



TEACHER - AGENT OF CHANGES OF PARADIGM IN MATHEMATICAL EDUCATION

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ABSTRACT

Mathematics education must keep pace with the dynamics of society in general. The changes, both at the system level and the curriculum one, have teacher as the main agent, understood in all the complexity of his/her personality by bringing both resources and his/her resistances. In the Romanian education system, a way to correlate the theoretical progress with implementation of the results at the system level is the improvement of teachers. The study results show the effects recorded for preschool and primary school teachers as a result of carrying out such a training program, applied for mathematics.

KEYWORDS : pedagogical triangle, curricular model, mathematics education

INTRODUCTION

The pace of the society has an effect on the education system, imposing structural and functional changes, including the mathematical education. The change does not reduce to updating curricula, being more complex. We will point out some landmarks in the change of paradigm in mathematics education, taking as benchmarks the teaching system and the curriculum.

The fundamental components of the educational process are summarized in *pedagogical triangle* (J. Houssaye, 2000), defined by the classical elements of *knowledge, teachers, students* and the relationships established between them in the context of teaching, namely *teaching, learning and training*. Dynamics of changes in the social factors involved in the teaching act, teacher and student, is present both internally (needs, expectations, personal motivations, etc.), and outside (roles, social expectations, perceptions of social status, etc.). The student role moves from passive accumulation of knowledge to active involvement in the school of their own training. The range of student resources deployed in the construction of knowledge, training skills required by society extends from cognitive, emotional, affective-motivational and traditionally motivational processes to metacognition and complex processes specific to personality psychology. Student's needs have migrated from forming a professional training to ensure integration and successfully functioning in the labor market, to preparing for the adaptation to change, sometimes dramatically, in the labor market and generally in the society (life-long learning skills).

External pressures exerted on teachers are generated by changes in many fields. The teacher's role changes from reservoir and broadcaster of structured knowledge, to mediator between the student and knowledge, the resource person who adapts, facilitates, controls and guides the student's school path, identifies and capitalizes the potential in each student. Expectations at the society level increased, often in inverse proportion to the amount recognized by society. The internal changes target the need of social recognition and appreciation as well as the material recognition of the value of work performed, which is a factor impacting teacher motivational state, and which is often related with the quality of education.

Knowledge links the *pedagogical triangle* with the curricular dimension of the school education. *The structural perspective* highlights the key components of the curriculum and the relationships between them. *The pentagonal curriculum* (Potolea apud Potolea&Păun, 2002) includes *educational aims, content of training, training/learning time, assessment strategies and instructional strategies, mandatory learning benchmarks* in defining, building and evaluating school mathematics.

Outcomes of mathematics education have expanded from the objectives (knowledge) to skills (knowledge, skills, attitudes) which requires a rethinking and a new method to the entire educational approach. Changes in content aim at rethinking and reorganizing

them in the sense of favoring a mathematical thinking, basic for mathematics skills, outlining the didactic transposition role.

The curriculum variables for *training/ learning strategies and training/learning time* are interrelated models of training/learning targeting *ability of student learning*. Learning generated conceptual development in teaching mathematics (conceptualization, learning obstacles and errors, didactic transposition, transfer etc.). As for learning mathematics, E. De Corte and L. Verschaffel (Crahay *et alii*, 2005, p.33) consider it "social construction of meaning and understanding", which is achieved through a "constructive process aimed at developing a disposition mathématiser à réel them." Thus, learning mathematics should be dynamic (i.e. self-regulated, contextualized and collaborative). In Neacsu's view (1999), effective learning must be *participatory, active and creative*.

Finally, *assessment strategies* used in mathematics, have made the leap from normative to criteria, expanding the methods and assessment tools used.

This brief description is intended to highlight the complexity of change. It should be added, however, that the biggest challenge for mathematics education in recent years is given by the introduction of IT resources in the teaching process.

In the process of change, the most complex aspect is the teacher who enters this process by agreeing to a greater or lesser extent, with resources (personality traits), but also with resistances. Teacher status obliges him/her to express his/her personality on two dimensions: a) bearer and executor of civil, epistemic, pragmatic and axiological functions, as human being that knows and values the work, thereby transforming the world and him/herself; b) Product and manufacturer of circumstances, environments and social situations; man not only treats but also creates, directs and circumstances change. (Golu, 2014). These issues require that teacher should have an attitude of acceptance of new paradigms in education, even of denying sometimes past practices and also of courage to experience new beginnings, regardless of age and experience. Attitudes to challenges coming from society (empathy, understanding, openness, etc.) to the new demands of the teaching activity (spirit of initiative, organization, responsiveness, etc.) and even the attitude towards oneself (self-esteem, optimism, humility, (self-) critical spirit, etc.) are expressions of personality traits necessary for the teacher, resources that go into the process of change. In addition to these, there are intelligence and creativity, the main pillars on which is built mathematical knowledge in school. Creativity means the ability to think quickly various original solutions to dealing with a problem situation (Raynal&Rieunier, 2005), and in the professional conduct there can be found the ability of the teacher to develop contexts and learning opportunities that meet diversity of students' training needs.

Math teacher resistances to change are generated mainly by two factors. The first refers to the training route as a teacher of

mathematics: models of teaching and learning, assessment, content, behavior patterns that have worked in a particular period, located often far in past, and who have demonstrated effective for his/her (the case of teachers strongly centered on the model of personal example and less sensitive to inter-individual differences). These teachers are carriers of the torch and they carry on what they have taken from their teachers, ignoring the fact that the world is changing. Another factor that generates resistance to change is experience in the teaching department. As this experience is longer and results in good performance of students in a particular period, the more resistant to innovation teachers are. Teaching practice is gradually becoming a "bed of Procrustes" for new generations of students, causing undesirable school behavior (lack of motivation and lack of interest in learning, aggression and violence in school, anxiety, failure and dropout, etc.).

RESEARCH METHODOLOGY

If the initial training of teachers keeps up with the pace of change, the solution is the continuing education and training. Teacher training system in the Romanian educational system is structured in three stages, in chronological order from the time of initial training completion: tenure (basic teacher's certification), the second didactic degree and the first didactic degree. All three stages contain a practical test (a series of lessons) and a theoretical one (for finalized and second degree), namely the production of their thesis (for first didactic grade). The paperwork is developed under the guidance of a university teacher on a methodology theme proposed in general by the coordinator, or it is established in agreement with the candidate if it is of interest for teaching mathematics. The paperwork structure contains some theoretical (a synthesis of recent research on the topic researched) and a part of pedagogical research, focused on practical part of the theme subject.

The present study aims at results of the design and carrying out of this paperwork for a total of 10 preschool and primary school teachers teaching mathematics.

The aim of the research was to evaluate the effects of improvement by developing methodological and scientific work in terms of practical implementation of the new visions at the curriculum level.

The premise of this program, run under the direction and control of a team of specialists in the theoretical and practical school training, was to provide the connection between the dynamics of research in theory-decision and change in practical use.

Qualitative research findings have been summarized and organized according to the following variables:

1. The benefits of the training phase:

- *strategies used in this activity class (methods, means, forms of organization) which resulted in improving the teaching process, optimizing learning, students developing of creativity and flexibility of thought;*
- *thinking, designing, organizing, conducting and evaluating curricular and extracurricular activities;*
- *optimal correlation of strategic resources with needs and interests of students, for a full learning of mathematics;*
- *impact on pupils' behavior and attitudes, group work skills training;*
- *achieving the aimed educational outcomes to a greater extent;*
- *deep understanding from multiple perspectives of the examined themes.*

2. The ways of reflecting upon the benefits in classroom practice:

- *better results obtained by students in their evaluations, higher interest for their activities, initiative, motivation and better involvement in their tasks;*
- *a positive and tonic classroom climate, tolerance, acceptance and*

better communication in the classroom, developing the team and self-help spirit;

- *anticipating the unwanted events in the development of teaching and easily identifying potential solutions for preventing or removing them.*

3. Value added in the personal, professional and teaching context:

- *good feeling of the better training, trust and confidence, new skills (skills for research, for application of analysis instruments and control, for critical evaluation of various approaches in teaching mathematics);*
- *opening to new interpretations, meanings, approaches, strategies for implementing mathematics curriculum;*
- *more experience, job satisfaction, effective teaching style and a richer base of teaching strategies;*
- *methodical, scientific research skills, increased capacity for application of analysis and control of the teaching process.*

4. Changing the perspective on teaching practice:

- *a new perspective on mathematics (as a field of knowledge included in the curriculum) and the specific learning process (knowledge, skills and mathematical skills), the possibility to transfer between mathematical and interdisciplinary knowledge in mathematical language and communication, building cognitive skills and educating students' creativity;*
- *identification of new resources that can be exploited in learning mathematics (cognitive, affective, emotional, motivational, metacognitive);*
- *a wide range of possibilities for teaching innovation and practical applicability of mathematical knowledge in various fields;*
- *mathematics can be learned with pleasure, learning activities can be approached as a game in more natural situations for students with various resources;*
- *being aware of the fact that mathematics prepares the child's mind to knowledge, therefore it "was, is and will be key to success in the future."*

CONCLUSIONS

The program of training for obtaining the first teaching degree is constructive in terms of updating practice to theory, both for the person involved in this process and for the community of affiliation. Research running is done with involving colleagues, pupils, school management, parents sometimes, and the results are presented and discussed in a public meeting. The personal gain of the teacher is obvious. The professional gain is the *reflective practice*, which involves "a posture, a form of identity, a habitus" (Perrenoud, 2006, p. 15) Through this experience, the teacher develops a reflexive attitude to teaching practices, preparing him/her for a critical approach to curricular changes required by changes in the light of specific conditions of carrying out activities for the benefit of students.

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