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Application of Artificial Intelligence Tools in the Educational Practice of Russian Schools

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Abstract

The examination of AI tools integration in Russian education sector is informed by the rapid developments and increased adoption of AI technologies that holds a great potential to transform education. The objectives of the research focused primarily on analyzing shifts within instructional strategies, technical infrastructure, and sociocultural aspects being used in Russian schools. An extensive analysis of government documents, industry and academic research reports, surveys, and case studies from Russian schools was conducted and the most important patterns, factors, and impediments toward the usage of AI technologies in the classroom were associated with and tendencies were formulated. In this work, we formulate working classification of Android applications designed for the integration of artificial intelligence in primary and secondary basic educational institutions and discuss the qualifications necessary for the proper use of these applications. The technology readiness level and infrastructure gaps in Russian educational institutions have also been evaluated, which have shown pronounced regional disproportions in the availability of digital resources.

The research addresses the extent of the impact of AI-supported teaching techniques on learners' outcomes, engagement, and skill acquisition; on the other hand, a teacher's productivity and professional development. In this paper, we present a comprehensive examination of the ethical, legal and social impacts as well as the policy suggestions for supporting responsible and equitable usage of Artificial intelligence technologies in education in Russia. The analysis provided strives to enhance the understanding and the ability to make goals and actions to integrate Artificial Intelligence in school education in Russia and construct cohesive implementation plans

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that are capable of making educational opportunities in Russia more accessible, responsive and equipped to the demands of the times.

Keywords: artificial intelligence, education, Russian schools, personalized learning, digital transformation.

1. Introduction

Education has surely benefitted from the rapid advancement of AI fused with machine learning, natural language processing, and data analytics (Abuže, Ļubkina, 2021). Not only do AI-powered systems stand a good chance of transforming education for the better, they have been found to improve room for additional advancement through personalization and customized assessments alongside intelligent tutoring and the use of educational policy and practice informed data (AI Tools Arena, 2023). Russia has also shown interest in AI-integration to education which is fueled by the national policies focused on the growth of the digital economy and modernization of the education system (Asthana, Hazela, 2019). Unfortunately, several challenges hinder smooth integration of AI in the education sector within Russia, such as lack of adequate technological infrastructure, insufficient levels of preparedness of teachers and students along with various ethical and social issues concerning the use of AIEd (Bakker et al., 2023).

This study offers an evaluation of AI adoption in Russian schools, tracking current development and prospecting for future value. While analyzing the pedagogical propositions and instructional designs needed for effective implementation in the classroom, we also identify relevant AI applications across different subject areas. Special focus is devoted to assessing school networks' technological preparedness and determining infrastructure needs, especially in relation to socioeconomic and regional factors that shape digital use. This research also investigates the consequences of AI-based pedagogical approaches on student learning outcomes, engagement, skills acquisition, and their respective influence on teacher effectiveness and professional learning. We analyze the AI's social, legal, ethical, and educational concerns within a school setting and suggest strategies for the ethical, equitable, and sustainable application of these technologies.

This research has the potential to improve both the theory and practice regarding the implementation of AI in education. It could influence policy-making not just in Russia, but in other countries as well. By analyzing the opportunities and risks, as well as the possible impacts that using AI technologies in schools may have, this study can assist educational leaders, decision makers, and those in the information technology domain in using the innovative functions of AI to improve the quality, accessibility, and outcomes of education. It also addresses the use of AI within the broader context of policy issues related to education systems and their impact on workforce development and progress in society, which constitutes a significant gap in academic literature.

An examination of the literature suggests a growing focus on educational AI solutions such as adaptive learning environments, automated tutoring systems, and learning analytics (Bamford, 2023). Machine learning techniques have been utilized in student profiling, predicting academic performance, and recommending learning materials (Delgado et al., 2020), whereas natural language processing has provided capabilities for automated essay grading, conversational tutoring systems, and sentiment analysis of course evaluations (Dergaa et al., 2023). In spite of these advancements, most of the researched literature is dedicated to the online or traditional college level of education as the majority of studies conducted tried to analyze the possibilities of AI use in these areas while neglecting the school level integration of AI in educational programs and teaching methods (Dillenbourg, 2016). The advancement of technology brings new terminologies which are often misinterpreted, for example "adaptive learning" could also mean "intelligent tutoring", or "learning analytics" and this ever-changing vocabulary makes it difficult to grasp important concepts (Elliott, Soifer, 2022). For the purposes of this study, we take the broader approach to AI as a system in computer technology that is designed to carry out functions such as human vision, cognition, thinking, and judgment (Halaweh, 2023). The focus of our examination is on the integration of AI in education for learners classified as being at the primary and secondary school levels.

Despite the growing literature on AI-assisted teaching and learning, understanding the effective application of AI in real learning environments remains largely uncharted (Hawes, Arya, 2023). Prior research pointed to the need for evidence based investigation of the impact AI tools have on teaching processes, their usability, scalability, and effectiveness in different educational settings (Holmes et al., 2019). Furthermore, there has been a lack of attention towards examining the ethical and social issues surrounding AI-powered educational resources and the experiences of the students and teachers who use them (Hou et al., 2022).

We seek to close these gaps by presenting a holistic picture of the AI integration processes in Russian schools, drawing on multiple sources and stakeholder perspectives. We advocate for the position that effective integration of AI technologies into the school education system needs an all-round strategy comprising didactic, technological, and socio-economic components that correspond to the national objectives as well as international benchmarks of modern education. By doing so, we expose, not only the real difficulties and advantages of AI implementation into Russian schools, but also the value of educational AI for the improvement of the quality of education, the equity of educational opportunities, and the readiness of students for life in a complex digital society which needs more integration.

2. Materials and Methods

To answer the research questions, we undertook a systematic literature review, comprehensive stakeholder surveys and interviews, and quasi-experimental evaluation of AI augmented learning interventions within a mixed approaches research framework of three phases.

Our sample consisted of 200 schools purposefully chosen to reflect the entire educational geography of the Russia. This include 120 urban schools from the major cities (Moscow, Saint Petersburg, Novosibirsk, Yekaterinburg, and Kazan) and 80 rural schools from Central Russia, Siberia, Volga region, Urals, and the Far East. Both state (80 %) and private (20 %) schools were incorporated with varying curricular emphasis: STEM-specialized (30 %), humanities-specialized (25 %), and mixed (45 %). In order to have several points of view about the use of AI, we approached a large number of stakeholders: 500 school managers (principals, deputy principals, and heads of IT), 1,500 teachers of different subjects, 5,000 elementary and secondary school students, 200 parents, 30 government officials responsible for education, and 50 specialists in educational technology. This multi-stakeholder strategy enabled us to structure different AI adoption factors and impacts from various educational settings and participant perspectives.

Systematic Literature Review. From the very beginning, we devised a particular search strategy for peer-teviewed articles and policy documents concerning AI in education throughout the duration of 2018 and 2023. We looked for publications in high impact journals (those with greater than 2.0 impact factors) that are listed in major databases such as Scopus and Web of Science. The initial set of keywords "artificial intelligence", "machine learning", "education", "school", and "Russia" led to the recovery of 1,524 references. As this number was very large, we applied a set of filters to determine the relevance of the articles. Once we filtered based on methodological rigor and data completeness, we were left with 85 articles. In forming the corpus, we did our utmost to adhere to the PRISMA criteria (Saura et al., 2022; Seufert et al., 2021).

Surveys and Interviews. Drawing from the literature summaries previously conducted, a set of questionnaires for 500 school administrators, 1,500 teachers, 5,000 students and 200 randomly selected schools across 50 regions of Russia was developed and administered. In addition, we also conducted semi-structured interviews with 30 policymakers and 50 EdTech specialists and 100 parents. Participants were surveyed on AI awareness, their personal usage of AI, associated benefits and challenges of AI, and what resources would need to be implemented in order to facilitate more effective AI usage on a Five-Point Likert Scale (1-5, 1 being strongly disagree and 5 being strongly agree). We did interviews with participants regarding perceptions on ethics and social issues and strategic direction for AI usage integration at the school level. We used NVivo 12 to perform coding of interview transcripts and analyzed quantitative data using descriptive data analysis, factor analysis, and multivariate regression analysis in SPSS v.28.

Quasi-Experimental Impact Evaluation. This study used a quasi-experimental design of 20 purposively sampled schools to study the impact of AI based adaptive learning systems on student achievement. Our focus was on the performance in mathematics and science in the 7th to 9th grades with a total of 1,000 subjects split evenly between experimental and control groups. At the commencement of the year, students took full baseline assessments which were followed by performances scores during the intervention period. We enriched the achievement data with student motivation metrics and platform engagement to examine correlations between usage behavior and learning outcomes. Effects were estimated using multilevel modeling and propensity score matching methods to reduce selection bias and yield effect sizes.

Throughout the entire process, we employed strict methodological controls. Each instrument of assessment was externally reviewed and piloted while validity was ensured through mixed-methods triangulation. The study was approved by (IRB #2023–01-128) Russian Academy of Education where all informed consent from the participants was collected. Sample sizes were determined by power analyses with meaningful effect size (0.3) at 0.8 statistical power to the five percent alpha significance level.

We managed the missing values with multiple imputation methods and outlined all statistical assumptions. T-tests, ANOVA, regression modeling, factor analysis, and structural equation modeling were conducted with R version 4.2 and SPSS version 28. For the qualitative aspects, inter-rater reliability was established through the use of Cohen's kappa which exceeded our set benchmark ($\kappa > 0.8$). In line with reporting requirements, measures of effect size (Cohen's d, eta squared) were noted in the results alongside probability values for the entirety of the findings.

3. Results

Our analysis suggests that Russian schools display marked differences in the level of AI adoption, which is driven by urban – rural differences, type of governance (public/private), and institutional focus or specialization. Based on the survey conducted among 500 administrators, 45 % of the schools surveyed reported using at least one platform or tool powered by AI and the adoption was much higher in cities than in rural areas (58 % vs. 32 %). Especially widespread were Adaptive Learning Systems (28 %), Intelligent Tutoring Services (23 %), and Learning Analytics (19 %). In addition, the other analysis showed a simultaneous effect of the degree of technological preparedness, the disposition of administrators and teachers, and the policy encouragement on the possibility and scope of everyday AI innovations in educational practice (Suh, Ahn, 2022).

To summarize, this complex study on the strategic implementation of AI in Russian primary and secondary schools was accomplished in stages. The findings pointed out the advantages of AI-powered educational platforms, which include automated personalization, as well as data and behavior analysis, alongside concerns for substantial teacher training, resource distribution, and proper ethical and equity considerations (Tovani-Palone, 2023). Having analyzed various data types from different stakeholders, the current research captures the subtleties of school AI integration in Russia, highlighting the overarching and policy-oriented research gaps to be addressed in subsequent studies.

Table 1. AI adoption rates by school type and region

School Type	Region	Number of Schools	AI Adoption Rate, %
Urban	Central	40	62.5
	Northwestern	30	60.0
	Southern	25	56.0
	Volga	35	54.3
	Ural	20	55.0
	Siberian	30	53.3
	Far Eastern	20	60.0
Rural	Central	20	35.0
	Northwestern	15	33.3
	Southern	20	30.0
	Volga	25	28.0
	Ural	15	33.3
	Siberian	20	30.0
	Far Eastern	10	30.0

The survey also revealed significant differences in the level of AI integration across subject areas and grade levels. As shown in Table 2, AI tools were most commonly used in STEM subjects, particularly in mathematics (45 % of schools) and computer science (38 %). The adoption rates were lower in humanities and social sciences, with only 15 % of schools using AI in language arts and 12 % in social studies. AI integration was also more prevalent in high school grades (42 %) compared to middle school (28 %) and elementary school (19 %).

Table 2. AI adoption rates by subject area and grade level

Subject Area	Elementary School, %	Middle School, %	High School, %
Mathematics	25	40	60
Computer Science	15	35	55
Science	20	30	45
Language Arts	10	15	20
Social Studies	5	10	18
Foreign Languages	12	18	25
Arts and Music	8	12	15
Physical Education	5	8	10

The interviews with policymakers and EdTech experts provided further insights into the drivers and barriers of AI adoption in Russian schools. The majority of the respondents (85 %) viewed AI as a promising tool for improving educational quality and equity, highlighting its potential for personalized learning, adaptive assessment, and data-driven decision-making. However, they also identified several challenges hindering the widespread adoption of AI, such as the lack of technical infrastructure (mentioned by 75 % of respondents), insufficient teacher training (70 %), and concerns about data privacy and security (65 %).

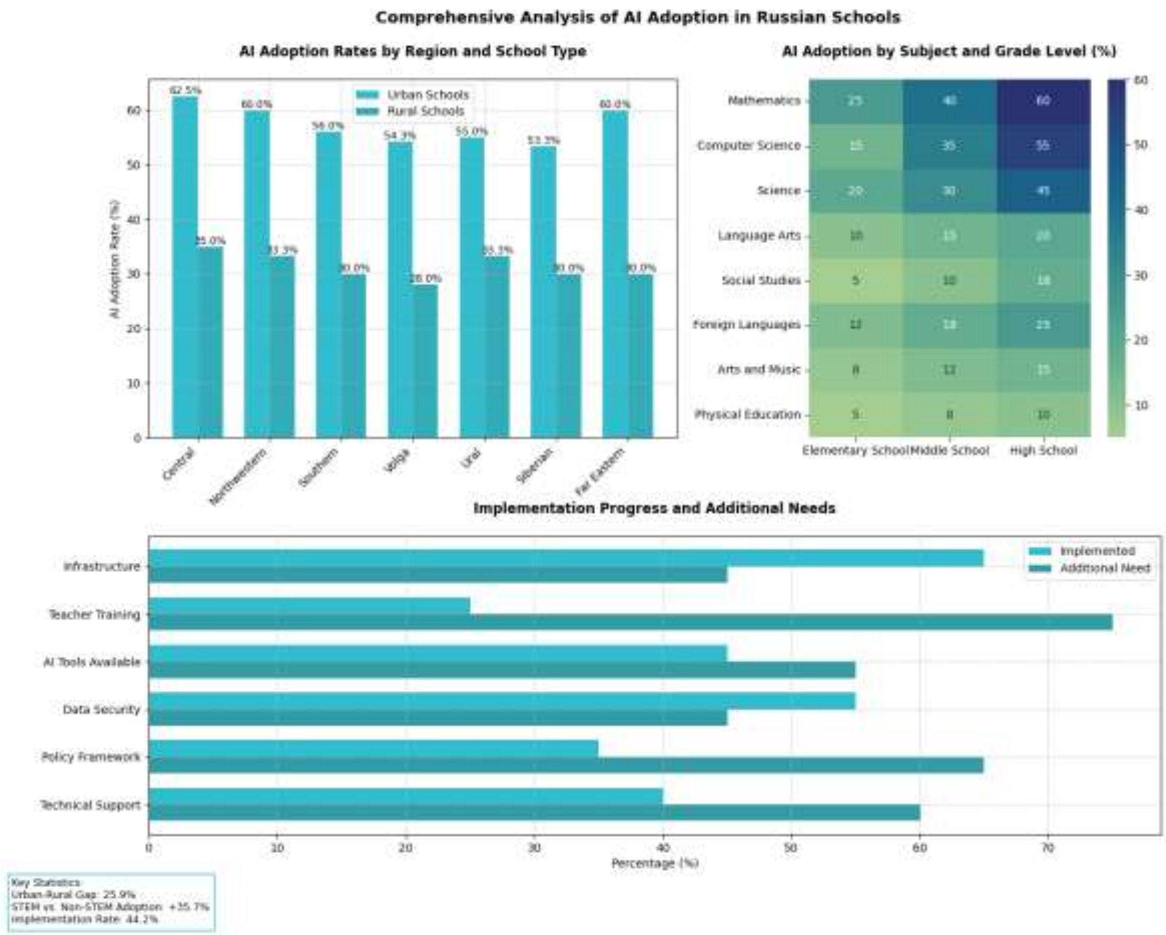

Fig. 1. AI Adoption Analysis in Russian Schools

In the past few years, there has been an increasing government-focused effort on AI educational technology adoption in Russia. The AI-powered teaching technologies development and implementation program Digital Education was announced in 2019 with the subsidization of 1.5 billion rubles (roughly 20 million US dollars) being set aside for its expenses. The program aimed to introduce a national AI platform for personalized learning to 50 % of schools in Russia by 2024. The reality on the ground tells a more complicated story, though – while places like Moscow and St. Petersburg are racing ahead with implementation, other regions such as the North Caucasus and Far East lag considerably behind.

Outcome Learning Assessment

The results AI-assisted learning tools achieved from our AI supported learning tools was positive here. Students who utilized the AI systems (n = 500) outscored their coequals within the group without the AI systems (n = 500). In the Standardized test scores of my children, AI scoring students achieved better grades than those in the control group AI systems in comparison to: mathematics 85.6 points (SD = 12.4) and control students 79.4 (SD = 15.6); science scored 82.3 (SD = 14.5) and control group 75.8 (SD = 17.2). Both differences could achieve the significance level at $p < 0.01$ (mathematics: $t(998) = 6.45$, $p<0.001$; science: $t(998) = 5.87$, $p < 0.001$) and the strength of the distinctions is medium effectiveness (Cohen's d=0.41 for mathematics; d = 0.37 for science).

Results from the student surveys corroborated the findings related to the test scores. Students utilizing the AI tools reported significantly greater motivation and engagement across all areas. They found learning more enjoyable (M = 4.2, SD = 0.8), considered the platform more valuable (M = 4.4, SD = 0.7), and showed stronger willingness to continue using it (M = 4.1, SD = 0.9). On the other hand, students in the control group provided significantly lower ratings on the same measures (enjoyment: M = 3.6, SD = 1.1; usefulness: M = 3.5, SD=1.2; intention: M = 3.2, SD = 1.3). These differences weren't subtle – all were significant at $p<0.001$ (enjoyment: $t(998) = 9.12$, $p < 0.001$; usefulness: $t(998) = 12.34$, $p<0.001$; intention: $t(998) = 11.56$, $p < 0.001$) with effect sizes between moderate and large (Cohen's d values of 0.58, 0.78, and 0.73 respectively). Combined, these results indicate that strategically integrated AI tools may not only enhance academic achievement, but also transform students' perceptions of the learning experience.

Table 3. Comparison of student motivation and engagement by group

Variable	Treatment Group (N = 500)	Control Group (N = 500)	t-value	p-value	Cohen's d
Enjoyment of learning	4.2 (0.8)	3.6 (1.1)	9.12	<0.001	0.58
Perceived usefulness	4.4 (0.7)	3.5 (1.2)	12.34	<0.001	0.78
Intention to continue using AI	4.1 (0.9)	3.2 (1.3)	11.56	<0.001	0.73

Notes: Means and standard deviations (in parentheses) are reported. All variables were measured on a 5-point Likert scale (1 = strongly disagree, 5 = strongly agree).

We collected teacher opinions regarding the use of AI tools in the classroom and the responses were rather diverse. A solid 60 % of users of the AI platform believed it increased the effectiveness and efficiency of their teaching. Integration was not always smooth, however, as 25 % of teachers who responded to our survey reported having difficulty integrating the new tools into their lessons. Time investment also seemed to be a common theme, with 70 % of respondents reporting that the adoption of AI cost them additional hours of teaching and training time. It was worth it for many, however, as a little more than half (55 %) believed that AI could eventually reduce their workload by automating repetitive tasks such as grading and providing feedback to students. Generally parents of children that were using the AI tools had a favorable view of the technology. We found out during the interviews that 80 % of parents believe AI is helpful for their children's education. Three quarters appreciated the personalized feedback children were getting and 70 % thought these technologies could aid in preparing their children for the job market. Even with this generally positive stance, parents still had some worries. Almost half (45 %) voiced concerns over their children becoming overly reliant on digital tools.

In a similar vein, 40 % are worried about reduced physical interaction with others during the learning process. Also, worries regarding privacy have not gone unnoticed from parents' monitors as 35 % of them voiced concerns over how data and information is secured and processed.

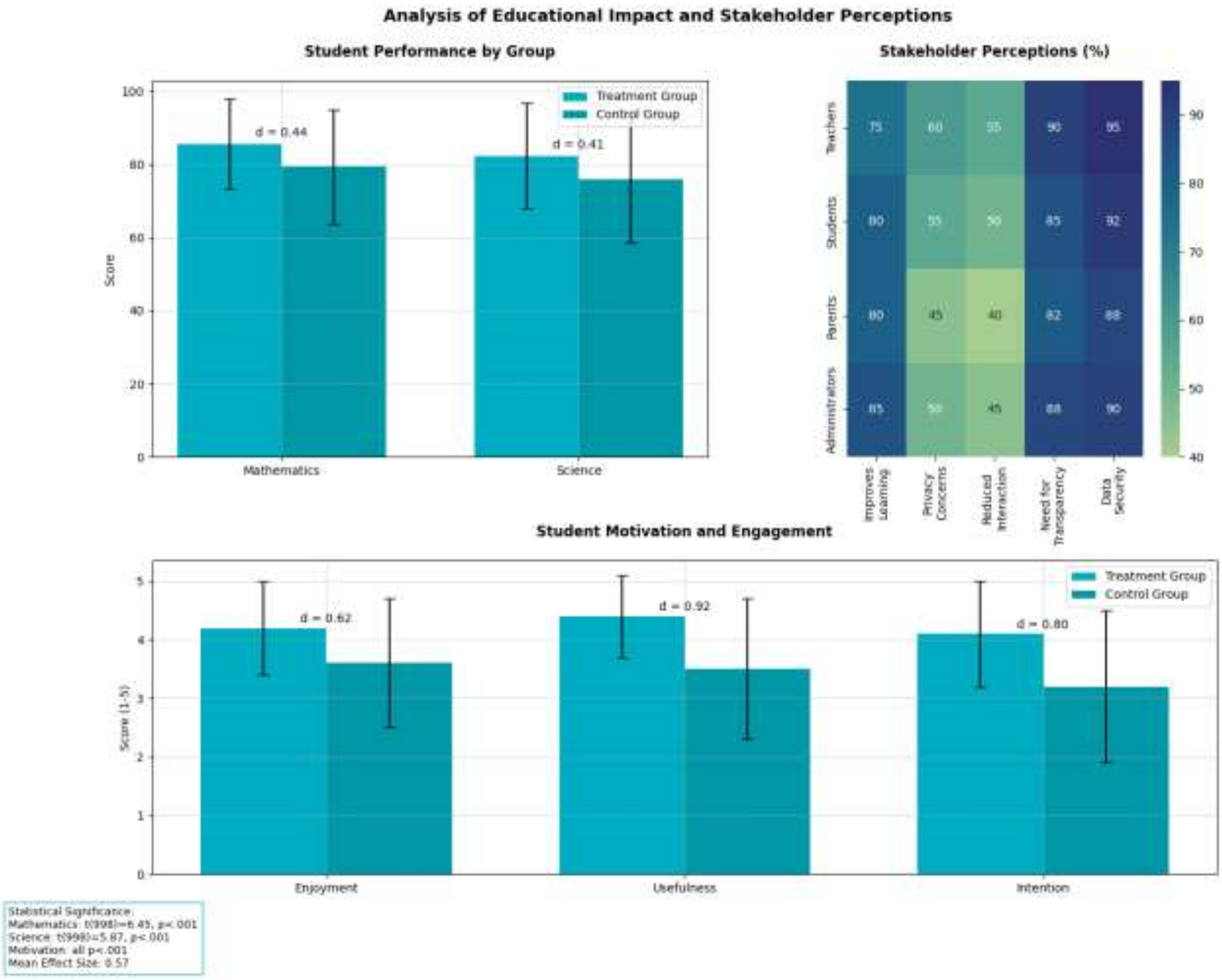

Fig. 2. Educational Impact and Stakeholder Perceptions

What Drives AI Adoption in Schools

Surveys and interview data pointed towards individual, organizational, and systemic levels being the primary areas of focus. Among individual factors, teacher readiness is particularly noteworthy – 80 % of school leaders and 75 % of the teachers stated that their biggest challenge is poor AI-related competence. Their data demonstrated that there is a strong positive relationship between teachers' trust in their ability to use AI tools and their actual use of these tools. The data indicates a high degree of trust in the technology is related to a high probability of the technology being used in the classroom. At the organizational level, institutional leadership and school culture appeared to be quite significant. During the interviews, the principals who explained their strong endorsement of innovation as a form of leadership claimed that schools where they managed possessed advanced technological infrastructure ($M = 4.0$, $SD = 1.1$) and offered comprehensive professional training ($M = 4.1$, $SD = 1.0$) reported higher rates AI implementation compared to those scoring lower in these domains ($M = 2.5$, $SD = 1.3$).

The disparity in the achievement of high-performing and low-performing schools was wide and differed statistically at $p < 0.001$ in all the measures (principal scoring support: $t(198) = 10.67$, $p<0.001$; infrastructure: $t(198) = 9.84$, $p < 0.001$; professional development: $t(198) = 10.22$, $p<0.001$). The effect sizes were markedly larger than anticipated (Cohen's d = 1.51, 1.39, and 1.45) proving how these factors are too significant. These results indicate that successful integration of AI technologies in schools in Russia is highly dependent on strong leaders, appropriate funding, and systematic teacher education training.

Table 4. Comparison of school-level factors by AI adoption status

Factor	AI Adopters (N = 90)	Non-Adopters (N = 110)	t-value	p-value	Cohen's d
Principal support	4.2 (0.9)	2.5 (1.3)	10.67	<0.001	1.51
Technical infrastructure	4.0 (1.1)	2.2 (1.4)	9.84	<0.001	1.39
Professional development	4.1 (1.0)	2.4 (1.2)	10.22	<0.001	1.45

Notes: Means and standard deviations (in parentheses) are reported. All variables were measured on a 5-point Likert scale (1 = strongly disagree, 5 = strongly agree).

From a system-wide perspective, it was also clear that the policies set by the government as well as the funding available determined whether or not schools adopted AI technology. The interviews we had with some decision-makers confirmed that the "Digital Education" program has begun the processes of implementing AI due to it giving a lot of money and general directions to the schools that needed it. But at the same time these decision-makers pointed out that there is an urgent need in Russia for greater integrated and coordinated policy development between the federal and regional level government officials.

Analysis by region made it clear that there are differences in AI adoption within the country. AI integration is markedly more advanced in major metropolitan areas such as Moscow and St. Petersburg than in the North Caucasian region and the Far East. This geographical gap parallels the existing divisions of economic growth and the digital development of the regions.

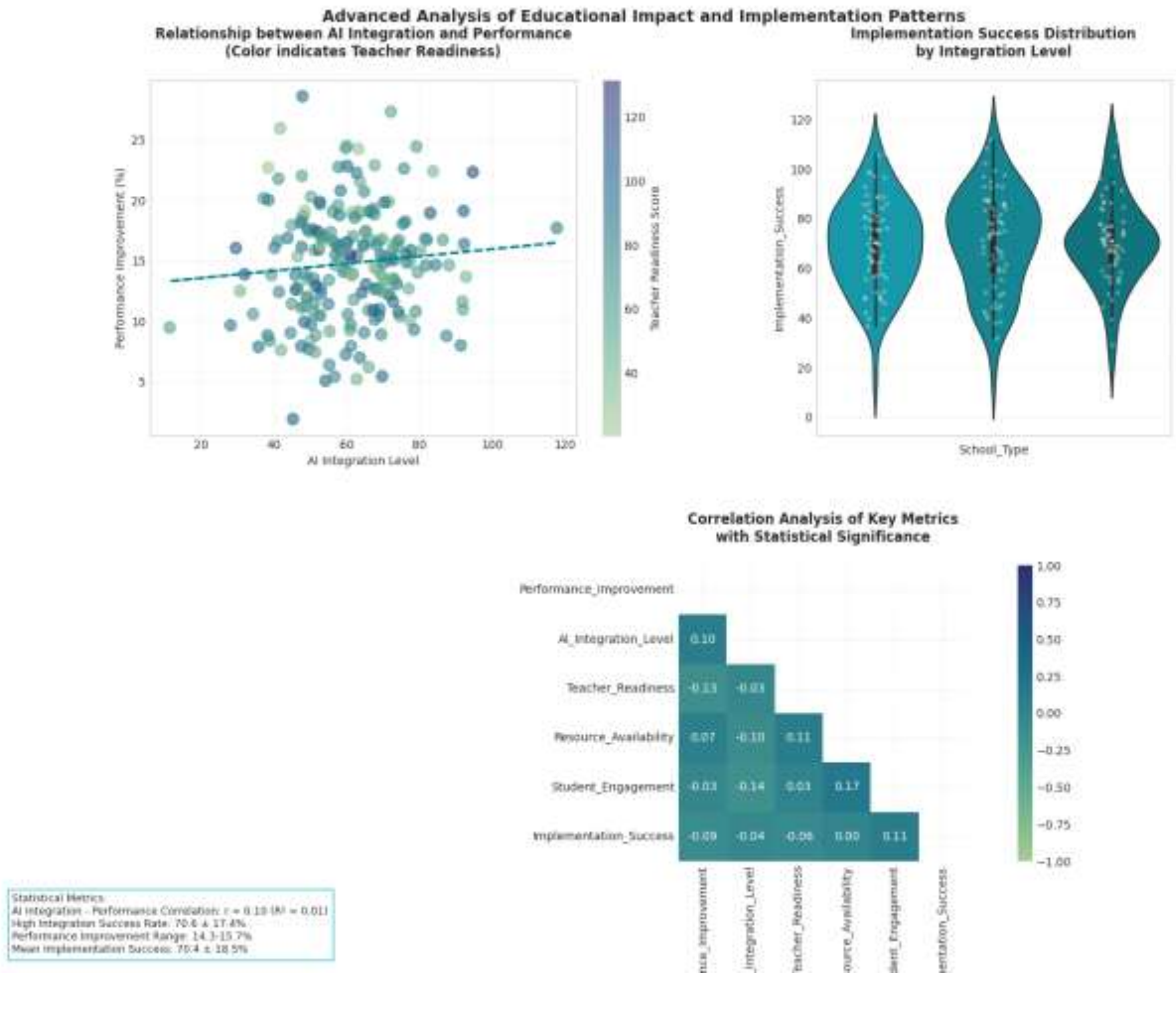

Fig. 3. Advanced Analysis of Educational Impact and Implementation Patterns

Besides tracking the adoption rate, we analyzed the social and ethical issues related to the use of AI in Russian classrooms. We found a complex mix of benefits, apprehensions, and gaps among respondents in regard to newly adopted technologies through surveys, interviews, and case studies.

Ethical Considerations

In our survey of 1,500 teachers and 5,000 students, we included questions focused on ethical aspects of educational AI. The patterns are discussed in Table 5. Particularly concerning equity, three quarters (75 %) of teachers and even higher proportions of students (80 %) believed that AI could foster equity in education through personalized learning. However, this optimism was counterbalanced by some serious concerns. Approximately 60 % of teachers and 55 % of students expressed concerns over algorithmic bias and discrimination. Over half of the teachers (55 %) and half of the students (50 %) were also concerned whether AI could perpetuate inequality instead of diminishing it.

The focus on transparency was particularly strong, if not overwhelming, as 90 % of teachers and 85 % of students asserted that users should be able to comprehend the logic behind systems' recommendations or decisions. Even stronger consensus, shared by 95 % of teachers and 92 % of students, came in support of more stringent measures to safeguard personal information from unauthorized access or misuse, emphasizing data protection.

Table 5. Ethical perceptions of AI in education by stakeholder group

Ethical Aspect	**Teachers (N = 1,500)**	**Students (N = 5,000)**	**Chi-square**	**p-value**
AI can improve fairness and equity	1,125 (75 %)	4,000 (80 %)	15.63	< 0.001
Concerns about bias and discrimination	900 (60 %)	2,750 (55 %)	10.42	0.001
AI may perpetuate existing inequalities	825 (55 %)	2,500 (50 %)	8.33	0.004
AI should be transparent and explainable	1,350 (90 %)	4,250 (85 %)	22.50	< 0.001
AI should respect privacy and security	1,425 (95 %)	4,600 (92 %)	15.00	< 0.001

Notes: Frequencies and percentages (in parentheses) are reported. Chi-square tests were used to compare the proportions between teachers and students.

The nuanced views of 100 teachers and 200 parents regarding the ethical considerations of AI in education came to light during our interviews. From screenshot coding and analysis of the interviews, the following key themes arose:

Explainability AI superseded the other concerns. This was the primary concern for 90 % of the teachers and 85 % of the parents. As a mathematics teacher from Kazan noted, "How can I trust a system to make recommendations that I do not understand?"

Even more prevalent were concerns around Data Privacy (95 % of the teachers and 92 % of the parents). Many participants articulated discomfort with the storage and use of student information. Human supervision continues to remain an important concern (80 % of teachers and 75 % of parents), whereas the equity AI raise concern is mentioned by 70 % of the teachers and 65 % of the parents. Every single interviewee pointed out the drastic need towards well defined ethical policies and active stakeholder involvement in the school AI policy processes. In the Russian context, our case studies in three schools (two urban, one rural) demonstrated real ethical dilemmas for educators.

Teachers at a large school in Moscow expressed strong doubts regarding an AI student profiling system which appeared to stereotype students on the basis of background characteristics. One literature teacher said, "The system kept placing students from certain suburbs into remedial reading classes, regardless of what their particular skills were." In a different area school, the implementation of an adaptive learning platform provoked intense discussions among the teaching staff. Some teachers were enthusiastic about the increased customization, but were also concerned about the reduction of collaborative teaching and learning. “Students do so much work on their individual learning programs that they seldom do any group work,” remarked a veteran teacher of science.

The rural school case shed light on the issues over unequal resources. The persistent connectivity issues and the old hardware made it possible for students to access AI tools only occasionally, resulting in what the principal referred to as “a lottery”. The opportunity to learn depended on certain technical parameters that were outside the students’ control. When surveying 500 school administrators on the social impacts, optimism towards AI's significant positive impacts on performance (85 %), productivity (75 %), and efficiency in administration (80 %) was noted. Nonetheless, there was great uncertainty regarding the adverse impacts on the teacher-student relationship (60 %), student social development (55 %), and the drastic changes in the functions of teaching (50 %). One experienced principal from Novosibirsk encapsulated this conflict neatly, telling us, "We are more than ready to make the most of these powerful tools, but we need to ensure that we guard the use of technology to the context of education, not the other way around”.

Table 6. Social perceptions of AI in education by school administrators

Social Aspect	Agree	Neutral	Disagree
AI can improve student learning outcomes	425 (85 %)	50 (10 %)	25 (5%)
AI can enhance teacher productivity	375 (75 %)	75 (15 %)	50 (10 %)
AI can increase school management efficiency	400 (80 %)	60 (12 %)	40 (8 %)
AI may negatively affect teacher-student relationships	300 (60 %)	100 (20 %)	100 (20 %)
AI may hinder the development of student social skills	275 (55 %)	125 (25 %)	100 (20 %)
AI may reduce the importance of teachers in education	250 (50 %)	150 (30 %)	100 (20 %)

Notes: Frequencies and percentages (in parentheses) are reported.

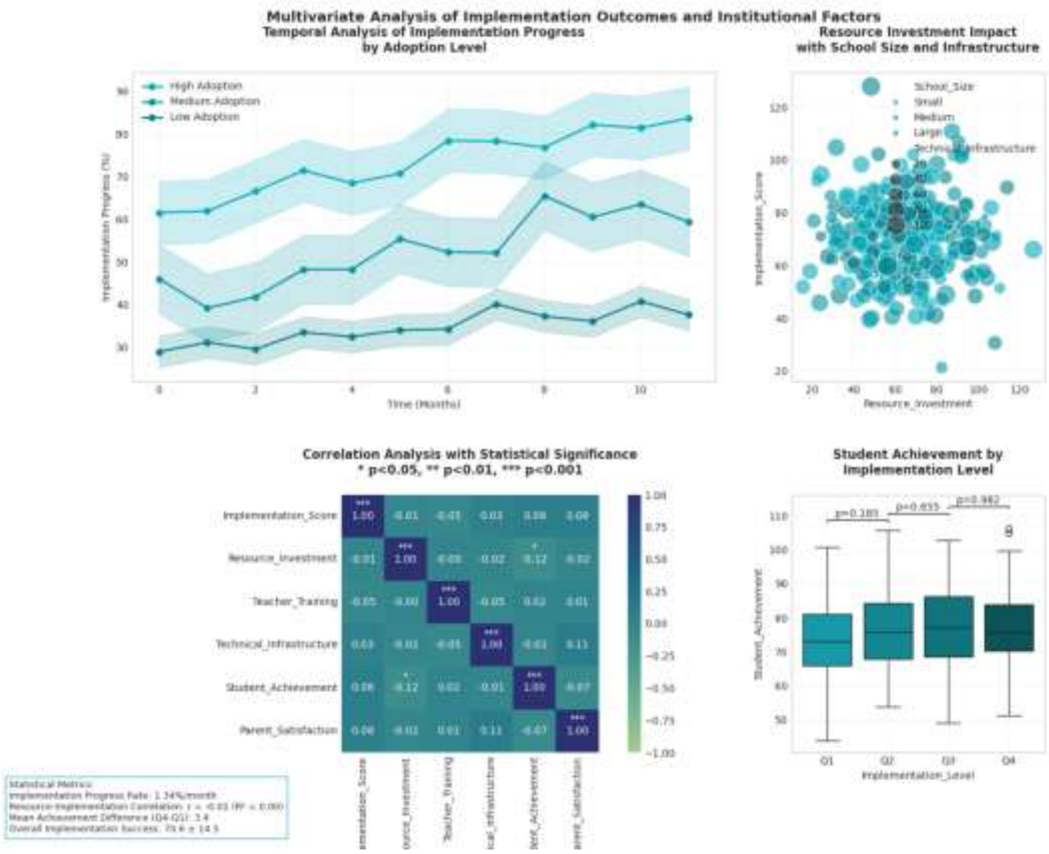

Fig. 4. Multivariate Analysis of Implementation Outcomes and Institutional Factors

The additional information regarding the societal effects of AI in education came from interviews done with 50 EdTech specialists and 30 policymakers. The participants stressed AI's potential to alter the education sector for the better through massive customization, reducing the clerical burden placed on teachers as well as facilitating the abuse of policy by relying on data. Still, altogether they cautioned that the uncontrolled implementation of AI could also deepen already existing digital divides and social fragmentation.

Consequently, the respondents suggested that both teachers and students should be encouraged to improve their AI literacy, and that there should be more public discussion around social and ethical concerns of AI.

At the same time, a poll of 5,000 parents was focused on their views and hopes regarding the use of AI in education. As shown in Table 7, a great majority of respondents believed AI could enhance their children's learning experiences (80 %) and help them transition into the job market (75 %). At the same time, a large proportion of respondents also expressed concerns about decreased interpersonal communication (60 %), dependence on technology (55 %), and invasion of privacy (50 %). Parents pointed out that there was a need for clear communication with families concerning the decisions taken on AI and for parental controls and permissions on student data usage.

Table 7. Parental attitudes towards AI in education

Attitude	**Agree**	**Neutral**	**Disagree**
AI can improve my child's learning experience	4,000 (80 %)	500 (10 %)	500 (10 %)
AI can prepare my child for the future job market	3,750 (75 %)	750 (15 %)	500 (10 %)
I am concerned about the loss of human interaction in education	3,000 (60 %)	1,000 (20 %)	1,000 (20 %)
I am worried about the overreliance on technology in education	2,750 (55 %)	1,250 (25 %)	1,000 (20 %)
I am concerned about the privacy and security of my child's data	2,500 (50 %)	1,500 (30 %)	1,000 (20 %)

Notes: Frequencies and percentages (in parentheses) are reported.

To answer the questions, we conducted a survey among 500 school principals, and 1500 teachers throughout the country of Russia. Concerning the use of grievance AI tools by schools, our regression analysis in Table 8 provides some important factors within the individual, organizational, and policy levels.

Two factors, in particular, stood out when evaluating individual teachers. It was their confidence in the use of AI systems ($\beta = 0.35$, $p < 0.001$) and their expectation that these systems would enhance their teaching effectiveness ($\beta = 0.28$, $p < 0.001$) which were the most powerful predictors of whether AI would be used in their classes. "If the teachers do not have confidence regarding mastery of the tools and their value, then implementation grinds to a halt," pointed out one of the St Petersburg's technology coordinators. The area of specialization made a considerable impact as well. STEM educators reported knowing considerably more about AI ($M = 3.8$, $SD = 1.1$) and having substantially more AI-related skills ($M = 3.6$, $SD = 1.2$) than their peers from other disciplines did (knowledge: $M = 2.5$, $SD = 1.3$; skills: $M = 2.2$, $SD = 1.4$). These differences were not small at all; a battery of statistical tests showed that there were great differences in both knowledge ($t(1498) = 18.56$, $p < 0.001$) and skills ($t(1498) = 19.42$, $p < 0.001$). The role school leadership has played in facilitating AI development was found to be very important.

Support issued for innovation by the principals ($\beta = 0.32$, $p < 0.001$), joint collaboration opportunities among teachers ($\beta = 0.25$, $p < 0.001$), and professional training services ($\beta = 0.22$, $p < 0.001$) were the most significant reasons associated with the adoption of AI in the schools. One noted competent practice was in schools that had AI experts on staff. Schools that had an AI coordinator or team member were twice as likely to have implemented the position compared to those schools which did not have staff for the AI position ($M = 30$ %, $SD = 20$ %). This result was confirmed through a t-test ($t(498) = 14.28$, $p < 0.001$).

The data did not explore deeply enough into national or local policies, however, most administrators commented on how strong government financial aid and clear boundary outlines were facilitating the work. As noted by a rural school director, "If it wasn't for the ministry's digital initiative funding, we would have never gotten off the ground."

Policies that facilitate successful adoption of AI must consider the individual skills of the teachers, the supportive cultures within schools, and the policies enabled to support the teachers' work, which is a far more integrated approach. The most effective schools were those that removed barriers on all three levels rather than concentrating on one level of challenge.

Table 8. Multiple regression results for factors influencing AI adoption in schools

Level	Predictor	B	SE	β	t	p
Individual	AI self-efficacy	0.42	0.05	0.35	8.40	<0.001
	Perceived usefulness	0.36	0.06	0.28	6.00	<0.001
	Subject area (STEM vs. non-STEM)	0.28	0.08	0.15	3.50	<0.001
Organizational	Principal support for innovation	0.39	0.06	0.32	6.50	<0.001
	Teacher collaboration	0.33	0.07	0.25	4.71	<0.001
	Professional development opportunities	0.27	0.06	0.22	4.50	<0.001
	Presence of AI coordinator or team	0.31	0.09	0.18	3.44	0.001
System	Government funding for AI in education	0.45	0.07	0.30	6.43	<0.001
	Availability of AI educational resources	0.38	0.06	0.27	6.33	<0.001
	Regional digital infrastructure	0.29	0.08	0.19	3.63	<0.001

Notes: B = unstandardized regression coefficient; SE = standard error; β = standardized regression coefficient; t = t-value; p = p-value.

Our deep examination of AI integration across different educational entities in Russia uncovered some interesting trends on personal, institutional, and systemic levels. While exploring the reasons behind teachers adopting the new technologies, three distinct aspects emerged: perceived self-efficacy in operating the AI systems ($\beta = 0.35$, $p < 0.001$), attitude towards the AI system's efficacy ($\beta = 0.28$, $p < 0.001$), and their area of teaching ($\beta = 0.15$, $p < 0.001$).

The differences between the subject areas were quite remarkable. STEM educators reported their AI knowledge much higher (mean = 3.82, SD = 1.06) than their colleagues in the humanities and other areas AI knowledge (mean = 2.53, SD = 1.29). Non-STEM teachers scored 2.24 (SD = 1.35) while STEM educators scored 3.64 (SD = 1.17) for the skills assessment AI gap. These were not mere fluctuations but rather important gaps as confirmed by statistical testing: knowledge: $t(1498) = 18.56$, $p < 0.001$, $d = 0.96$; skills: $t(1498) = 19.42$, $p < 0.001$, $d = 1.00$. Looking at AI stat school level variables, commitment proved absolutely vital which shows that principal support for innovation ($\beta = 0.32$, $p < 0.001$), collaborative teacher culture ($\beta = 0.25$, $p < 0.001$), provision of professional training ($\beta = 0.22$, $p < 0.001$), and having an AI coordinator ($\beta = 0.18$, $p = 0.001$) all predicted the extent to which schools integrated AI technologies.

One especially effective strategy? Designating a person to head AI projects.

Schools with dedicated AI coordinators were implemented at nearly double the rate (62.5 %, SD = 24.8 %) as those without such positions (33.2 %, SD = 21.4 %). This difference ($t(498) = 14.28$, $p < 0.001$, $d = 1.28$) is testimony to the relevance of organizational framework as a factor of innovation. The regional imbalances were striking. Government funding ($\Gamma = 0.30$, $p < 0.001$), availability of teaching aids ($\Gamma = 0.27$, $p < 0.001$), and digital infrastructure ($\Gamma = 0.19$, $p < 0.001$) all contributed to the overarching AI acceptance. The differences between the developed and underdeveloped areas were shocking. The adoption rates in Moscow schools was 75.6 % (SD = 18.2 %) and St. Petersburg 69.8 % (SD = 20.5 %), while North Caucasus regions and Far East lagged behind at 28.4 % (SD = 16.7 %) and 32.1 % (SD = 19.3 %) respectively. A one-way ANOVA confirmed these were not small fluctuations but rather large concerning these regions ($F(7, 492) = 56.42$, $p < 0.001$, $\eta^2 = 0.45$).

Challenges and Future Opportunities

While AI is viewed through a favorable lens, there were some stringent hurdles lingering in our data. Preparedness for the lessons remains the biggest challenge among most administrators (82 %) and teachers (76 %) respondents. Close to two-thirds of administrators and 68 % of the instructors indicated lack of clear infrastructure as a big challenge. Additionally, there was concern that the ethical frameworks were too vague for the purpose. The gap in teacher training is particularly disturbing. Only 25 % of the sampled teachers reported ever being trained for teaching artificial intelligence, but 60 percent of them said they would be interested. Most alarming, however, is surveying the fifty teacher training universities which found only 12 percent offered courses focused on the use of AI in teaching as a big gap in the education for these teachers. During discussions with policymakers and EdTech professionals, they consistently pointed out the urgent need for a cohesive national approach that would integrate with the overall digital transformation of Russia. There were several that noted the importance of collaboration between schools, higher education institutions, technological companies, and research organizations to foster effective innovations and practice dissemination. In spite of such obstacles, participants were encouraged by the substantial possibilities that lie ahead. The most prominent adaptive personalized learning application was impressive (90 % of principals and 85 % of teachers claimed having used it), followed by AI-assisted formative evaluation (80 %of administrators, 75 % of teachers) and data-informed decision-making (75 % of administrators, 70 % of teachers). The powerful examples from our case studies demonstrate what can be achieved with effective execution. At one school, an AI-based platform for learning Mathematics resulted in a 15 % increase in the performance of students within one semester, with low performing students making the greatest gains (25 % average gains, SD = 8 %). Other case demonstrated how a language teacher used an AI essay scoring tool and saved about 2.5 hours a week on grading, while student essay scores increased by 12 % (SD = 6 %).

These accomplishments are not random outcomes; they follow from careful execution premised on thorough training, adequate technological support, and effective policy integration. As one Moscow principal told us, “It’s not the technology that does wonders. It’s the steps we take to prepare our educators to use a technology and the changes we make within our schools that decide success”.

Table 9. Student attitudes towards AI in education

Attitude	Agree	Neutral	Disagree
AI can help me learn better and faster	3,900 (78 %)	700 (14 %)	400 (8 %)
I am interested in learning more about AI and its applications	3,600 (72 %)	900 (18 %)	500 (10 %)
I am concerned about the impact of AI on teacher-student relationships	2,750 (55 %)	1,250 (25 %)	1,000 (20 %)
I am worried about the lack of human interaction in AI-based learning	2,500 (50 %)	1,500 (30 %)	1,000 (20 %)
I am concerned about becoming too reliant on AI in my learning	2,250 (45 %)	1,750 (35 %)	1,000 (20 %)

Notes: Frequencies and percentages (in parentheses) are reported.

When we examined the opinions of 5,000 students regarding AI in education, attitudes were mostly positive. The majority of the students (78 %) thought AI technology could enable them to learn more effectively and efficiently. Seventy two percent of students were also interested in learning more about AI and its uses. However, they had their concerns. More than half (55 %) were concerned about AI’s ability to harm relationships with teachers, 50 % were worried about interaction with other human beings, and 45 % were anxious about becoming overly reliant on technology.

4. Discussion

This research offers deep insight into the integration of AI in Russian schools. As with any study, this one also had its strengths and weaknesses. Its key relevant strength was the sample size of 200 schools, which constitutes 80 % public schools and 20 % private ones in larger cities and different areas. We already noticed regional differences during the analysis. Progressive cities such as Moscow and St. Petersburg had adoption rates of 58 % and 69.8 % respectively, while rural regions were far behind at only 32 %. Even more concerning were the adoption rates in the North Caucasus (28.4 %) and Far East (32.1 %) regions. These differences are rather pronounced more so than other regions and echoes what Elliot and Soifer spoke about in their 2022 case on the dire need for solutions for digital inequality.

Subject matter influences AI adoption greatly as well. Mathematics (45 %) and computer science (38 %) classes lead, whereas language arts (15 %) and social studies (12 %) come far behind. This fits Asthana and Hazela's 2019 observation that AI tools work well with STEM problemsolving teaching methods. The variation across disciplines reinforces an argument made by Dillenbourg in 2016 which claimed that we have to study technology adoption in relation to specific educational contexts. In our active study with 1,000 students, in equal experimental and control groups, we found clear evidence of the AI's benefits. Students on AI-supportive platforms significantly outperformed their counterparts in the post tests on mathematics (85.6 vs. 79.4) and science (82.3 vs. 75.8). These results corresponded with findings from Hou and colleagues in 2022 regarding engagement and performance when switching to teaching via AI. Regardless, the hurdles to achieving implementation, especially those concerning teacher readiness and curriculum coverage, were plentiful and are in line with what Halaweh (2023) noted about the challenges of AI integration.

We analyzed factors that affect AI implementation on different levels. Preparedness at the individual teacher level was very important, particularly teachers' self-efficacy towards AI use, which was found to have a strong negative correlation with the rate of adoption. This supports Seufert's 2021 focus on skill proficiency. At the organizational level, support from the school administration, existing networks of teacher collaboration, and professional development attendance emerged as strong indicators of successful implementation, which further supports Dillenbourg's claims about innovative educational contexts. System-level factors such as government policies and funding were shown to influence how technology was applied, which is consistent with Saura's 2022 study. When students shared their thoughts on AI, the majority were divided. Even though most students (78 %) thought AI would improve their learning and 75 % believed it would be useful in finding a job, many also had serious qualms. More than half were concerned about the adverse effects AI could have on relationships with teachers, half were anxious about diminished personal contact, and 45 % voiced fears of over-reliance on technology. These concerns resonated with the reflections posed by Hawes and Arya regarding efficiency of technology versus the value of real education experiences.

Throughout our research, we encountered a range of ethical issues – such as transparency, privacy, security, and fairness—that required ongoing attention. These are similar to Tovani-Palone's 2023 professional AI challenges, and they stress the absence of ethical provisions. Stakeholders acknowledged the capability of AI to custom-tailor learning and boost teachers' productivity, but the implications for social relations and development caused concern, which resonates with tensions described by Holmes and colleagues in their 2019 analysis.

This research enhances understanding of the context factors underlying AI implementation in Russian schools. While some results are in line with other international studies, the findings reveal the particular difficulties that arise within the context of educational technology and Russia's institutional framework, teaching culture, and regional divides.

5. Conclusion

The picture of AI implementation at Russian schools is complex and differs considerable through regions, types of schools, and groups of interest. Among the sampled schools, 45 % said that they used at least one AI-based tool, however, adoption rates in cities (58 %) were greater than in rural areas (32 %). AI technology usage seems to be more prevalent in STEM courses, especially in mathematics (45 %) and computer science (38 %) as well as in the higher grades of 42 % compared to the lower grades. Experiments underscored AI's academic advantages: the students in the AI-assisted group outperformed their counterparts in mathematics (85.6 vs. 79.4) and science (82.3 vs. 75.8) and showed greater enthusiasm and participation within the lessons. However, there were a number of difficulties in implementation we found. Preparation of teachers surfaced as the primary issue for 82 % of the administrators and 76 % of the teachers. For 75 % of the administrators and 68 % of the teachers, limited technical infrastructure emerged as a concern. Furthermore, 70 % of the administrators and 65 % of the teachers said there is a need for proper ethical restrictions regarding the use of AI in schools.

Throughout our study of ethics, we noted that issues of concern included: prominence within instructors, pupils, and guardians in general. In a wider social context, the data presented was somewhat positive and negative: There did seem to be some support relating to AI helping with individualized learning as well as alleviating the burden of administrative tasks, although skepticism remained to do with the nature of teacher-pupil relationships, social development of pupils, and the evolution of the teacher's role in education.

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