

ПЕДАГОГИКАЛЫҚ ЖӘНЕ ПСИХОЛОГИЯЛЫҚ ҒЫЛЫМДАР –
ПЕДАГОГИЧЕСКИЕ И ПСИХОЛОГИЧЕСКИЕ НАУКИ – PEDAGOGICAL AND
PSYCHOLOGICAL SCIENCES

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FAMILY OR SCHOOL? SOCIOECONOMIC COMPOSITION AND
MATHEMATICS ACHIEVEMENT IN KAZAKHSTAN, PISA 2022 AND 2025

Abstract: It is widely assumed in Kazakhstan that a family's resources decide a child's school results and that the school itself is a supplement. This study tests that assumption directly on the two most recent PISA cycles. Using the OECD Public Use Files for Kazakhstan, 19,769 students in 571 schools in 2022 and 22,680 students in 643 schools in 2025, the mathematics score is decomposed into the part explained by a student's own family background and the part explained by the average background of the school they attend. The design, the hypothesis, the falsifier and every robustness check were written down and committed before any student-level number was computed. Estimation follows the PISA methodology: ten plausible values combined by Rubin's rules and sampling variance from eighty Fay replicate weights. The pipeline reproduces the OECD's published country means to within half a point in both cycles. The result contradicts the stated assumption and does so by a wide margin. Within a school, one unit of family socioeconomic status is worth 6.4 score points in 2022 and 7.0 in 2025. The school's own mean socioeconomic status is worth 56.4 and 58.1 points, roughly nine times more, and the gap is stable across three years. It survives reading and science, a leave-one-out construction of the school mean, restriction to schools with at least ten sampled students, and controls for school type and community size. Thirty to thirty-four per cent of the variance in mathematics lies between schools. In a regional comparison Kazakhstan has one of the lowest within-school family gradients measured, 7.0 against 24.9 in Estonia, while its contextual effect is among the highest. The practical reading is narrow and should not be overstated: this is an observational association, and the school mean carries peer composition, unobserved school quality and family sorting together. What the data do establish is that in Kazakhstan the question "which school" separates pupils far more sharply than the question "which family", and any policy aimed at the second while ignoring the first is aimed at the smaller of the two.

Keywords: PISA; Kazakhstan; socioeconomic status; school composition; contextual effect; educational inequality; mathematics achievement

Introduction. Ask most people in Kazakhstan why one pupil scores better than another and the answer arrives quickly: the family. A household with money buys tutors, books, a quiet room, a language environment; a household without them cannot, and the school is treated as a background condition that a determined family can compensate for. The assumption is so ordinary that it is rarely stated, let alone tested on national data.

This paper states it and tests it. The author wrote the assumption down as a hypothesis before seeing any result, in these words: a pupil's result in Kazakhstan depends more on the family's resources than on the particular school, because a family with income can compensate for any gap through courses and mentoring, while the school only sets the academic bar.

The question that makes this testable is not whether family background matters. It plainly does, and a large literature has measured how much [1]. The question is whether the socioeconomic character of the school a pupil attends predicts their score ****beyond**** their own family's position. That quantity has a name in the literature, the contextual or compositional effect, and it has been studied across the PISA countries [2, 3, 4], but not, as far as we could find, reported for Kazakhstan as a separate within-and-between decomposition on the most recent cycles.

It matters which of the two is larger, because the two point at different policies. If the family effect dominates, the lever is the household: targeted allowances, tutoring vouchers, subsidised materials. If the school effect dominates, the lever is the composition of schools themselves, and money handed to a family changes little unless it changes which school the child sits in.

Data. Both cycles come from the OECD PISA Public Use Files: the student questionnaire file, which also carries the performance estimates, and the school questionnaire file. Kazakhstan is identified by the country code 'KAZ'. The 2022 files are openly downloadable; access to the 2025 files was granted through the OECD's data-access form, and the raw files are not redistributed with this paper.

The 2022 Kazakhstan sample is 19,769 students in 571 schools, of whom 19,683 carry a socioeconomic index. The 2025 sample is 22,680 students in 643 schools, of whom 21,198 carry the index.

Achievement is measured by the ten plausible values for mathematics, with reading and science used as robustness checks. Socioeconomic status is the OECD's index of economic, social and cultural status (ESCS). The school is identified by 'CNTSCHID', and the school's socioeconomic position is the weighted mean ESCS of its sampled students. All estimates use the final student weight and the eighty Fay replicate weights.

One check was run before anything else. The pipeline was asked to reproduce the country means the OECD has already published. It returned 425.4 in mathematics for 2022 against the published 425, and 413.7 for 2025 against the published 414, with reading and science equally close. A pipeline that cannot reproduce a known number should not be trusted with an unknown one.

I honestly thought that a family's own financial capital decided almost everything, because that is what pays for tutors, equipment and basic freedom. The results showed something quite different: the effect of the school itself turned out to be incomparably stronger than family wealth. What surprised me most is that a school can give that kind of enormous boost regardless of a pupil's individual background, when it seemed that tutors and resources at home ought to outweigh it. Just as unexpected was that private status in itself is no guarantee of an outstanding result, and that what decides it is the environment and the mix of pupils you end up among. This is a very interesting error in my hypothesis, and it shows plainly how strong the systemic influence of the right learning environment is.

The author's own school illustrates why the two quantities are not the same thing. It is a private international school in Almaty; in the IB grade-11 cohort there are 31 pupils; roughly half hold academic grants or fee discounts and the other half pay in full, and for about five or

six families the fee sits at the edge of what they can manage. Family circumstances inside that one room therefore vary widely, while the school itself is fixed. That is exactly the contrast the models below separate.

Method. The pre-registered plan, written and committed before any Kazakhstan student-level number was computed, fixed the hypothesis, the condition that would refute it, the models, the robustness checks and the stated limits. No deviation was made; one amendment, also before any result, added PISA 2025 as the primary cycle once access was granted, leaving every model unchanged.

Every model is weighted least squares with the final student weight. Sampling variance comes from the eighty Fay replicate weights with the standard adjustment, and each model is run on all ten plausible values and combined by Rubin's rules, so the reported standard errors carry both the sampling and the imputation component.

Four models were specified in advance.

M0 splits the variance in mathematics into a within-school and a between-school part.

M1 regresses the score on the pupil's own ESCS. This is the total gradient, and it mixes the two effects that the next model separates.

M2 is the Mundlak decomposition [5]. The score is regressed on the pupil's ESCS measured as a deviation from their school's mean, and on the school mean itself. The first coefficient is the within-school family effect: what one unit of family advantage buys among pupils sitting in the same school. The difference between the two coefficients is the contextual effect: what the school's own composition adds on top. The hypothesis is tested by comparing these two.

M3 repeats M2 with the school's type, public or private, and the size of its community, to see whether the contextual effect is simply those two things wearing a disguise.

Robustness was fixed in advance as well: repeat on reading and science; recompute each school's mean leaving the pupil themselves out, so that no one can inflate their own school's average; restrict to schools with at least ten sampled pupils; and drop the community-size category "a megacity of over ten million", which cannot describe any settlement in Kazakhstan and which twenty-one principals nevertheless selected in each cycle.

Results

How much lies between schools

Table 1 — Kazakhstan samples, the reproduction check against the OECD's published means, and the share of achievement variance lying between schools rather than within them.

Quantity	PISA 2022	PISA 2025
Students (with ESCS)	19,683	21,198
Schools	571	643
Mean mathematics score	425.4	413.7
Published OECD mean	425	414
Between-school share of variance, mathematics	30.0%	33.6%
Between-school share, reading	33.1%	34.9%

Between-school share, science	29.4%	33.3%
Top-minus-bottom ESCS quarter gap, mathematics	43.3	44.4

About a third of all variation in Kazakhstani mathematics scores is variation between schools rather than between pupils inside them, and that share rose slightly between the two cycles.

Family or school

Table 2 — Score points per unit of ESCS. The within-school effect is what family background buys among pupils in the same school; the contextual effect is what the school's own average background adds beyond that. Every row uses ten plausible values and eighty replicate weights.

Model	Cycle	Within-school family effect	Contextual school effect
M2 — mathematics	2022	6.37 (SE 0.87)	56.43 (SE 3.99)
M2 — mathematics	2025	7.03 (SE 0.82)	58.13 (SE 4.34)
M3 — + school type and community size	2022	6.47 (SE 0.95)	58.38 (SE 5.44)
M3 — + school type and community size	2025	7.05 (SE 0.86)	60.44 (SE 4.20)
Reading	2022	7.55 (SE 1.11)	62.72 (SE 4.78)
Reading	2025	5.13 (SE 0.84)	48.86 (SE 3.57)
Science	2022	7.02 (SE 1.02)	56.15 (SE 3.99)
Science	2025	7.50 (SE 0.83)	52.08 (SE 3.79)
Leave-one-out school mean	2022	8.39 (SE 0.86)	54.14 (SE 3.86)
Leave-one-out school mean	2025	9.19 (SE 0.79)	55.59 (SE 4.19)
Schools with 10+ sampled students	2022	6.19 (SE 0.89)	60.00 (SE 4.20)
Schools with 10+ sampled students	2025	7.07 (SE 0.81)	61.07 (SE 4.47)

The hypothesis is refuted, and not narrowly. Among pupils sitting in the same school, one unit of family advantage is worth about six or seven score points. The school's own average background is worth between forty-nine and sixty-one. The ratio is roughly nine to one, it is the same size in both cycles three years apart, and no robustness check moves it.

The total gradient in M1, 18.73 points in 2022 and 19.29 in 2025, is therefore a blend and a misleading one on its own. Reported alone it suggests a moderate family effect; decomposed, most of it turns out to be the school.

M3 rules out the simplest alternative explanation. Adding whether the school is private and how large its settlement is does not shrink the contextual effect at all; it grows slightly. Private schools score about seventeen to twenty points lower once composition is held constant, which is not a claim about their quality but a reminder that in this sample the private sector is not a uniformly advantaged one.

The leave-one-out check is the one that matters most for honesty, because a pupil contributes to their own school's mean and could mechanically inflate it. Removing them raises the within-school effect by about two points and lowers the contextual effect by about two. The conclusion is untouched.

Kazakhstan against the region

Table 3 — The same decomposition, PISA 2025 mathematics, for the other post-Soviet systems in the file. Uzbekistan is absent: its 2025 design produced a degenerate estimate and was dropped rather than reported.

System	Within-school family effect	Contextual school effect
Kazakhstan	7.0	58.1
Estonia	24.9	49.2
Moldova	15.9	45.6
Mongolia	12.6	51.6
Latvia	12.8	55.0
Lithuania	11.0	83.1
Georgia	10.3	47.1
Armenia	8.5	40.8
Kyrgyzstan	7.5	57.4
Azerbaijan	7.3	77.0

Kazakhstan sits at one extreme of this table. Its within-school family effect, 7.0 points, is among the lowest measured; Estonia's is three and a half times larger. Its contextual effect is in the upper half. The combination is what matters: in Estonia a family's position still moves a pupil noticeably among their own classmates, while in Kazakhstan it barely does, and almost the whole socioeconomic signal has migrated to the level of which school a child attends.

Discussion. The finding has a plain reading and a careful one, and both should be stated.

The plain reading is that in Kazakhstan the sentence "rich families do better" is a poor description of the data, while "children in rich schools do better" is a good one. Once a pupil is inside a given school, how much their own family has adds surprisingly little. Which school they are inside adds a great deal.

The careful reading is that the contextual effect is an association, not a mechanism, and it bundles at least three things that this design cannot separate: genuine peer effects, school quality that is correlated with composition but not caused by it, and the sorting of families into schools by resources and ambition. A wealthy family that moves its child into a high-composition school buys some mixture of all three, and this paper cannot say in what proportion.

That caveat does not dissolve the policy point, it sharpens it. Whatever the mechanism, the measured separation between Kazakhstani pupils runs along school lines far more than

household lines. An intervention that raises household resources without changing which school a child attends is acting on the six-point channel. The nine-times-larger channel lies elsewhere.

The regional comparison suggests this is not a universal pattern but a Kazakhstani one, or at least one shared with a few neighbours. Estonia's profile, a substantial within-school gradient and a moderate contextual effect, looks like a system where schools are more alike and families differentiate pupils inside them. Kazakhstan's looks like the opposite.

Limitations. The design is cross-sectional and observational. Nothing here identifies a causal effect of schools, and the contextual coefficient should not be read as what would happen if a pupil were moved.

The school mean is estimated from the sampled pupils, not the whole school, so it is measured with error. The leave-one-out check addresses one form of this, not all of it.

ESCS is a constructed index combining parental occupation, education and household possessions. It is comparable across the PISA countries by design, but it is not a direct measure of income, and its components may function differently in Kazakhstan than in the OECD average.

The two cycles are independent samples of fifteen-year-olds, not the same pupils followed over time, so the stability reported here is stability of a population pattern, not of individuals.

Finally, the comparison in Table 3 uses the systems present in the 2025 file. Uzbekistan was dropped because its design produced a non-finite estimate; it is named here rather than quietly omitted.

Conclusion. Across the two most recent PISA cycles, the socioeconomic composition of a Kazakhstani pupil's school predicts their mathematics score about nine times more strongly than their own family's socioeconomic position does, and the ratio is stable across three years, three subjects and every robustness check specified in advance. The assumption the study set out to test, that the family decides and the school supplements, is the reverse of what the data show. Roughly a third of all achievement variance in Kazakhstan lies between schools rather than within them, and in a regional comparison the country has one of the weakest within-school family gradients measured alongside one of the stronger contextual effects. The mechanism behind that contextual effect, how much is peers, how much is school quality and how much is families sorting themselves, is the obvious next question and is not answered here.

Data availability and replication

The analysis code (`'analysis.py'`), the pre-registered plan with its amendment, and the complete machine-readable results for both cycles accompany this paper. The PISA Public Use Files are not redistributed: the 2022 files are openly downloadable from the OECD and the 2025 files are obtained through the OECD's data-access form, in accordance with the terms of use accepted there. Running the code against those files reproduces every number in every table, including the reproduction check against the OECD's published country means.

Declarations

Funding: none. Conflicts of interest: none. Ethics: the study uses only anonymised aggregate survey data published for research; no personal data were collected and no human subjects were involved.

Use of AI tools. The author used generative AI tools to help write the analysis code, run the statistical computations and edit the English text. The research question, the hypothesis recorded before the data were seen, the school description in the author's own account and the interpretation are the author's. Every number reported here is produced by the released analysis

script from the OECD's own files; none was generated by a language model. The OECD is acknowledged as the source of the PISA data.

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МАЗМҰНЫ – СОДЕРЖАНИЕ – CONTENT

ӘЛЕУМЕТТІК-ЭКОНОМИКАЛЫҚ ЖӘНЕ ҚҰҚЫҚ ҒЫЛЫМДАРЫ - СОЦИАЛЬНО-ЭКОНОМИЧЕСКИЕ И ЮРИДИЧЕСКИЕ НАУКИ - SOCIO-ECONOMIC AND LEGAL SCIENCES

Төлегенов Тимур Сейфуллаулы

**ДИНАМИКА ТУРИСТСКИХ ПОТОКОВ И ЭФФЕКТИВНОСТЬ ИНФРАСТРУКТУРЫ
ТУРКЕСТАНА: ОТ ЭКСТЕНСИВНОГО РОСТА К СМАРТ-УПРАВЛЕНИЮ 10**

Alexander Gorevoy

**WHICH INEQUALITY STATISTICS SURVIVE AN ADMINISTRATIVE BOUNDARY CHANGE?
EVIDENCE FROM KAZAKHSTAN, 2010–2023 14**

Rakhimov Djalil

**DOES THE SHIFT TO CASHLESS PAYMENTS GO TOGETHER WITH FASTER GROWTH IN
HOUSEHOLD CREDIT? EVIDENCE FROM THE REGIONS OF KAZAKHSTAN, 2023-2025 26**

Kazhgerey Asan

**HOW MANY FOOD BASKETS DOES AN AVERAGE WAGE BUY? WAGES AND FOOD PRICES IN
THE 20 REGIONS OF KAZAKHSTAN, 2024-2026 37**

Tagimova Alua

**WHO WAS LEFT BEHIND? EDUCATION AND FINANCIAL INCLUSION IN KAZAKHSTAN AND
THREE CENTRAL ASIAN NEIGHBOURS, 2021-2024 44**

Wei Wei, Mynzhanova Gulzhakan, Niyetalina Gaukhar

**DIGITAL–PHYSICAL INTEGRATION AND ECONOMIC PERFORMANCE IN INDUSTRIAL
INTEGRATED ENERGY SYSTEMS: A SCENARIO-BASED ANALYSIS OF SMART GRID
CONTROL, BATTERY ENERGY STORAGE, AND DIGITAL TWINS 51**

Xu Fumin, Wei Wei, Ruziyeva Elvira, Moldabekova A.

**FROM CULTURAL RESOURCES TO GLOBAL CONSUMER VALUE: THE BRIDGE–IMC MODEL
AND THE INTERNATIONALIZATION OF BLACK MYTH: WUKONG UNDER THE BELT AND
ROAD INITIATIVE 64**

Ibraimkhan Alikhan

**WHICH CRIMES CAN A 14-YEAR-OLD BE TRIED FOR? THE LIST IN ARTICLE 15 OF
KAZAKHSTAN'S CRIMINAL CODE COMPARED WITH 30 OTHER JURISDICTIONS 80**

Yerboluly Madi

**DID IMPORTED CARS REALLY GET CHEAPER? CHINESE CARS AND THE AVERAGE
CUSTOMS VALUE OF PASSENGER CARS IMPORTED INTO KAZAKHSTAN, 2015-2025 91**

Салимбаев Ербол Аманжолович

**АНАЛИЗ ИНВЕСТИЦИОННОЙ АКТИВНОСТИ КАК ИНДИКАТОР ИЗМЕНЕНИЙ
ПОТЕНЦИАЛЬНОГО СПРОСА НА КОНСАЛТИНГОВЫЕ УСЛУГИ 99**

Rambergenov Ramil

**REGIONAL NEW-FIRM FORMATION IN UZBEKISTAN AFTER THE 2017 REFORMS:
PERSISTENCE IN SCALE, CONVERGENCE IN INTENSITY, AND RECOMPOSITION TOWARD
TRADE 107**

Abdesh Dinara

**FROM A WOMEN'S LEAD TO A MEN'S LEAD: THE GENDER GAP IN DIGITAL PAYMENTS IN
KAZAKHSTAN AND THREE CENTRAL ASIAN NEIGHBOURS, 2021-2024 116**

Amangeldi Aidana

**DID SMALL BUSINESS IN KAZAKHSTAN REALLY SHRINK IN 2026? THE NEW TAX CODE,
REGIONAL TAX RATES AND THE FALL IN THE NUMBER OF INDIVIDUAL ENTREPRENEURS 124**

Cheng Che	
BUILD, BUY, OR PARTNER? ENTRY MODE SELECTION AND RISK GOVERNANCE FOR WIND POWER INVESTMENT IN KAZAKHSTAN	133
Wang Liang	
FROM CAPACITY EXPANSION TO SYSTEM VALUE: COORDINATED DEVELOPMENT OF RENEWABLE ENERGY, GRID FLEXIBILITY AND ENERGY STORAGE IN KAZAKHSTAN	146
Chen Jun	
CONSTRUCTION-PERIOD CREDIT RISK MANAGEMENT FOR LARGE INFRASTRUCTURE PROJECT FINANCE IN KAZAKHSTAN	159
Alniyaz Danial	
HOW MUCH FUEL DOES A HYBRID REALLY SAVE? A SAME-MODEL COMPARISON OF HYBRID AND GASOLINE CARS IN US FUEL ECONOMY	173

ТЕХНИКАЛЫҚ ҒЫЛЫМДАР - ТЕХНИЧЕСКИЕ НАУКИ - TECHNICAL SCIENCE

Nurmakhan Almira	
ADVANTAGES OF FIBER OPTIC COMMUNICATION OVER TRADITIONAL COPPER CABLES	180
Kozhabai Bereke	
SECURITY CHALLENGES IN IOT-BASED TELECOMMUNICATION NETWORKS	188
Azamatuly Yerassyl	
WHY AI-GENERATED CODE FAILS A BENCHMARK: A FAILURE ANALYSIS OF THREE OPEN LANGUAGE MODELS ON 30 HUMANEVAL+ TASKS	197
Nurzhan Sanzhar	
A FEW SHELLS, A FEW OPERATORS: WHERE LOW EARTH ORBIT IS CROWDED IN AN ALTITUDE-INCLINATION MAP OF 16,620 ACTIVE SATELLITES	206
Askarbek Nurislam	
CAN THE WEATHER TELL WHICH DAYS IN ASTANA WILL BE POLLUTED? CLASSIFYING PM2.5 EXCEEDANCE DAYS WITH MACHINE LEARNING AND CHECKING THE DATA AGAINST A GROUND MONITOR	212
Iliyas Arman	
SHOOTING ON THE MOVE: HOW MUCH AIM A ROBOT LOSES BY IGNORING ITS OWN VELOCITY, AND WHETHER A VIRTUAL-TARGET CORRECTION RECOVERS IT	223
Ануар Әлімжан Бахытжанұлы, Сексенбаева Айша Курманбековна	
СРАВНИТЕЛЬНЫЙ АНАЛИЗ СТАНДАРТОВ И МЕТОДИК ОБУЧЕНИЯ КИБЕРБЕЗОПАСНОСТИ: NICE FRAMEWORK, ECSF И ПРАКТИКО- ОРИЕНТИРОВАННЫЕ ТЕХНОЛОГИИ	229
Mukhamedzhan Yerganat	
GROWTH OF GITHUB DEVELOPER COMMUNITIES IN KAZAKHSTAN, UZBEKISTAN AND KYRGYZSTAN, 2020-2026: EVIDENCE FROM THE GITHUB INNOVATION GRAPH	239

ПӘНДЕР АРАЛЫҚ ҒЫЛЫМДАР – МЕЖДИСЦИПЛИНАРНЫЕ НАУКИ – INTERDISCIPLINARY SCIENCES

Albiyev Asser	
HOW MUCH OF AN ARTICLE COUNT IS HUMAN WORK? DECOMPOSING THE CREATION OF FIVE WIKIPEDIAS, 2010–2025	251
Amangeldy Nurbolat	
HOW MUCH OF KAZAKHSTAN'S URBAN BUILT STOCK PREDATES ITS SEISMIC CODES, AND WHERE DOES THAT STOCK SIT RELATIVE TO HAZARD?	261

Torekhan Sabrina

WHERE ALMATY WALKS ITS OWN WAY: INFORMAL SHORTCUTS IN OPENSTREETMAP AND THE DETOURS THEY AVOID	267
---	------------

ӘЛЕУМЕТТІК ЖӘНЕ ГУМАНИТАРЛЫҚ ҒЫЛЫМДАР - СОЦИАЛЬНО-ГУМАНИТАРНЫЕ НАУКИ - SOCIAL SCIENCES AND HUMANITIES

Мұқатаева Айзат Амантайқызы, Стамбекова Жанат Байғазықызы, Слямханова Гүлім Болатқызы, Қызырбек Аяулым Ерболқызы

ЖАСАНДЫ ИНТЕЛЛЕКТ ДӘУІРІНДЕГІ ҒЫЛЫМИ ТАНЫМ: ПОППЕР, КУН ЖӘНЕ ЛАКАТОС ИДЕЯЛАРЫ ТҮРҒЫСЫНАН ТАЛДАУ	272
--	------------

Мұқатаева Айзат Амантайқызы, Сапарханова Мадина Төлегенқызы, Окенова Аружан Муратхановна, Тұрсынғазыева Ақерке Ерболатқызы

ШӘКӘРІМ ФИЛОСОФИЯСЫНДАҒЫ ЕРКІНДІК ЖӘНЕ МОРАЛЬДЫҚ ТАҢДАУ МӘСЕЛЕСІ	282
---	------------

Komekova Saida

DO UNHAPPY REVIEWERS MIX IN MORE RUSSIAN? STAR RATINGS AND KAZAKH-RUSSIAN CODE-SWITCHING IN 175,002 ONLINE REVIEWS	291
---	------------

Zhumagali Yerbol

DOES A BIGGER MODEL CLOSE THE GAP? KAZAKH-LANGUAGE ACCURACY ON KAZAKHSTAN-SPECIFIC VERSUS UNIVERSAL SCHOOL SUBJECTS IN SMALL OPEN-WEIGHT LANGUAGE MODELS	304
---	------------

Abdrakhmanova Madina

DOES A MEDAL BUY ATTENTION? WIKIPEDIA VIEWS OF KAZAKHSTAN'S ATHLETES BEFORE AND AFTER THE PARIS 2024 OLYMPIC	308
---	------------

ПЕДАГОГИКАЛЫҚ ЖӘНЕ ПСИХОЛОГИЯЛЫҚ ҒЫЛЫМДАР – ПЕДАГОГИЧЕСКИЕ И ПСИХОЛОГИЧЕСКИЕ НАУКИ – PEDAGOGICAL AND PSYCHOLOGICAL SCIENCES

Kaldarbek Mergen

FAMILY OR SCHOOL? SOCIOECONOMIC COMPOSITION AND MATHEMATICS ACHIEVEMENT IN KAZAKHSTAN, PISA 2022 AND 2025	316
--	------------

Zhenis Adilzhan

WHICH OLYMPIAD PROBLEMS DO STUDENTS TAKE TO THE BOARD? CHOICES AND DEFENCES IN THE 8TH-GRADE LEAGUE OF KARAGANDY MATHBATTLES 2026	323
--	------------

Базарбаева Айнура Бектуровна

ДЕТСКИЙ ФОЛЬКЛОР И ПОДВИЖНЫЕ ИГРЫ КАК ИНСТРУМЕНТЫ ФОРМИРОВАНИЯ ОСНОВ ПРАВОВОЙ КУЛЬТУРЫ У ДЕТЕЙ СТАРШЕГО ДОШКОЛЬНОГО ВОЗРАСТА	330
---	------------

БИОЛОГИЯ ҒЫЛЫМДАР - БИОЛОГИЧЕСКИЕ НАУКИ - BIOLOGICAL SCIENCES

Bazhenova Diana

GROWTH DYNAMICS OF STERLET (<i>Acipenser ruthenus</i> L.) REARED IN A RECIRCULATING AQUACULTURE SYSTEM	333
---	------------

ТУРИСТИЧЕСКИЕ И СПОРТИВНЫЕ НАУКИ - ТУРИСТІК ЖӘНЕ СПОРТ ҒЫЛЫМДАРЫ - TOURISM AND SPORTS SCIENCES

Төлеп Жазира Маратқызы

ГАСТРОНОМИЯЛЫҚ ФЕСТИВАЛЬДЕРДІҢ ТУРИСТІК ДЕСТИНАЦИЯ ТАРТЫМДЫЛЫҒЫН ҚАЛЫПТАСТЫРУДАҒЫ РӨЛІ МЕН ДАМУ ҮРДІСТЕРІ	340
--	------------

ЕСТЕСТВЕННЫЕ НАУКИ - ЖАРАТЫЛЫСТАНУ ҒЫЛЫМДАРЫ - NATURAL SCIENCES

Нургельдина Асель Ермаковна, Серикбаева Жанерке Алимжановна

ШЕКАРАСЫЗ ФИЗИКА: ӘР ЕЛДЕГІ ФИЗИКАЛЫҚ БІЛІМДІ САЛЫСТЫРУ 347