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A. M. Abdiyeva, L. E. Anuarova, G. I. Ernazarova, A. M. Zlydareva

Kazakh State Women's Pedagogical University, KGU "General education school" No. 97.
E-mail: ai-kerim01@mail.ru

PROJECT BASED SCIENCE IN THE CONTEXT OF THE INTERNATIONAL SYSTEMS OF THE RESEARCH PISA, TIMSS

Abstract. Nowadays Kazakhstan faces a formation of the new education system which focused on world educational practice. This process is initiated by essential changes in the pedagogical theory and practice of teaching and educational process. The teacher jobs requires new skill as ability to find a right pedagogical method in a wide range of modern innovative approaches and create a constructive training materials of new generation. This aspiration of reaching all students spans disciplines, age levels, and all varieties of institutions. Most teachers do so out of a genuine love for their discipline and a desire to share the wonder of their chosen field with others. Science teaching is no different than other disciplines in this respect. However, try as we may in science, the lack of diversity apparent in the statistics of who chooses to pursue scientific disciplines professionally suggests that we still have much to learn about how to reach all students.

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. The rating of Kazakhstan is only in the fourth ten. Monitoring of quality of education at PISA school is carried out in four main directions: literacy of reading, mathematical literacy, natural-science literacy and computer literacy. The PISA monitoring allows revealing and comparing the changes in education systems in the different countries and estimating efficiency of education strategic decisions. Analyzing our failures in the PISA tasks, scientists have selected the long list of "deficiencies" – those skills which aren't enough for school students for the successful solution of tasks.

Key words: project, design technology, TIMSS, PISA.

Introduction. Teachers aspire to have all of their students learn. This aspiration of reaching all students spans disciplines, age levels, and all varieties of institutions. Most teachers do so out of a genuine love for their discipline and a desire to share the wonder of their chosen field with others. Science teaching is no different than other disciplines in this respect. However, try as we may in science, the lack of diversity apparent in the statistics of who chooses to pursue scientific disciplines professionally suggests that we still have much to learn about how to reach all students.

The project method, also discussed under headings like project work, project approach, and project-based learning, is one of the standard teaching methods. It is a sub-form of action-centered and student-directed learning and an enterprise in which children engage in practical problem solving for a certain period of time. Projects, for example, may consist of building a motor boat, designing a playground, or producing a video film. For the most part, projects are initiated by the teacher but as far as possible they are planned and executed by the students themselves, individually or in groups. In project work, the students generate tangible products that frequently transcend disciplinary boundaries and are typically

displayed to the general public on parents days or at school fairs. Contrary to traditional methods, projects focus on applying, not imparting, specific knowledge or skills, and more rigorously than lecture, demonstration, or recitation, they aim at the enhancement of intrinsic motivation, independent thinking, self-esteem, and social responsibility [1].

A major aim of project-based science (PBS) is to develop students' thinking and problemsolving skills by allowing them to solve authentic problems. Students can engage in inquiry-based activities that require them to generate questions, design investigations, gather and analyze data, construct explanations and arguments in light of empirical evidence, communicate their findings, and make connections among ideas (NRC 2000; Minstrell and van Zee 2000) [2, 3].

Features of PBL include students initiating learning with an illstructured problem, using the problem to structure the learning agenda, using the instructor as a metacognitive coach, and working in collaborative groups. Ill-structured problems are those in which V the initial situations do not provide all the information necessary to develop a solution; V there is no single right way to approach the task of problemsolving; V as new information is gathered, the problem definition changes; and V students are never completely sure that they have made the best selection among solution options.

Project-based learning (PBL) is a student-centered pedagogy that involves a dynamic classroom approach in which it is believed that students acquire a deeper knowledge through active exploration of real-world challenges and problems.[1] Students learn about a subject by working for an extended period of time to investigate and respond to a complex question, challenge, or problem [2]. It is a style of active learning and inquiry-based learning. PBL contrasts with paper-based, rote memorization, or teacher-led instruction that simply presents established facts or portrays a smooth path to knowledge by instead posing questions, problems or scenarios.

Thomas Markham (2011) describes project-based learning (PBL) thus: "PBL integrates knowing and doing. Students learn knowledge and elements of the core curriculum, but also apply what they know to solve authentic problems and produce results that matter. PBL students take advantage of digital tools to produce high quality, collaborative products. PBL refocuses education on the student, not the curriculum– a shift mandated by the global world, which rewards intangible assets such as drive, passion, creativity, empathy, and resiliency. These cannot be taught out of a textbook, but must be activated through experience" [3]. James G. Greeno (2006) has associated project-based learning with the "situated learning" perspective [4] and with the constructivist theories of Jean Piaget. Blumenfeld et al. elaborate on the processes of PBL: "Project-based learning is a comprehensive perspective focused on teaching by engaging students in investigation. Within this framework, students pursue solutions to nontrivial problems by asking and refining questions, debating ideas, making predictions, designing plans and/or experiments, collecting and analyzing data, drawing conclusions, communicating their ideas and findings to others, asking new questions, and creating artifacts" [5] (Blumenfeld, et al., 1991). The basis of PBL lies in the authenticity or real-life application of the research. Students working as a team are given a "driving question" to respond to or answer, then directed to create an artifact (or artifacts) to present their gained knowledge. Artifacts may include a variety of media such as writings, art, drawings, three-dimensional representations, videos, photography, or technology-based presentations.

Proponents of project-based learning cite numerous benefits to the implementation of its strategies in the classroom – including a greater depth of understanding of concepts, broader knowledge base, improved communication and interpersonal/social skills, enhanced leadership skills, increased creativity, and improved writing skills. Another definition of project-based learning includes a type of instruction, where students work together to solve real-world problems in their schools and communities. Successful problem-solving often requires students to draw on lessons from several disciplines and apply them in a very practical way. The promise of seeing a very real impact becomes the motivation for learning [6].

John Dewey initially promoted the idea of "learning by doing". In My Pedagogical Creed (1897) Dewey enumerated his beliefs regarding education: "The teacher is not in the school to impose certain ideas or to form certain habits in the child, but is there as a member of the community to select the influences which shall affect the child and to assist him in properly responding to these.....I believe, therefore, in the so-called expressive or constructive activities as the centre of correlation" [7] (Dewey, 1897). Educational research has advanced this idea of teaching and learning into a methodology known as "project-based learning". Blumenfeld & Krajcik (2006) [8] cite studies by Marx et al., 2004, Rivet &

Krajcki, 2004 and William & Linn, 2003 state that "research has demonstrated that students in project-based learning classrooms get higher scores than students in traditional classroom".

PISA is one of the largest educational surveys in the world. Although initially envisaged as a means of supplying OECD countries with data on which to base policy, more non-OECD than OECD countries took part in PISA 2009. Its size, coupled with the prestige of the OECD name, has led to what Grek (2009) called 'a taken-for grantedness' about the education indicators it produces. However, it is worth remembering that the OECD is, as its name suggests, dedicated to economic growth, co-operation, and development. PISA reflects OECD aims, with an emphasis on economic priorities, and the drive to create efficient education systems, offering value for money, and producing quality outputs. As Bonnet (2002) noted, studies such as PISA are appealing to policy makers because of a belief that countries with effective education systems become successful economies. Bonnet's point is not about the strength (or weakness) of such a relationship, but that political interest in cross-national studies is largely derived from economic, not educational, interests. An economic perspective is apparent in the selection of reading, mathematics, and science as the key skills or competencies for future life (the corollary of this selection being that subjects such as social science, foreign languages, art and music do not provide students with key life skills). Similarly, the desire to compare education systems and measure value for money or 'added value' can be traced to the economic priorities of the OECD.

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).

Will present 8 261 15-year-old students of 232 organizations of secondary education including from 16 NICHES to PISA-2015 Kazakhstan.

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.

9 890 Kazakhstan school students from 179 schools of all regions of the country will take part in TIMSS-2015 (the 4th classes – 4 852 people, the 8th classes – 5 038 people).

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 [9].

Their influence on the general results of Kazakhstan has been corrected in proportion to a share of pupils of NICHES from total number of pupils of the republic. Indicators of school students of NICHES on mathematics and natural sciences are in the top ten of the leading educational systems (Singapore,

Hong Kong, Macau, the Chinese Taipei, Japan, etc.). Participants from Nazarbayev of intellectual schools on mathematics have gained 523, to natural sciences - 517 and to reading 492 points. Results of Kazakhstan are presented to PISA-2015 on the closed questions. 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) [10].

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 1960s. 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 (Programme 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 Organisation 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.

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А. М. Абдиева, Л. Е. Ануарова, Г. И. Ерназарова, А. М. Злыдарева

Қазақ мемлекеттік қыздар педагогикалық университеті, 97 жалпы білім беретін Мемлекеттік мекемесі

PISA, TIMSS ХАЛЫҚАРАЛЫ ЗЕРТТЕУЛЕР ЖҮЙЕСІКОНТЕКСІНДЕГІ ЖОБАЛАУ ТЕХНОЛОГИЯСЫ

Аннотация. Қазіргі таңда Қазақстанда әлемдік білім беру кеңістігіне бағытталған жаңа білім жүйесі қалыптасып келеді. Бұл процесс оқу-тәрбие процесінің педагогикалық теориясы мен тәжірибесінде елеулі өзгерістер арқылы жүреді. Бұл жағдайда мұғалім бүгінгі жас ұрпақтың қазіргі заманғы инновациялық тәсілдерін оқу материалдарын кең спектрінде құрастыруына назар аудару керек. Білім беру тәжірибесінде оқу материалдарының жаңа түрлерін дайындау, олардың функциялары мен зерттеу әдістерін өзгерту білім модернизациясының (жаңартылуының) бірі болып табылады.

Берілген тапсырмаларды әзірлеу мен оларды қолдану кезінде халықаралық PISA, TIMSS-тің халықаралық салыстырмалы зерттеулерінің тапсырмалар жүйесіне негізделу керек.

TIMSS пен PISAның негізгі айырмашылықтары зерттеудің іріктелуімен және оның фокусымен 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 болып табылады (Не? Қайда? Қашан?), TIMSS тапсырмаларының 80% білімді жаңғыртуғабағытталған. 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, түсіндіру (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.

Осы алынған рейтинг есебі бойынша біздің ел тек төртінші ондыққа ілінді.

Мектептегі білім сапасының мониторингісі PISA төрт негізгі бағытта жүргізіледі: оқу сауаттылығы, математикалық сауаттылық, жаратылыстану-ғылыми сауаттылық және компьютерлік сауаттылық.

PISA зерттеуі мониторингтік болып табылады, ол түрлі елдерде болып жатқан білім беру жүйелеріндегі өзгерістерді анықтауға, салыстыруға және білім беру саласындағы стратегиялық шешімдердің тиімділігін бағалауға мүмкіндік береді. Ғалымдар PISA тапсырмаларындағы білім алушылардың жіберген қателеріне талдау жасаған кезде, "тапшылығы" тізімін құрастырып, оқушыларға қойылған міндеттерді сәтті шешу үшін.жетіспейтін дағдыларды анықтап берді.

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

А. М. Абдиева, Л. Е. Ануарова, Г. И. Ерназарова, А. М. Злыдарева

Казахский государственный женский педагогический университет,
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ПРОЕКТНЫЕ ТЕХНОЛОГИИ В КОНТЕКСТЕ МЕЖДУНАРОДНЫХ СИСТЕМ ИССЛЕДОВАНИЯ PISA, TIMSS

Аннотация. В современном Казахстане идет становление новой системы образования, ориентированной на мировое образовательное пространство. Этот процесс сопровождается существенными изменениями в педагогической теории и практике учебно-воспитательного процесса. В этих условиях учителю необходимо ориентироваться в широком спектре современных инновационных подходов к конструированию учебных материалов нового поколения. Подготовка новых видов учебных материалов, изменение их функций и способов использования в образовательной практике являются одной из составляющих модернизации образования. При разработке и использовании данных заданий необходимо ориентироваться на систему заданий международных сравнительных исследований PISA, TIMSS. 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. В получившемся рейтинге наша страна оказалась лишь в четвертом десятке. Мониторинг качества образования в школе PISA проводится по четырём основным направлениям: грамотность чтения, математическая грамотность, естественнонаучная грамотность и компьютерная грамотность. Исследование PISA является мониторинговым, оно позволяет выявить и сравнить изменения, происходящие в системах образования в разных странах и оценить эффективность стратегических решений в области образования. Анализируя наши неуспехи в заданиях PISA, ученые выделили длинный список «дефицитов» – тех навыков, которых школьникам не хватает для успешного решения задач.

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

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