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ИСТОРИЯ ПЕДАГОГИКИ, ЭТНОПЕДАГОГИКА
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INTERNATIONAL RESEARCH SYSTEMS PISA, TIMSS: SYSTEM OF TASKS AND THEIR ANALYSIS

In the last 20 years, international surveys assessing learning in reading, mathematics and science have been headline news because they put countries in rank order according to performance. The three most well-known surveys are TIMSS, PISA and PIRLS. The main difference between TIMSS and PISA is type of sample and focus of research. Pupils of the 4th and 8th classes take part in TIMSS. Only 15-year-old pupils of schools (7–12 classes) and colleges participate in PISA. TIMSS measures the academic knowledge (What? Where? When?), 80 % of the TIMSS tasks are directed to reproduction of knowledge. PISA measures functional competences – ability to effectively apply knowledge in various life situations, to logically think and draw valid conclusions (Why? What for? As?) to interpret information schedules and charts, etc. Our teenagers know the school program in biology, but don't understand what GMO is. They are not bad in calculations, but have problems with statistics... Recently was published results of PISA-2015, sample is more than 400 thousand teenagers from 57 countries.

Keywords: project, design technology, TIMSS, PISA.

Introduction

The current trends in the education of the Republic cause the necessity of reconsideration of their role, functions and a place in the general education system, elaboration of new approaches in their further development.

The highly effective education system is one of the significant factors in providing a steady rise of the national economy and the Kazakhstan society. The purpose of the new economic and social reforms in an education system of our state – ensuring its high-quality transformation in the conditions of the market economy within globalization. Reforming of education demands creation of new legal, scientific and methodical, financial and material requirements and adequate staffing for deepening and development of this process from the preservation of the positive potential which is saved up in this sphere.

It is possible to carry out a qualitative education reform in the conditions of dynamic social and economic changes in society only in the presence of detailed worked strategy considering as the real situation which developed in education, the accruing tendencies, and the operating relations, and possible ways of future development of society and state.

Development of the program is dictated by the need for changes in the organizational and economic, substantial and methodical, legal and social and psychological relations which developed in education. It along with the existing state and departmental programs in education and its new standard and legislative providing will make an organizational basis of realization of public policy in education.

The state program of development of the Republic of Kazakhstan for 2010-2025 is a new round of increase of competitiveness of education, construction of the human capital by ensuring availability of quality education to a steady rise of the economy [1].

One of the strategically essential directions of modernization of the Kazakhstan education is a transition to the 12-year model of training. The Ministry of Education revises the state general education standard of 12 years' education and develops training programs, textbooks for the 9th experimental classes within the transition to 12 years' training.

Urgent question on the agenda, there is a development and examining textbooks. Expertize of 831 books and EMB is carried out, from them it is recommended to use in educational process 756. Now the experimental integrated training programs in 15 subjects are developed. The Ministry of Education and Science of Kazakhstan together with International Bank for Reconstruction and Development realizes the project on modernization of system of technical and professional education (further – TPE) according to inquiries of society and industrial and innovative development of the economy, integration into world educational space.

Object of study – research systems PISA, TIMSS.

Subject of study – International research systems PISA, TIMSS: system of tasks and their analysis.

The purpose – study the essence of the tasks of the international research systems PISA, TIMSS.

Objective: to study the essential differences building of tasks PISA and TIMSS; conduct a comparative analysis of participants in international research; to determine the practical significance of the conducted measuring systems.

Research methods: analysis and synthesis of information data; comparative analysis.

Results: comparative analysis in the context of countries participating in international studies; participation of Kazakhstani schoolchildren and their effectiveness.

According to the large-scale international studies TIMSS and PISA, Kazakhstan students demonstrate high results at subject mastery level, but they are much less able to cope with tasks embedded in non-mathematical settings. These results seem to be true both for mathematics and science. To solve PISA tasks formulated in the context of everyday life, it is necessary to have the modeling skills - that is, to be able to build a mathematical model of the proposed daily situation [2]. Thus, relatively lower students' results in PISA compare to student's results in TIMSS may indicate, that students in Russia experience difficulties to apply gained in school knowledge in a real-life context.

Such the gap in the students' TIMSS and PISA results in Kazakhstan could be explained with the fact how education is organized in Kazakhstan [3; 4]. That is, it was shown that teacher get insufficient methodological support for the use of real-life context in his subjects at school [5; 6].

It is important to note that the problem identified on the TIMSS and PISA data is relevant for several school disciplines such as chemistry, biology, physics and mathematics.

Government standard for education in primary and secondary school emphasizes the growth of «a value of mathematics and computer science in the daily life of a person». That is, a person should be able «to model real-life situations in the language of algebra, to study the constructed models by using the algebra conceptions, to interpret the obtained results» and «to apply the concepts, results, methods for solving practical problems and problems from related disciplines». The necessity to develop the abilities of students to use school knowledge in everyday life is emphasized in the «Fundamental core of the content of general education» as well.

PISA (Programme for International Student Assessment) – an assessment of mathematical, natural-science and reader's literacy of 15-year-old students.

The research is conducted by OECD 3-year cycles since 2000. Kazakhstan has experience of participation in two PISA-2009 and PISA-2012 projects.

In comparison with PISA-2009 Kazakhstan has improved results in the direction mathematical and natural-science functional competence of school students. Growth of an indicator of effectiveness on mathematical literacy has made 27 points (2009 – 405, 2012 – 432 points) and 25 points on natural sciences (2009 – 400, 2012 – 425 points).

However, the results of the international study of PISA 2015 revealed quite opposite results: students in CIS are more familiar with the tasks and concepts that can be attributed to formal mathematics, rather than to applied mathematics. For example, the 9th students in CIS noted that they more often work in math lessons with concepts from algebra (quadratic and exponential functions) and geometry (vectors, polygons), solve equations, than with real-life word problems. Compare to other countries the frequency of formal math problems is one the highest among them.

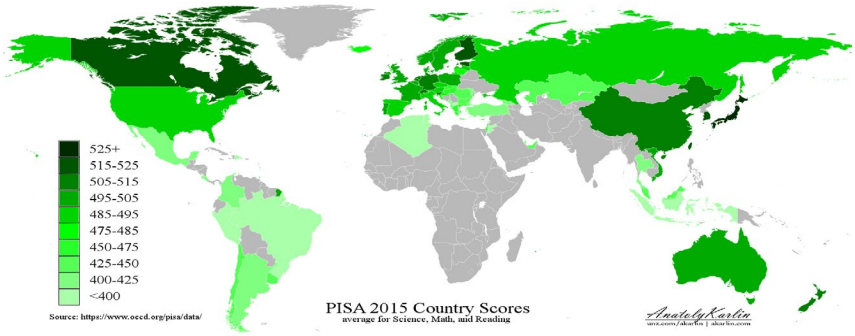

Figure 1 – The result of PISA 2015

The Organization for Economic Cooperation and Development has released the influential PISA rankings based on tests taken by 15-year-olds in more than 70 countries, including Kazakhstan. In total over 500,000 15-year-olds took part in the PISA 2015. Kazakhstan was represented by 5,780 15-year-old schoolchildren and students from 16 regions of the country (189 schools and 27 colleges). The OECD rankings doesn't rank countries by points, instead, it highlights the high-achieving education systems. Compared to the 2012 results, Kazakhstani students demonstrated progress in maths (28 points), reading (34 points) and science (31 points). It became possible after Kazakhstan launched the National Action Plan on the development of functional literacy of schoolchildren on instruction

of Head of State Nursultan Nazarbayev and took steps to update the content of secondary education. The Program for International Student Assessment (PISA) provides education rankings on the basis of international tests taken by 15-year-olds in maths, reading and science. The tests are taken every three years. It should be noted that Asian countries have been dominating the rankings for the past couple of years with Singapore at the top.

TIMSS (Trends in International Mathematics and Science Study) – an assessment of quality of mathematical and natural-science education of pupils of the 4th and 8th classes. It is carried out by 4-year cycles since 1995.

In TIMSS-2011 the GPA of the Kazakhstan fourth-graders in the direction mathematical literacy has made 501 and 495 – natural-science competence (on 1000 mark system). Eighth-graders on mathematics have gathered – 487, on natural sciences – 490 points.

Table 1 – Results of TIMMS survey 2016

№	Country	Math	Reading	Science	Mean	«IQ»
1	Singapore	564	535	556	551.7	107.8
2	Hong Kong (China)	548	527	523	532.7	104.9
3	Japan	532	516	538	528.7	104.3
4	Macao (China)	544	509	529	527.3	104.1
5	Estonia	520	519	534	524.3	103.7
6	Canada	516	527	528	523.7	103.6
7	Chinese Taipei	542	497	532	523.7	103.6
8	Finland	511	526	531	522.7	103.4
9	Korea	524	517	516	519.0	102.9
10	B-S-J-G (China)	531	494	518	514.3	102.2
13	Germany	506	509	509	508.0	101.2
21	Australia	494	503	510	502.3	100.4
22	Viet Nam	495	487	525	502.3	100.4
23	United Kingdom	492	498	509	499.7	100.0
28	Russia	494	495	487	492.0	98.8
31	United States	470	497	496	487.7	98.2
32	Latvia	482	488	490	486.7	98.0
44	Kazakhstan	460	427	456	447.7	92.2
52	Turkey	420	428	425	424.3	88.7

63	Georgia	404	401	411	405.3	85.8
73	Dominican Republic	328	358	332	339.3	75.9
	OECD Average	**490**	**493**	**493**	**492.0**	**98.8**

The latest Timss makes better reading for Russia which moved from 10th up to 7th in the primary maths table, stayed at 6th in secondary maths, climbed from 5th to 4th in primary science and stayed at 7th for secondary science. Kazakhstan also shot up the tables – from 27th to 12th place in primary maths, 17th to 7th in secondary maths, 32nd to 8th in primary science and 20th to 9th in secondary science.

Kazakhstan was presented by 5780 15-year-old school students and students of 16 regions of the country (189 schools and 27 colleges). The OECD doesn't range the country on the gained points. The main reason of this assessment is to show progress of educational systems all around the world. In comparison with PISA-2012 the Kazakhstan participants of the international test have shown progress in all directions of a research. Growth on mathematics has made 28 points and to natural sciences – 31 points. The trend of progress of mathematical and natural-science competences remains at the high level. In 2012 progress in comparison with 2009 made 27 and 25 points respectively. The highest rate of a gain of points in PISA-2015 was shown by our 15-year-old students on reader's literacy (+34). It has become possible thanks to the «National plan of action for development of functional literacy of school students» realized at the request of the Head of state and actions for transition to the updated maintenance of school education. Thus, target indicators of the state program of development of education and science, the strategic plan of the Ministry of Education and Science for 2014-2018 where expected values have been provided in 440 points on mathematics (fact 460), 430 on natural sciences (456), 400 on reader's literacy (427) are reached. Besides, all 15-year-old school students Nazarbayev Intellectual Schools (2 061 people) have for the first time taken part in the PISA-2015 project. Their influence on the general results of Kazakhstan has been corrected in proportion to a share of pupils of NIS from total number of pupils of the republic [7].

The full and deep analysis with concrete conclusions and recommendations will be presented in the National report in 2017. 70 % of the questions PISA estimate abilities to apply knowledge. Earlier it was reported that the Kazakhstan pupils of 4 classes have taken the seventh place on mathematics and the eighth place on natural sciences in TIMSS. Pupils of 57 countries have entered the international monitoring research of quality of school mathematical and natural-science education of TIMSS (Trends in Mathematics and Science Study) [8].

In the last 20 years, international surveys assessing learning in reading, mathematics and science have been headline news because they put countries in rank order according to performance. The three most well-known surveys are TIMSS, PISA and PIRLS. The first to be run was TIMSS (Trends in International Mathematics and Science Study) in 1995, although it was a successor of international studies going back to the 1960 s. TIMSS is now repeated every 4 years and tests learners of 10 and 14 years old. It is managed by the International Association for the Evaluation of Educational Achievement (IEA). Next came PISA (Programmer for International Student Assessment) in 2000, with a survey that is repeated every three years. This survey assesses learners who are a little older – aged 15 – and are nearing the end of compulsory secondary education. It assesses performance in reading, mathematics, science and problem solving. Special focus is placed on one of these areas in each year of assessment. PISA is a project of the Organization for Economic Cooperation and Development (OECD). Each participating country has an agent that runs the survey – in the UK, it is the National Foundation for Educational Research (NFER) – which invites a sample of schools to take part.

What are the benefits of international surveys? Governments need to know what is going on in the systems for which they are responsible. Leaders have to decide where to allocate resources according to greatest need. International surveys could help them to make better decisions based on clearer data. The announcement of performances has had a significant impact on national discussions about education systems and policies. Schools and teachers can reflect on a survey's global analysis and consider recommendations for good practice. The surveys obtain supplementary information through questionnaires and correlate this with the test results. For example, PISA 2012 states that lack of punctuality and truancy are negatively associated with test performance, and makes recommendations regarding learner engagement. National research and professional development programmers often use the data from the international surveys as a starting point.

Every year or two, the mass media is full of stories on the latest iterations of one of the two major international large scale assessments, the Trends in International Mathematics and Science Study (TIMSS) and the Program for International Student Assessment (PISA). What perplexes many is that the results of these two tests – both well-established and run by respectable, experienced organizations – suggest different conclusions about the state of U.S. mathematics education. Generally speaking, U.S. students do better on the TIMSS and poorly on the PISA, relative to their peers in other nations. Depending on their personal preferences, policy advocates can simply choose whichever test result is convenient to press their argument, leaving the general public without clear guidance.

Now, in one sense, the differences between the tests are more apparent than real. One reason why the U.S. ranks better on the TIMSS than the PISA is that the two tests sample students from different sets of countries. The PISA has many more wealthy countries, whose students tend to do better – hence, the U.S.'s lower ranking. It turns out that when looking at only the countries that participated in both the TIMSS and the PISA we find similar country rankings. There are also some differences in statistical sampling, but these are fairly minor.

There is, however, a major distinction in what the two tests purport to measure: the TIMSS is focused on formal mathematical knowledge, whereas the PISA emphasizes the application of mathematics in the real world, what they term «mathematics literacy». As a consequence, it would not be surprising to find major differences in how students perform, given that some countries' teachers might concentrate on formal mathematics and others' on applied mathematics.

But the real surprise is that these differences may not matter quite as much as we might suspect. For the first time, the most recent PISA test included questions asking students what sorts of mathematics they had been exposed to, whether formal mathematics, applied mathematics, or word problems. After analyzing the new PISA data, we discovered that the biggest predictor of how well a student did on the PISA test was exposure to formal mathematics. This is a notable finding, to be sure, since the PISA is designed to assess skill in applied rather than formal math. Exposure to applied mathematics has a weaker relationship to mathematics literacy, one with diminishing marginal returns. After a certain point, more work in applying math actually is related to lower levels of mathematics literacy.

Why these unexpected results? One reason might be that students need to be very comfortable with a mathematical concept before they can apply it in any meaningful way. One cannot calculate what percentage of one's income is going to housing without a clear understanding of how proportions work. It appears that a thorough grounding in formal mathematical concepts is a prerequisite both to understanding and to using mathematics.

Conclusions

In general, this study allowed us to consider the use of real-life context in teaching mathematics from several points of view, as well as from an international perspective. The conducted analysis and comparison of teaching methods on datasets of TIMSS, PISA have shown us significant differences in the frequency of using tasks with low and high cognitive loads. Further, the analysis of the teachers' approaches towards word problems has demonstrated that math teachers both in Kazakhstan and other countries similarly work with the real-life context of word problems. And an analysis of teachers' beliefs has revealed similar attitudes of math teachers both in CIS and abroad to the use of real-life context in teaching

mathematics. Thus, the use of real-life context in math lesson is rather similarly organized in Kazakhstan and in other countries.

It is important to note, that the real-life context plays a secondary and supportive role in teaching subject in school, according to the results of the study. First, due to the teachers' approaches towards word problems, the teacher implicitly signals to students what is relevant to learning math in school. By skipping elaborating the problem context, a teacher indirectly shows these interventions should not be paid attention to and that learning in school has nothing to do with real-life context. Secondly, the secondary role of real-life context was shown by the using of those word problems which often were not a correct model of the real-life. Finally, in teachers' beliefs, the real-life context also plays only a supporting role in the math learning process.

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PISA, TIMSS ХАЛЫҚАРАЛЫҚ ЗЕРТТЕУ ЖҮЙЕЛЕРІ: ТАПСЫРМАЛАР ЖҮЙЕСІ ЖӘНЕ ОЛАРДЫ ТАЛДАУ

Соңғы 20 жылда оқу, математика және жаратылыстану пәндерін оқытуды бағалайтын халықаралық сауалнамалар басты тақырыпқа айналды, өйткені олар елдерді академиялық үлгеріміне қарай рейтингке бөледі. Үш ең танымал шолулар – TIMSS, PISA және PIRLS. TIMSS пен PISA арасындағы негізгі айырмашылықтар зерттеудің үлгісі мен бағытына байланысты. TIMSS-ке 4-ші және 8-сынып оқушылары қатысады. PISA-ға тек 15 жастағы (7-12 сынып) мектеп оқушылары мен колледжде оқитындар қатысады. TIMSS өлшемі академиялық білім болыптабылады (Не? Қайда? Қашан?), TIMSS тапсырмаларының 80 % білімді жаңғыртугабағытталған. PISA өлшемі функционалдық құзыреттілік болып табылады, яғни түрлі өмірлік жағдайларда білімді тиімді қолдана білуге,логикалық дұрыс ойлауға және дұрыс қорытындылар жасай білуге негізделген (Неге? Не үшін? Қалай?), ақпараттық кестелерді, диаграммаларды, т.б. дұрыс талдау, түсіндірйу (интерпретациялау). Біздің жасөспірімдер биология бойынша мектеп бағдарламасын біледі, бірақ ГМО-ның не екенін түсінбейді. Олар есептеулерді жақсы жүргізеді, бірақ манипуляция мен статистикаға оңай беріледі 57 елден 400

мыңға жуық жасөспірім қатысқан PISA -2015 білім беру жүйесін зерттеу нәтижесі осындай.

Кілтті сөздер: жоба, жобалық технология, TIMSS, PISA.

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МЕЖДУНАРОДНЫЕ ИССЛЕДОВАТЕЛЬСКИЕ СИСТЕМЫ PISA, TIMSS: СИСТЕМА ЗАДАНИЙ И ИХ АНАЛИЗ

В последние 20 лет международные опросы, оценивающие обучение чтению, математике и естественным наукам, были заголовками новостей, потому что они ставят страны в порядок в соответствии с их успеваемостью. Три самых известных обзора – это TIMSS, PISA и PIRLS. Основные отличия TIMSS и PISA связаны с выборкой и фокусом исследований. В TIMSS принимают участие ученики 4-х и 8-х классов. В PISA участвуют только 15-летние учащиеся школ (7-12 классы) и колледжей. TIMSS замеряет академические знания (Что? Где? Когда?), 80 % заданий TIMSS направлены на воспроизведение знаний. PISA замеряет функциональные компетенции – умение эффективно применять знания в различных жизненных ситуациях, логически мыслить и делать обоснованные выводы (Почему? Зачем? Как?), интерпретировать информационные графики и диаграммы и др. Наши подростки знают школьную программу по биологии, но не понимают, что такое ГМО. Они неплохо производят вычисления, но легко поддаются на манипуляции со статистикой... Таковы результаты исследования образования PISA-2015, в котором участвовало около 400 тыс. подростков из 57 стран.

Ключевые слова: проект, проектная технология, TIMSS, PISA.

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