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INFLUENCE OF THE PERSONAL ORIENTATED APPROACH IN MATHEMATICS EDUCATION ON THE DEVELOPMENT OF TRANSVERSAL COMPETENCES OF PUPILS 5 – 7 CLASS

The article discusses the impact of personal approach in mathematics education for development of transversal competences of pupils. The importance of mathematics for building the personality of the adolescents is highlighted. The development of competences is influenced by the genetic, physiological, psychological characteristics of the pupils as well as the ethnic and gender differences and also by their activity in the learning process, inclusion in extracurricular forms of education. The girls achieve higher success in mathematics and develop competences in a higher degree than boys. The success of Turkish ethnicity pupils was little higher than the Bulgarian ethnicity pupils. Correlation between the competences and success (r = 0,999) and activity of the pupils in education with competences (r = 0,868) and success (r = 0,869) was established. Regression equations among competences and success were developed.

Keywords: personal learning, mathematics, competences, correlations

Abbreviations: R – coefficient of determination; **r –** correlation coefficient, **SEE –** standard error; **F –** relation among parameters, **P <** Statistical significance.

Introduction

In the new dynamic conditions it is necessary the acquisition of abilities of the pupils to ensure their successful integration in the society, the ability to live valuable and in cooperation with other elements of social systems. Mastering the key competences in the ERF (European Refernce Frame) is a priority task of school education. The Bulgarian learning strategy focuses on a complete approach that includes all areas of knowledge and learning. Synergy as a new direction and NDM as “a new synthesis variant of eydetics, reflection, synectics, synergetics, enigmatics, acmeology, creativity, cognitions, emotions and motivation” affect all spheres of public life and the process of learning. Personal orientated “subject-subject” learning occupies an important role in the development of competences, creating opportunities for active participation of learners and maximum expression of their creative abilities. The construction of educated, highly intelligent, communicative, creative people, meeting the changing conditions, requires the methods of interactive learning to be continuously improved.

Purpose, subject and methodology of the study. This study aims to highlight the impact and effect of the application of POL (Personal Orientated Learning) of pupils in mathematics (5 – 7 class) for competences development. The subject of the

research was a personal orientated approach in mathematics education as a system of methods, techniques, organizational environment through which transversal competences could be developed. To increase the attainment of competences, it was necessary to: 1. Test techniques and methods of teaching that lead to developing the competences of pupils in maximal degree. 2. To organize educational environment in which to use active forms of education, transforming learning and teaching into a real creative activity. 3. Making interdisciplinary connections, through which to develop transversal competences, transferable in the educated disciplines.

Material and methods

Longitude pedagogical study was conducted in the period 2014 – 2017 at „St. Kliment Ohridski“ primary school, Haskovo. The study included three groups of pupils: Group A-22 pupils (8 boys and 14 girls), 18 of Bulgarian ethnicity (BE), 4 of Turkish ethnicity (TE); Group B-23 pupils (11 boys and 12 girls), 19 BE, 4 TE; Group G-23 pupils (11 boys and 12 girls), 17 BE, 6 TE. The number of pupils in the years – 2014/15; 2015/16 and 2016/17 was permanent. The success of the pupils was track out in dynamics-at the beginning, during the two semesters and at the end of the year. To assess the achievement of competences, a 4-level scale was used (90 %; 70 %; 50 %; 30 % development of competences) according to SER (State Educational Requirements). All results for success and competences were processed statistically by ANOVA of STATISTICA 10 for WINDOWS 2010.

To identify the impact of pupils participation in mathematics learning in increasing the degree of competence attainment, stimulating interactive “subject-subject” training, three types of methods were applied: situational (case study, role play), discussion (talk, communication, brainstorming), empirical (project development). The inclusion of interdisciplinary activities was related to the products of the project elaboration – presentations, boards, drawings, models.

Literature review

The improvement and wider application of POL is a very actual problem at present stage in the organization of the learning process. In the present world particular importance acquires the social skills and knowledge such as: stable skills for interpersonal communication and presentation; personal and social responsibility and self-control; multicultural tolerance and understanding. Very important trait of multilateral development is the requirement for lifelong learning (Sultanova 2011). This impose realization of a personal approach in mathematics education, in which the learners are not passive listeners. POL puts the trainee in the center of the methodological attention as “communication is linked to the idea of its overall development, beyond the development of the speech skills” (Simeonova 2000:33). This builds new relations and interaction between the trainee and the learner, characterizing with the harmony and equal participation of the communicating partners. According to

Todorina (2007) personal-orientated technologies provide "subject-subject" interactions at teacher-pupil and pupil-pupil level, consideration of pupils' interests, needs and abilities, the creation of an individual educational trajectory. Tcanev (2003:34) believes that the school can not and should not predict the future of each pupil. Mastering the methods of knowledge is the main purpose of learning. According to Ivanov, Kalinova (2015:27) not the amount of knowledge is important, but to teach pupils how to teach themselves, "to construct their own knowledge, not only to receive information". According to Temnikova (2016), "to learn constructively means to learn actively, to understand and to derive own experience; learning conducted in a stimulating didactic environment; to develop skills for transform what they have learned for solving different types of authentic tasks; to develop imagination and creative thinking".

According to Krasteva (2005:36) "The new culture of learning implies a new design of education. It is directed primarily to the pupils (personal-orientated lerning) and not to the educational content and teaching as it is now. The new toolkits (methods, technologies, educational environment) engrave the activity and creativity of subjects in the learning process".

Delibaltova (2015:6) considers that "Metacognitive development could be helped by the creation and implementation in different contexts of didactic situations, constructed on the base of building relations with the environment, with others and with respect to itself, including the use of different spaces and environments, levels of thinking and reciprocity". In today's global world, more and more competences must to integrate the person into the society. It is necessary „orientation of education to provoke thinking and independence, formation of practical skills and personal development" (National Programme 2006).

According to Mandeva (2015:44) education is the remaining after „forgetting" everything learned. Rasheva-Merdjanova (2014:234–235) summarizes the new faces of the school in the POL and education paradigm: The school is a mediator; moderator, transitional and accessible territory; leading personality to identification and self-identification; territory for intercultural interaction. According to Rasheva-Merdjanova (2017:86) „Key competences operate as a pragmatic manifestation and expression of transversal base competences". Rasheva-Merdjanova (2014:97–98) summarizes that transversal competences are important not only as portable and universally valid, but also as metacompetences, including the autocorrection mechanisms of selfeexpresing and selfdeveloping of the persons.

Problematic learning is one of the important approaches for optimizing the learning. Developing of modern education is related to the application of different approaches that allow the development of personality in multiple dimensions: social, psychological, emotional, intellectual, cognitive and cultural. Problem based training is an opportunity to achieve this, as it can be realized outside the classroom, and this will lead to the opening of the educational environment (Tcankov 2018:68–69). In a didactic experiment with pupils, related to study the effectiveness of the implementation of technology aimed to improv competence for problem solving,

Tcankov (2018:76 – 78) found that in solving problems the pupil is in active position; the activity is aimed at solving problems through cognitive situations; between the experimental and the control group exists proven difference in cognitive skills, result from the targeted use of integrated problems in the course of training. The core of competence for problem solving is the ability to transfer skills. The need for the development of transversal competences to be portable in the educated disciplines, as well as the achieved lower results for mathematics of the NEE (National External Evaluation), necessitate the search for specific learning approaches that will increase the success and pupils' competences. Modern mathematics training creates prerequisites for the development of transversal competences related to self-learning and acquisition the ability for critical thinking, manifestation of creativity, ability to work in a team. According to Tcvyatkov (2015) mathematics is one of the most significant achievements of the mankind, because it is inconceivable to analyze the economic, etc. phenomena, as well as to create models without the help of mathematics. On the base of a stable mastery of the calculus emphasis is placed on reasoning, activity and knowledge (European Qualifications Framework. Luxembourg, 2009). Training in competence cannot be qualitative if it is not developed through tactical and strategic learning (Radev 2005).

The basic competences of mathematical literacy are: mathematical thinking and reasoning; argumentation; mathematical communication; modeling; solving a mathematical problems; presentation of mathematical objects and situations; use of appropriate mathematical language; use of tools, support materials and technologies (Study of the reading and mathematical literacy of pupils in VI class. Centre for control and evaluation quality of school education. Foundation "Together in time" 2012).

According to Hristova (2016) mathematics training allows pupils to develop skills to think, to expose logical arguments and to make correct conclusions, to assimilate the logic of other subjects, to understand modern society.

According to Mihaleva (2015), "Mathematical education should be open to societal needs". The training should be aimed at the formation of sustainable knowledge and skills, having an essential connection with the experience of the pupils. In education there are number of processes and phenomena, the internal mechanism of which is synergetic. It is necessary to uncover this mechanism in order to be understood, studied and properly used (Grozdev 2007:132). Grozdev (2007:62) described the "synergistic conditions" by which the pupil-mathematician to be self-critical to his results. Pupils' achievements in solving tasks in mathematics and informatics are related to the organization and self-organization of the training (Grozdev 2002:51 – 58). According to Georgieva, Grozdev (2016:9) at the base of NDM (New Dynamic Modification) stands a complex, synergistic, interdisciplinary approach of learning, stimulating the intellectual development of learners and trainers.

One of the most complex and interesting method of training, widely used in lower secondary school, is the project. The inclusion of interdisciplinary activities is related to the presentation of the products from the project training – presentations,

boards, drawings, models. It is essential to develop skills in pupils to transform speech information into a symbolic mathematical or geometry, analyzing, establishing relationships and dependencies between defined values. This is essential for the development of spatial thinking and at the same time aproximation the information to easily describe processes, phenomena and actions. Cross-curricular relations are also understood as the combination of methods, techniques and approaches used in different subjects. The project method combines theory and practice, knowledge and skills. This method is always linked to creative activity of the pupils.

For example in our school in 6th class an interdisciplinary lesson in Bulgarian language-mathematics was realized. The pupils were divided into 4 groups. Each group received a task from a certain number of verbs to form the appropriate type of the participle and to determine their grammatical signs: 1 Group-Present activity participle; 2 Group-The past rites of activity participle; 3 Group-Past unfinished activity participle; 4 Group-Past bled participle. After that each group must draw with the verbs and the generated participle, textual task in mathematics. The knowledge gained in mathematics lessons, developed the logical thinking of the pupils and their ability to apply arguments, improve their observation and combinative ability, make it easier to assimilate the logic of other objects.

The interactive "subject-subject" education, application of interdisciplinary lessons and different approaches for stimulating active personal participation of pupils in learning process are very important manners for diversification of educational environment, improvement of pupil's success and competences, but up to now they are not widely applied yet in primary schools. This imposes performing of the present exact investigation for establishing their effect on the improvement of success and competences of pupils in our school as a model.

Results and discussion. Analysis of the results of the empirical study

The degree of achievement of competences in mathematics depends on a great extent on the success of pupils during the years. On average for the three years, pupils from group G had a higher success – Very good 5.02. The difference with the other two groups was statistically signifficant ($P < 0.01$ **Table 1)**. Secondly was a group A with success Very good 4.74. With a slightly lower success was group B. The differences in the success between the groups was statistically significant and proven at $P < 0.05$.

The analyse on the success by gender from all groups showed that the success in the three years in the girls -Very good 4.93 was higher compared to the success of boys – Very good 4.54. The difference in success between girls and boys was very well proven at ($P < 0.001$). The girls in the three years showed much more effort in training and their success was higher. According to Bayazit (2017:87) in solving various problems in mathematics, girls show different approach in choosing the method of resolution compared to the boys.

The comparative analyse of the pupils success by ethnicity showed that during the three years there was not a significant difference in the success of the pupils from Bulgarian and Turkish ethnicity. Although in the three years the differences in the success of the ethnicity were not statistically proven, on average for the whole period due to the accumulation of positive effect and the higher number of the evaluations, the success of the Turkish ethnic pupils in mathematics was higher compared to the success of pupils of Bulgarian ethnicity ($P < 0.05$).

Table 1. Average success and degree of achievement of the competences, %. N=204

Groups	Competences, %				Success 2014–17
	2014–15	2015–16	2016–17	2014–17	
Group					
A	**68,18a**	**60,91ab**	**70,00a**	**66,36ab**	***4,74****
B	**61,30a**	**56,09a**	**69,13a**	**62,17a**	**4,52***
G	**71,74a**	**69,13b**	**76,96a**	**72,61b**	**5,02****
All Grps	**67,06**	**62,06**	**72,06**	**67,06**	**4,75**
Gender					
Female	**71,05***	**66,32***	**73,16a**	**70,18****	**4,93*****
Male	**62,00***	**56,67***	**70,67a**	**63,11****	**4,54*****
All Grous	**67,06**	**62,06**	**72,06**	**67,06**	**4,76**
Ethnicity					
Bulgarian	**67,09a**	**61,64a**	**70,73a**	**66,48a**	**4,72***
Turkish	**66,92a**	**63,85a**	**77,70a**	**69,49a**	**4,94***
All Grps	**67,06**	**62,06**	**72,06**	**67,06**	**4,76**
Participation in Extracurricular education forms					
Active	**79,52*****	**78,57*****	**82,24*****	**80,32*****	**5,54*****
Weakly	**46,92*****	**44,55*****	**45,79*****	**45,64*****	**3,84*****
All Grps	**67,06**	**62,06**	**72,06**	**67,06**	**5,00**

* Differences are statistically significant at *P<0,05,**P<0,01, ***P<0,001 and if not equal letters.

The comparative analysis to define the influence of the main factors: group, gender, ethnicity, having a major influence on the pupils' success, showed that in the first year with the strongest influence was the group as factor – 45.35%. Secondly was the interaction between group and ethnicity – 24.19%, the third was the interaction among group-gender – 19.35%. The factors gender and ethnicity had no significant influence and were not statistically proven. During the second year, with the strongest influence on success was the factor gender – 45.26%. The group as factor this year occupied second place with influence – 25.47%. The power of these

two factors was statistically proven. The interaction among the factors group and ethnicity was proven. In the third year, the factor gender (as in the first year) was with lower influence than the group as factor. In this year with the strongest influence was the interaction among group by gender. On average, for the three years, group as factor was with higher influence on success (29.9%). Secondly was the interaction group-gender. The gender as a factor was with a lower influence.

In the fifth class (2014–2015), the degree of attainment of the competences was on average 67.06%. The difference between the groups was small and statistically unproven. Slightly higher rate of competences was achieved in group G and the lowest for group B. Girls showed a slightly higher level of achievement of the competences than boys ($P < 0.05$). In mathematics training there was no statistical significant difference in the achievement of competences between ethnic groups.

The differences in the competences of pupils were well expressed by indicator activity of participation in the learning process. For the active participated in interdisciplinary lessons practice and developing projects pupils, achievement of competence was 79.52%, while in pupils who did not actively participate, the achievement was 46.92%. The difference was very well proven at $P < 0.001$. In the second year, the achievement of competences was lower than in the first year. The reducing was higher for group A (7.27 percentage units) – from 68.18% to 60.91%. In group B, the decreasing was 5.21 percentage units. With the lower decreasing was group G – 2.61 percentage units. The difference between group B and group G was proven, and between A and G also. Pupils from group B were with the lowest level of competences achievement. For both male and female pupils, there was a tendency to decrease the achievement of competences in the second year. There was no difference by ethnicities in the second year. The reducing of competences was slightly higher for the pupils of Bulgarian ethnicity. During the second year, the tendency of the pupils actively involved in the training to achieve in a higher degree competences was also definitely expressed ($P < 0.001$).

In the third year, group G showed a slightly higher score, but the difference with the other groups was not statistically proven. On average for the whole period group B showed a statistically proven lower attainment of competences than the other two groups. The difference between group G and group A was statistically unproven. In the third year (unlike the previous two years) the difference between girls and boys was not proven, indicating that their capacity was almost equal. On average for the period girls showed a higher degree of achievement of competences ($P < 0.01$). Also on average for the whole period was confirmed that among the ethnic groups, the difference was not statistically proven. This confirmed the view that in the discipline mathematics pupils from the both ethnicities achieved almost equal level of competences.

In the third year higher attainment of competences (with 4.67%) compared to the second year was established in the group of actively participating in the learning process pupils. In total this year compared to the previous year the increase of competences was with 16.11%. The average of the three years the difference in the degree

of attainment of competences in the active participating pupils compared to the lower participating pupils was very well-proven ($P < 0.001$).

Comparing the tendencies in development and variations in success and achievement of competences in pupils during the observed years on the base of statistical analyse, very high positive correlation was established between the percentage of achieved competences with the success-r = 0,999. The most important was the very well proven very high positive correlation between the pupils' participation activity in mathematics classes with competences (r = 0,868) and success (r = 0,869). Of the other investigated factors influencing on the achievement of the pupils' success and competences, only gender correlated poorly with participation, success and competences.

The summarised comparative analysis of the changes in the success and competences of the pupils over the years and the comparing factors influencing on the results achieved, clearly confirm the importance of the activation of the pupils' participation in the learning process. By enlarging application of interactive approaches, methods and forms of teaching, enhancing interest, creativity, striving for self-expression, could result in achieving the competences of learners in a greater extent.

Based on the established high correlations between success and the achieved competences, regression equations were developed for approximate determination of competences as dependent variable by the success achieved. The applied two regression patterns (linear and polynomial) confirm the high regression relation between success and competences. The coefficients of determination R=0,965 – R=0,966 are enough high and express the dependence between the two parameters – success and competences (Table 2). The statistical significance of the equations is very high ($P < 0,0000$). With a little higher accuracy and a lower error was the linear model. This allowed the linear regression equation to be used for approximate determination, prediction and control the degree of development of competences by the success of the educated pupils.

Table 2 .Regression dependences among the competences and success in Mathematics

Equation	R	SEE	F	P<
Y=–30,6659+20,5724 X	0,965	1,9	2750,5	0,00000
$Y=-19,3295+15,3444\ X+0,576\ X^2$	0,966	7,9	1384,3	0,00000

Y – **competences,%; X – success;** R – Coefficient of determination; SEE-standard error of estimation; F – relation among the parameters, P<statistical significance of the model.

The established regression equations could be used by the teachers in the learning process to guide the degree of accumulation of learners' competences through the success. This is easier to control and to correct early pupil's behavior in education, to select appropriate approaches and methods to activate pupil's participation in learning proces.

The applied frequency analyse (distribution fitting), showing the achieved competences of the studied pupils during the three years, demonstrated the share of the dominant groups devided by the degrees of achievement of competences. Total for the three years training period of the 204 observations included in the investigation, the highest share (32.84%) occupy the highest degree of achievement – 90% (Fig. 1). Second with 30.88% are the achieved competences – 70%.

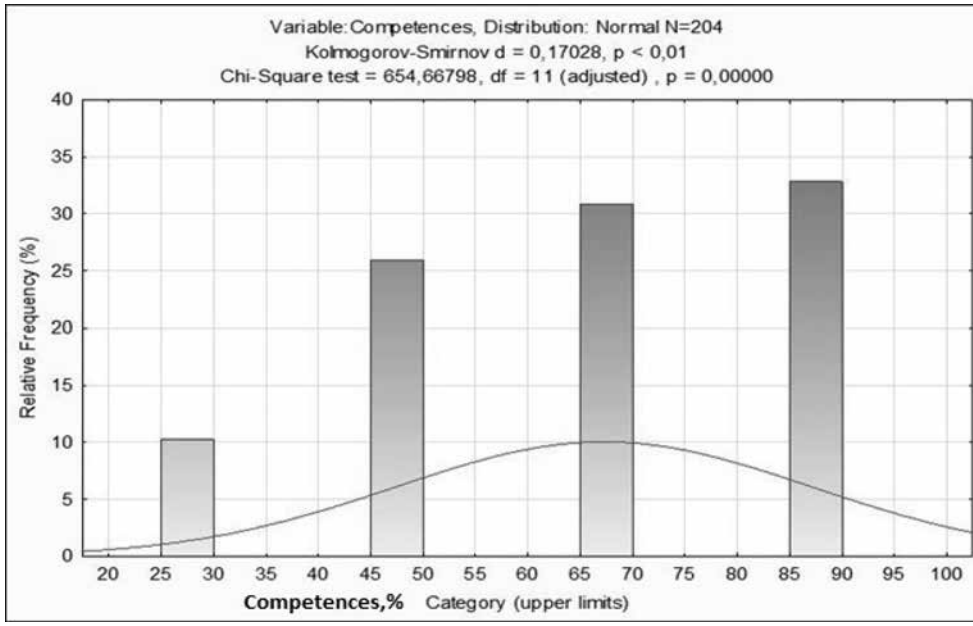

Figure 1. Distribution and participation of groups of competences.

With the smallest share (10.29%) was the lowest level of competences attainment (30%). In the investigated database, dominated the highest (90%) and the next (70%) degree of achievement of the competences, which definitely indicate the positive role of active forms of pupils' education.

The greater participation of pupils in extra curriculum, interdisciplinary forms of education, which have achieved a greater degree of key and transversal competences, confirm the positive effect of the application of the POL "subject-subject" training for the increase creative activity and contribution of the learners in the education process.

Conclusions

The construction and development of transversal competences of pupils in mathematics at lower secondary level is most closely related to the success and activity of their participation in the extracurricular and interdisciplinary forms of interactive "subject-subject" training. The high correlation between pupils' activity in mathematics with competence (r = 0,868) and success; (r = 0,869) confirms the need to expand and diversify the implementation of approaches and methods for active participation of learners in the education process.

The high correlation and regression relation between success and competences make easier to control the degree of achievement of competences through success.

The gender and ethnicity of learner's are also important factors influencing on the degree of achievement of competences. Average for the investigated period, girls show a higher degree of competences achievement ($P < 0.01$) compared to boys. This necessitates taking into account the ethnicity and gender of learners, and trainers to select and apply specific approaches to achieve competences in maximal degree.

With the help of a personal orientated approach, the tasks of modern mathematics education can be achieved in a higher degree. By more effective communication, based on support and collaboration, combination the efforts of all participants in the learning process, achieving personal, conceptual thinking, a higher degree of competences could be obtained for resolving of global problems of education.

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