

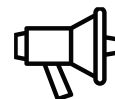
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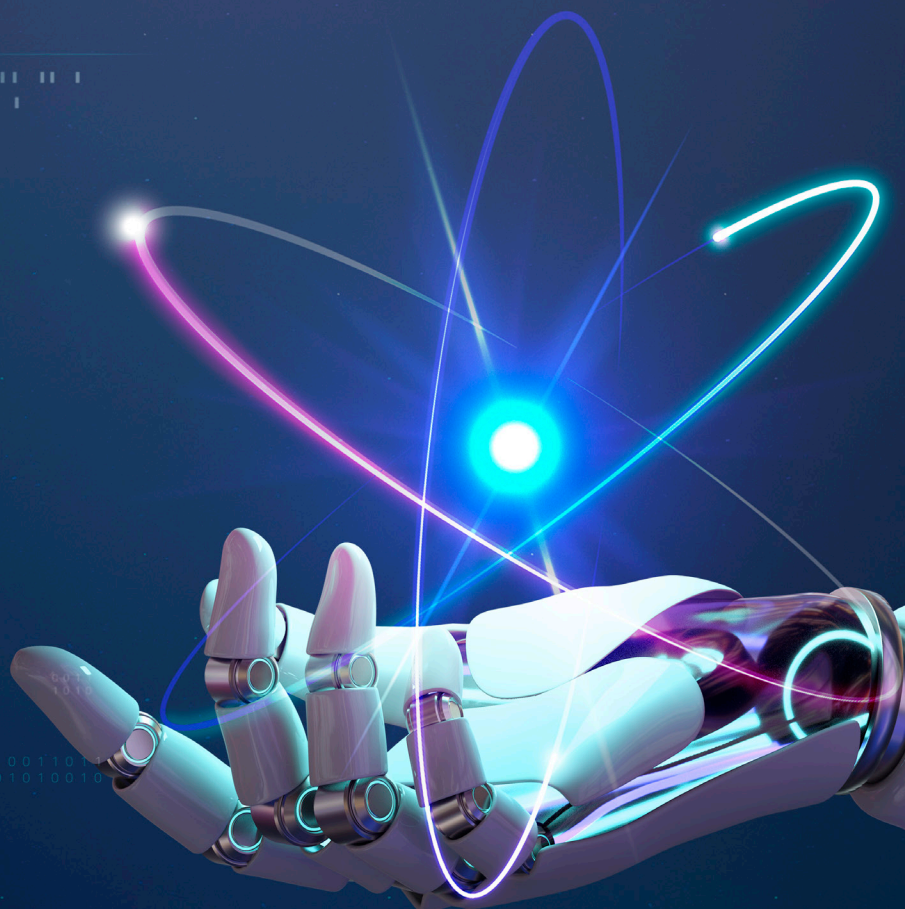
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IMPROVING THE MANAGEMENT SYSTEM OF PRIVATE SCHOOLS BASED ON INNOVATIVE TECHNOLOGIES

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Abstract: The purpose of this article is to comprehensively examine the organizational and technological factors that may influence the effective implementation of innovative technologies in private schools. Although numerous studies have explored the integration of technology across various educational environments, limited research has addressed the reasons why private schools have not yet fully adopted these innovations in their management systems.

This study aims to analyze the impact of increased participation of school stakeholders in management processes, as well as its influence on the overall performance of private schools, with a particular focus on enhancing the efficiency and quality of governance in non-state educational institutions. In identifying the structure of management challenges, the research highlights the priority areas considered by school leaders when addressing governance-related issues.

A total of 300 respondents were selected using a purposive sampling method, including 200 participants from private schools located in Tashkent, Samarkand, Bukhara, and Fergana, as well as 100 experts from academic and administrative fields. Using the Analytic Hierarchy Process (AHP), regression analysis, and a quantitative research approach, the study examines the priority factors and interrelationships between the adoption of innovative technologies and the improvement of management systems in private schools.

The findings reveal a significant relationship between the implementation of innovative technologies and management efficiency within private school systems. The analysis emphasizes the importance of correctly identifying priorities when addressing management challenges. Although the scope of the study is limited, the results provide a valuable foundation for future research.

This article contributes to the existing literature by addressing priorities, constraints, and opportunities within the private school sector that have not been sufficiently explored in previous studies.

Key words: private schools, innovative technologies, management improvement, Analytic Hierarchy Process (AHP), regression analysis, technology implementation, Uzbekistan.

INTRODUCTION

Gebremeskel and Hasmirati [9,12] support the view that innovative technologies contribute to improving school performance by facilitating effective management decision-making.

Existing literature indicates that the adoption of innovative technologies among private school students remains a relevant issue [4,5,13], and most studies have primarily focused on the integration of technologies within educational environments [6]. The integration of technology implies improvements in efficiency, coordination, and effectiveness within school management, ultimately enhancing institutional performance. The higher the level of administrative and technological knowledge, the faster a school is able to adopt a particular innovation [13].

Despite the availability of advanced technologies, many members of school communities demonstrate a cautious approach toward their adoption. This is often due to limited confidence in the tangible benefits of such technologies and uncertainty regarding their effectiveness in improving management processes [8].

A recent review by Liu et al. [13], examining the impact and application of ICT in educational management over the past five years, highlights that institutional barriers play a significant role in this issue. These barriers often limit the provision of necessary skills and support required for effective task performance. The problem is influenced by both internal and external factors. One key factor is that school leaders may not consistently

engage in professional development, or even when they do, they may not receive sufficient guidance and institutional support.

LITERATURE REVIEW

Although innovative technologies offer significant opportunities and advantages, their implementation is not straightforward compared to other practices, as barriers such as cost, resistance, infrastructure limitations, and preparedness exist within school management systems [4]. The contribution of innovation to educational quality and development has been discussed by earlier scholars, including Hakim et al. and Masinambow et al. [1,4], who emphasize that the pace of innovation is largely determined by the level of institutional readiness. Schools operating in the digital era tend to adopt technologies more rapidly due to relatively lower resistance to change.

Previous studies indicate that additional pressures contribute to challenges faced by private school stakeholders in adopting management innovations, including financial, technical, organizational, and human-related factors [3,5,6,11]. Sanoto and Kusuma [5] identified several management-related constraints, such as limited infrastructure, reluctance to learn new systems, disparities in institutional capacity among schools, and insufficient leadership support.

However, the lack or limited scope of empirical research focused specifically on private school management has resulted in only partial conclusions rather than comprehensive practical improvements within Uzbekistan's education sector. Nevertheless, researchers note that schools with higher levels of technology utilization often report similar constraints as those with lower levels of adoption.

A key gap in the literature is the absence of a comprehensive explanation of why private schools in Uzbekistan have not yet fully implemented innovative technologies to improve their management systems. At the same time, there is a shortage of studies aimed at reducing management disparities among private schools through the analysis of challenges in academic and administrative domains.

The objectives of this study are as follows: (1) to identify priority management factors for private schools in Tashkent, Samarkand, Bukhara, and Fergana; (2) to examine the types of technologies required by school leaders in these regions; and (3) to determine the relationship between the adoption of innovative technologies and the improvement of management systems in private schools in Uzbekistan.

Accordingly, this study aims to describe the management challenges faced by private schools in ensuring sustainable operation and development amid a growing number of students. Achieving these objectives is important not only for the private education sector but also for society as a whole in Uzbekistan.

If school leaders are able to strengthen and improve their management systems, it is likely that government institutions, private investors, and the broader community will be more willing to provide comprehensive support.

Data for this study were collected using quantitative approaches, including the Analytic Hierarchy Process (AHP), regression analysis, and survey methods. The quantitative methodology enabled the researcher to actively engage in the analysis of the problem through these analytical tools. Hakim and Liu [1,13] emphasize that each private school has a unique structure, highlighting the importance of examining leadership priorities across different educational contexts.

RESEARCH METHODOLOGY

A total of 300 respondents were selected using a purposive sampling method, including 200 participants from private schools in Tashkent, Samarkand, Bukhara, and Fergana, as well as 100 experts from academic and administrative fields. In line with this approach, the study conducted by Hakim and Liu [1] examined the relationship between the use of technology in school management and organizational performance in private schools in Uzbekistan, utilizing surveys and interviews with school leaders as primary data collection methods.

Accordingly, the present study identified the lack of technological knowledge among private school stakeholders as one of the key factors influencing the adoption of innovative technologies. Based on survey data collected from a sample of 300 respondents, including 200 school members and 100 experts, the research identified major challenges related to improving management systems in private schools.

Overall, this study applied four main stages of the Analytic Hierarchy Process (AHP). The research was conducted across four selected regions, and the sample included academic and administrative staff, school leaders, and sector experts from private schools.

In the first stage, key management factors (i.e., constraints) and technological needs were identified. This stage is critical, as schools may not fully recognize existing barriers, priorities, or how leadership can effectively improve management systems (AHP, regression). Previous studies on organizational learning and the implementation of new technologies in schools indicate that understanding institutional challenges

and managing the implementation process are essential for fostering a positive attitude toward technological innovation.

To collect quantitative data, a structured instrument titled “Innovative Technologies and School Management Improvement” was used. The questionnaire was developed based on literature review, discussions with school leaders, expert opinions, and insights from academic and administrative staff, as well as pilot testing. The study was conducted in selected private schools across Tashkent, Samarkand, Bukhara, and Fergana. It is also noted that the introduction of new technologies in private school contexts places increased demands on both academic and administrative teams.

Regression analysis was applied to determine the significance of relationships between variables within the model. The findings suggest that the adoption of innovative technologies creates mutual benefits: organizations improve performance outcomes, while the reduction of institutional constraints enhances the long-term advantages of improved management systems.

According to Liu et al. [2], schools that implement innovative production and management systems are more likely to improve decision-making processes, reduce costs, increase efficiency, and enhance overall performance. Technological knowledge refers to an individual's understanding of the use, value, and role of innovative technologies, as well as their contribution to management development [2].

Existing literature highlights several important organizational and technological factors that school leaders and administrators should consider during the implementation process [1–3]. Hakim and Liu [1] emphasize that higher levels of knowledge enable individuals to more effectively address management challenges.

The management and technological variables developed in this study were defined as key challenges within private school systems, particularly in the context of increasing student numbers across academic and administrative domains [1]. Responses were measured using pairwise comparisons, where respondents evaluated priorities and preferences based on their experience and judgment.

The research questions were addressed using analytical tools such as AHP, regression analysis, and survey data analysis. The AHP method was applied to assess the relative importance of factors, while final data analysis was conducted using statistical techniques, including AHP, regression, and percentage analysis.

Previous studies have shown that financial and organizational pressures act as barriers to technology adoption, innovation implementation, and management processes in schools, although these are often followed by long-term benefits such as time and cost efficiency [2]. The AHP method was selected because, as proposed by Saaty and Vargas [4], it provides a structured hierarchical approach to support decision-making in complex problem situations.

The survey instrument was adapted to reflect school management challenges and technological needs. Although some adaptation challenges may arise during the implementation phase, these are generally outweighed by the long-term benefits associated with improved management systems and technological integration.

ANALYSIS AND RESULTS

The majority of respondents believe that the implementation of innovative technologies can contribute to improving school management systems. The main conclusion derived from this study is that there is a lack of sufficient support from school leaders regarding the importance of innovative technologies, along with a relatively low level of technological knowledge (Table 1).

Table 1. AHP Priority Matrix and Global Weights for Innovative Technology Alternatives and Evaluation Criteria in Improving Private School Management¹

| Elements | Administrative Management Information System | Integrated Smart School Management System | Teaching–Learning and Communication Technology Platform | Cost and Financial Feasibility | Human Resources and Training Capacity | Impact on Management Efficiency | Technological Infrastructure Readiness | Goal |
|--|--|---|---|--------------------------------|---------------------------------------|---------------------------------|--|---------|
| Administrative Management Information System | 0.00000 | 0.00000 | 0.00000 | 0.61533 | 0.08522 | 0.61533 | 0.09091 | 0.17585 |

¹ author's development

| | | | | | | | | |
|---|---------|---------|---------|---------|---------|---------|---------|---------|
| Integrated Smart School Management System | 0.00000 | 0.00000 | 0.00000 | 0.31866 | 0.73750 | 0.06601 | 0.18182 | 0.16300 |
| Teaching–Learning and Communication Technology Platform | 0.00000 | 0.00000 | 0.00000 | 0.06601 | 0.17728 | 0.31866 | 0.72727 | 0.16115 |
| Cost and Financial Feasibility | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.12500 |
| Human Resources and Training Capacity | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.12500 |
| Impact on Management Efficiency | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.12500 |
| Technological Infrastructure Readiness | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.12500 |
| Goal | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |

Approximately 60% of respondents believe that private school students feel more confident and motivated when they are provided with opportunities to engage with contemporary global developments.

The results also indicate a significant relationship between school leaders' priorities and the improvement of management systems in private schools, particularly in academic and administrative areas related to the implementation of innovative technologies ($p < 0.01$) (Table 2).

Table 2. Final Priority Weights of AHP Alternatives for the Implementation of Innovative Technologies in Private School Management²

| Alternatives | Ideal Values | Normalized Values | Raw Values |
|---|--------------|-------------------|------------|
| Administrative Management Information System | 1.000000 | 0.351698 | 0.175849 |
| Integrated Smart School Management System | 0.926924 | 0.325997 | 0.162998 |
| Teaching–Learning and Communication Technology Platform | 0.916427 | 0.322305 | 0.161153 |

According to the study conducted by Hakim, Liu, and Sanoto ([1,2,5]), which examines the factors influencing the improvement of private school management systems, it was found that management practices in private schools are gradually transitioning toward innovative technologies, and nearly half of private educational institutions have already adopted smart systems.

For instance, the quantitative study conducted by Hakim and Liu ([1]) at the private school level demonstrates that management efficiency is significantly associated with technological knowledge, which is, in turn, closely linked to the support provided by school leadership (Table 3).

Table 3. Linear Regression Analysis³

| Variables | Coefficient (β) | Standard Error | t-value | p-value | 95% Confidence Interval | Significance |
|-------------------------|-------------------------|----------------|---------|---------|-------------------------|--------------|
| Leadership Support | 0.596 | 0.113 | 5.28 | 0.000 | 0.370 ; 0.822 | *** |
| Infrastructure Adequacy | 0.145 | 0.096 | 1.52 | 0.135 | -0.047 ; 0.337 | — |
| Resistance to Change | -0.295 | 0.070 | -4.18 | 0.000 | -0.436 ; -0.153 | *** |
| Management Efficiency | 0.018 | 0.061 | 0.29 | 0.772 | -0.105 ; 0.141 | — |
| Constant | 42.308 | 5.770 | 7.33 | 0.000 | 30.745 ; 53.871 | *** |

*** $p < .01$, ** $p < .05$, * $p < .1$

The regression results indicate that leadership support has a strong and statistically significant positive effect on technological knowledge ($\beta = 0.596$, $p < 0.001$). This suggests that active involvement and support from school leadership play a crucial role in enhancing technological awareness and adoption in private schools.

In contrast, resistance to change shows a significant negative relationship with technological knowledge ($\beta = -0.295$, $p < 0.001$), indicating that organizational resistance remains a key barrier to the successful implementation of innovative technologies.

² author's development

³ author's development

However, infrastructure adequacy and management efficiency do not demonstrate statistically significant effects ($p > 0.05$), implying that, while important, these factors may not directly influence technological knowledge in the current context.

Overall, the findings highlight that human and organizational factors, particularly leadership support and openness to change, are more decisive than structural factors in driving technological advancement in private school management systems (Table 4).

Table 4. Model Summary Statistics⁴

| Indicator | Value | Indicator | Value |
|------------------------------------|---------|--|---------|
| Mean of Dependent Variable | 48.453 | Standard Deviation of Dependent Variable | 9.085 |
| R-squared | 0.742 | Number of Observations | 60 |
| F-statistic | 39.604 | Prob > F | 0.000 |
| Akaike Information Criterion (AIC) | 362.707 | Bayesian Information Criterion (BIC) | 373.179 |

The model demonstrates a strong explanatory power, with an R-squared value of 0.742, indicating that approximately 74.2% of the variation in the dependent variable is explained by the independent variables included in the model.

The F-statistic (39.604) with a significance level of $p = 0.000$ confirms that the overall regression model is statistically significant.

Additionally, the relatively moderate values of AIC (362.707) and BIC (373.179) suggest that the model provides a good balance between fit and complexity.

Overall, these results indicate that the model is statistically robust and suitable for explaining the relationship between technological knowledge and the selected explanatory variables.

Approximately 60% of the 300 respondents indicated that leaders in private schools actively exercise decision-making authority in management processes; however, they emphasized the need for stronger and more supportive leadership practices (Table 5).

Table 5. Variance Inflation Factor (VIF) Results for the Regression Model⁵

| Variable | VIF | 1/VIF |
|-------------------------|------|----------|
| Management Efficiency | 2.13 | 0.468959 |
| Leadership Support | 1.84 | 0.544319 |
| Infrastructure Adequacy | 1.81 | 0.552280 |
| Resistance to Change | 1.68 | 0.594656 |
| Mean VIF | 1.87 | — |

The results indicate that management practices in private schools are gradually transitioning toward innovative technologies, and nearly half of private educational institutions have adopted smart systems. This finding confirms a significant relationship between the implementation of innovative technologies and the improvement of management systems in private schools in Uzbekistan (Table 6-7).

Table 6. Shapiro–Wilk W Test for Normality⁶

| Variable | Observations | W | V | z | Prob > z |
|-------------------|--------------|---------|-------|--------|----------|
| Residuals (resid) | 60 | 0.98640 | 0.739 | -0.651 | 0.74248 |

⁴ author's development

⁵ author's development

⁶ author's development

Table 7. Skewness/Kurtosis Tests for Normality⁷

| Variable | Observations | Pr(Skewness) | Pr(Kurtosis) | Adjusted chi ² (2) | Prob > chi ² |
|-------------------|--------------|--------------|--------------|-------------------------------|-------------------------|
| Residuals (resid) | 60 | 0.4658 | 0.1812 | 2.43 | 0.2973 |

The VIF values for all independent variables are below the commonly accepted threshold of 5, indicating the absence of multicollinearity in the regression model. The mean VIF value of 1.87 further confirms the robustness of the model.

The Shapiro–Wilk test results ($p = 0.742$) and Skewness/Kurtosis test results ($p = 0.297$) indicate that the residuals are normally distributed. This confirms that the assumptions of regression analysis are satisfied, ensuring the reliability of the estimated results.

Overall, the findings demonstrate that the model is statistically sound and that innovative technologies play a meaningful role in enhancing management efficiency in private schools.

The findings suggest that the adoption of innovative technologies has the potential to transform management processes and, in turn, enhance the capacity of private schools, particularly in regions where such institutions are actively expanding. The observed differences in responses regarding priority levels among private schools in Tashkent, Samarkand, Bukhara, and Fergana can be explained by variations in infrastructure readiness, leadership practices, and levels of institutional preparedness. These differences may indicate that, in some regions, school management processes are still evolving and require more balanced support and strategic alignment.

Although the private school sector employs a considerable number of academic staff, some institutions are not yet fully prepared to implement innovative technologies. Instead, they tend to rely on traditional management approaches, which may be less effective in addressing the growing number of students in Uzbekistan's education system.

A study conducted by Liu et al. ([2]) across three major regions also confirmed a significant relationship between technological knowledge and the improvement of management systems. However, the relationship with infrastructure adequacy in Tashkent, as well as leadership support in Samarkand, Bukhara, and Fergana, was found to be relatively weaker. While the expected interaction between leadership and infrastructure did not reach statistical significance, the interaction between resistance to change and technology adoption was statistically significant.

The discussion presented in this study is expected to contribute to future research in this field by providing valuable insights into the impact of key factors on school management. Overall, the findings highlight that private schools encounter a range of challenges when introducing innovative technologies and improving management systems [1,2,3].

At the same time, the results confirm a significant relationship between the adoption of innovative technologies and the improvement of management systems in private schools in Uzbekistan. A lack of technological knowledge among school stakeholders can be identified as an important factor influencing the effectiveness of technology implementation [4,5], which also reflects the need for stronger institutional support.

A key consideration is the role and responsibility of school leadership, particularly in managing change processes and facilitating the integration of new technologies. The differences observed among schools can largely be attributed to variations in infrastructure readiness across regions.

Technology plays a crucial role in the development of schools, as it enables them to operate more efficiently and strengthen their position within society. Schools that possess adequate knowledge, effective support systems, and sufficient infrastructure are more likely to achieve better performance compared to those lacking these essential factors [6,7].

While innovative technologies can significantly enhance the management capacity of private schools, their effectiveness is maximized when supported by appropriate institutional conditions. Effective leadership is therefore characterized not only by formal positions but also by the ability to adapt to challenges and implement necessary changes [8].

In the context of Uzbekistan, private schools face several challenges, including infrastructure limitations, financial constraints, insufficient preparedness, limited support, internal resistance among stakeholders, lack of guidance, and variations in institutional capacity across schools [9,10].

Regression analysis further confirms that leadership support is statistically significant ($p < 0.01$). Previous studies also support this finding, indicating that private schools may require longer adaptation periods to fully benefit from innovation processes, as innovative technologies typically demand sustained attention and long-term commitment [11,12].

⁷ author's development

Unlike previous studies, this research contributes to the academic literature by addressing priorities, constraints, and opportunities within the private school context that have not been sufficiently explored [13,14,15]. However, the study is subject to certain limitations, particularly due to its limited scope. Additionally, the generalizability of the findings beyond the selected regions remains constrained.

CONCLUSION AND RECOMMENDATIONS

This study contributes to the existing body of knowledge by providing a comprehensive and empirical analysis of the key factors influencing the relationship between the implementation of innovative technologies and the improvement of management systems in private schools in Uzbekistan. The article encourages further discussion and research on the differences between managerial constraints and technological needs, particularly within private schools that experience challenges in aligning these two dimensions.

It is widely recognized that increasing the level of technology adoption can have a positive impact on both the private school sector and the overall education system. Therefore, the findings of this study should be carefully considered, and achieving improved management practices requires the active support of all stakeholders, including school leaders, government institutions, and private investors. In particular, in regions with a high number of students, school leaders should foster a more supportive environment that enhances management efficiency through effective decision-making processes.

Reducing existing management disparities is essential, and the role of school leaders should evolve from that of traditional administrators to more supportive and adaptive managers.

The discussions presented in this article are expected to stimulate further research in this field and provide valuable insights into the influence of key factors on school management. For both academic and administrative personnel, the implementation of innovative technologies should be supported through well-designed training programs aimed at strengthening management and decision-making capabilities. Such programs should be developed based on practical needs rather than formal requirements.

These initiatives may include the development of smart school systems, the reduction of organizational barriers, the provision of continuous training and institutional support, the improvement of technological infrastructure, and the enhancement of technological knowledge among school stakeholders, particularly those interested in actively contributing to the development of the private education sector.

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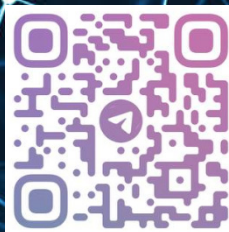
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