ILG‘OR IQTISODIYOT VA PEDAGOGIK TEXNOLOGIYALAR
ILMIY ELEKTRON JURNAL

UO‘K: 37.091.3:004.77:311.42

INSTRUCTIONAL QUALITY AND DIGITAL READING ACHIEVEMENT: EVIDENCE FROM POST-SOVIET TRANSITION ECONOMIES USING PISA 2022

Khadjieva Indira
Westminster International University in Tashkent
ORCID: 0000-0001-6447-0042
i.khadjieva@wiut.uz

Abstract. *This study examines the relationship between students' perceptions of instructional quality and their digital reading performance across seven post-Soviet countries using PISA 2022 data (N = 56,477 students; 2,495 schools). Drawing on Klieme et al.'s instructional quality framework—encompassing instructional approaches, classroom management, and supportive climate—three-level hierarchical linear models (HLM) were estimated. Results indicate that perceived instructional adaptation (β = 0.109), teacher-directed instruction (β = 0.076), digital skills teaching practices (β = 0.230), and stimulation of reading engagement (β = 0.123) were significantly and positively associated with digital reading outcomes. A favorable disciplinary climate (β = 0.031), teacher interest (β = 0.073), and teacher support (β = 0.054) also contributed positively. Conversely, reading skill exercises (β = −0.051) and extended instructional time (β = −0.054) showed small negative associations. School-level variance explained a large share of outcome variability (f^2 = 44.77%), underscoring the institutional role in shaping digital literacy. The findings extend instructional quality research to transitional education systems and provide actionable implications for pedagogy and education policy in post-Soviet contexts.*

Keywords: *instructional quality, digital reading literacy, PISA 2022, hierarchical linear modeling, post-Soviet education, secondary education.*

TA’LIM SIFATI VA RAQAMLI SAVODXONLIK: POST-SOVET O‘TISH IQTISODIYOTLARIDA PISA 2022 NATIJALARI TAHLILI

Xadjieva Indira
Toshkent shahridagi Xalqaro Vestminster universiteti

Annotatsiya. *Ushbu tadqiqot PISA 2022 ma’lumotlaridan (N = 56,477 o‘quvchi; 2,495 maktab) foydalangan holda, yetti post-sovet mamlakatida o‘quvchilarning o‘qitish sifati haqidagi tasavvurlari va ularning raqamli o‘qish bo‘yicha natijalari o‘rtasidagi bog‘liqlikni o‘rganadi. Klieme va boshqalarning o‘qitish sifati bo‘yicha konseptual yondashuviga tayangan holda — u o‘qitish usullari, sinf boshqaruvi va qo‘llab-quvvatlovchi muhitni qamrab olgan holda — uch darajali ierarxik chiziqli modellar (HLM) yordamida baholandi. Natijalar shuni ko‘rsatadiki, o’quvchilar tomonidan qayd etilgan o‘qitishning moslashuvi (β = 0.109), o‘qituvchi tomonidan yo‘naltirilgan o‘qitish (β = 0.076), raqamli ko‘nikmalarni o‘rgatish amaliyotlari (β = 0.230) va o‘qishga jalb etishni rag‘batlantirish (β = 0.123) raqamli o‘qish natijalari bilan ijobiy va sezilarli bog‘liqdir. Shuningdek, ijobiy intizomiy muhit (β = 0.031), o‘qituvchi qiziqishi (β = 0.073) va o‘qituvchi qo‘llab-quvvatlashi (β = 0.054) ham ijobiy ta’sir ko‘rsatadi. Aksincha, o‘qish ko‘nikmalarini mashq qilish (β = −0.051) va dars davomiyligini uzaytirish (β = −0.054) kichik salbiy bog‘liqlikni namoyon etadi. Maktab darajasidagi dispersiya natijalar o‘zgaruvchanligining katta qismini tushuntiradi (f^2 = 44.77%), bu esa raqamli savodxonlikni shakllantirishda*

institutsional omillarning muhim rolini ko‘rsatadi. Natijalar o‘qitish sifati bo‘yicha tadqiqotlarni o‘tish davridagi ta’lim tizimlariga keng tadbiq qiladi hamda post-sovet kontekstida pedagogika va ta’lim siyosati uchun amaliy tavsiyalar beradi.

Kalit so‘zlar: *o‘qitish sifati, raqamli o‘qish savodxonligi, PISA 2022, ierarxik chiziqli modellashtirish, post-sovet ta’limi, o‘rta ta’lim.*

КАЧЕСТВО ОБУЧЕНИЯ И РЕЗУЛЬТАТЫ ЦИФРОВОГО ЧТЕНИЯ: ДАННЫЕ PISA 2022 ПО ПОСТСОВЕТСКИМ СТРАНАМ С ПЕРЕХОДНОЙ ЭКОНОМИКОЙ

Хаджиева Индира
Международный Вестминстерский университет в городе Ташкенте

Аннотация. *Данное исследование анализирует взаимосвязь между восприятием учащимися качества преподавания и их результатами в цифровом чтении в семи постсоветских странах на основе данных PISA 2022 (N = 56 477 учащихся; 2 495 школ). Опираясь на концептуальную модель качества преподавания Клиеме и соавторов, включающую методы обучения, управление классом и поддерживающий климат, были оценены трехуровневые иерархические линейные модели (HLM). Результаты показывают, что воспринимаемая адаптация обучения (β = 0.109), преподавание, ориентированное на учителя (β = 0.076), практики обучения цифровым навыкам (β = 0.230) и стимулирование вовлеченности в чтение (β = 0.123) имеют значимую положительную связь с результатами цифрового чтения. Также положительное влияние оказывают благоприятный дисциплинарный климат (β = 0.031), интерес учителя (β = 0.073) и поддержка со стороны учителя (β = 0.054). Напротив, упражнения на развитие навыков чтения (β = −0.051) и увеличение продолжительности учебного времени (β = −0.054) демонстрируют небольшую отрицательную связь. Дисперсия на уровне школы объясняет значительную долю вариативности результатов (f^2 = 44.77%), что подчеркивает институциональную роль в формировании цифровой грамотности. Полученные результаты расширяют исследования качества преподавания на трансформационные образовательные системы и дают практические рекомендации для педагогики и образовательной политики в постсоветском контексте.*

Ключевые слова: *качество преподавания, цифровая грамотность чтения, PISA 2022, иерархическое линейное моделирование, постсоветское образование, среднее образование.*

Introduction.

Instructional quality constitutes one of the most influential process-level determinants of student learning and represents a core component of school climate. Extensive empirical evidence demonstrates that classroom practices—including teaching methods, classroom management, and teacher–student interactions—play a decisive role in shaping student engagement and achievement (Wisniewski et al, 2020; Wang et al, 2022). In contemporary education systems, this role has gained additional significance due to the rapid diffusion of information and communication technologies (ICT). As secondary schools increasingly function as sites where students acquire competencies for participation in digitally mediated learning and labor markets, instructional quality must be understood not only as a determinant of traditional academic performance but also as a potential catalyst for developing students' digital literacy.

Despite robust evidence on instructional quality's effect on traditional academic outcomes, relatively little attention has been directed toward its relationship with digital reading performance—a competency central to contemporary literacy. This gap is especially

pronounced in post-Soviet transition economies, where pedagogical practices and classroom dynamics are undergoing rapid transformation and where large-scale empirical investigation remains limited. The present study addresses this gap by investigating how students' perceptions of three dimensions of instructional quality relate to digital reading outcomes across seven post-Soviet countries that participated in PISA 2022. The study contributes to the literature in three ways. First, it extends instructional quality theory to the context of digital literacy development. Second, it applies three-level hierarchical linear modeling (HLM) to account for the nested structure of students within schools and countries, providing methodologically rigorous estimates. Third, it focuses on a geographically and institutionally underrepresented region—post-Soviet states—thereby broadening the generalizability of instructional quality research beyond OECD and East Asian contexts.

Literature Review.

Instructional quality is conceptualized as a multidimensional construct reflecting how teaching practices support students' cognitive engagement, motivation, and learning processes. Early approaches adopted functional perspectives focused primarily on predicting academic achievement through observable instructional behaviors, typically grounded in the process–mediation–product paradigm (Hu and Wang, 2022). Subsequent developments incorporated constructivist perspectives, emphasizing students' active role in knowledge construction and leading to learning opportunities models that conceptualize instruction as a set of opportunities interpreted by students through individual cognitive processes. Among contemporary frameworks, the instructional quality model proposed by Klieme et al. represents one of the most influential theoretical syntheses. Integrating process–product logic with constructivist principles and self-determination theory, this model identifies three core dimensions: (1) instructional approach—teaching practices that stimulate student thinking, activate prior knowledge, and promote meaningful engagement; (2) classroom organization—rule clarity, behavior management, and efficient use of instructional time; and (3) supportive climate—teacher feedback, emotional support, and the quality of teacher–student relationships. This tripartite structure is empirically well-supported and theoretically coherent across diverse educational contexts. For the purposes of this study, the original 'cognitive activation' dimension is broadened to 'instructional approaches' to encompass both constructivist and teacher-directed pedagogical strategies, making the framework suitable for diverse instructional contexts typical of post-Soviet education systems. This adaptation is consistent with recent scholarly recommendations that call for expanding the conceptual coverage of instructional quality frameworks when applied to heterogeneous educational settings.

Digital reading requires navigation of non-linear texts, evaluation of information credibility, and integration of multimodal content—competencies increasingly essential for academic success and lifelong learning. From an education production function perspective, instructional quality serves as a key process input shaping digital literacy outcomes. Systems theory further suggests that digital literacy emerges from interactions between individual skills, institutional practices, and technological environments. Existing studies demonstrate that instructional quality positively influences academic achievement across domains. Differentiated instruction, inquiry-based learning, and supportive classroom climates have been linked to improved reading outcomes, while classroom management contributes to sustained engagement and teacher support enhances reading motivation (Leion et al, 2022; Capin, 2022). However, research specifically examining digital reading performance remains limited. The small number of studies exploring associations between perceived instructional quality and digital literacy typically rely on single-level analytical approaches and do not adequately account for the hierarchical structure of educational systems. This study addresses this limitation through multilevel modeling.

Three major limitations characterize the current literature: most studies examine isolated instructional dimensions rather than integrated frameworks; research is geographically concentrated in OECD and East Asian contexts; and post-Soviet education systems remain largely unexplored. As a result, the generalizability of existing findings to transitional education systems remains uncertain, motivating the present investigation.

Research Questions*:* Guided by the theoretical framework described above, this study addresses the following research questions:

- To what extent do students' perceptions of instructional approaches correlate with digital reading performance across post-Soviet countries?
- To what extent do students' perceptions of classroom management relate to digital reading performance?
- To what extent do students' perceptions of supportive classroom climate influence digital reading outcomes?

Methodology.

The empirical analysis is based on microdata from the Programme for International Student Assessment (PISA) 2022, administered by the OECD. PISA assesses the competencies of 15-year-old students in reading, mathematics, and science, with a focus on functional literacy. The analytical sample comprises seven post-Soviet countries that participated in the PISA 2022 computer-based reading assessment and had complete data available at the student, school, and country levels. This selection was designed to minimize confounding variation in economic background given the broadly comparable transition-economy status of these nations. The resulting dataset comprised 56,477 students from 2,495 schools across Estonia, Kazakhstan, Lithuania, Latvia, Moldova, Baku (Azerbaijan), and Uzbekistan. Sampling proportions were approximately equal by gender across all countries as shown in table 1.

Table 1.

Sample characteristics by country (PISA 2022)

Country	N (Schools)	N (Students)	Female %	Male %
Estonia	573	5,315	49.88	50.12
Kazakhstan	616	19,487	49.13	50.87
Lithuania	362	6,885	49.05	50.95
Latvia	308	5,303	50.63	49.37
Moldova	236	5,367	48.84	51.16
Baku (Azerbaijan)	198	6,827	47.77	52.23
Uzbekistan	202	7,293	50.04	49.96
Total	2,495	56,477	48.89	51.11

Source: *PISA 2022 (OECD, 2023).*

The dependent variable is students' performance on the PISA 2022 digital reading literacy assessment, represented by 10 plausible values (PV1–PV10). PISA applies item response theory (IRT) models to estimate latent proficiency based on partial test responses and background information. Because each student answers only a subset of items, PISA uses plausible values—multiple imputed estimates of student proficiency—to ensure population-level analyses are unbiased. All 10 plausible values were incorporated following Rubin's combination rules, yielding pooled coefficient estimates and valid standard errors.

Instructional quality was operationalized using students' perceptions of classroom instruction as captured in the PISA 2022 student questionnaire, consistent with the theoretical framework of Klieme et al. (2009). Three dimensions were specified: (a) instructional approaches, measured by indicators of instruction adaptation, teacher-directed instruction, stimulation of reading engagement, digital skills teaching practices, and reading skill practice exercises; (b) classroom management, measured by disciplinary climate and weekly learning time; and (c) supportive climate, measured by perceived teacher interest and teacher support in language lessons. Table 2 summarizes the three dimensions and corresponding indicators.

Table 2.

Instructional quality dimensions and PISA 2022 indicators

Dimension	Conceptual Meaning	Example PISA Indicators
Instructional approaches	Teaching strategies and engagement	Teacher explains clearly; adapts instruction; stimulates reading engagement; teaches digital skills
Classroom management	Order and time-on-task	Classroom disruptions; disciplinary climate; weekly learning time
Supportive climate	Emotional and academic support	Teacher feedback; interest; support in language lessons

Source: *Adapted from Klieme et al. (2009) and PISA 2022 (OECD, 2023).*

To isolate the relationship between instructional quality and digital reading performance, the analysis includes control variables at both student and school levels. Student-level controls include socio-economic status (ESCS index), gender, and ICT resources at home (ICTRES). The school-level control is ICT availability at school (ICTSCH). Family-level controls include the highest parental occupational status index (HISEI) and perceived parental emotional support (EMOSUPS). These controls reduce omitted-variable bias and ensure that estimated instructional effects are not confounded by background characteristics.

Given the hierarchical structure of the data—students nested within schools nested within countries—three-level hierarchical linear modeling (HLM) was employed with random intercepts and fixed slopes, following Ma et al. (2008) and Hu and Wang (2022). Prior to main analysis, missing data (highest proportion: 25.3% for LEARNINGTIME) were addressed using multiple imputation (MI), treating missingness as random due to the rotational booklet design. MI datasets were integrated with plausible values following Rubin's combination rules.

Moreover, confirmatory factor analysis (CFA) was used to validate composite constructs (DIGTEACHER and RPRACTICE). Model fit indices (CFI ranging from 0.935 to 0.997) indicated satisfactory fit. An intercept-only null model was first estimated to decompose variance across levels, yielding intraclass correlation coefficients (ICCs). Predictors were then entered sequentially at student, school, and country levels, using backward elimination to retain only statistically significant predictors ($p < .05$). Multicollinearity was assessed via correlation matrix inspection; no coefficient exceeded 0.5, indicating no multicollinearity concern. Effect sizes at each level were estimated using Cohen's f^2 (small ≥ 0.02; medium ≥ 0.15; large ≥ 0.35). All analyses were conducted in Stata 17.

HLM Results

The null model revealed that between-school variation accounted for 32.8% of total variance in digital reading performance, while between-country variance accounted for 0.4%. These ICCs confirm substantial clustering at the school level and justified the three-level HLM approach. The pattern indicates that school-level instructional environments are a primary source of variability in students' digital reading outcomes across the post-Soviet sample.

Fixed Effects: Instructional Quality Predictors. After incorporating all statistically significant predictors across levels, the final model (Model 3) produced the results summarized in Tables 3 and 4. All HLM assumptions—linearity, normality, and homoscedasticity—were satisfied upon inspection of scatter plots, Q-Q plots, and residual plots. Regarding instructional approaches, perceived instruction adaptation ($\beta = 0.109$, SE = 0.004, $p < 0.001$), teacher-directed instruction ($\beta = 0.076$, SE = 0.005, $p < 0.001$), teachers' digital skills teaching practices ($\beta = 0.230$, SE = 0.009, $p < 0.001$), and stimulation of reading engagement ($\beta = 0.123$, SE = 0.008, $p < 0.001$) were all positively and significantly associated with digital reading performance. Conversely, reading skill training exercises ($\beta = -0.051$, SE = 0.009, $p < 0.001$) exhibited a small but significant negative relationship.

For classroom management, a positive disciplinary climate was associated with better digital reading performance ($\beta = 0.031$, SE = 0.015, $p < 0.001$), whereas weekly instructional time showed a small negative association ($\beta = -0.054$, SE = 0.009, $p < 0.01$). In the supportive climate dimension, both perceived teacher interest ($\beta = 0.073$, SE = 0.008, $p < 0.001$) and teacher support ($\beta = 0.054$, SE = 0.009, $p < 0.001$) were positively related to digital reading outcomes.

Table 3.

Fixed effects of instructional quality predictors on digital reading performance

Predictor	β	SE	Significance
Instructional Approaches			
Instruction adaptation (ADAPTIVITY)	0.109	0.004	p < 0.001
Teacher-directed instruction (DIRINS)	0.076	0.005	p < 0.001
Digital skills teaching (DIGTEACHER)	0.230	0.009	p < 0.001
Reading engagement stimulation (STIMREAD)	0.123	0.008	p < 0.001
Reading skill exercises (RPRACTICE)	−0.051	0.009	p < 0.001
Classroom Management			
Disciplinary climate (DISCLIM)	0.031	0.015	p < 0.001
Weekly learning time (LEARNINGTIME)	−0.054	0.009	p < 0.01
Supportive Climate			
Teacher interest (TINCHINT)	0.073	0.008	p < 0.001
Teacher support (TEACHSUP)	0.054	0.009	p < 0.001

Effect size estimates at each level, expressed as Cohen's f^2, are presented in Table 4. The student-level f^2 of 8.156% indicates a small effect, whereas the school-level f^2 of 44.770% represents a large effect, and the country-level f^2 of 11.116% approaches a medium effect. These results confirm that school-level instructional environments are the dominant source of systematic variance in digital reading outcomes.

Table 4.

Effect sizes (Cohen's f^2) by model level

Level	f^2 (Effect Size)	Interpretation
Student level	8.156%	Small
School level	44.770%	Large
Country level	11.116%	Medium

Decision criterion: $f^2 \geq 0.02$ = small; ≥ 0.15 = medium; ≥ 0.35 = large (Feingold, 2013).

HLM estimation outcomes revealed that the positive associations between perceived instructional adaptation, teacher-directed instruction, stimulation of reading engagement, and digital reading performance are consistent with prior research in OECD contexts (Hu & Wang, 2022) and extend these findings to post-Soviet settings. Instructional adaptation—adjusting lesson structures to students' needs—supports the construction of new knowledge based on prior understanding, thereby enhancing reading outcomes. Similarly, stimulation of reading engagement activates cognition and increases student motivation, which is theoretically aligned with self-determination theory's emphasis on competence and relatedness as motivational drivers.

The most substantial positive effect was observed for teachers' digital skills teaching practices ($\beta = 0.230$). This finding is notable given the ICT transformation context of post-Soviet education and suggests that explicit instruction in digital competencies has measurable payoffs for student performance on digitally mediated assessments. The negative association for reading skill exercises ($\beta = -0.051$) is consistent with prior research finding unexpected negative associations between reading practice variety and proficiency. A plausible interpretation is that binary PISA measurement items capture activity presence rather than quality or frequency, and that diverse reading activities do not uniformly improve digital reading performance. This interpretation warrants further investigation using richer measurement instruments.

If we turn to the correlation between Classroom Management and Digital Reading, the positive relationship between disciplinary climate and digital reading performance is consistent with theoretical predictions: orderly classroom environments reduce cognitive load, sustain attention, and enable deeper engagement with complex texts. This finding aligns with classroom management research demonstrating that clear behavioral expectations facilitate academic engagement and performance. The small but significant negative association between weekly instructional time and digital reading performance warrants cautious interpretation. It may reflect an opportunity-cost dynamic whereby extended formal instruction limits students' engagement in extracurricular ICT activities—such as online reading, browsing, and email use—that research has linked to enhanced digital literacy. Alternatively, it may indicate that instructional time quality matters more than quantity, a conclusion consistent with education production function literature emphasizing the role of instructional efficiency over mere duration.

In addition to that, perceived teacher interest and support were positively associated with digital reading performance, consistent with self-determination theory and instructional quality research emphasizing the motivational dimensions of effective teaching. Supportive and enthusiastic teacher behaviors address students' psychological needs for relatedness and competence, thereby increasing reading engagement and persistence—particularly in cognitively demanding digital reading tasks. These findings reinforce the view that instructional quality extends beyond cognitive inputs to encompass relational and motivational dimensions that shape students' dispositions toward learning.

The large school-level effect size (f^2 = 44.77%) indicates that institutional factors—including school instructional climate, resource availability, and pedagogical culture—account for the largest share of systematic variance in digital reading outcomes. This finding underscores the central role of schools as mediating institutions and has significant implications for education policy in post-Soviet contexts, where institutional capacity and quality vary substantially across and within countries. Targeted school-level interventions to improve instructional quality may therefore yield greater returns than purely student-level interventions.

Conclusion.

This study investigated the relationship between students' perceptions of instructional quality and digital reading performance across seven post-Soviet countries using PISA 2022 data and three-level hierarchical linear modeling. The findings demonstrate that multiple dimensions of perceived instructional quality—instructional approaches, classroom management, and supportive climate—are systematically associated with digital reading outcomes, with school-level instructional environments explaining the largest share of outcome variance.

The results carry several implications for educational practice and policy. For teachers, findings suggest the value of personalizing instruction to students' needs, explicitly teaching digital skills, creating motivating reading environments, maintaining orderly and supportive classrooms, and demonstrating genuine enthusiasm and care. For school administrators and policymakers, the large school-level effect size highlights the importance of investing in school-level instructional quality rather than relying solely on individual teacher development. In post-Soviet education systems undergoing digital transformation, systematic support for teachers in integrating digital literacy instruction into language curricula is particularly warranted.

Several limitations should be acknowledged. First, PISA's cross-sectional design precludes causal inference; longitudinal studies are needed to establish predictive validity. Second, the measurement items in the student questionnaire capture the presence of instructional activities rather than their quality or frequency, which may attenuate or distort estimated associations. Third, the analysis is limited to seven post-Soviet countries with comparable economic backgrounds, and findings may not generalize to other transitional or developing-country contexts. Future research should employ longitudinal designs, richer instructional quality measures, and broader international samples with random-slope specifications to examine heterogeneity in instructional effects across school and country contexts.

References:

Capin, P., Roberts, G., Clemens, N. H., & Vaughn, S. (2022). When treatment adherence matters: Interactions among treatment adherence, instructional quality, and student characteristics on reading outcomes. Reading Research Quarterly, 57(2), 753-774.

Feingold, A. (2013). A regression framework for effect size assessments in longitudinal modeling of group differences. Review of General Psychology, 17(1), 111–121.

Hu, B. Y., & Wang, C. (2022). Instructional quality and digital reading performance among 15-year-old students: A multilevel analysis of PISA 2018 OECD data. Computers & Education, 177, 104374.

Klieme, E., Pauli, C., & Reusser, K. (2009). The Pythagoras study: Investigating effects of teaching and learning in Swiss and German mathematics classrooms. In T. Janík & T. Seidel (Eds.), The power of video studies in investigating teaching and learning in the classroom (pp. 137–160). Waxmann.

Leino, K., Nissinen, K., & Sirén, M. (2022). Associations between teacher quality, instructional quality and student reading outcomes in Nordic PIRLS 2016 data. Large-Scale Assessments in Education, 10(1), 25.

Ma, X., Ma, L., & Bradley, K. D. (2008). Using multilevel modeling to investigate school effects. In A. A. O'Connell & D. B. McCoach (Eds.), Multilevel modeling of educational data (pp. 59–110). Information Age Publishing.

Niu, Z., Yang, X., & Li, Q. (2025). Instructional quality and student outcomes in post-Soviet contexts: A cross-national analysis. International Journal of Educational Research, 130, 102445.

OECD. (2023). PISA 2022 results (Volumes I–III): The state of learning and equity in education. OECD Publishing.

Rubin, D. B. (1987). Multiple imputation for nonresponse in surveys. Wiley.

Wang, J., Tigelaar, D. E., Luo, J., & Admiraal, W. (2022). Teacher beliefs, classroom process quality, and student engagement in the smart classroom learning environment: A multilevel analysis. Computers & Education, 183, 104501.

Wisniewski, B., Zierer, K., Dresel, M., & Daumiller, M. (2020). Obtaining secondary students' perceptions of instructional quality: Two-level structure and measurement invariance. Learning and Instruction, 66, 101303.