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Mathematical Education in Terms of Innovative Development

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Abstract: *The subject and issues mentioned in this paper relate to modern trends in researchers about teaching mathematics:* ***problems of mathematical education of students in terms of innovative development in different countries and cultural traditions****. It is the reason why a lot of international scientific conferences are being organized in Poland and in other countries as well. They discuss issues related to teaching mathematics and quality of mathematical education. During these meetings, benefits, effects and lacks of: a) changes in system of education that have been already introduced as a result of Bolognese Process in many countries; b) introduced reforms and demands of Bolognese Process; are analyzed in detail. Authors of the paper refers to some researches' results, examples of practices in mathematical education observed in Kazakhstan, Poland and Russia. Methodology of the issues mentioned in this paper is based on: a) well-thought-over choice of publications in didactics of mathematics; b) papers and reports from researches about reforms in system of education and about quality of recent mathematical education. This kind of attitude made it possible to: 1) undertake trial of describing theoretical rudiments of testing quality of mathematical education; 2) formulate diagnosis about condition of mathematical education; 3) show symptoms of the crisis in contemporary mathematical education of students from schools and universities; 4) state conclusions for improving the way that system of education functions, for higher rate of students who pass exams in mathematics and for hot issues for prospective researches.*

*This paper is a case study of its authors experience, experience of their colleagues in practice of mathematical education of students from the university and finally experience shared with mathematics teachers. The research aim of this paper is to point down and describe factors that influence the quality of mathematical education. The authors trie to find out the answer for research question: what are the points of people's view and what do they know about effects of already introduced reforms, using computer technologies in teaching and present and future quality of students and pupils mathematical education****?*** *In final conclusion of the research authors indicate two sides of the same coin,* ***namely mathematics and mathematical education for the need of the future.*** *On one hand, it is important to minimize and restrict symptoms of the crisis and of lacks in mathematical education among contemporary generation of students. On the other hand, the question what the mathematics should look like when new generation of students is being brought-up is crucial. There is need of: a) improving methodology of problems in teaching mathematics monitoring and diagnosing quality of students mathematical education; b) monitoring and exchanging world-wide experience in reforms of mathematical education for the well-being of future society; c) analyzing in detail benefits, effects and gaps in used tools and methods in teaching mathematics, in particular within designing and implementing on line courses to mathematical education.*

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1. Introduction

The article extends and expands its earlier version, see A. Pardała, N.K. Ashirbayev, D. Rakhymbek(2015). The problem of education quality of students and preparing them for entering universities was a hot issue among the society of math teachers, math scientists and math didacticians before introducing compulsory matura exams in mathematics. During Brenna conference in 2004 A. Dąbrowicz, from Gdansk University, said: *for some years we have been watching decrease in level of knowledge that students who start the university posses. The range of curriculum to be taught before matura exam is being narrowed. Part of pupils are not prepared to undertake systematic work which is what the studying at the university is all about. Recent level of matura exam does not guarantee that a prospective student has acquired all the needed knowledge in mathematics and physics to study successfully at the university.* J. Rachoń also expressed his worries about the level of the mathematics education among pupils and teenagers as well as students at university. He presented his preoccupations at the opening of the seminar called**: You will not have a good career without mathematics**, claiming that method of learning mathematics by heart; the method that is supported by the majority of teachers; is one of the reason of the situation mentioned above. He said that this phenomena is a social issue as more and more pupils are not able to comprehend school mathematics. That leads to the tendency that shows that less and less people choose faculties which curriculum includes mathematics. This trend is at the odds with the recent need of increasing the number of students at for example technical universities.

Diagnosis that can be found in report called Tackling the Mathematics Problem prepared by the Institute of Mathematics and its Applications, the London Mathematical Society and the Royal Statistical Society shows the importance, accuracy and actuality of testing the quality of mathematical education especially among university students. Authors of the research claim that in is not a mere coincidence that a lot of students are worse prepared and their "high achievements" are about the lack of knowledge in basic math concepts. The researchers also express their and the society of mathematics' anxiety about mathematical readiness among the students of the first year, see: www.1ms.ac.uk/policy/tackling/report.html. The results of this research correspond with some findings of N. Woolock (2008) that can be found in the article: “Lack of mathematical knowledge is taking revenge”, in which some conclusions about the GCSE exams in mathematics that is a British national examination for pupils in age of 14 to 16 appear. Authors of this research say that decrease in standards of education threatens national economy. Furthermore, people should be ashamed of their lack of mathematical numeracy and not be proud of it as it is very often observed.

Even if we do not take into account previously mentioned reasons of the worries about students’ preparation, we still should be aware that their mathematics negligence and

difficulties are common in terms of mathematics that they get familiar with and their mathematical reasoning. Worldwide, the usefulness of mathematics as well as computer science has been underlined. Mathematics applications and mathematical modelling have growing impact on solving problems of the contemporary world in such disciplines as nanotechnology, public media and communication, insurances and banking. In fact, it is not difficult not to notice the importance of mathematics and its applications, mathematical education, mathematical culture for the prospective economical development of nations and intellectual development of societies in the recent world. Mathematics is without any doubts wonder of international culture in which history of human thought development and great human achievements are reflected. Some of them have been implemented into process of students mathematical education. The Internet, computers and computer technologies support traditional methods of recognizing the new educational content that is being introduced for students. They also facilitate methods of mathematical modelling of problems and phenomena. The results of researches confirm that rational usage of modern visualization technologies, educational platforms and e-learning has a positive impact on efficacy of educational process and should not threaten traditional methods of mathematical education. Then, according to the discovery of brain activeness' asymmetry by R. Sperry, the practice of mathematical students' education should simultaneously involve the activity of both hemispheres of brain. Otherwise some blockages in training students' memory and motivation may appear together with weakening the need for logical thinking and mathematical justification. This is caused by taking the Internet and computers as the only authority. Growing interests in the Internet and computer technology among teenagers is a fact, nevertheless it not always has reflection in their being into mathematics and their internal motivation to learn mathematics. On the other side, low level of mathematical competences and minimalistic teenagers' attitude towards acquirement of mathematical knowledge may cause lower interests in taking studies in mathematics or in technical disciplines. This phenomena can be observed in Poland as well as in other countries all over the world. There are also common dilemmas and tendencies that upset not only academic societies. Students learn mathematics fewer and fewer and with poorer effects.

Actual tendencies and problems in education development, introducing nanotechnologies, using innovative technologies in key branches of industry, growing dynamics of solving social and economic problems of countries and societies imply the urgent need of educating and training staff with higher education such as engineers, computer programmers, mathematicians, economist or managers. The process of preparing students of these faculties should focus on mastering competences and methods within applied mathematics, mathematical modelling, computer science and innovative technologies as well as on acquiring hard and soft competences, practical experience that will be useful in their future work. These challenges are also connected with problem of quality of educating teenagers in secondary and high schools. Among secondary schools graduates with passed matura exams we can observe prominent shortages and gaps in mathematical education. This phenomena has been known in many countries. In Poland it

has been revealed not only during education process in 1st year of mathematics studies, see A. Pardała (2011, 2012), but also in former stages of education. Unfortunately, introduction of compulsory matura exam in mathematics in 2010 together with introduction of extra tutoring for slow-learners and absentees in 1st year of mathematics studies and so called ordered specialities in computer science did not improve quality of mathematical education among students. It also did not have impact on higher percentage of students who gained credits. In next parts of this paper our attention will be focused on conditions and effects of introducing reforms in mathematical education of pupils and students in Poland, Kazakhstan and Russia.

2. Mathematics education in Poland after reform in education

In many countries all over the world, the idea of changing system of education, especially in terms of mathematics, has different descriptions of its standards and stated concepts in students mathematical education as well as teachers in-service training and education. This differentiation has impact on the practice of teaching mathematics and its effects during consecutive stages of mathematics education. It is worth to mention words spoken by outstanding Russian Mathematician V.I. Arnold during his paper titled "Antiscientific Revolution and Mathematics" prepared for The International Congress of Papal at Academy of Sciences in Vatican in October 1998. He said: *that those who did not acquired numeracy in mathematics and in giving explanations, would not be able to differentiate between real and false justification. Those people* - according to V.I. Arnold - *are easy aims for politics to be manipulated by them.* Similar phenomena, this time in American schools, was underlined by Bill Gates during the meeting of Congress of the USA. He appealed for the change in curriculum of mathematics, physics and other subjects as the sciences are becoming less and less competitive in the whole world. In that time also Polish system of education called for changes. The reform introduced in 1999, in particular change in mathematical education, was not generating satisfactory improvement in quality of education. Also in 1999, the Bolognese Declaration was introduced in Poland and its assumptions came into life that were supposed to correspond with the growth of teenagers and society's ambitions as well as with the need of intensification of national economy and creating the society based on knowledge, see Z. Marciniak (2008, 2009). Deteriorating quality of mathematical education in Polish secondary schools caused the agreement between The Minister of National Sport and Education with vice chancellors of Polish High Schools that is now being called "new revolution in matura exams". As a result schools restored the compulsory matura exam in mathematics in 2010 which became a revolutionary change for the future of mathematical education at each stage of school as well as at the academic level. It was supposed that the introduction of the reform and changes in system of education should be the reason of improved education quality, in particular in terms of mathematics. What is now being said about the Polish school and about the efficacy of mathematical education at all stages?

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Some graduates of secondary schools from 2010 as students of 1st year at the university showed major ignorance of school mathematics. Among them there were some students who cannot tell the difference between product and quotient. They were not familiar with terminology and system of mathematical symbols, they had problems in solving elementary linear or square equations that were connected with the lack of knowledge. They preferred innovative technologies and the Internet and they completely depended on their infinite possibilities. Furthermore they criticized traditional methods of teaching and learning mathematics and the need of strict and exact explaining mathematical thesis. The quality of mathematical education of students is being assessed taking into consideration effectiveness of teachers' work as well as effects of teachers' training and education, see Z. Leszczyńska (2011). To improve situation described before and to cease some ineffective practices as well as to achieve higher exams results in mathematics is essential to:

1) Animate cooperation between mathematics teachers with their schools and the teachers from the universities in terms of solving actual problems in mathematics education of students;
2) Change and modernize the system of education for prospective teachers and introduce trainings and practices for in-service teachers as well as testing teachers knowledge and competences so as to enable them to gain some certificates;
3) Create a system of centres to assist the work of in-service teachers that would be aimed on improvement of their quality of mathematical education.

Statement saying that theories comes and goes away and there are examples that stay which is being ascribed to I. M. Gelfand refers also to didactics. Without doubts, examples of mathematical situations about realization of mathematics curriculum are of some gravity. It is about some effective situations that have already appeared and that are to be used again in students or teachers education. Hence, we are going to direct our focus on the examples that shows level of students' knowledge within school or academic mathematics.

1st Example

Equation $\sin x + \sin y = \sin(xy)$, where $x, y \in (0, \frac{\pi}{2})$ turned out to be untypical and even difficult for students of 5th year of their mathematics studies, the ones that are to become mathematics teachers. When students were looking for a method to solve the task, I was surprised with their difficulties, blockages and mistakes in mathematical reasoning. Some of the students while trying out methods such as case study, trial and error or other untypical ways to solve the task, came to conclusion that given equation has no solution in stated subset, see A. Pardała (2011).

2nd Example

Since 1995 I have had lectures and seminars with students of 1st year of their computer science studies. According to my experience, their effective education and quality of that education has fallen when computer science became a so called ordered faculty. For

instance in academic year 2011/2012 there were 12 exercises groups in Mathematical Analysis and Linear Algebra. Lectures and Exercises in this subject were conducted accurately in open and friendly atmosphere. There were large number of students during each lecture and exercises with less than 30 participants. Materials were accessible for each student as well as some examples of exam papers from former years. Some sets of tasks given to students during resit of the exam or test were the same as in the last few years. To pass the exam it was enough to gain 40% of all possible to achieve points. On the base of positive grade from exercises' classes student could get a positive result from the exam. Nevertheless, an average result was not higher than 50% of possible points. Lecturers and leaders of classes were all surprised with so low efficacy of students' education. It was the worst result at this faculty of studies since 1995. Detailed analysis of the results showed that only 70% of those students wanted to complete this subject. According to their teachers poor results were caused by:

1) Lack of internal motivation and their indifference and by low attendance rate;
2) Some lacks of knowledge in school mathematics (despite of passed matura exams by 70 % of all students);
3) Wide range of knowledge to acquire in terms of given subject and not sufficient number of lectures and exercises' classes that caused quick pace of progressing with new material;
4) No relation between the discipline and achieved results with the scholarship that students received on the base of choice the ordered speciality.

The situation described above caused introducing by the Dean some procedures that are not true to regulations such as: second resit for credit before external board, second resit of exams before external board, annulment of re-sit exam before external board. These procedures were introduced for students that failed to gain a credit or to take the exam. Thanks to that another 15% of students passed the exam. It also meant that difficulties in mathematical education of computer science students and quality of mathematical education were swept under the carpet. After protests against this situation, Department of Supervision of High School Organization said that using this kind of procedures is not legal and has no justification in Studies Regulations, nevertheless in his next letter he added that all issues concerning organization of the studies and principles in carrying out exams are to be decided within ruling authorities at given University.

To make conclusion, giving too much power to University authorities leads to extorting poor quality of teaching university students. Given example illustrates extorting development of mathematical competences at the cost of simultaneous reduction of quality of mathematical education in particular within so called ordered specialities.

3rd Example

M. Ciosek, A. K. Żeromska (2013, pp. 50-54) describe research on real lesson during which the task as follows was given to students: *In a wholesaler you can get a 20% discount on condition that you pay 15 % consumer tax. What do you prefer to have firstly counted discount and only after the tax or vice versa?* It is a task with percentage calculations that turned out to be difficult for some secondary school graduates who took

their matura exams in 2013 and who were admitted to mathematical studies. During an extra tuition for slow-learners and absentees from 1st year of mathematics studies I asked pupils to do this task in a written form. The results surprised me. Only 18% of the students solve the task correctly. The rest of the students did not achieve right result as they have mistaken concepts of discount and tax or did not recognize the mathematic model for this realistic situation. As a opinion poll I asked 2nd year students to solve the same task and only 37% of them came to the correct solution. This example shows lack of competences in mathematical modelling of simple situations and applying mathematics by both secondary and university students.

4th Example

Curriculum, mathematical school education, its results, quality and efficacy of teachers' work in a given area or country should be also analysed from the point of view of the most important research project PISA (Programme for International Student Assessment) that is organised every 3 years by OECD (Organization for Economic Cooperation and Development). The results of PISA 2012 research carried out among 15 year old students from Poland are published in report: see www.ifispan.waw.pl . It is worth adding that OECD modified theoretical assumptions of PISA in 2010. Basic mathematical competences that are being analysed and tested are: mathematizing, strategic reasoning, reasoning and justification. In 2008 these competences were mentioned in Polish core curriculum as the most important in mathematical education. Full description of task situation and three assignments that were used in PISA 2012 research can be found on web page: see www.ifispan.waw.pl . Each of those tasks was to test and check different competences and each has different level of difficulty and could be ascribed to different general requirement stated in core curriculum. In Polish report from PISA 2012 research we can read: *1st task checks ability to use mathematical knowledge in simple geometric situation. It can be classified as II general requirement of core curriculum : using and interpreting representations. 2nd task calls for not easy reasoning hence it may represent V general requirement: reasoning and justification. 3rd task checks ability to plan and perform few consequent actions. These competences meet IV core requirement: creating and using strategies.* Authors of this report also claim: *Polish students who took place in PISA 2012 research gained 518 points for their mathematical competences. An average result has improved over 23 points (in comparison with the result from 2009) and reached level above the average of OECD. Poland is the only country that achieved so high improvement, see* www.ifispan.waw.pl, pp.14-15.

During PISA 2000 research, among pupils form the UE, Polish ones were in tail of Europe but in 2009 they improved their results so as they were at 5th place in reading, and at 7th place in the sciences. In mathematics they were at poor 11th place. This not good result in mathematics was influenced by 20,5 % of Polish pupils who achieved result below minimum. In PISA 2000 Polish pupils were in 3rd ten in terms of mathematics and they were above the results of their peers from the USA. Three years later Polish students overtook American ones and in the last PISA research in 2012 Poland and Polish students took place in the forefront, still overtaking students from the USA, what is a reason for

pride and what surprised the world. Amanda Ripley (2013) writes in her book: *The smartest kids in the world. And how they got that way?.* She describes in her book in detail systems of educations, how schools function, status and prestige of teachers' work, problem of keeping education at an adequate level in four countries: the USA, Poland, South Korea and Finland. The reasons why she got so interested in successes of 15 year old students from Poland during PISA tests may be found while getting familiar with an interesting interview with her titled "Polish school is better", see E. Sarnacka-Mahoney (2014). Problem of keeping this trend true or further improvement of the results from PISA 2012 requires constant hard work of students and teachers as well. Used standards and way of PISA organizers' thinking should be taken into account. Strategic actions taken by the whole pedagogical staff and schools' authorities should:

1) Support changing the way in which schools work, support students and support system of trainings for in-service teachers;
2) Promote organization of cooperation and exchanging experience between outstanding in-service teachers and academic teachers;
3) Introduce using innovative technologies and e-learning in educating students in each stage of education; support individual attitude toward each student adjusted to intellectual development of given student, especially when it is a gifted or outstanding pupil.

It is worth adding that results of the research *testing mathematic education in junior high schools* conducted by Work Group of Institute of Mathematics of Educational Researches confirm good preparation on basis of content of mathematics teachers together with good realization of core curriculum in terms of implementing and using mathematics tools. Results of the same research illustrate also problems and poor condition of mathematical education in junior high schools. Among these problems are:

1) Unsatisfactory realization of core curriculum and its aims which are connected with competences in reasoning, justification and choosing own strategy of learning;
2) Inadequate interaction and communication between mathematics teacher and student.

M. Karpiński, who is a leader of already mentioned Work Group, claims that junior high schools are dominated by *lectures and the way that lesson is organized leaves no place for creative attendance, rare reactions to student's need, doubts and questions. These are the elements that have deep roots and to change them it is not enough to introduce some trainings for teachers. Well-thought-over programme is needed, the one that would involve students as well as teachers. The system of testing students and teachers competences and supporting good methodical solutions are indispensable as well,* see www.ibe.edu.pl .

5th Example

M. Makiewicz (2013, pp. 28-30) in her monograph examines in detail the various ways, values and comments on problem solving of D. Hilbert: *On the left is glass A with a juice and on the right the glass B with the same amount of water. One teaspoon of juice was*

poured from glass A to the glass B. Then one teaspoon of the mixture from the glass B was poured into the glass A. Is the ratio of juice to water in the glass A is now larger, smaller or equal to the ratio of juice to water in the glass right B? This job comes from his famous lecture of 8 August 1900 delivered at the International Congress of Mathematicians in Paris together with the collection of 23 issues that if solved, would pave the directions of mathematical creativity in the twentieth century. However, in the social perception task indeed has been perceived as very difficult to solve, or as insoluble, see: M. Kordos (2009). The result of analysis by M. Makiewicz are as follows: 1) the appropriate instantiation of this task can lead to a successful solution, while reviewing at the same time knowledge about fractions, 2) the final solution of this task and its credibility may be preceded by performing the experiment and record the results of these fluids pouring and making final calculations, 3) after obtaining a solution is possible to extend the process of solving this task as a result of the modification of its terms.

M. Makiewicz (2013, pp.173-175) describes in her work on the diagnosis results of spatial imagination and imagination in the construction of eight treatment groups: three groups of teachers of mathematics, three groups of students in mathematics and two groups of graduate students in mathematics. To this end, the study used the task: *Imagine and give a figure, which at the same time (for three mutually perpendicular walls of the room) will throw a shadow in the shape of a square, circle and triangle*. This task is also characterized by the relationship of mathematics with some phenomenon reality. Correct solution required the respondents to have developed imagination, creativity, skill "relationship" and the use of certain geometrical messages. The results of the eight tests confirmed that this task proved to be very unusual for the test and difficult. A correct and complete his solution was rare among those tested (only 1 - 2 person in the group correctly solve them).

3. Actual condition and problems in mathematical education in Kazakhstan

A prominent philosopher and thinker I. Kant in the 18th century wisely said: "In every science as much truth as it mathematics". Indeed, mathematics is the highest title of "queen of the sciences". She is the main language of any science, a basic tool of knowledge and transformation of Nature. So the level of development come into a person's life is largely dependent on mathematics all his subsequent actions, the success of problem solving, contribution to the development of the country. Therefore, the quality of teaching mathematics will start the process of improving the quality of all education. Raise mathematics education - will be tightened, and other items, both natural and humanitarian cycle. This applies not only to the school level, but also further stages of education: technical, professional and higher.

Kazakhstan became the first Central Asian state as a full member of the European educational space, because has implemented the Bologna Process. We can definitely say that Kazakhstan has great scientific potential in the field of mathematics, there are good scientific schools. But along with the achievements, there are questions that need to be addressed. These include, in particular, the problem of staffing mathematics young

researchers. And, of course, the quality of mathematical training at all levels. Therefore, the improvement of school mathematics education is for this country very important.

In world practice, attempts to change the school curriculum in mathematics are from the beginning of the twentieth century, and the controversy has not stopped to this day. Here are facing two trends: purely scientific and pragmatic approach. In particular, since the late 50s we have experienced an era of "new math", which lasted 10-12 years. One of its main ideas was to combine mathematical program based on abstract concepts and structures. Then began the change in the content of mathematics based on set theory and geometric transformations, but also has not met expectations. And in the struggle began to take the upper hand pragmatic paradigm. As a result, public school refused to attempt to keep up with the mathematical sciences, and the gap between them has become increasingly grow.

Similar processes, although with some delay occurred in the Soviet Union. The beginning of failure of Soviet mathematics to train mathematics graduates. It is a mistake to think that this process is associated only with the country's post-Soviet period. In the mid-80s another math program was adopted, which implemented the compulsory set-theoretic approach to the curriculum of the course. Most of the concepts were formed on the basis of content, and increased practical significance of the mathematics. Thus constructed school mathematics has continued to exist in the post-Soviet period. As pointed out by many international experts observed worldwide lowering of the level of teaching mathematics is due to the fact that teaching methods can't keep up with the rapid development of mathematics as a scientific discipline. And Kazakhstan in this issue is no exception. Consequently, at this stage we should not go, probably into the teaching of modern mathematics. This is especially true in light of the implementation of the new state program of development of education in our country. Here, of course, a lot is of questions.

At present moment, Kazakhstan has a good reputation in education all over the world. Throughout years of independence, system of education based on the best world practices together with own experience was created. Kazakhstan is in 35^{th} placed out of 188 countries according to rates of level of education created by United Nations Development Programme (UNDP). In world league tables describing competitiveness of citizens' with secondary education achievements Kazakhstan is 50^{th} out of 148 countries. What is more in recent years some actions to elaborate and implement national education standards of new generation have been taken. There have been some changes in system of education and work at creating criteria for assessment quality of education has been done. Nevertheless, actions taken to modernize system of education turned out not to be satisfactory for development of school education. Recently, the aim of education in Kazakhstan is set to educate and develop creative, competent and competitive human being, the one that would be able to train themselves on their own for their own and society's well-being. These aims may be achieved through competent attitude to education. It means that students should obtain together with deep knowledge also routines and competences so as to be able to use their knowledge in real-life situations.

Being able to apply acquired knowledge in practise, according to PISA research, is at poor level in Kazakhstan. In terms of comprehension of mathematical competences students of Kazakhstan take 49th place in PISA 2012 research. There are some factors that have negative impact on the result. These are:

1) Paying not enough attention in core curriculum to development of private, civil moral features of character as well as to creating essential motives for choosing profession and building life perspectives;
2) Overloading students with too much material what leads to decreased motivation to learn and to poorer health;
3) Lack of diagnosis of aims that are being achieved by students;
4) Old system of assessment which is orientated only on testing competences.

Contemporary geographic, economic and social location of Kazakhstan and status of Kazakhstan society in particular its integration with educational area requires modernization, especially in terms of secondary schools. International standard for secondary schools that states 12-year-long school has been melded. Planning and implementing new 12-year-long school model would provide creating social and pedagogical staff to develop standards of living in Kazakhstan. Education as a system provides children with basic values in terms of upbringing process within school and family as well, which should correspond to the stage of education. In addition education should reflect knowledge, competences and routines of given graduate and core curriculum in area of mathematics and computer science is defined by given modules of education: geometry, algebra, mathematics and computer science. While organizing core curriculum in Kazakhstan the major attention was paid to:

1) Increasing potential of courses and classes focused on application of the material, and balanced realization of their two main functions: pure mathematical education and educating thorough (using) mathematics;
2) Getting familiar with mathematics language that extends communicative possibilities of a given graduate.

Wide and multifunctional methodical-informative environment for teaching mathematics is created with use of different course books and didactic materials for teachers and students in paper or in electronic version. This environment is changing according to education paradigms which are being modernized. Nowadays, personality of a student and their future is in the centre of education process.

An equivalent of matura exam in Kazakhstan is unified national test (EHT) which is a system of students' work assessment in secondary schools. The result of this test has impact on:

1) Final grades at matura certificate;
2) Possibility to enter university in Kazakhstan;
3) Possibility of obtaining President Scholarship.

Test is being conducted in 10 tours in 10 first days of June (one tour = one day) and is being assessed according to 125 points scale. Students have to take 5 subjects in this test.

These are: mathematics, Kazak history, Kazak language, Russian language, and additional subject that may be chosen from world history, foreign language, biology, geography, chemistry, physics and literature. During the test students are to solve 25 tasks from each subject and they can get maximum of 25 point for solving all of the tasks correctly. The EHT lasts 210 minutes what is 3,5 hour. For example, in 2013 students had to gain 60 points to be accepted for the university. For graduates this test is also important psychological experience. Furthermore, the possibility of introducing EHT that would consist of 2 stages is being discussed in Kazakhstan. According to this project first part of the test would be taken by students who want to study at private universities. In contrast, people interested in obtaining grants and graduates from previous years and foreign school graduates would be obliged to take KTA complex test for graduates. Unfortunately, this project has not been implemented in Kazakhstan yet.

4. Modern problems mathematics education after reform in Russian Federation

Actual problems and condition of education in Russia, problems in implementing effective, innovative and informative technologies in teaching and learning mathematics were analyzed by participants of XXI international scientific conference "Mathematics. Education" in Chuvash in 2013 and XXI international scientific conference "Mathematics, Computer, Education" in Dubna in 2014. The most outstanding representatives of scientific society such as Zh.I. Alferov (Ж. И. Алфёров)(2012); G.G. Malinetskii (Г.Г. Малинецкий)(2013); N.H. Rozov (Н.Х Розов)(2013) are interested in these problems. In fact, mathematical education in 21st century may be characterized as the one that provides students with quick and easy access to all information through the use of the Internet or specialist programmes that enable students to solve difficult tasks and problems. On the other side, results of education of "mass student" are far away from expectations in many countries. How contemporary problems in mathematical education of students and education of prospective specialists for the development of Russian Federation are perceived by laureate of Nobel Prize in physics Zh. I. Alferov? He says:

1) *In this situation analysis of Russian and world economy is essential. When education and learning are so strongly connected with each other, when we say about Bolognese Process, then it is essential to understand that two-level system of education (bachelor- master) may be useful for preparing scientific workers of some specialities. It is even good when young person can change faculty of their studies and prospective work and continue their master degree in different speciality or at other university. In this situation a person becomes a specialist only after achieving master degree. By necessity, system of educating specialists should be preserved as it takes place in different countries for example in Germany. Transformation to two-level system of education should be a result of real need and real possibilities.*
2) *We have to refer to the system of new matura exam (ЕГЭ). The system that is based on tests,in particular new matura exam, was implemented to make it possible for officials to work in education despite professional pedagogues. System of exams in form of tests is a departure from real upbringing of a*

> *specialist that may appear only through interpersonal and mutual influence. With no doubts, it is important to use computer and on-line technologies but still it should not be forgotten that the essence is in mutual work and the influence between teacher and student. And it is essential for real economics and actual development*, see Ж. И. Алфёров (2012, p. 19).

Reflections of N. H. Rozov touching implementation and functioning of new matura exam in Russia are interesting and critical. New matura concept's implementation among all graduates in only one version created a need for private tutors who even managed to invent system of "teaching about matriculations". Nowadays it has turned out that in order to pass matura exam in mathematics it is enough to learn by heart (even without understanding) some solutions of sample tasks. It caused not only overloading bookshops' shelves with published in mass printing of *tutorials in how to pass matura exam in mathematics* but also heyday for private tutors who *guarantee gaining the most point in matura exam in mathematics*, see Н.Х. Розов (2013).

G.G. Malinetskii (2013) in his paper *Russian education. Triumph. Tragedy. Hope* analyses diagnosis of Russian education condition and crisis, its actual problem and directions to be taken in future. He writes, that the aim of his careful study is to *assess ways of softening or eliminating effects of bad luck that is taking place and to define road to the future* so as not to *damage school mathematics* as was said by S. N. Nikolsky. The author appeals to statistics of browsing in the USA phrase "interesting mathematics" in Google system in 2011. It has turned out that within few years interest in this entry increased by 2800%. Inquires about "mathematics" in the USA, Europe and Asia are also at the fore. By contrast, in Russia Federation the situation looks differently. The most popular entry in Russia is connected with matura exam in mathematics and number of inquires for "already done homework" increased by 5000%. Hence in contrast to other counties, conclusion comes that in Russia the generation of students who want *copy despite of solve, see answer in spite of think* was brought up.

6th Example

G. G. Malinetskii writes in his article that in 2013 he had a lecture titled "risk management of national management" in which 150 students took part. They were really interested in solving realistic, practical tasks and problems that appear in human staff's management at different levels. Students as well as graduates were eager to take part in such an international team work organization. However, some gaps in their education appeared, especially in justification of their work or in taking some logical consecutive steps to solve given problem. They also lack knowledge of basic mathematical models. While solving tasks, it turned out that solid lectures and gained credits in mathematical subjects have no impact on their life. It shows that system of education in Russia does not work as students do not know what they actually know. It means that they do not know how to use competences and knowledge which they already acquired. G. G. Malinetskii continues his conclusions saying that at schools as well as at universities educational classes are changing too fast to be followed. There is no need of showing mutual

relations, only pragmatic needs are stated. *What and how it should be learnt so as to pass an exam? examination period is over. Forget about it; they were joking when I was a student, but in that time it was only a joke.*

Furthermore, G. G. Malinetskii underlines the need of focusing the process of education at schools and at universities on integration between different subjects, on their mutual relations. Otherwise, contemporary generation of pupils and students would not remember anything except for their educational documents. He also reminds, that in 21st century interest in mathematics has risen. Mathematics has been an important part of human culture and it constitutes a base for other disciplines such as: computer engineering, computer science and other specialities connected with computers. Mathematics is also a foundation for mathematical modelling development and increase in interdisciplinary attitudes. G. G. Malinetskii grieves a slump in Russian system of education which have been taking place since 1991. The bill "About education" accepted only in 2012 predicts ceasing tendency of worsening the condition of Russia education together with intensifying teachers' work and bringing them back to giving private lessons which would increase their salary. What to do in this difficult for the system of education situation? What are experts' in risk management suggestions? G. G. Malinetskii in response to these questions indicates key steps and ideas:

1) change in strategy of education and in aims of education that should correspond with the ones on which the process of education is focused;
2) giving up matura exam which is only a technology that supports corruption, so as to make schools responsible for the process of education and its aims and universities responsible for testing knowledge of candidates for high school;
3) giving up trials to adjust high schools to Bolognese Model, that does not work at conditions of Russian job market and replacing it with education of specialists of high-quality;
4) supporting education of specialists in natural science, computer and technical disciplines;
5) making school free from parasitic subjects and from minor material and early specialization so as to turn focus on main aims of education.

G. G. Malinetskii analyses in detail relation between educating and education. He realizes that educating when it is seriously treated is not an easy job but the honourable and responsible one. Education is needed so as to enrich and serve for standards of educating. Scientific researches and processes of education development should take place at the university how it is organised for example in the USA or in West Europe. Fundamental education, researches and creativity of outstanding students are a huge treasure and acceleration for system of education. Hence *professors, lecturers and not deans, vice chancellors and well-paid administration should be main figures at the university.* If those people perform their job well, it is a satisfactory reason to respect them, to support and pay well for their job. Unfortunately, in contemporary Russia, culture of lectures is not appreciated and value and importance of teacher's work are not understood. G. G.

Malinetskii (2013, p.155) in conclusion of his paper claims: *education crisis in Russia and in other countries as well is a very good but cruel teacher. It may become a reason for Russian society to cease system of education degradation and can put it back on its feet, push it forward despite of backwards.*

7th Example

Current problems of mathematics education in Russia also take other authors research. Multi-level system of higher education (bachelor, specialist, MA) in Russia officially exists since 1992. This system is currently undergoing significant changes related to its accession in 2003 year, the Bologna Process. However, the quality of higher education in Russia has deteriorated, as noted by most researchers. We can also agree with the statement L. I. Lurie (Л. И. Лурье) (2013, p.28) that: *Our time is distinguished by the fact that, by actively participating in the Bologna Process, Russia is not yet a member of the international educational community. Mutually agreed not turned into a purposeful activity: pre-university education does not have a continuity with it like in the West and elsewhere in the world, post-graduate education in the two-tier system of certification of scientific personnel is also not consistent with what is in the other countries. The higher education system in our country acquires features Western, but requires a global scale, and subsequent reforms*. He offers a number of measures for the development of modern pedagogical education, among which are the following: 1) an in-depth analysis of the achievements of the Russian system of education in the different years of the XX century. and in comparison with the best international practices; 2) train teachers for bilingual teaching of subjects on models, close to the EU to ensure the openness of the Russian education, enrich it with international experience; 3) to ensure entry into the international system of teacher education with all its institutional members, which means not only the election of forms of training undertaken abroad, but also the promotion of a positive proven experience in teaching activities in Russia.

M. A. Choshanov (М. А. Чошанов) (2013) analyzing the state of school mathematics education in the United States, focuses on system errors that need to be taken into account in the development of the Russian concept of mathematical education. As he calls the negative factors: 1) a residual investment in human capital; 2) the gap between school mathematics and mathematical science; 3) reduction of the fundamental mathematical education, it is important to lay the foundations of which are already in elementary school; 4) coaching for tests instead of the full process of teaching mathematics; 5) inconsistent and unsystematic in the conduct of school reform; 6) reduction of the teaching load of mathematics and its translation into the category of elective courses.

The main conclusion set out in article V. V. Zuckerman (В. В. Цукерман) (2014) is as follows: for the success of any reform of mathematics education, significant changes are needed in the training of mathematics teachers. This is especially true teaching and mathematics education. Also *f*or example, V. A. Dalinger (В. А. Далингер) (2015) points out the main reasons: 1) a sharp decrease in the number of hours in the study of mathematical disciplines in the new curriculum Bachelor - future teachers of

mathematics; 2) a weak financial base of pedagogical institutes. The author of that article provides for further improvement of mathematics education to give up undergraduate and graduate and go back to training specialties.

Based on the experience of 20 years of training of mathematics teachers in Togliatti and six years of experience in the preparation of bachelors and masters of mathematics education on the basis of Togliatti State University, we can state the following: 1) the transition to a four-year undergraduate in the preparation of future teachers of mathematics in Russia currently is not justified; 2) the best results in the mathematical and pedagogical training of future teachers of mathematics provides a model: specialist (5 years) + Master (2 years), see: R. A. Uteeva (Р. А. Утеева) (2015). The Ministry of Education and Science of the Russian Federation has high expectations in terms of modernization of mathematical and pedagogical education based on the adopted in 2013 year a professional standard and the conception of mathematical education. However, the authors of these documents are not taken into account the many comments that have been expressed by math teachers in schools and universities.

5. Summary and conclusions

Aims of education, in particular mathematical one, should be, at each stage, realized form the point of view of individual, society, country and civilization's expectation. What is more, education cannot be treated as one of economy or industry's branch. It should be a future of any student. During Congress of Academic Culture in Krakow 2014, Lena Kolarska-Bobińska who is minister of Education and High Schools in Poland underlined that contemporary universities and high schools should be open for: 1) social needs; 2) cooperation with business, schools and teachers; 3) different kinds of students and different ways of educating.

Both sides of the coin are essential: **mathematics and mathematical education for needs of the future.** Hence, following conclusions for ceasing mathematics degradation and system and practices of students education and for the use of prospective researches are stated:

1) To update concept of education at schools and at universities in particular core curriculum, programmes of education and methodology of core curriculum realization. To monitor and to improve descriptions of quality of education. To make students aware of mathematics and mathematical education's value. In fact, usefulness of mathematics, its applications and mathematical modelling can be noticed in solving problems in different disciplines not only in natural science, technology and the arts. In process of learning mathematics and getting familiar with its methods students find out existence of mutual relations.
2) To cease degradation of system of mathematical education. *To put it back on its feet*, as suggests G. G. Malinetskii (2013). Furthermore, to define and rebuild lost system of education as students do not know what they actually know. Researches about system of education admit that right now the aim of education is to *know how and what should be learnt to pass an exam, gain credit and forget about mathematics.* Hence students have no clue how they can use competences and the

knowledge that they have already acquired. If this situation lasts, students will not remember anything except for education documents.

3) To constrain school, university and their authorities' autonomy so as not to support forcing poor quality of mathematical education. There are some well-known examples of universities at which *improving mathematical education efficiency is forced at the cost of simultaneous worsening its quality* in particular at so called ordered specialties of studies.
4) To prepare and train teacher staff to carry out classes with the use of informative an innovative technologies. To design, implement and monitor efficacy of on-line courses in mathematical education. G. Siemens (2010), world-wide known authority in using these technologies in teaching and learning process during the interview titled "challenges for modern education" in his short-cut statement says that *the Internet has not caused the phenomena of slump in system of education.* In fact it is the other way round, these are contemporary systems of education that have not yet adjusted to the need of education, students' expectations and to the contemporary world. He also adds that *e-learning courses are the best when they serve the purpose of deepening the basic knowledge and qualifications.*
5) To work out, improve and monitor efficacy of e-learning courses in mathematics for students. While working at it, access to this courses and students' needs should be taken into consideration. Possibility of choosing topics of material, speed of learning, methods of education (mobile or on-line) and ways of stimulation (mentoring or self-education) should be created for students.
6) Contemporary ways of students' stimulation and methods of their education are moving more and more far away from classic concepts and methods, from solutions proposed by the country. These trends are changing concepts of education and the way a school and a teacher function. Computer companies with their products put pressure on the need of future education modernization and on professionalism of teacher work. In particular, job of teacher or lecturer is undertaking a lot of changes. Its classic prototypes, methods of work and the way classes are carried out, ways of stimulating students' work and of communication between contemporary student and a teacher that had been used so far loses in actuality and does not correspond with students' expectations. This generation anticipates increased efficiency of teacher work and wider help in solving their difficulties in learning mathematics. They even requires that teacher takes care of finding and stating their possibilities and gifts, of their professional orientation and of educative, practical and social routines.

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