

METHODOLOGY OF ORGANIZING AND CONDUCTING PEDAGOGICAL EXPERIMENTAL STUDIES

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Abstract

The article highlights the methodology of organizing and conducting pedagogical experimental studies. It explains the stages of forming experimental and control groups, developing methodological materials, organizing experimental activities, selecting diagnostic tools, and analyzing results on a scientific basis.

Keywords: Pedagogical experiment, trial studies, methodology, control group, experiment, educational effectiveness.

Introduction

In pedagogical research, it is of great importance to test the effectiveness of newly developed methodological approaches, educational technologies, or teaching methods through experimental trials. This is because, in addition to being theoretically justified, any innovation must be scientifically proven in terms of the results it produces in real educational processes and the extent to which it influences students' knowledge, skills, and competencies¹. Therefore, pedagogical experimental trials serve as a key methodological tool in assessing the quality of innovative approaches in education, determining their effectiveness, and identifying opportunities for their widespread implementation in practice².

The significance of the pedagogical experiment lies in its ability to ensure a close interconnection between theory and practice in the educational process. The true effectiveness of theoretically developed methodological recommendations, educational technologies, or teaching methods can only be determined when they are tested under experimental conditions. This process requires conducting pedagogical practice with scientific consistency, collecting objective data, analyzing, and generalizing the results. Furthermore, experimental trials contribute to improving the quality of education, introducing advanced practices into the learning process, and fostering the innovative activities of teachers³. In this process, the impact

1 Cohen, L., Manion, L., & Morrison, K. Research Methods in Education. – 8th ed. Routledge, 2018.

2 Ziyayeva D. Pedagogik tadqiqot metodlari. – Toshkent: Fan, 2019.

3 Best, J. W., & Kahn, J. V. Research in Education. – 10th ed. Boston: Pearson, 2006.

of a new methodology or technology is studied not only in terms of students' learning outcomes, but also in relation to the development of their competencies such as independent thinking, problem-solving, and collaborative work. Thus, organizing and conducting experimental trials in pedagogical research requires a scientifically grounded approach and serves as an essential methodological basis for ensuring the innovative development of the educational process⁴.

The aim of this research is to determine the effectiveness of applying digital technologies in the educational process, to examine the practical significance of new methodological approaches in shaping students' knowledge, skills, and competencies, and to develop scientific and methodological foundations for their integration into education.

In the study, pedagogical experimental trials are directed towards solving the following tasks:

- identifying the didactic potential of the methodological system created on the basis of digital tools;
- investigating students' learning motivation, independent learning activities, and level of creative approach during experimental sessions;
- developing criteria and indicators for assessing the effectiveness of education;
- statistically substantiating the practical efficiency of the methodology by identifying differences between control and experimental groups.

Pedagogical experimental trials are carried out step by step in accordance with the educational process of the institution and are aimed at applying the results of scientific research to practice⁵.

Object of the research. The organization of the educational process in general secondary and higher education institutions, as well as the pedagogical methods, tools, and forms of educational activities applied on the basis of digital technologies.

Subject of the research. The methodology of effectively organizing the educational process based on digital technologies, the strategies used in conducting pedagogical experimental trials, and the methodological approaches that contribute to the development of students' knowledge, skills, and competencies.

Review of related literature. The methodology of organizing and conducting pedagogical experimental trials has been studied by numerous local and foreign scholars. In these studies, the essence of the pedagogical experiment, its stages, criteria of effectiveness, and methods of analyzing the results have been highlighted from different perspectives.

In local research (Ziyayeva, 2018; Abdullayeva & Khojayev, 2020), the main stages of pedagogical experimentation – preparation, the formation of experimental and control groups, diagnostics and monitoring, and the mathematical-statistical analysis of results – are described

4 Карпов А.В. Методология педагогического эксперимента. – Москва: Академия, 2018

5 Хуторской А.В. Методология педагогического исследования. – Москва, 2001.

in detail. According to these scholars, the principles of scientific validity, objectivity, and reliability must come first in the organization of pedagogical experiments⁶.

In foreign sources, pedagogical experimentation is studied within a broader methodological framework. For example, Kerlinger (2000), in his work *Foundations of Behavioral Research*, identifies experimentation as a fundamental scientific method in the social and educational sciences and emphasizes its role in testing scientific hypotheses. Likewise, Creswell (2018), in his handbook *Educational Research*, provides a systematic explanation of various experimental designs in education (quasi-experimental, controlled experimental, and mixed-methods), highlighting their advantages and limitations⁷.

In modern scientific studies (Anderson, 2019; Johnson & Christensen, 2020), the pedagogical experiment is explored not only in terms of measuring knowledge, skills, and competencies, but also with regard to its impact on students' motivation, as well as their critical and creative thinking abilities. This approach allows for a more comprehensive assessment of educational quality.

An analysis of the scientific literature shows that the methodology of organizing pedagogical experimental trials serves as a fundamental scientific tool for testing innovations in the educational process, determining their effectiveness, and facilitating their broader implementation. While local research has focused more on the practical aspects of experimentation, international studies have been directed towards methodological approaches, experimental design, and statistical methods of evaluating results⁸.

Research Methodology

In organizing and conducting pedagogical experimental trials, scientific methodology plays a crucial role. Research methodology is a set of theoretical foundations, principles, methods, and approaches applied in the process of studying a scientific problem, collecting data, analyzing it, and drawing scientific conclusions. The methodology of this study relies on the following key principles:

Principle of scientific validity – experimental trials are carried out on the basis of theoretical sources, scientifically grounded methods, and pedagogical laws.

- Principle of objectivity – research results are free from personal opinions or subjective judgments and rely solely on scientific facts.
- Principle of systematicity – the pedagogical process under study is considered in close connection with all factors, including both external and internal influences.
- Principle of comparison and differentiation – the results of the experimental and control groups are compared, and the differences are scientifically analyzed.

6 Abdullayeva, N., & Khojayev, T. (2020). *Pedagogical experiment methodology in educational research*. Samarkand: [Publisher].

7 Kerlinger, F. N. (2000). *Foundations of Behavioral Research* (4th ed.). Fort Worth, TX: Harcourt College Publishers.

8 Creswell, J. W. (2018). *Educational Research: Planning, Conducting, and Evaluating Quantitative and Qualitative Research* (6th ed.). New York: Pearson.



- Principle of statistical reliability – mathematical and statistical methods are applied in the analysis of results, and the degree of reliability is determined.

Research Methods

The following methods are employed in the research process:

1. Theoretical methods – analyzing scientific literature, generalizing existing practices, and studying pedagogical concepts.
2. Empirical methods – collecting practical data through observation, interviews, questionnaires, tests, and pedagogical diagnostics.
3. Experimental methods – forming experimental and control groups, testing the new methodology in practice, and evaluating the effectiveness of teaching.
4. Statistical methods – conducting mathematical and statistical analysis of the collected data, identifying differences, and determining the level of reliability.
5. Comparative methods – comparing various teaching methods, approaches, and their outcomes.

1. Preparatory Stage

Identifying the scientific problem, studying the literature, and developing the program.

2. Experimental Stage

Formation of experimental and control groups, and testing of the methodology.

3. Stage of Data Processing and Analysis

Statistical analysis of the data, comparison of the results of the groups.

4. Conclusion and Generalization Stage

Drawing conclusions, developing recommendations, and implementing the methodology.

Figure 1. Stages of Pedagogical Research⁹.

The process of effectively organizing pedagogical research experimental trials is carried out sequentially in several stages (Figure 1).

⁹ Figure 1 (adapted from Ziyayeva, 2018; Kerlinger, 2000; Creswell, 2018) shows the main stages of pedagogical research.



Each stage is characterized by specific tasks, types of activities, and expected outcomes. At this stage, the theoretical and organizational foundations of the scientific research are determined¹⁰.

The main tasks are as follows:

- identifying the scientific problem and substantiating its relevance;
- defining the aim and objectives of the research;
- analyzing scientific literature, best practices, and existing methodological approaches related to the process under study;
- determining the object and subject of the research;
- developing the experimental program, diagnostic tools, and evaluation criteria;
- selecting the institution, subject, topic, and groups in which the experiment will be conducted.

In conclusion, the research methodology ensures that pedagogical experimental trials are organized on a scientifically grounded basis, that their results are objective and reliable, and that the effectiveness of the new teaching methodology can be determined.

Analysis and Results

In assessing the effectiveness of pedagogical experimental trials, it is important to compare the initial (baseline) and final results. During the study, the indicators of the experimental and control groups were collected through various diagnostic tools (tests, control works, questionnaires, and observations). The collected data were processed using mathematical and statistical methods, and the results were analyzed on a scientific basis¹¹.

1. Analysis of Initial Results. Diagnostics conducted before the start of the experiment showed that the experimental and control groups were almost equal in terms of knowledge level. This is an important prerequisite for the experiment, since the differences between the groups would arise solely as a result of the methodology applied during the research¹².

2. Observations During the Experiment. In the course of the experiment, teaching in the experimental group was organized based on the new methodology. It was observed that students' learning activity, independent working skills, and motivation gradually increased. In the control group, however, traditional teaching methods continued, and no significant changes in student activity were noted.

3. Analysis of Final Results. The results of the control works and tests conducted at the end of the experiment showed that:

¹⁰ Creswell, J. W. (2018). *Educational Research: Planning, Conducting, and Evaluating Quantitative and Qualitative Research* (6th ed.). New York: Pearson. (Creswell emphasizes that each stage of research is tied to tasks, procedures, and outcomes).

¹¹ Shuttleworth, M. (2009, November 3). Pretest-Posttest Designs. Explorable.com. Retrieved July 27, 2025, from Explorable.com website

¹² Campbell, D. T., & Stanley, J. C. (1963/2015). *Experimental and Quasi-Experimental Designs for Research*. Boston: Houghton Mifflin / Ravenio Books. (One of the most cited works emphasizing equivalence of groups as a prerequisite for experimentation).



- In the experimental group, students' knowledge levels significantly improved, their creative and critical thinking skills developed, and their independent working abilities were strengthened.

- In the control group, growth was relatively lower and was mainly limited to the acquisition of theoretical knowledge.

The results of the experimental and control groups (in terms of average scores) are presented in Table 1.

Table 1. Results of the Experimental and Control Groups

Group	Initial Score	Average	Final Score	Average	Growth (%)
Experimental Group	65,2		84,7		+19,5 %
Control Group	64,8		70,5		+5,7%

The comparative results of the experimental and control groups at the initial and final stages are illustrated by two separate lines (Figure 2). The graph clearly shows a significant increase in the experimental group.

Experimental group:

- At the initial stage, the average knowledge level of students was 65.2 points.
- After the application of the new methodological approach and educational technology during the experiment, the final average score rose to 84.7 points.
- This indicates an improvement of +19.5%.

Control group:

- At the initial stage, the students' average score was 64.8 points.
- Since the teaching was carried out using traditional methods, the final result increased only slightly, reaching 70.5 points.
- This corresponds to an increase of +5.7%.

Scientific conclusion

1. The graph clearly demonstrates that the students in the experimental group achieved a significant improvement in their knowledge level, which confirms the effectiveness of the new methodology.
2. The results of the control group were relatively lower, showing only minor growth attributed to natural development and the traditional teaching process.
3. The sharp difference between the two lines (84.7 points in the experimental group vs. 70.5 points in the control group) provides scientific justification for the high efficiency of the applied methodology.
4. Statistical analysis also revealed that the growth observed in the experimental group was 3.4 times higher than that of the control group, which is of considerable scientific importance.

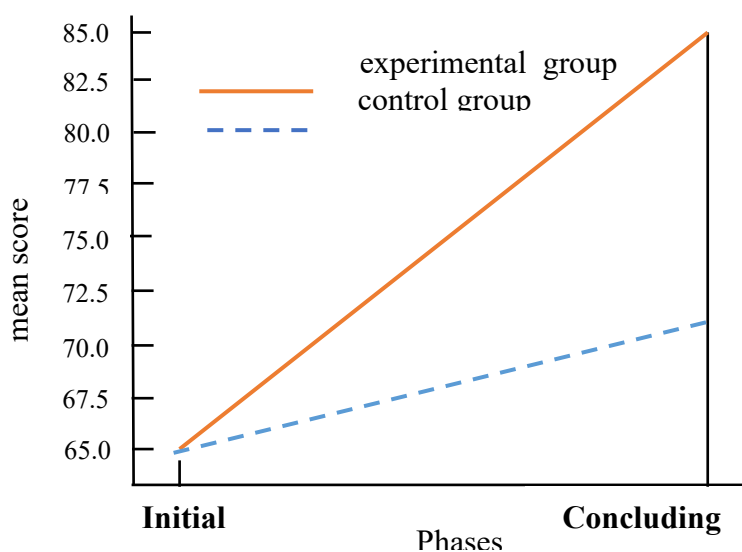


Figure 2. Graph comparing the initial and final results of the experimental and control groups.

Mathematical-statistical analysis (χ^2 – Pearson's criterion, Student's t-test) demonstrated that the differences between the groups were statistically significant ($p < 0.05$). This confirms, on a scientific basis, the effectiveness of the new methodology.

4. Scientific and practical significance of the results.

The obtained results indicate that the new methodology applied in the experiment had a significant impact on the development of students':

- thorough acquisition of knowledge;
- skills in applying knowledge in practical activities;
- ability to think independently and creatively;
- competencies in collaboration and solving problem situations.

Furthermore, the research results can serve as a methodological guide for teachers and play an important role in developing recommendations for the widespread introduction of new pedagogical approaches into educational practice.

Conclusion and Recommendations. The analysis of the pedagogical experimental studies showed that the application of the new methodology and educational technologies is an effective tool for the development of students' knowledge, skills, and competencies. During the research, the following main scientific conclusions were drawn¹³:

1. Pedagogical experimental studies provide an opportunity to test new methodological approaches in practice and scientifically substantiate their effectiveness in the teaching process.
2. The results of initial and final diagnostics revealed a significant difference between the groups, confirming the effectiveness of the applied methodology.

¹³ Kerlinger, F. N. (2000). Foundations of Behavioral Research (4th ed.). Holt, Rinehart & Winston.

3. The level of knowledge, independent work skills, and creative thinking ability of the students in the experimental group significantly improved.
4. Mathematical-statistical analysis demonstrated that the differences were statistically significant ($p < 0.05$).
5. The research results scientifically confirm the necessity of widely introducing the new methodology into the educational process.

Practical Recommendations. Based on the results of the study, the following practical recommendations can be proposed:

1. For teachers – develop methodological guides on the use of the new methodology and educational technologies, and disseminate them through professional development programs.
2. For educational institutions – implement teaching methods whose effectiveness has been confirmed in experimental studies into the educational process and establish a system of regular monitoring.
3. For students – widely apply interactive tasks, project work, and problem-solving methods that develop independent and creative activity.
4. For researchers – explore the applicability of this methodology in other subjects and at different stages of education, conduct comparative analyses, and carry out new scientific investigations.
5. At the level of state and educational policy – gradually integrate innovative methodology-based teaching and learning packages into the education system and create the necessary conditions for their effective implementation.

The results of the pedagogical experimental studies provide a solid scientific and practical basis for increasing the effectiveness of education, developing modern competencies in students, and ensuring the quality of education through the application of new methodologies and technologies in the learning process.

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