

THE EFFECTIVENESS OF EXPERIMENTAL AND PILOT STUDIES CONDUCTED USING THE “PROFESSOR ALI” ARTIFICIAL INTELLIGENCE SYSTEM

Jumaniyazov Jasurbek Nazarboyevich

Urgench State Medical Institute

Abstract. This thesis presents the results of experimental and pilot studies conducted to determine the effectiveness of a methodology for teaching the subject “Contemporary History of Uzbekistan” based on artificial intelligence technologies. The “Professor Ali” artificial intelligence system, developed on the basis of the author’s concept, was used as the principal technological tool. The study examined the impact of individualized learning trajectories, adaptive tests, and interactive multimedia materials on students’ learning outcomes. The results were analyzed using mathematical and statistical methods, including Student’s t-test, the chi-square test, Pearson correlation analysis, and Cohen’s effect size, providing empirical evidence of the pedagogical effectiveness of the proposed methodology.

Keywords. artificial intelligence, “Professor Ali,” experimental study, history education, individualized learning, adaptive testing, learning trajectory, mathematical and statistical analysis, pedagogical effectiveness.

Today, alongside the introduction of artificial intelligence technologies into education, determining the practical effectiveness of pedagogical methods and tools developed on their basis has become an important scientific and methodological task. In particular, the use of artificial intelligence in history education expands opportunities to take students’ individual levels of knowledge into account, adapt learning tasks, analyze historical information, and systematically assess learning outcomes.

This process is particularly important for the subject “Contemporary History of Uzbekistan.” In teaching history, it is important for students not only to remember historical events, but also to analyze them, compare different historical sources, identify cause-and-effect relationships, and express independent opinions about historical processes. Therefore, practical verification of the effectiveness of a methodology based on artificial intelligence is essential.

Within the framework of the study, the “Professor Ali” artificial intelligence system, developed on the basis of the author’s concept, was selected as the principal tool for the experimental and pilot studies. The system was officially deposited by the Intellectual Property Center under the Ministry of Justice of the Republic of Uzbekistan under Certificate No. 007653 dated May 10, 2024. The experimental and pilot studies were conducted in general education schools in Urgench city and Khiva district of

Khorezm Region, involving a total of 246 students. In the extended statistical analysis, data from 126 ninth-grade students were examined separately.

During the diagnostic stage of the experimental study, the initial level of knowledge of the experimental and control groups was examined. Student's t-test and the chi-square test were used to determine the statistical equivalence of the groups at the beginning of the study. The results showed that there was no statistically significant difference between the initial indicators of the experimental and control groups. This provided an initial methodological basis for attributing subsequent changes primarily to the methodology applied during the formative stage.

During the formative stage, individualized learning trajectories, adaptive tests, and interactive multimedia materials developed on the basis of the "Professor Ali" artificial intelligence system were systematically introduced into the educational process. Students' levels of knowledge and individual learning needs were taken into account, and learning tasks and materials were adapted accordingly.

The results obtained during the control stage demonstrated a significant increase in students' knowledge levels in the experimental group. In particular, the mean score increased from 3.50 to 4.11 points. In the extended analysis, the proportion of students demonstrating a high level of knowledge increased from 24% to 58%, representing an increase of 34 percentage points.

The statistical reliability of the obtained results was examined using Student's t-test and the chi-square test. The analysis yielded $t_{\text{emp}} = 3.01-4.82$; $p < 0.01-0.05$. In addition, $\chi^2_{\text{emp}} = 9.06 > \chi^2_{\text{critical}} = 7.81$, indicating that the difference between the experimental and control groups was statistically significant.

To determine the practical significance of the experimental results, Cohen's effect size was also calculated. The value $d = 0.54$ indicates a medium-sized pedagogical effect. Furthermore, the Pearson correlation coefficient was $r = 0.98$; $p < 0.01$, indicating a very strong statistical relationship between the intensity of artificial intelligence use and the increase in students' learning achievement.

To assess the effectiveness of the experimental methodology more comprehensively, a delayed post-test was also administered. The results showed that the retention rate of acquired knowledge was 79% in the experimental group, compared with 54% in the control group. This finding indicates that the artificial intelligence-based methodology may have a positive effect not only on short-term learning outcomes but also on the relatively long-term retention of knowledge.

The results were also analyzed through internal replication across different schools. The analysis demonstrated that the observed outcomes were not attributable solely to a particular class or individual teacher, but reflected a consistent tendency associated with the methodology implemented in the experimental study.

Based on the generalization of the experimental results, the following effectiveness indicators of the methodology based on the “Professor Ali” artificial intelligence system were identified:

- adapting educational content according to students’ individual levels of knowledge;
- identifying students’ knowledge gaps and generating appropriate learning tasks;
- systematically monitoring learning achievement through adaptive tests;
- increasing the effectiveness of acquiring historical knowledge through interactive and multimedia tools;
- contributing to the longer-term retention of acquired knowledge;
- enabling teachers to monitor individual learning and development dynamics.

Thus, the results of the experimental and pilot studies demonstrated that the individualized learning methodology implemented through the “Professor Ali” artificial intelligence system has the potential to improve the effectiveness of teaching the subject “Contemporary History of Uzbekistan.” The reliability of the statistical analyses, the increase in mean and high-level achievement indicators, the results of the delayed post-test, and the replication of findings across different schools provide empirical support for the practical effectiveness of the proposed methodology.

In conclusion, the experimental and pilot studies conducted using the “Professor Ali” artificial intelligence system demonstrated the practical validity of the scientific hypothesis proposed in the study. The mathematical and statistical findings indicate that the use of artificial intelligence-based individualized learning methods in history education can contribute to improving students’ knowledge levels and their retention of acquired knowledge.

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