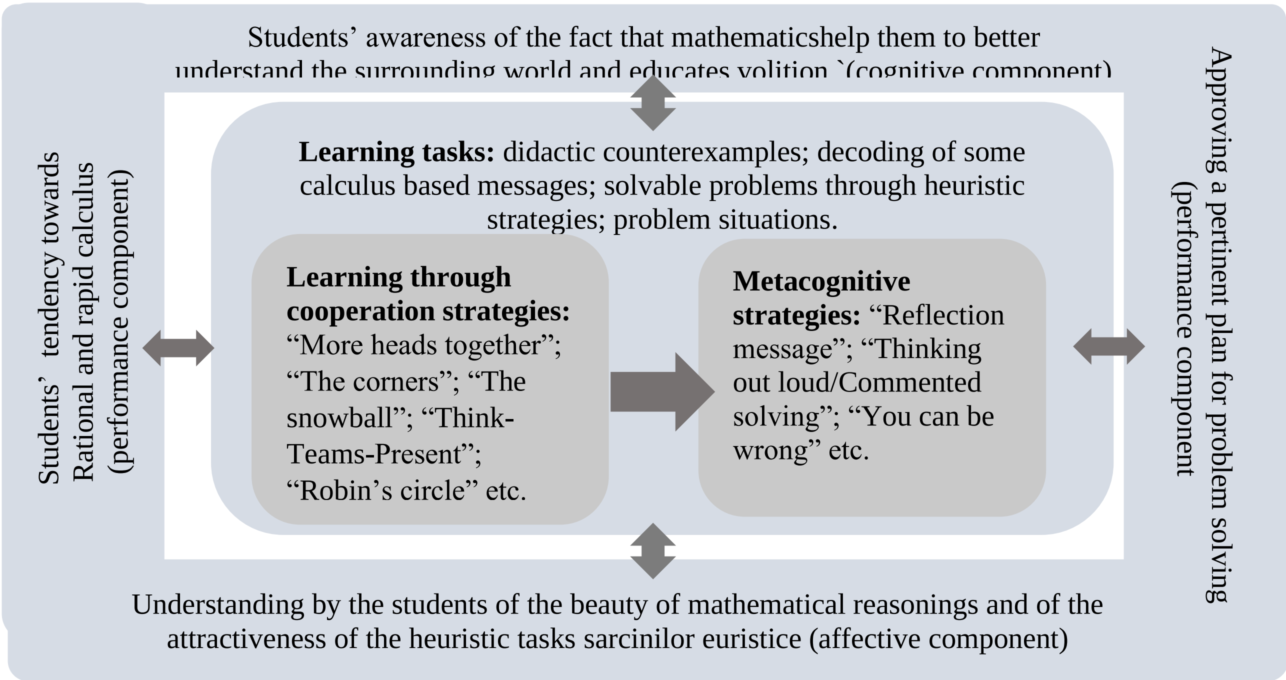

Figure 2. A model of didactic strategies for MA development

In what follows, we will provide further details and examples.

- *Cooperative learning:* "is learning through specific collaboration: students learn in small groups; the activity is structured; students are assessed for individual work; the work realized by the whole group is assessed; students communicate together directly – face to face; students learn to work as a team" [6, p. 5]. In the context of MA development, among the ways of grouping students, we can emphasize the heterogeneous grouping (for example, in a team of four children one will be of high level, two of medium/reduced level and one of reduced/minimum level). The following group work techniques can be useful: "More heads together"; "Corners"; "Snowball"; "FRISCO"; "6-3-5 technique (brainwriting)"; "Robin's circle"; "Think – Teams – Present" [6].
- *Metacognitive strategies* "encompass the actions the student takes in order to improve his/her learning process" [3, p. 117]. In the context of MA development, we will mention the following among the metacognitive strategies: monitoring (verification of the activity quality or progress; the task and the steps necessary for its solution analysis); performance prediction; self-motivation; searching for related information (library, internet); asking for help (peers, teachers and other competent people). Several metacognition techniques can be useful: "Letters with reflective message"; "Think out loud/Commented solution"; "You can be wrong" [4, p. 151-152].
- In *significant didactic situations* for MA development, we can capitalize the following ones as learning tasks: didactic counterexamples (any exercise or problem, which, provoking students to make mistakes, allow elucidation and preventing understanding mistakes" [7, p. 6]); calculus-based message decoding; solvable problems through heuristic strategies; problem situations. The task from the 3rd grade mathematics textbook, presented in figure 3 can serve as an example.

2 Calculează valorile numerice ale literelor și decodifică un cuvânt cu același sens ca și cuvântul *problemă*. Străduiește-te să calculezi cât mai mult în minte.

I = 160 000 : 4 000	E = 5 000 : (23 + 77)	D = 10 000 − 9 905
C = 40 × 25 : 500	F = 5 600 : (20 × 35)	A = 4 000 : 50 : 5
L = 95 + 95 × 100	U = 200 × 15 : 600	T = 6 700 × 80 − 800 × 670

95	40	8	40	2	5	9 595	0	16	0	50

- De ce atitudini trebuie să dai dovadă pentru a rezolva cu succes probleme de matematică? În ce situații de viață te ajută aceste atitudini?

Figure 3. Task for creating significant didactic situations in MA development [8, p. 47][1]

We suggest the description of a variant of in-class realisation of this task according to the above-presented model.

- The numbers range from the textbook is written on the blackboard beforehand. After doing the calculation, under each number one will write the corresponding letter. Thus, by the end, the word “difficulty” will be obtained.
- After the students have got acquainted with the task from the textbook, the teacher gives the class a model activity. He/she asks for the frontal calculation of the letter T value, orienting students to attentively observe the respective mathematical expression and to think rationally, manifesting ingenuity. It will be noticed that the products of 6 700 × 80 and 800 × 670 are equal (both are calculated by multiplying 67 by 8 and adding of the three zeroes to the right of the obtained number), thus the searched difference is 0. Finally, the teacher is writing on the blackboard the letter T under number 0 and draws students’ attention to the beauty of the conducted reasoning, motivates them for a rational and correct calculus, which will allow them to discover the solution rapidly, easily, beautifully. Such an activity favours all the components of an MA: cognitive, affective and performance.
- Afterwards, the cooperative learning is organised, based on the Think-Teams-Present technique. The students are grouped in teams of four. Each team gets the task to calculate the values of four letters. For example, the teams with the even number – letters I, C, L, E, the teams with odd number – letters F, U, D, A. The teacher draws attention to the request to calculate mentally, rationally, ingenuously as much as possible. Each student calculates the value of a letter, then, by rotation, the correctness of the conducted calculations is ensured. The team which obtained the results most rapidly, is writing the respective letters on the blackboard, under the corresponding numbers.
- If the students made any calculation mistakes, the teacher ensures the self-correctness of these by the students, using the metacognition technique “Think out loud”. The student that has made the mistake is invited to explain the way he was thinking, being guided to identify and correct the mistake. The application of this technique will be useful in the case when there

[1] **2.** Calculate the numerical values of the letters and decode the word with the same meaning as the word *problem*. Try to do as much mental calculation as possible.

- Which attitudes should you imply in order to successfully solve mathematical problems? In which life situations can these attitudes help you?

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are no calculation mistakes as well. For example, the students can be asked which calculation required ingenuity and how they manifested it. In their responses, the students need to be oriented by the teacher to the three components of MA:

- the cognitive component: "What mathematical knowledge have you used?";
- the affective component: "How beautifully you have thought!";
- performance component: "How can you characterise your reasoning? (It is correct, rational, rapid, beautiful.)

- The encoded word "difficulty" is read, the students are reminded that it is the synonym to the word "problem", the attitudes which helped to the resolution of the task are generalised.
- Then, in the key of the "Think – Teams – Present" technique, the post-solution task is approached. First, students meditate individually on the questions, then discuss them in teams, afterwards, the commonly accepted ideas ae presented to the class.

It should be mentioned that the mathematics textbooks for grades I-IV, approved by the Ministry of Education and Research according to the 2018 curriculum, contain various tasks which directly target the MA development, as the above-mentioned task. The creativity of the teaching staff, based on the knowledge of theoretical-methodological landmarks, can generate effective and beautiful didactic approaches within the framework of the model suggested in the article.

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